ABSTRACTS

OF LECTURES AND POSTERS

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Orals

1 WHAT IS THE REAL EXTENT OF 'GENETIC' CONTROL ON CRANIOFACIAL DEVELOPMENT?

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AIMS: To assess the influence of genetic and environmental factors on craniofacial morphology.
SUBJECTS AND METHOD: Fifty pairs of twins were selected [29 monozygotic (MZ) and 21 dizygotic (DZ)]. The mean age of the subjects was 16.2 (13.4-19.8) and 17.6 (13.8-20.1) years in the MZ and DZ groups, respectively. Using serological techniques and iris pattern recognition, the zygosity of all MZ twins was determined. Lateral cephalograms were used for this twin study. Inclusion criteria were completion of the pubertal growth spurt and no previous orthodontic treatment. The skeletal maturity age of all subjects, determined with Cervical Vertebral Maturation Index, was either stage 5 or 6 (i.e. all patients were in the stage of pubertal deceleration). Thirty-three linear and angular cephalometric variables were identified and used. Fifteen cephalograms were selected, retraced and remeasured. Errors were calculated according to Dahlberg's formula. Heritability assessments were undertaken according to the path analysis model and also using Holzinger's equation. For each cephalometric variable, Pearson's intra-pair correlation coefficients were calculated for the MZ and DZ twin pairs. The estimate of heritability (h2) and coefficient of cultural heritability (c2) were then calculated for the cephalometric variables.
RESULTS: Vertical variables showed higher heritability than horizontal variables. The anterior cranial base (S-N), saddle angle (NSBa), total anterior facial height (N-Me), lower anterior face height (ANS-Me), SNA, SNB, SNPog, gonial angle, SN-GoGn angle and the SN-Maxillary plane angle showed high heritability. Heritability was low to moderate for the dental variables.
CONCLUSIONS: Vertical variables (total and lower anterior face height) showed more heritability than horizontal variables. Heritability seems to be expressed more anteriorly than posteriorly. The lower third of the face seems to be under a strong genetic control.

2 COMPARISON OF THE EFFECTS OF CONTINUOUS VERSUS INTERMITTENT CONTROLLED ORTHODONTIC FORCES ON ROOT RESORPTION

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AIM: To compare the effects of controlled-intermittent and continuous forces on root resorption.
SUBJECTS AND METHOD: Twenty-five female and seven male patients (mean age, 14.4 years) randomly divided into two groups. In each group, intermittent force was applied on one side and continuous force on the other side for 84 days. The periods of intermittent force were determined as 11 days on 3 days off (11/3) and 18 days on 3 days off (18/3). Sixty-four upper premolars were subjected to a buccally directed tipping force (150 g) with 0.017 × 0.025 inch TMA (Beta III titanium, 3M Unitek, Monrovia, California, USA) cantilever springs. After extractions, surface analysis was performed via micro-computed tomography (Sky Scan 1172, Belgium) and specially designed software (CHull2D) for direct volumetric analysis. Buccal premolar movement was also measured on the images of the study casts that were taken prior to the experiment and extractions.
RESULTS: Continuous force produced more resorption than intermittent force on the total volume for both groups. However, in the 18/3 group this difference was significant ($P < 0.01$) and distinguished itself on the compression regions as cervicomesial ($P < 0.01$) and cervicobuccal ($P < 0.05$). In the 11/3 group, differences were evident in the tension regions as middle-distal ($P < 0.05$) and middle-lingual ($P < 0.05$). Continuous forces produced significantly more tooth movement than the intermittent forces of 11/3 ($P < 0.01$) and 18/3 ($P < 0.001$) periods. No significant differences were observed between intermittent force periods regarding root resorption and tooth movement.
CONCLUSIONS: Total root resorption volumes were higher with continuous force application. However, statistically significant differences were not observed between the continuous and intermittent force periods, except for group 18/3. Although the continuous force resulted in more resorption, it was more effective on tooth movement than intermittent forces.

3 NF-κB AS A TARGET OF MECHANICAL STIMULATION IN OSTEOBLASTIC CELLS

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AIMS: Orthodontic tooth movement occurs due to the ability of alveolar bone to remodel following force application. It has previously been demonstrated that osteoblasts sense force application and respond by induction/phosphorylation

of the transcription factors, Runx2 and AP-1, via the MAPK signalling pathway, hence potentiation of the transcriptional machinery of osteoblastic cells resulting in osteoclast activation through RANKL. The NF-κB transcription factor seems to be involved in bone remodelling by triggering osteoclast formation and stimulating inflammatory responses. Mechanical cues have been shown to trigger NF-κB activation and its nuclear translocation in osteoblastic cells and might therefore be implicated in induction of Runx2 expression. The aim of this study was the functional characterization of putative NF-κB/c-Rel binding sites on the promoter of the Runx2 gene in human periodontal ligament (hPDL) cells after mechanical stimulation.
MATERIALS AND METHOD: hPDL cells were cultured in 80 per cent confluence, exposed to mechanical stretch for 6, 12, 24 and 48 hours and cell extracts (nuclear, cytosolic) were prepared. Electrophoretic mobility-shift assay employing these extracts and a specific antibody against NF-κB/c-Rel was performed to detect and investigate DNA-protein complexes formed on the promoter region of the Runx2 gene.
RESULTS: Low level mechanical deformation of hPDL cells rapidly induced NF-κB/c-Rel nuclear translocation and concomitantly upregulated the DNA-binding capacity of NF-κB/c-Rel on the Runx2 promoter in a time-dependent manner i.e. increase from the 6 hour time point to the 24 hour time point followed by a slight decrease at 48 hours post-stretching.
CONCLUSIONS: This is the first study that shows NF-κB is possibly involved in modulating Runx2 expression, hence affecting osteoblast differentiation after mechanical stimulation. This finding also provides a potential molecular link between mechanostressing, osteoblast differentiation and the inflammatory response.

4 MODELLING CLEIDOCRANIAL DYSPLASIA: INSIGHTS IN GENOTYPE-PHENOTYPE CORRELATIONS USING BIOINFORMATICS

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AIM: Mutations in the *RUNX2* gene are the genetic basis of cleidocranial dysplasia (CCD). CCD is an autosomal dominant inherited skeletal dysplasia showing a wide variety of skeletal changes, including abnormal clavicles, patent sutures and fontanelles, supernumerary teeth, and short stature. The transcription factor, RUNX2, plays a crucial role in bone development and bone remodelling. The purpose of this study is to report on the use of the bioinformatics methods to evaluate *RUNX2* gene mutations and their correlation with the CCD phenotype.
MATERIALS AND METHOD: *RUNX2* gene mutations taken from the literature and derived from previous investigations were analyzed with respect to the mutation type, their position within the RUNX2 gene/protein, and functional consequence. Bioinformatics tools, such as multiple sequence alignments and homology modelling derived three-dimensional structures, were applied.
RESULTS: Analysis of the distribution pattern of the different types of mutations revealed: 1) No mutations were identified in exons 0 and 6; 2) Missense mutations were mostly found within the RHD that is involved in heterodimerization with CBFβ; 3) The amino acids most frequently found to be mutated were R190, R193, and R225 residues. These positions define mutation hot spots.
CONCLUSION: The hot spots correspond with highly conserved amino acids, playing a crucial role in the function of the RUNX2 transcription factor. A comparison of mutation type and mutation site gives striking results: missense mutations, i.e. modifications that lead to the replacement of amino acids, are found mostly in the highly conserved RHD. In contrast, deletions, insertions and nonsense mutations are more frequently found to affect specific domains, which are responsible for the modulation of the RUNX2 response. They seem to act as entities. Here the complete loss of function of these domains is responsible for inactivation of RUNX2 function.

5 EFFECTS OF SYSTEMIC ADMINISTRATION OF L-THYROXIN AND DOXYCYCLINE ON ORTHODONTICALLY INDUCED ROOT RESORPTION IN RATS

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AIM: To histologically evaluate and compare the effects of the systemic administration of L-thyroxin (TX) and doxycycline (DX) on orthodontically induced root resorption.
MATERIALS AND METHOD: Twenty-eight male 50-60 day old Wistar rats. Seven rats served as the baseline control group. Seven animals received TX (20 μg/kg bodyweight/day) and seven DX (1.2 mg/kg bodyweight/day), by means of a mini-osmotic pump implanted subcutaneously. Seven rats were separated as a sham, in order to evaluate the pure effect of the surgical procedure on the health of the animals. Tooth movement was achieved by placing coil springs between the right maxillary first molar and incisors for 14 days. The animals were killed and specimens were processed for light microscopy. The surface area

of root resorption lacunae was measured histomorphometrically using digital photomicrographs. To evaluate the resorptive changes on the molar root surface of each group, scanning electron microscopy examinations were also performed.
RESULTS: Histomorphometric analysis of the root resorption, expressed as a percentage, showed that the average relative root resorption affecting the maxillary molars on the tooth movement side was 0.32 ± 0.25 in the TX, 0.26 ± 0.06 in the DX, and 2.19 ± 0.86 in the control groups. Statistically significant inhibition of root resorption was found in both the DX and TX groups ($P < 0.001$) on the tooth movement side. There was no statistically significant difference in root resorption relationship between the DX and TX tooth movement groups.
CONCLUSIONS: Systemic administration of TX and DX demonstrated similar effects on root resorption in rats and may have inhibitory effects on orthodontically induced resorptive activity.

6 A FOLLOW-UP STUDY OF CHANGES IN OCCLUSION BETWEEN THE AGES OF 8 AND 65 YEARS

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AIMS: To examine the implications of malocclusion with a life long perspective.
SUBJECTS AND METHOD: Selected subgroups of a population of 2500 eight-year-olds recruited in 1950, who had a deep bite (DB), crossbite (CB), dental irregularity (DI), or a normal occlusion [(NO) comparison group] were invited for a re-examination in 2007. Among the 69 patients responding (37%), 20, 21, 11, and 18 subjects belonged to the DB-, CB-, DI-, and NO groups, respectively. In addition to an in-depth interview, the respondents were clinically examined and photographs, similar to those from 1950, were taken.
RESULTS: Two subjects in the DB-, eight in the CB-, and two in the DI-groups had received simple orthodontic treatment. The DB had decreased in nine and increased in five subjects, of which four had experienced trauma to the palate. The anterior CB persisted in eight subjects and had been corrected by early treatment in six, whereas a posterior CB persisted ($n = 11$) in all, except one who had been treated. In the CB-group seven subjects reported various degrees of temporomandibular dysfunction (TMD). In several subjects irregular tooth position had been corrected prosthodontically. In the NO-group a high degree of occlusal stability was observed in all except one subject. Almost all respondents were regular dental attendees and the standard of oral hygiene was high. The number of restored teeth was the same in the groups, but the number of missing teeth was higher in the malocclusion groups (4.1) compared with the NO-group (1.6).
CONCLUSIONS: A high degree of stability of the occlusion was observed in the NO group. Changes in deep bite varied and caused palatal trauma in every fifth individual. Crossbites tended to aggravate. TMD was recorded in one-third of the subjects in the crossbite group. Compared with NO subjects, those with a malocclusion had more missing teeth.

7 THREE-DIMENSIONAL CONDYLAR MORPHOLOGY IN TEMPOROMANDIBULAR DISORDER

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AIM: To elucidate the relationship between condylar morphology and signs and symptoms of Research Diagnostic Criteria (RDC) group III temporomandibular dysfunction (TMD) patients, using three-dimensional (3D) surface models constructed from cone beam computed tomographic (CBCT) images.
MATERIALS AND METHOD: 3D shape correspondence was used to localize and quantify the condylar morphological differences of 29 female RDC/TMD group III (arthralgia, arthritis, arthrosis) patients (mean age = 38.7 years) as compared with 35 asymptomatic females (mean age = 23.7 year). 3D models of the condyles were constructed from CBCT images and shape analysis performed using the publicly available SPHARM-PDM software. The right and left condyles of each subject were normalized using rigid Procrustes alignment to an overall mean condylar model. Spearman rank tests were used to assess the local correlations of visual analogue scale pain intensity values and the time of pain onset to the modification of the shape of the condyles at every surface point. The differences between the group mean surfaces were visualized with colour-coded magnitude and difference vectors.
RESULTS: The average condylar morphology in the RDC/TMD group III patients showed resorption of the antero-superior surface of the lateral pole and flattening of the articular surface, compared with the mean morphology in asymptomatic subjects. 3D shape correspondence colour maps of both left and right condyles for the TMD subjects showed areas in the antero-superior surface of the condyle of strong positive correlation coefficients at every surface point with pain score and pain duration/onset ($r = 0.6$, surface red regions and $P < 0.05$).
CONCLUSION: A statistically significant correlation exists between pain intensity and pain onset and specific locations in condylar morphologic variation in RDC/TMD III patients, as determined using 3D shape correspondence of surface models constructed from CBCT images.

8 HEDGEHOG SIGNALLING IN CRANIOFACIAL DEVELOPMENT AND DISEASE: NOT TOO MUCH AND NOT TOO LITTLE

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Holoprosencephaly (HPE) is a heterogeneous developmental anomaly affecting the central nervous system and face in which, the embryonic forebrain fails to divide into distinct halves. The aetiology is complex, but mutation in the Sonic hedgehog (Shh) gene is a known cause in both mice and humans. Gas1 encodes a GPI-linked protein previously demonstrated to have an antagonistic effect on Shh signalling in the somite. However, Gas1-/- mice have microform HPE with mid-facial hypoplasia, maxillary incisor fusion and cleft palate. These defects are associated with partial loss of Shh transduction in cells distant from the transcriptional source; suggesting that Gas1 can potentiate long-range Hedgehog signalling in the early face. Loss of a single Shh allele in a Gas1-/- background worsens the craniofacial phenotype, providing genetic evidence that Shh and Gas1 function in the same pathway. These results establish Gas1 as a potential modifier for HPE in human populations. Nevoid Basal Cell Carcinoma Syndrome (NBCCS) is an autosomal dominant disorder characterized by multiple NBCC, odontogenic keratocysts and skeletal anomalies. Causative mutations occur in the PTCH1 gene, which encodes the principle Shh receptor.
The craniofacial phenotype of a transgenic mouse model for NBCCS, which expresses Shh in basal epithelium was investigated. These mice have an absence of flat bones within the skull vault, cleft lip and palate, and arrested tooth development. Increased Hedgehog signal transduction seen in these mice can also influence cell fate within epithelial tissues of the craniofacial region. In palatal epithelium, increased Shh activity prevents apoptosis and subsequent fusion of the palatal shelves. In contrast, high levels of transcription in tooth epithelium arrests development at the bud stage, secondary to a lack of cell proliferation. Together, these findings illustrate the importance of appropriately regulated Hedgehog signalling during early craniofacial development.

9 INTERLEUKINS 2, 4, 6, 8, AND 10 LEVELS IN THE HUMAN GINGIVAL SULCUS DURING ORTHODONTIC TREATMENT

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AIMS: To determine the levels of interleukins (IL) 2, 4, 6, 8 and 10 during tooth movement, and to establish whether they differ from each other with levelling and distalization forces used in various treatment stages of fixed orthodontic therapy.
SUBJECTS AND METHOD: Forty patients (16 female, 24 male; aged: 17-19 years; mean: 17.7 ± 0.4 years) diagnosed with Class II division 1 malocclusions and referred for the extraction of the first premolars. All subjects underwent an oral hygiene programme in order to improve their use of interdental and regular brushes and they also received also several oral hygiene instructions. Three months later fixed orthodontic treatment was initiated. The patients were seen at baseline, on days 7 and 21 and 6 months later, as the teeth were levelled. For the distalization stage, records at baseline were taken at the first sixth month appointment. During the distalization phase the scores of days 7 and 21 and also at 6 month were recorded. Gingival crevicular (GFC) samples were taken at all time points.
RESULTS: Increases were seen in the volume of GFC fluid and the concentrations of IL 2, 6, and 8 mainly in the distalizing stage of treatment. IL 4 and 10 did not show any statistically significant variations during orthodontic therapy.
CONCLUSIONS: Levelling and distalization of the teeth during orthodontic treatment evokes increases in the proinflammatory IL-2, 6 and 8 detectable in the GFC.

10 EVALUATION OF PERIODONTAL STATUS OF ECTOPIC CANINES AFTER ORTHODONTIC TREATMENT

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AIM: To assess the periodontal health of buccally or palatally ectopic maxillary canines after orthodontic treatment.
SUBJECTS AND METHOD: Thirty subjects (21 females, 9 males) who initially had a unilateral maxillary ectopic canine and whose orthodontic treatment had been completed at least 6 months previously. They had optimal oral hygiene and no systemic disease. The mean age of the subjects at the beginning of the treatment was 11.43 ± 1.45 years. Fifteen of the subjects initially had a palatally ectopic canine that had been exposed with a closed surgical approach, while the remaining 15 had a buccally ectopic canine. The mean treatment duration was 3.71 ± 1.32 years. The periodontal status of the originally ectopic canines and their normally positioned contralaterals were assessed by measuring the plaque index, gingival bleeding index, pocket depth, width of attached gingiva, gingival level and crown length. Bone level and root length measurements were made on periapical films obtained with a long cone paralleling technique.

RESULTS: Canines that had originally been palatally ectopic had greater pocket depths ($P < 0.01$), higher gingival levels ($P < 0.05$) and reduced bone levels ($P < 0.01$) compared with the contralateral canines. Canines that had originally been buccally ectopic had increased plaque index scores ($P < 0.01$), increased gingival bleeding index scores ($P < 0.01$), reduced width of attached gingiva ($P < 0.001$), higher gingival levels ($P < 0.001$) and increased crown lengths ($P < 0.001$) compared with their contralaterals. Comparison of the periodontal status of the palatally and buccally ectopic canines revealed a significant difference only in bone level, with higher bone levels in buccally ectopic canines.
CONCLUSION: Comparison of the parameters related to periodontal health showed clinically significant differences between initially ectopic maxillary canines and their normally positioned contralaterals.

11 *IN VITRO* CYTOTOXICITY OF ORTHODONTIC PRIMERS VIA REACTIVE OXYGEN SPECIES PRODUCTION IS COUNTERACTED BY N-ACETYL CYSTEINE

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AIMS: To evaluate the cytotoxicity of four orthodontic primers, the role of the reactive oxygen species (ROS) in induced cell damage and the potential amelioration of the adverse efffects with an anti-oxidant amino acid, N-acetyl cysteine (NAC).
MATERIALS AND METHOD: Balb 3T3 murine fibroblasts were exposed to different concentrations of primers (0–0.20 mg/ml). Mitochondrial dehydrogenase activity was evaluated by MTT assay and cell death was measured by flow cytometry (propidium iodide staining). In order to evaluate the increase of ROS levels, human primary gingival fibroblast (HGF) were incubated with primers with or without NAC, and ROS production was detected by flow cytometry measuring the increasing fluorescence of the oxidation-sensitive dye 2′,7′-dichlorofluorescein diacetate.
RESULTS: After 24 hours all materials decreased cell viability in a dose related manner. Cytotoxicity of orthodontic primers based on concentrations which caused a 50 per cent decrease of mitochondrial activity (TC50) in Balb 3T3 cells was ranked as follows: Transbond XT (45.57 mg/ml) > Eagle Fluorsure (49.27 mg/ml) > Transbond MIP (64.35 mg/ml) > Ortho solo (70.09 mg/ml). Moreover, in HGF cells all materials induced a dose-dependent increase of ROS levels between 4 and 7.5-fold compared with untreated cells. Incubation of HGFs with NAC significantly reduced ROS production and decreased cell damage and cytotoxicity ($P < 0.001$).
CONCLUSIONS: Hydrophilic primers are less cytotoxic than hydrophobic materials. The major role of ROS in the induction of cell death was demonstrated since the antioxidant NAC was able to prevent cell damage induced by the tested materials. The cytotoxic effects of the primers might be of clinical relevance and antioxidants might be used as chemoprotectants in order to prevent the adverse effects of orthodontic materials.

12 EVIDENCE BASED ORTHODONTIC TREATMENT: FACT OR FALLACY?

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AIMS: To systematically review the scientific basis of orthodontic treatment and its contribution to oral health and function.
MATERIALS AND METHOD: Literature searches were carried out based on PICO's, using appropriate MeSH and free search terms for Ovid-Medline® and Emtree tools® for Embase®. Inclusion/exclusion criteria were established to select studies for further appraisal of methodological quality (Guyatt *et al*., 2006). Guidelines, systematic reviews, meta-analyses, other reviews or original studies were looked for by searching Ovid-Medline, Embase and Tripdatabase, and Cochrane database of systematic reviews.
RESULTS: Initially, 8490 potentially relevant citations were identified of which 92.9 per cent (7887 articles) were excluded on title and abstract, leaving 603 studies to be evaluated on full text. From this, 112 clinical studies were selected. Moderate quality evidence was found for adverse effects of untreated malocclusions, including risk of trauma in subjects with a large overjet and absence of a lip seal. Benefits of orthodontic treatment in cleft lip and palate patients are generally accepted (according to clinical expert opinion), while maximally moderate evidence can be considered for other malocclusions, including prominent upper anterior teeth and effectiveness of protraction facemask in Class III malocclusion subjects. For Class II division 1 treatment, a moderate level of evidence was found in favour of one-phase over two-phase treatment except for trauma prevention and psychosocial benefit. Forced bite treatment can be recommended, while evidence was lacking for open bite treatment. Moderate to low scientific evidence was found for bone level reduction and root resorption as adverse effects of orthodontic treatment.
CONCLUSIONS: Few orthodontic treatment indications are supported by clinical evidence. The main methodological limitations comprise publication bias, lack of homogeneity of primary data, lack of information on sample/control groups and range of indices to assess initial and outcome measures.

13 THREE-DIMENSIONAL ASSESSMENT OF FACIAL ASYMMETRY DURING GROWTH

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AIMS: Quantitative and qualitative analysis of facial soft tissue asymmetry during growth.

SUBJECTS AND METHOD: Non-invasive optical laser surface scanning was performed at two time points (T1 and T2), with a 2½ year interval, to capture facial images of 39 Caucasian Finnish children (18 boys, 21 girls, mean age 11.5 years). Two high-resolution Konica Minolta Vivid 900 laser scanners were used. Acquired images were processed in Rapidform 2006 (Inus Technology, South Korea) with an in-house developed subroutine. Twenty-one facial soft tissue landmarks were identified (defined by Farkas, 1994) and proven to be reliable. For each subject, a mirror image was generated and superimposed on the original image to create a symmetric face and establish the mid-sagittal plane. Coincidence of the original face to the symmetric face (amount of symmetry) was measured for the whole face, upper, middle and lower thirds at a tolerance level 0.5 mm and presented as colour maps. Three angular and 14 linear measurements were calculated and statistically analysed. As the amount of symmetry was not normally distributed, Wilcoxon's signed rank test ($P < 0.05$) was performed for each parameter at T1 and T2.

RESULTS: No statistically significant difference was found. Mann-Whitney test ($P < 0.05$) showed that there was also no statistically significant difference between males and females. Angular measurements did not differ significantly over time, and for linear measurements only a deviation of the tip of the nose (pronasale) and glabella from the mid-sagittal plane showed a statistically significant difference over time (Wilcoxon signed rank test, $P < 0.05$).

CONCLUSIONS: There is no difference in asymmetry of faces over a 2½ year period, except for points, pronasale and glabella. The sample size was too small to extrapolate the results and apply them to a given population. However, this research may act as a pilot study. A longer study period is also suggested.

14 SKELETAL STABILITY OF LE FORT I OSTEOTOMY IN PATIENTS WITH UNILATERAL CLEFT LIP AND PALATE

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AIMS: To retrospectively evaluate the post-operative stability of Le Fort I osteotomy in unilateral cleft lip and palate (UCLP) patients.

SUBJECTS AND METHOD: Thirty-three patients with UCLP (16 females, 17 males) were evaluated cephalometrically. Skeletal stability was analyzed both horizontally and vertically from lateral cephalograms taken shortly before surgery, immediately afterwards, and 1 year post-operatively. The patients had been operated on at the Helsinki Cleft Palate and Craniofacial Centre between 1997-2001 by one surgeon. Their mean age at the time of surgery was 23.5 years (range 15.0- 52.0). The one-piece Le Fort osteotomy was fixed with titanium plates and the osteotomy line was bone-grafted. After surgery, intermaxillary elastics were used for one month. Neither intermaxillary fixation nor occlusal splints were used post-operatively.

RESULTS: The mean maxillary advancement (point A) during the Le Fort I was 5.2 mm (range 4.3-6.2 mm) and the mean vertical lengthening 3.8 mm (range 2.7-4.9 mm). One year post-operatively the mean maxillary horizontal relapse was 0.9 mm, range 0.3-1.6 mm (17%) whereas the mean vertical relapse was 0.2 mm, range: 0.1-0.6 mm (5%).

CONCLUSIONS: Le Fort I osteotomy with bone-grafting and rigid fixation is stable in patients with a UCLP although minor horizontal relapse can be expected.

15 MUTILATING DENTAL TRAUMAS: OUTCOME OF TREATMENTS

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AIMS: To investigate which injuries are referred for interdisciplinary treatment planning by general practitioners and specialists. Further objectives were to examine how treatment plans were carried out, and to assess treatment outcome and patient satisfaction.

SUBJECTS AND METHODS: All 113 trauma cases (61% boys, 39% girls, median age 11 years) referred to the interdisciplinary specialist team at the University of Oslo from 1998 to 2003 (T1). In 2008 (T2) all were recalled for an examination and asked to complete a questionnaire. Photographs, dental casts, and dental pantomograms at T1 and T2 were available for 69 individuals (61%).

RESULTS: Most patients (73%) had 2-6 traumatized teeth, with the maxillary incisors being the most frequently (97%) injured. The rates of exarticulation, root fracture, and intrusion/luxation were 43, 30, and 15 per cent respectively. In 74 per cent ankylosis or resorption made tooth replacement necessary. The plan was: orthodontic space closure 28 per cent, transplantation

29 per cent, implants 30 per cent, prosthodontics 7 per cent and other treatments 6 per cent. At T2, 80 per cent had been treated according to the recommended plan, and 74 per cent had orthodontic treatment. Orthodontic space closure was considered to have been successful in 10 out of 13 cases, even if suboptimal tooth positioning was seen in some subjects. Sixteen transplants in 13 individuals were all present, and the success rate was 88 per cent, two teeth had root resorption. A potential for aesthetic improvement by replacing composite build-ups with porcelain veneers was observed in both groups. Most of the patients (88%) were satisfied and perceived the tooth replacements no different from their other teeth.
CONCLUSIONS: The most frequent indication for referral to the interdisciplinary team was that multiple teeth were traumatized. Recommended treatment plans were generally followed with good results even if a potential for improvement was identified in some patients. Patient satisfaction rate was high.

16 CRANIOFACIAL MORPHOLOGY IN ADULT JUVENILE IDIOPATHIC ARTHRITIS PATIENTS

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AIM: To evaluate craniofacial morphology in adult juvenile idiopathic arthritis (JIA) patients in relation to temporomandibular joint (TMJ) involvement.
SUBJECTS AND METHOD: The original material included 103 children (mean age 9 years) diagnosed with JIA. From these, 60 participated in a follow-up study at adulthood (mean age 35 years). Six patients who had undergone surgery in the craniofacial area were excluded from the study. Craniofacial morphology was evaluated with lateral cephalograms and analysed by the digital tracing program, Facad®. Fifty-four healthy subjects served as the controls. JIA involvement in the TMJs was evaluated using computed tomography and magnetic resonance imaging. The patients were subgrouped according to TMJ involvement: those without (PO), with unilateral (PU), with bilateral (PB), and those with internal derangement. Craniofacial morphology was compared in the subgroups PO and PB, and the healthy controls. The data set was analyzed by regression analysis using the Statistical Package for Social Sciences, version 14.0.
RESULTS: A similar craniofacial morphology was found in the PO group and healthy controls. Compared with the controls, the PB group showed smaller snB ($P < 0.001$) and larger AnB ($P < 0.001$) and ML/NSL ($P < 0.001$) angles. For linear measurements, mandibular length ($P < 0.001$), and posterior face height ($P < 0.001$) were smaller in the PB patients. The ratio between anterior and posterior face height was larger ($P < 0.001$) in the PB group. When comparing the PB and PO groups, larger AnB ($P = 0.001$) and ML/NSL ($P = 0.001$) angles were found in the PB group. A shorter mandibular length ($P = 0.002$) and a shorter posterior face height ($P < 0.001$) were found in the PB group along with an increased ratio between anterior and posterior face heights ($P = 0.002$).
CONCLUSION: Craniofacial morphology was altered in adult JIA patients with bilateral TMJ affection. JIA patients without TMJ involvement showed a similar craniofacial morphology to healthy controls.

17 IN SEARCH OF CLINICAL EXCELLENCE: IDENTIFICATION OF IDEAL CANDIDATES FOR FUNCTIONAL JAW ORTHOPAEDICS

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AIM: This double-blind clinical trial on consecutively treated patients compared the effects of two protocols for one-phase comprehensive treatment of Class II division 1 malocclusions (bonded Herbst followed by fixed appliances (BH+FA) versus headgear followed by fixed appliances and Class II elastics (HG+FA) at puberty and identified preferential candidates for the protocol incorporating the functional appliance (BH+FA)
SUBJECTS AND METHODS: Both BH+FA and HG+FA samples comprised 28 patients. All patients started treatment at puberty (CS3 or CS4), and completed treatment at an advanced post-pubertal stage (CS5 or CS6). Lateral cephalograms were taken before therapy (T1) and at an average interval of 6 months after the completion of therapy (T2). In both groups the male-to-female ratio was 1:1 with a mean age at T1 of 13 years, and a mean T1-T2 interval of 33 months. The treated groups were compared with a matched control group of 28 subjects with untreated Class II malocclusions. ANOVA with Tukey's *post-hoc* test was used for statistical comparisons. Discriminant analysis was applied to identify preferential candidates for the BH+FA protocol.
RESULTS: The BH+FA group showed a significantly greater increase in mandibular protrusion associated with a significantly greater forward movement of the soft tissue chin when compared both with the HG+FA and control group. Discriminant analysis identified two pre-treatment variables (Co-Go-Me angle and Pogonion to Nasion perpendicular) that were significant ($F = 4.48$; $P < 0.01$) in predicting the post-treatment amount of mandibular soft tissue improvement.
CONCLUSIONS: The protocol incorporating functional jaw orthopaedics at puberty had a greater favourable impact on the advancement of the chin. With the aim of achieving clinical excellence, ideal candidates for the BH+FA treatment protocol

should be identified; they are represented by Class II patients with mandibular retrusion associated with a small Co-Go-Me angle before treatment.

18 NASOLABIAL AESTHETICS IN CHILDREN WITH COMPLETE UNILATERAL CLEFT LIP AND PALATE

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AIM: Facial aesthetics play an important role in social interactions. However, children with a repaired complete unilateral cleft lip and palate usually show some disfigurement of the nasolabial area. Few studies have assessed nasolabial appearance following different treatment protocols. The aim of this study was to compare nasolabial aesthetics following one- and three-stage surgical treatment protocols.
MATERIALS AND METHOD: Four components of the nasolabial appearance: nasal form, nasal deviation, mucocutaneous junction, and profile view were assessed by four raters for 108 consecutively treated children who underwent either one-stage closure, when the cleft lip and palate was repaired simultaneously between 6 and 12 months (Warsaw group, 41 boys, 19 girls, mean age: 10.8, SD 2.0 years) or three-stage closure, when lip, soft palate, and hard palate were repaired separately (Nijmegen group, 30 boys, 18 girls, mean age 8.9, SD 0.7 years). The five-grade aesthetic index of Asher-McDade was used, where grade 1 represents the most aesthetic and grade 5 the least aesthetic outcome.
RESULTS: Nasal form was judged as the least aesthetic in both groups and graded 3.1 (SD = 1.1) and 3.2 (SD = 1.1). Nasal deviation, mucocutaneous junction, and profile view were scored from 2.1 (SD = 0.8) to 2.3 (SD = 1.0) in both groups. Treatment outcomes following the Warsaw and Nijmegen protocols were comparable. Neither overall, nor any of the four components of the nasolabial appearance showed inter-centre difference ($P > 0.1$).
CONCLUSIONS: Nasolabial appearance following a one- or three-stage protocol was comparable. Technique of lip repair (triangular flap or Millard rotation-advancement) gave comparable results for aesthetics of the nasolabial area at the age of approximately 10 years.

19 COMPARISON OF THREE-DIMENSIONAL FACIAL SOFT TISSUE MEASUREMENTS OBTAINED WITH DIFFERENT METHODS

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AIMS: To compare clinical facial soft tissue measurements with the measurements of facial plaster casts, three-dimensional (3D) scanned facial plaster casts, 3D digital photogrammetric models and 3D laser scanned models.
MATERIALS AND METHOD: Facial models of 15 adults were obtained using silicone impression material, 3D digital surface photogrammetry and 3D laser scanner. Plaster casts were also scanned. Landmarks were marked on the subjects and plaster casts and digitized on the 3D models and then measured using Mimics 12.0 software.
RESULTS: No statistically significant differences were found between the five 3D measurement methods in terms of mouth width, philtrum median height and width of the nose. Comparison of clinical measurements with facial plaster cast measurements revealed that philtral width, columella height, right lip and nostril heights were wider and longer in clinical measurements than in facial plaster cast measurements. Comparison of clinical measurements with the laser scanned and stereophotogrammetric model measurements revealed that philtrum lateral heights, lip heights and philtral width were significantly different between methods. When laser scanned and stereophotogrammetric measurements were compared, significant differences were observed in lip and nostril heights.
CONCLUSIONS: Direct clinical measurement of the facial soft tissues is the gold standard of all methods although slight pressure application on the soft tissues in the lip region may be responsible for the differences. The common method of facial plaster may be problematic due to the depression caused by the impression material on the tip of the nose. Laser scanning is not sufficiently sensitive to visualize deeper indentations such as the nostrils. 3D digital photogrammetry is promising for 3D facial measurements and will be improved when colour identification between mucocutaneous junctions of the lip region is achieved.

20 COMPUTED TOMOGRAPHIC EVALUATION OF THE POSITION AND BONY SUPPORT OF THE UPPER AND LOWER INCISORS

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AIMS: To verify, via cone beam computed tomography, the existence of a correlation between the morphology of the upper jaw, the position of the upper incisors and facial type, and the existence of a correlation between the morphology of the mandibular symphysis and various facial typologies.

SUBJECTS AND METHOD: From 191 patients, the Frankfort mandibular plane angle was employed to select 20 short face types, 20 normal faced and 20 long face patients. Tomography was carried out using NewTom 3G. On sagittal sections, some parameters defining the dentoskeletal relationships and the alveolar thickness were measured. The following parameters were then measured on the sections corresponding to the lower incisors: height, thickness and area of the symphysis, distance of the vestibular and lingual cortices from the apices of the incisors, and possible inclination of each lower incisor. The measurements obtained were processed using ANOVA and Tukey's *post hoc* test.
RESULTS: At the upper incisors, the short faced patients presented greater alveolar bone thickness than the long face patients. In short and normal facial types, the root apex of the upper incisors was further away from the lingual cortex than in the long face patients. No difference was found between the facial types regarding dental inclination. In almost all cases, the total thickness of the symphysis was greater in brachyfacial than in dolicofacial subjects, whereas no statistically significant differences in the total and cancellous areas of the symphysis were found between the three facial types. Comparing the measurements of the symphysis at the lower incisors, the total and cancellous heights and areas were greater at the central than at the lateral incisors.
CONCLUSIONS: At the upper incisors, facial type was correlated in a statistically significant manner with both alveolar bone thickness and the distance between the root apex and lingual cortex. A statistically significant relationship exists between facial type and the morphology of the mandibular symphysis.

21 CRANIOFACIAL AND DENTAL CHARACTERISTICS OF PATIENTS WITH MILD TO SEVERE HYPODONTIA
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AIM: To evaluate the relationship between congenital absence of permanent teeth and craniofacial and dental morphology.
SUBJECTS AND METHOD: One hundred and fifty four patients with two or more congenitally missing teeth divided into three groups. Group I (mild) comprised 68 patients with two missing teeth, group II (moderate) 50 patients with 3 to 5 missing teeth and group III (severe) 36 patients with six or more missing teeth. Fifty Class I patients without any missing teeth served as the control. Eighteen angular and 17 linear measurements were measured on lateral cephalograms and the mesiodistal and labiolingual dimensions of the teeth were recorded on dental casts. All recorded data were statistically analyzed and compared among the groups.
RESULTS: All hypodontia groups showed smaller teeth than the controls. The reduction in size was greater in group III. Significant differences were found in the mandibular plane angle, upper and lower incisor measurements, anterior and posterior face heights, ramus height and soft tissue measurements.
CONCLUSIONS: Patients with congenitally missing teeth have different skeletal and dental features. In treatment planning of these patients, these characteristics should be taken into consideration.

22 INCREASED FACIAL ASYMMETRY CORRELATES WITH OCCLUSAL CHARACTERISTICS IN CHILDREN WITH CONGENITAL HIP DISLOCATION
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AIM: To examine the associations between developmental dysplasia of the hip (DDH), facial and head shape asymmetry, and malocclusions in preschool and school children.
SUBJECTS AND METHOD: Sixty Finnish children (40 girls, 20 boys) born during 1997-2001 in Northern Ostrobothnia Hospital District and having developmental dysplasia of the hip and treated by Von Rosen method. The control group comprised 71 Finnish children (46 girls, 21 boys) matched by age and gender. The children participated in a cross-sectional study at the age of 5-10 years; the mean age of the DDH children was 8.04 (SD 1.41) and controls 7.86 (SD 1.35) years. Computerised and digitized facial imaging in supine, lateral and frontal positions, and of the occlusal plane, were performed and analysed. The facial area and head shape were measured and analysed using the computer program, WinCeph 9.0 (Rise Corp., Sendai, Japan). For statistical analysis, the 'L-plot' program for elliptic regression of head shape was used. Dental examinations, intraoral photographs and clinical examination were also carried out.
RESULTS: The DDH children had significantly more crossbites than the controls (30% = 9.9%) ($P < 0.003$). In facial imaging, the frontal plane, ratio of the right and left lower face was significantly more asymmetric ($P < 0.006$) in DDH children compared with the controls, indicating asymmetry of the lower face. DDH subjects also showed significantly more distortion/rotation of the head compared with the controls ($P < 0.001$).
CONCLUSIONS: Children with CHD may be more predisposed to asymmetric growth and asymmetry of craniofacial structures and the development of a crossbite. The intrauterine conditions and treatment of the dysplasia of the hip by the

Von Rosen method (splint therapy), may be possible influencing factors. This study provides additional information on the development of facial asymmetries and the results are important in orthodontic treatment planning.

23 EMBRYONIC AND FOETAL MYOSIN HEAVY CHAIN mRNA IN THE MASSETER MUSCLE BEFORE AND AFTER ORTHOGNATHIC SURGERY

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AIM: In a previous study it was found that there was a shift in the expression of myosin heavy chain isoforms (MHC) from MHC type-I to MHC-IIa after orthognathic surgery. For this change in composition of MHC and fibre types the developmental myosins should be important because they are expressed in undifferentiated cells and in contrast to other skeletal muscles are present in the masseter muscle of adults. The aim of this study was to analyse the expression of embryonic and foetal MHC (MYH3 and MYH8) in the masseter muscle of patients before and after orthognathic surgery.
SUBJECTS AND METHOD: Twenty adults with mandibular prognathia (Class III) or retrognathia (Class II). Four tissue samples were taken from the anterior and posterior parts of the left and right masseter muscle before (T1) and six months after (T2) orthognathic surgery. Relative quantification of MYH3 and MYH8 was performed with real time polymerised chain reaction with EF-2 as the house keeping gene. Gene regulations were analysed with the relative expression software tool. Additional absolute quantification using the computed tomographic (CT) values was calculated and the values of T1 were correlated with T2.
RESULTS: MYH3 (embryonic) was 5 to 20 fold upregulated from T1 to T2 in both groups ($P < 0.001/0.005$). MYH8 (foetal) was 5.8 fold upregulated in Class II patients and 2.8 fold downregulated in Class III patients. There was a correlation of 0.66 between the T1 and T2 level of the CT values in the Class II patients for MYH3.
CONCLUSIONS: MYH8, but more so MYH3, have an active part in the differentiation and adaptation in muscle function after orthognathic surgery. The correlation between the levels of MYH3 at the beginning to the magnitude of concentration after surgery in adult patients with mandibular growth deficiency could have a general significance for Class II treatment in children and adolescence.

24 PERMANENT TOOTH ERUPTION DIMORPHISM IN OPPOSITE SEX TWINS

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AIM: To compare permanent tooth eruption difference between boys and girls in opposite sex (OS) twins and non-twins.
SUBJECTS AND METHOD: The subjects were 2159 black (60%) and white (40%) children from the 60 000 pregnancies that comprised the U.S. Collaborative Perinatal Project in the 1960s, including altogether 40 OS twin pairs. Their age range was 6 to 12 years. Dental casts were compared in matched pairs, including also blind replicate measurements. Concordant/discordant tooth pairs were formed on the basis of the four clinical stages of eruption: unerupted, emerged, half erupted and completely erupted. Binomic distribution of advanced pairs and mean tooth emergence times were compared among OS twins and controls.
RESULTS: In general there was no significant difference in permanent tooth eruption times between OS twins and controls, but lower canines erupted approximately 4 to 5 months later in OS girls compared with non-twin girls ($P < 0.03$). However, based on comparisons between discordant pairs, the dimorphism in tooth eruption disappeared in OS twins in teeth other than the lower canines and first premolars, when compared with controls, other twin types included.
CONCLUSIONS: Prenatal diffusion of sex hormones (e.g. testosterone) between OS twins through membranes or placental anastomoses may have an impact on the dimorphism of tooth eruption and times of emergence.

25 DENTAL DEVELOPMENT AND CRANIOFACIAL CEPHALOMETRIC MORPHOLOGY IN CHILDREN WITH CATCH 22 SYNDROME

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AIM: To evaluate dental age, the number of missing teeth and craniofacial cephalometric morphology in children with CATCH 22.
SUBJECTS AND METHOD: Forty-one children (20 girls) with CATCH 22 were studied retrospectively from dental pantomograms and lateral cephalograms taken at a mean age of 8 years (range 5.8-12.9 years). The deletion of 22q11 was verified by FISH techniques. Thirteen of the children with CATCH 22 had palatal clefts. The dental stages were assessed using the method of Demirjian, and dental age was calculated according to Finnish dental maturity reference values. The lateral cephalograms were compared with age- and gender-matched controls. Student's *t*- and a paired Student's *t*-test were used for statistical analysis. Standard deviation scores (SDS) were calculated to quantify the variation.

RESULTS: Dental maturation in children with CATCH 22 was delayed by 5 months ($P < 0.004$). Missing teeth, mainly lower incisors and upper lateral incisors, were found in eight patients (20%). The children with CATCH 22 had obtuse cranial base angles and long anterior cranial bases. Their faces were long with increased facial convexity. Both jaws were retrognathic and the lower jaw posteriorly diverged. The pharynges were wide in the nasopharyngeal area and narrow in the hypopharyngeal area. The development of the hyoid bone was delayed. The morphology of the children with CATCH 22 with and without a palatal cleft was similar. Despite several statistically significant differences between the children with CATCH 22 and the controls, the SDS did not exceed +2 for any of the measurements.
CONCLUSIONS: The children with CATCH 22 had several minor distinctive morphological features in the craniofacial and pharyngeal areas. The need for a thorough clinical and radiological dental examination in children with CATCH 22 is emphasized.

26 MANDIBULAR DISTRACTION OSTEOGENESIS ON PHARYNGEAL STRUCTURES AND BREATHING FUNCTION OF SYNDROMIC CHILDREN

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AIM: The am of this descriptive clinical study was to find out how mandibular distraction osteogenesis (DO) affects pharyngeal structures and nighttime breathing and how the achieved treatment outcome is maintained at a 5-year follow-up.
SUBJECTS AND METHOD: Ten syndromic children (mean age 7.6 years) with a severely hypoplastic lower jaw were osteodistracted with a bilateral distractor. Of the 10 children, three were dependent on a tracheostomy tube and others had nighttime breathing problems (4 severe snoring, 3 apnoea). Skeletal and pharyngeal structures were measured on lateral cephalograms taken pre- and post-distraction and at the 1- and 2-year follow-ups and compared using a Student's *t*-test. Nighttime breathing was recorded using questionnaire or sleep polysomnography.
RESULTS: The post-distraction measurements showed a significant lengthening of corpus and ramus and correction of the mandibular retrognathia. The lower airways showed marked expansion in diameter and the nighttime breathing was improved. The dependency on a tracheostomy tube ended in 2 of the 3 children, and in other patients snoring and apnoea ended. However, at the 1 and 2 year follow-ups the mandible and all hypopharyngeal diameters gradually reverted towards their original shape. Reduction of the lower airways correlated with recurrence of mandibular retrognathia. Five of the 10 subjects had apnoea and three had started to snore. None was re-tracheostomized.
CONCLUSIONS: Although DO produced excellent short-term results, this study showed disappointing long-term outcomes in syndromic children. During growth the mandible became more impaired and retrognathic while maxillary growth continued forward and downward. This led to posterior autorotation of the mandible, reduction of the hypopharyngeal airways and re-appearance of nighttime breathing problems. This suggests re-considering the indication for mandibular DO. Early mandibular DO is mainly indicated for decannulation from a tracheostomy tube, not for aesthetic correction.

27 SOCIAL PERCEPTIONS OF ADULTS WEARING ORTHODONTIC APPLIANCES: A CROSS SECTIONAL STUDY

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AIM: To ascertain the influence of orthodontic appliances on subjective ratings of personal characteristics, specifically: social competence, intellectual ability, psychological adjustment and attractiveness in young adult orthodontic patients.
SUBJECTS AND METHOD: A cross-sectional analytical questionnaire study was conducted with 130 undergraduates from the United Kingdom. Each participant was asked to look at a single, randomly assigned colour photograph of a young adult female and then to make judgements about her personal characteristics. Five modified photographs of the same young adult female were used: 1. Unmodified appearance resembling a lingual fixed appliance; 2. Stainless steel fixed orthodontic appliance; 3. Ceramic fixed orthodontic appliance; 4. Gold fixed orthodontic appliance and 5. Clear colourless aligner appliance. Each participant only looked at one photograph using Likert scales for scoring. Higher scores indicated more positive ratings.
RESULTS: A greater perceived intellectual ability was associated with the appearance of no brace (mean value: 7.56) compared with steel (6.67) and ceramic (6.65) braces, but similar to the gold (7.35) and aligner appliances (7.08). No significant differences between the different orthodontic appliance appearances were found for social competence and psychological adjustment. A trend existed where the unmodified image (resembling a lingual appliance) or clear aligner appliances were considered more attractive than visible buccal fixed appliances.
CONCLUSIONS: In the absence of other information, the judgements an individual young adult makes concerning the personal characteristics of other young adults are influenced by dental appearance and orthodontic appliance design. This may have an influence on orthodontic appliance choice.

28 CHANGES IN MECHANICAL BEHAVIOUR OF THE PERIODONTAL LIGAMENT DURING ORTHODONTIC TOOTH MOVEMENT

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AIM: It is well known that the structure and composition of the periodontal ligament (PDL) changes during orthodontic tooth movement. Although it is hypothesized that this leads to changes in the biomechanics of the PDL, to-date all biomechanical studies on orthodontic tooth movement have used descriptions of a normal PDL. Therefore the aim of this study was to describe the mechanical behaviour of the PDL in different phases of tooth movement.
MATERIALS AND METHOD: In seven beagle dogs implants were placed in the mandible to allow standardized bodily distalization of the second premolars with a force of 100 cN. To determine the mechanical behaviour of the PDL, continuous 5 hour measurements were carried out under standardized loading conditions at three time points: (1) before any orthodontic tooth movement had taken place, (2) in the hyalinization phase, and (3) in the linear phase of orthodontic tooth movement. For each phase, time-transposition curves were constructed. Statistical analysis was performed with two-way ANOVA and subsequent Tukey's multiple comparisons tests.
RESULTS: In all groups tooth movement was bi-phasic. In the first few seconds a very rapid displacement occurred. It was approximately 20 μm in the initial and linear phase and about 10 μm in the hyalinization phase. This indicates a slower redistribution of fluid in the PDL as a result of reduced porosity during hyalinization. The first phase was followed by a gradually decreasing creep phase. The total 5 hour movement in the initial phase was approximately 45 μm, in the hyalinization phase about 20 μm, and in the linear phase about 75 μm indicating changes in the viscoelastic properties of the PDL.
CONCLUSION: The changing mechanical behaviour of the PDL during orthodontic tooth movement indicates the necessity for reconsidering the mechanical parameters used in biomechanical studies on orthodontic tooth movement.

29 AN ALTERNATIVE MEDIA FOR RATING DENTAL ARCH RELATIONSHIPS IN BILATERAL CLEFT LIP AND PALATE PATIENTS

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AIM: Dental arch relationships are an important diagnostic proxy for the underlying skeletal relationship. Yardsticks have been developed to measure dental arch relationships in cleft lip and palate (CLP) patients. However, travelling with plaster casts to compare results between CLP centres is difficult. Therefore the aim of this study was to investigate the reliability of using digital models or photographs of dental casts as an alternative to plaster casts for rating dental arch relationships in children with bilateral cleft lip and palate (BCLP).
MATERIALS AND METHOD: Records of children with complete BCLP (n = 26) at the age of 6, 9, and 12 years. Plaster casts of each child were available as well as photographs and digital models of the plaster casts at the three ages. All three record modalities were scored using the Bauru-BCLP Yardstick (Shaw *et al*., 2008). Four observers scored all models in the three formats in random order. Kappa statistics were used to calculate intra- and interobserver agreement.
RESULTS: No significant differences were found for the Bauru-BCLP scores between the rating of plaster casts, digital models and photographs of the same casts. Intra- and interobserver statistics showed weighted kappas between 0.692 and 0.885 and 0.716 and 0.846, respectively.
CONCLUSION: Photographs and digital models can be used for rating dental arch relationships in patients with BCLP at the age of 6, 9 and 12 years and provide a reliable alternative to the application of the Bauru BCLP Yardstick on conventional dental casts.

30 THREE-DIMENSIONAL MORPHOLOGICAL ASSESSMENT OF UPPER AIRWAY MEASUREMENTS

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AIMS: Lateral cephalograms are commonly used to evaluate and measure the morphological aspects of the upper airways in a lateral position. Several studies advocate the use of this diagnostic method and a number of linear measurements to evaluate the upper airways. Even though they are widely used, lateral cephalograms have some limitations as they provide a two-dimensional projection of a three-dimensional (3D) anatomical structure. The aims of this study were to evaluate antero-posterior and transverse linear measurements, cross-sectional area and total volume of the upper airways using a cone-beam computed tomography (CBCT) data-set.
MATERIALS AND METHOD: CBCT scans of 40 subjects taken with the patients awake, in a supine position and with the teeth in occlusion. Lateral cephalogram, cross-sectional images and a 3D airway model (volume) were generated.

RESULTS: The upper (nasopharyngeal) and lower (oropharynx) pharynx dimensions showed a weak correlation in most patients. Significant anatomical and volume variation of the airways was detected among patients. Correlation between the sagittal, transverse, cross-sectional area, and volume of the airways was poor.
CONCLUSIONS: The morphology of the airways cannot be truly depicted with sagittal and/or transverse linear measurements. As airflow through the airways is greatly influenced by the lumen dimension (cross-sectional area), small variations in sagittal and/or transverse dimensions can substantially affect breathing mode. Therefore 3D analysis of the airways can improve diagnostic precision.

31 VALIDITY OF PANORAMIC RADIOGRAPHS IN THE ASSESSMENT OF THE MESIO-DISTAL PROXIMITY OF ROOTS OF ADJACENT TEETH

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AIM: A correct tooth position in the three planes of space is one of the major objectives of orthodontic treatment. An appropriate axial inclination of the roots with near-parallel roots has often been discussed in the orthodontic literature, and is one of the criteria in the examinations of the American Board of Orthodontics and the European Board of Orthodontists (information for candidates). The aim of this study was to determine whether panoramic radiographs provide a true assessment of mesio-distal root relation of adjacent teeth.
MATERIALS AND METHOD: Near-end of treatment panoramic radiographs of patients in the permanent dentition with fixed appliances in both dental arches were taken before debonding. In 22 consecutive cases where signs existed on the panoramic radiographs that roots of adjacent teeth were touching each other, cone beam computed tomography (CBCT) was used to study these areas, to reveal the true root proximity, in order to correct their position, if necessary, by orthodontic means before debonding.
RESULTS: Panoramic radiography and CBCT provided access to 232 common sites. The panoramic radiographs indicated 53 areas where there was contact between the adjacent roots. However, CBCT revealed that true contact existed in only five of these areas, i.e. less than 10 per cent of the diagnosis based on panoramic radiographs were true positive, while the rest, 90 per cent, were false positive. The sites on the panoramic radiographs with no signs of contact between the adjacent roots were 179, which was confirmed by CBCT.
CONCLUSIONS: Panoramic radiographs have a very low sensitivity but high specificity to detect adjacent roots that are touching each other. These findings on panoramic radiographs should be interpreted with caution.

32 AN ANTI-INFLAMMATORY AND ANALGESIC OINTMENT FOR THE RELIEF OF TEMPOROMANDIBULAR JOINT AND MASTICATORY MUSCLE PAIN

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AIM: To compare the effectiveness of using a topical cream, Ping On ointment, or Vaseline in the treatment of temporomandibular joint (TMJ) and masticatory muscle pain, in order to establish the true efficacy of Ping On ointment.
SUBJECTS AND METHOD: In this randomized, double-blinded, placebo-controlled trial, 55 subjects with TMJ and/or masticatory pain (Group 1 patients according to the Research Diagnostic Criteria for Temporomandibular Disorder) received Ping On Ointment for 4 weeks or a placebo for 4 weeks. The subjects were evaluated with standard measures of efficacy: pain intensity measured by visual analogue scale and maximal comfortable mandibular opening, at baseline and after 4 weeks of treatment.
RESULTS: Ping On ointment significantly reduced the symptoms of painful TMJs and/or masticatory muscles. Maximal comfortable mandibular opening also improved significantly with Ping On ointment compared with the placebo, but this was not clinically significant.
CONCLUSIONS: Topical application of Ping On ointment may be considered to be one of the first line treatment modalities before prescribing analgesics, for the management of temporomandibular dysfunction (TMD). It is topically applied, with minimal systemic effect, reversible, economical and effective in managing TMD and masticatory muscle pain.

33 EVIDENCE WITH A TWIST: PUBLICATION ETHICS AND SEEING THE REAL EVIDENCE

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AIMS: Clinicians are now aware of the need to practice in an evidence-based manner. High level skills need to be developed, and many postgraduate courses seek to embed these in their training. However, clinicians and researchers may still be unaware of breaches in publication ethics. Yet, these can render ‘evidence’ invalid or even fraudulent. This presentation aims to raise awareness of such issues.
MATERIALS AND METHOD: Literature searches have demonstrated various breaches in ethical publication. These include examples in high profile, scientific and medical publications including those of orthodontic relevance.

RESULTS: For obvious reasons, precise, quantifiable data are difficult to obtain. However, a survey undertaken by the American Association for Dental Research found that falsification of data had been observed by 30 per cent of the 76 (out of 98) programme chairs/association officers responding and 54 per cent reported having observed plagiarism at least once (Bebeau and Davis, 1996). In a separate survey of 3247 US, NIH-funded scientists, amongst the various findings, it is reported that 15.5 per cent changed the design, methodology or results of a study in response to pressure from a funding source; 10 per cent withheld details of methodology or results in papers or proposals (Martinson *et al.,* 2005).
CONCLUSIONS: Ensuring 'evidence' is real cannot be left only to journal editors and referees. It is essential that all clinicians, including teachers, trainees, researchers, authors, readers and even professional societies are aware of such issues and take positive steps to minimise their development.
Bebeau M J, Davis E L 1996 Survey of ethical issues in dental research. Journal of Dental Research 75: 845–855
Martinson B C, Anderson M S, de Vries R 2005 Scientists behaving badly. Nature 435: 737–738

34 CANINE RETRACTION – EFFICIENCY OF DENTOALVEOLAR DISTRACTION OSTEOGENESIS

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AIMS: To assess the efficiency of rapid canine retraction through dentoalveolar distraction (DAD) osteogenesis, and to evaluate the following parameters: the rate of retraction, the amount of anchorage loss, the occurrence of root resorption, and the volume and density of newly formed bone.
SUBJECTS AND METHOD: Twenty-four distractions were carried out with custom made, intra-oral distraction devices on 12 patients. DAD was undertaken in both the right and left segments in the upper arch. The first premolars were extracted during the surgical procedure. Osteotomies surrounding the canines were made to achieve rapid movement of the canines in the dentoalveolar segment in compliance with the principles of distraction osteogenesis. Measurement of the amount of retraction and anchorage loss during canine retraction was undertaken on photocopies of the study models at a resolution of 1:1 before and after retraction. The rate of retraction was defined as the amount of retraction obtained divided by the time required for completing space closure. This was recorded in millimetres per unit interval. An interval was regarded as a single day. Evaluation of newly formed bone in the distracted segment was carried out after 4 months on computed tomographic scans.
RESULTS: The rate of retraction was between 0.44 and 0.88 mm per day, with a mean of 0.68 ± 0.11 mm per day. The canines were distracted bilaterally into the extraction site in 8 to 13 days (mean 9.8 ± 1.4 days). Anchorage loss was minimal (0.24 ± 0.07 mm). Any root resorption that occurred was mild. The volume, density and quality of newly formed bone was found to be similar to that of normal bone.
CONCLUSION: DAD is an innovative method that reduces overall orthodontic treatment time by nearly 50 per cent, with no unfavourable effects on the surrounding structures.

35 EFFECT OF HISTAMINE ANTAGONISTS ON BONE MODELLING DURING ORTHODONTIC TOOTH MOVEMENT IN RATS

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AIM: Osteoblasts, the bone forming cells and osteoclasts, the bone resorbing cells, are the main cells involved in bone modelling during orthodontic tooth movement (OTM). Their actions are guided by many mediators, one of which might be histamine, which exerts its actions through H1 and H2 receptors. Therefore the effect of histamine antagonists on histomorphometric parameters during OTM in rats was investigated.
MATERIALS AND METHOD: Thirty-two animals divided into four equal groups, one control and three appliance groups. In the control group animals without an orthodontic appliance were treated daily with 0.1 ml of saline orally (P.o). In the appliance group animals, an appliance was inserted and they were treated daily with 0.1 ml of saline P.o. (appliance only group), 30 mg/kg of cetirizine P.o. (H1 antagonist group) or 10 mg/kg of famotidine P.o. (H2 antagonist group). The orthodontic appliance was adjusted weekly. On day 42 the animals were sacrificed. Tissue samples of the maxilla containing all three molars were prepared for histomorphometric analysis. Bone histomorphometry was performed to determine osteoclast, osteoblast and alveolar bone volume around the root of the left first maxillary molar in all groups.
RESULTS: Osteoclast volume in the H1 and H2 antagonist groups was decreased compared with the appliance only group ($P < 0.001$). Osteoblast volume was higher in the H2 antagonist group than in the H1 antagonist ($P < 0.05$) and appliance only ($P < 0.01$) groups. Alveolar bone volume was decreased in all three appliance groups compared with

the control group ($P < 0.05$, $P < 0.001$), and was higher in the H1 antagonist group than in the other two appliance groups ($P < 0.05$).
CONCLUSIONS: Cetirizine, an H1 antagonist and famotidine, an H2 antagonist, lower the number of osteoclasts but only cetirizine reduces the amount of bone resorption. Although famotidine increases the number of osteoblasts it does not affect alveolar bone volume during OTM.

36 BACTERIAL ADHESION FORCES AT THE BRACKET-ADHESIVE-ENAMEL JUNCTION

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AIM: Bacterial adhesion at the bracket-adhesive-enamel junction is a growing problem, because bacteria can adversely affect orthodontic treatment by causing demineralization of the enamel surface. The aim of this study was to determine the forces at which bacteria adhere to the junction materials, as they are determinant for their ease of removal.
MATERIALS AND METHOD: Bacterial adhesion forces for initially colonizing and cariogenic strains to an orthodontic adhesive, stainless steel and enamel, with and without a salivary conditioning film were compared. Adhesion forces were determined using atomic force microscopy and a bacterial probe.
RESULTS: In the absence of a salivary conditioning film, the strongest bacterial adhesion forces were measured at the adhesive surface (–2.9 to –6.9 nN), while adhesion to the enamel surfaces were lowest (–0.8 to –2.7 nN). In the presence of a salivary conditioning film, adhesion forces reduce to less than 1 nN and the differences between the various materials reduced to values that may not be clinically relevant. On average however, initial colonizers of dental hard surfaces present stronger adhesion forces to the different materials (–4.7 and –0.6 nN in the absence and presence of a salivary conditioning film, respectively) than cariogenic strains (–1.8 and –0.5 nN).

37 ASSOCIATION BETWEEN MOUTH OPENING CAPACITY AND THE TEMPOROMANDIBULAR JOINT IN JUVENILE IDIOPATHIC ARTHRITIS CHILDREN

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AIM: Temporomandibular joint (TMJ) arthritis is a common but often asymptomatic manifestation of juvenile idiopathic arthritis (JIA) that can severely affect growth and function of the jaw. In children with JIA magnetic resonance (MR) imaging is the gold standard for diagnosis of TMJ arthritis. The aim of this study was to determine the correlation between mouth opening capacity (MOC) and the severity of TMJ arthritis on MR images of children with JIA.
SUBJECTS AND METHOD: Seventy-two consecutive JIA patients. Orthodontic examination was performed within 1 month of MR imaging in a blinded fashion, including measurement of MOC taking individual overbite into account. Joint effusion and/or increased contrast enhancement of the synovium were considered signs of active arthritis on the MR images.
RESULTS: Signs of TMJ involvement were found in 50/73 patients (68%) and in 86/146 joints (59%). Active inflammation with either mild (71%) or severe (21%) increase of synovial enhancement was present in 79/86 (92%) of affected TMJs. The mean MOC for TMJs with no, mild, and severe increases of synovial enhancement was 48, 47 and 41.5 mm, respectively. The difference in MOC between the groups was statistically significant ($P = 0.003$). Condylar deformity of either a mild (28%) or severe (17%) degree was found in 39/86 (45%) of affected TMJs. The mean MOC for TMJs with no, mild, and severe condylar deformity was 48, 45.7 and 41.5 mm, respectively. The difference of MOC between the groups was statistically significant ($P < 0.001$).
CONCLUSION: MOC showed a significant inverse correlation with the severity of TMJ arthritis as diagnosed by MR imaging. A reduced MOC is an indicator of TMJ involvement in children with JIA. The broad range of MOC for the different stages of TMJ involvement necessitates longitudinal follow-up of MOC in these children.

38 JUVENILE CHRONIC ARTHRITIS – A SYSTEMATIC REVIEW. ORTHODONTIC TREATMENT PRINCIPLES

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AIM: To systematically search for literature published on orthodontic treatment principles in patients with juvenile chronic arthritis (JCA).
MATERIALS AND METHOD: Several electronic databases (PubMed, Medpilot, Web of Science, DIMDI) were searched for studies published until April 2008. Additionally, a hand search of the orthodontic and rheumatology literature and of the reference lists of the selected articles was performed. The articles were rated by two independent reviewers and included

after three selection steps (title-abstract-full text). Articles had to be studies performed on ≥5 patients with a disease onset before the age of 16 years.
RESULTS: The selection process resulted in the inclusion of six publications on combined surgical-orthodontic therapy and two on dentofacial orthopaedics. Whereas the surgical studies were case series with a large age-span of patients (5–12 subjects, aged 10-44 years), the orthodontic approaches with functional appliances comprised larger and more homogeneous patient samples (30 and 72 subjects, ages 6-16 years). In the surgical treatment approaches, orthodontics was limited to pre-surgical levelling and post-surgical finishing, while the skeletal discrepancy was treated surgically by a variety of techniques (costochondral grafts, bilateral sagittal split osteotomies, Le Fort I, genioplasty). The two studies on dentofacial orthopaedics aimed to improve the mandibular retrusion by means of removable functional appliances (activator). The treatment goals of both approaches were improvement of aesthetics and function and/or pain reduction and both approaches showed satisfactory results.
CONCLUSIONS: Due to the heterogeneity of the subject material and the different treatment modalities, a 'one-size-fits-all' approach to the treatment of temporomandibular joints during JCA cannot be proposed. It appears as if removable functional appliances can improve mandibular growth in adolescent JCA patients, which might prevent a more complex and expensive surgical approach.

39 POSTERIOR CROSSBITE AND IRREGULAR OROFACIAL FUNCTIONS DURING GROWTH AND DEVELOPMENT – IS THERE A CORRELATION?

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AIM: To find a correlation between irregular orofacial functions and morphological traits of malocclusion, as well as a correlation between irregular orofacial functions and unilateral posterior crossbite development in the years of growth and development.
SUBJECTS AND METHOD: Two hundred and forty-three children, aged 3 to 12 years, were examined. Sucking habits (dummy, bottle), atypical swallowing and impaired nasal breathing, were clinically assessed and evaluated. Quantitative registrations of space and occlusal anomalies were performed on study casts. Posterior crossbite was diagnosed when one or more teeth were in crossbite together with a midline deviation. The relationship between incorrect orofacial functions in the early years and later morphological changes was determined using Spearman's correlation. The correlation between irregular orofacial functions and posterior crossbite was also analysed.
RESULTS: Dummy sucking was statistically significantly correlated with a posterior crossbite at all observation periods ($r = 0.16$ to 0.27; $P = 0.001$ to 0.05). The effect of bottle-feeding became evident only at 11 ($r = 0.18$; $P = 0.037$) and 12 ($r = 0.21$; $P = 0.014$) years of age. Sucking habits until 6 years of age, were also correlated with posterior crowding in the upper arch ($r = 0.18$, $P = 0.04$) and transverse malocclusion traits ($r = 0.20$, $P = 0.02$) at 12 years of age.
CONCLUSIONS: Irregular orofacial functions, in particular deleterious sucking habits, were found to have a direct effect on the developing occlusion and should therefore be considered a major aetiological factor for malocclusion development, especially a posterior crossbite, during the years of growth and development.

40 EFFECTS OF ZOLEDRONIC ACID ON BONE FORMATION AND RELAPSE AT THE SUTURE AFTER EXPANSION

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AIM: To investigate the effects of systemically applied zoledronic acid on osteoblastic bone formation and relapse in rat sagittal sutures after expansion.
MATERIALS AND METHOD: Eighteen Wistar rats divided into three equal groups. In the first group, saline solution was given subcutaneously after expansion and the retention period lasted 14 days. In the second group, saline solution was also given subcutaneously, but the retention period lasted for 7 days. In the third group, 0.1 mg zoledronic acid was diluted with saline solution and given subcutaneously after expansion and the retention period lasted for 7 days. After retention, the appliance was removed and subjects underwent a seven day relapse period. Computed tomography (CT) measurements were taken at the beginning and end of the expansion period, after the retention period, and at the end of the relapse period.
RESULT: CT measurements showed that zoledronic acid stimulated bone formation. When the relapse ratios were compared, minimum relapse was observed in the zoledronic acid group.
CONCLUSION: The retention period can be shortened and relapse can be reduced by the application of zoledronic acid after expansion.

41 COLLATERAL PATHOLOGIES IN CONE BEAM COMPUTED TOMOGRAMS OBTAINED FOR ORTHODONTIC DIAGNOSTIC PURPOSES

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AIM: Cone beam computed tomograms (CBCTs) are commonly used in the diagnosis of specific orthodontic problems. However, beside orthodontic indications, other pathologies might be present. The aim of this study was to evaluate the frequency of collateral pathologies in CBCTs obtained for orthodontic purposes.
MATERIALS AND METHOD: Ninety-two consecutive CBCTs from 51 female and 41 male patients with a median age of 13.9 years. All scans were obtained with a small volume CBCT (Accuitomo, Morita Corp., Japan). An experienced radiologist and an orthodontist analyzed the CBCTs and recorded all collateral pathologies. Nasal septum deviations were not recorded because of the reduced size of the field of view used.
RESULTS: In 27 CBCTs (29.3%) collateral pathologies not linked to the orthodontic indication were found. All of these were located in the maxillary sinus and were of three types: polypoid mucosal thickening (12 patients/13%), flat mucosal thickening (11 patients/11.9%) and signs of acute sinusitis (4 patients/4.3%). No signs of osteomyelitis or malignant bone neoplasms were found.
CONCLUSIONS: A relatively high percentage of the CBCTs obtained for orthodontic diagnostic purposes exhibit pathologies not associated to the orthodontic indication. Orthodontists should be aware of this when analyzing CBCTs.

42 CORRELATION BETWEEN NEUROBEHAVIORAL STATUS AND MOTOR DISORDERS IN CHILDREN WITH MALOCCLUSION

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AIM: Assessment of the psycho-neurological status and motor disorders in children with malocclusions.
SUBJECTS AND METHOD: Twenty children, aged 8–12 years, with malocclusions and sucking habits were assessed using a special questionnaire (Zavadenko, 2005) designed to reveal the symptoms of neurobehavioral dysfunctions. All patients were examined for soft neurological signs (Denckla, 1984) and stabilometry tests were performed with the BioPostural System.
RESULTS: The questionnaire revealed psychosomatic problems in 31 per cent of subjects, anxiety symptoms in 37 per cent, hyperactivity in 31 per cent, attention deficit in 31.25 per cent and speech problems in 37.5 per cent. Motor function and movement coordination showed an increased number of errors in all patients (by 3–4 times) and an increased performance time (by 1.5–2 times) in tests for 20 repetitive or successive movements. Parameters of statokinesiogram surfaces during examination with the eyes open and closed revealed that in 37.5 per cent the volume of stabilometric ellipses was increased with values of 58.99 mm^2 (open eyes) to 128.88 mm^2 (closed eyes), which corresponds to a normal range. However, in 62.5 per cent of subjects the volume of stabilometric ellipses was decreased from 95 mm^2, (open eyes) to 44.53 mm^2 (closed eyes) indicating some neurological disturbances. The range of transverse fluctuations in 50 per cent of patients was within the normal range (±5%) in 2.5 per cent on average, while in 50 per cent the offset of the patient's gravity centre varied, on average, by 7.5 per cent.
CONCLUSIONS: Patients with malocclusions and sucking habits require a detailed neurobehavioral examination and should be studied in collaboration with other specialists, such as child neurologists and kinesotherapists.

43 THREE-DIMENSIONAL EVALUATION OF EARLY CROSSBITE CORRECTION – IS THERE A RELAPSE?

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AIM: To assess facial asymmetry and palatal volume (pre-, post-treatment and at a 1 year follow-up) in two groups of children: one with unilateral crossbites (CB) and the other with no crossbites (NCB) in order to evaluate the effectiveness of treatment in the primary dentition.
SUBJECTS AND METHOD: Thirty children with CB (13 males, 17 females, mean age 4.9 + 0.98 years) and 28 children with NCB (17 males, 11 females, mean age 5.3 ± 0.36 years). Those with a CB were treated with an intra-oral expansion appliance. The children's faces and dental casts were scanned using a three-dimensional laser scanner at baseline (T0), after six months of treatment (T1) and after a follow-up period of 1 year (T2). Student's *t*-tests were used to assess differences between the two groups in facial symmetry and palatal volume over the 18 month period.
RESULTS: The CB children had statistically significantly greater asymmetry of the face ($P = 0.042$), and a significantly smaller palatal volume ($P = 0.045$) than the NCB subjects at T0. There were no statistically significant differences between the two groups at T1. At T2, relapse in four (13.33%) children was observed. However, there were no statistically significant differences between the two groups either for asymmetry or palatal volume ($P > 0.05$).

CONCLUSIONS: Treatment of a CB in the primary dentition corrected the facial asymmetry. The palatal volume of CB children increased due to orthodontic intervention to similar levels exhibited by children with NCB. Even though relapse was observed after a period of follow-up, the majority of treated patients appear to have benefited from early treatment in terms of facial symmetry and growth of the palate.

44 BONE MORPHOGENETIC PROTEIN SIGNALLING REGULATES CRANIOFACIAL GROWTH

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AIM: Bone morphogenetic protein (BMP) signalling has critical roles in controlling bone development, growth and homeostasis. These actions are tempered by several antagonists and one important antagonist. Noggin, is known to regulate interfrontal suture closure in mice. This suture is equivalent to the metopic suture in humans and closes within the first three post-natal weeks. The aim of this research was to investigate the role of BMP signalling in calvarial and suture development.
MATERIALS AND METHOD: mRNA expression pattern analysis was performed of BMP ligands and their antagonists by S35-labelled *in situ* hybridisation. The craniofacial skeletal phenotype of Noggin null allele mice (*Noggin*$^{-/-}$) was analysed paying special attention to calvarial and facial suture patency.
RESULTS: Transcripts of *BMP2*, *4* and *7*, and *Noggin* were differentially expressed in the developing sagittal suture. *Noggin*$^{-/-}$ mice displayed multiple intramembranous bone fusions, including synostosis of the coronal suture, synostosis of the internasal suture, fusion of the premaxillary and premaxillary-maxillary sutures and fusion of the mandibular symphysis. Furthermore, cell proliferation in the facial sutures was increased in *Noggin*$^{-/-}$ mice, and the key osteoblastic regulatory genes, Twist1, Runx2 and Osterix, were missexpressed. This indicates that the cell fate of sutural cells changed and that this ultimately contributes to suture obliteration.
CONCLUSIONS: As Noggin is an inhibitor of BMP signalling these data show that BMP signalling has a critical role in regulating whether a suture stays open or closes. As sutures must stay open to function as growth sites, this finding has major implications for the understanding growth of the upper face and calvaria and the aetiology of craniosynostosis.

45 EFFICIENCY AND PERCEPTION OF PAIN DURING INITIAL ORTHODONTIC TOOTH ALIGNMENT: A RANDOMISED CLINICAL TRIAL

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AIM: To compare the alignment efficiency of a self-ligating and conventional pre-adjusted edgewise orthodontic bracket system during initial tooth alignment.
SUBJECTS AND METHOD: A multicentre randomized clinical trial was conducted in two orthodontic clinics. Sixty-two subjects (32 males, 30 females, mean age 16.27 years) with lower incisor irregularity between 5–12 mm and a prescribed extraction pattern including lower first premolars were randomly allocated to treatment with Damon3 self-ligating or Synthesis conventional-ligated brackets. Fully-ligated 0.014 inch nickel titanium (NiTi) archwires were used as the initial archwire in both groups, followed by a sequence of 0.014 × 0.025 and 0.018 × 0.025 inch NiTi and 0.019 × 0.025 inch stainless steel. Study casts were taken at the start (T1), first archwire change (T2) and placement of the final 0.019 × 0.025 inch archwire (T3). A cephalometric lateral skull and long-cone periapical radiograph of the lower incisor teeth were taken at T1 and T3. Following archwire insertion at T1, the subjects were also given a prepared discomfort diary to complete over the first week, recording discomfort by means of a 100 mm visual analogue scale at 4 hours, 24 hours, 3 days and 1 week. The subjects also noted any self prescribed analgesics taken during the period of observation. No significant differences were noted ($P > 0.05$) in perceived discomfort levels or initial rate of alignment for either bracket system.
RESULTS: Initial irregularity influenced the subsequent rate of movement, but gender, age and appliance type were statistically insignificant. Alignment was associated with an increase in intercanine width, reduction in arch length and proclination of mandibular incisors for both appliances, but the differences were not significant. Incisor root resorption was not clinically significant and did not differ between systems.
CONCLUSION: Damon3 self-ligating brackets are no more efficient than conventional-ligated pre-adjusted brackets during initial tooth alignment.

46 CEPHALOMETRIC CHANGES IN EARLY CLASS III TREATMENT WITH FACEMASK THERAPY

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AIM: To evaluate whether early Class III protraction facemask therapy results in rotation of either the maxilla, the functional occlusal plane, or the maxillary occlusal plane.

MATERIALS AND METHOD: This study is part of a multi-centre trial involving eight orthodontic units in the United Kingdom which included five district general and three teaching hospitals. In accordance with a sample size calculation, 96 patients were recruited to the trial and randomly allocated to a control group (no treatment) or a facemask group (treatment). Patients in the treatment group were fitted with adjustable protraction headgear and were asked to wear the headgear for at least 14 hours per day. Lateral cephalograms were taken before treatment and after 15 months for both groups. Rotational change of the maxilla, functional occlusal plane and maxillary occlusal plane was assessed by cephalometric superimposition. The superimpositional method for this study was reliable.
RESULTS: A total of 67 patients were applicable to this study: 34 control and 33 in the facemask group. The mean maxillary rotational change after 15 months was 2.07 degrees for the control group and –2.27 degrees for the facemask group; this was statistically significant ($P < 0.001$). The mean functional plane rotational change was 1.59 and –2.89 degrees, respectively; this was statistically significant ($P < 0.001$). The mean maxillary occlusal plane rotational change was 1.09 degrees for the control group and –3.86 degrees for the facemask group ($P < 0.001$).
CONCLUSIONS: Early treatment of skeletal Class III malocclusions with a protraction facemask causes a backward and downward rotation of the maxilla and forward and upward rotation of the functional and maxillary occlusal planes.

47 LIP, CHEEK AND TONGUE PRESSURE IN CHILDREN WITH A SKELETAL CLASS III MALOCCLUSION VERSUS A SKELETAL CLASS I OCCLUSION

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AIM: To study the pressure of the lips, cheeks and tongue in children with a skeletal Class III malocclusion compared with those with a skeletal Class I occlusion.
SUBJECTS AND METHOD: Measurements of soft tissue pressure at rest and during swallowing were performed with the help of miniature pressure sensors in 30 children (7-12 years of age) with a Class III malocclusion and 27 children with a skeletal and dental Class I occlusion and minimal crowding, chosen according to a standardized procedure after examination of 2136 school children. The pressure on the vestibular surface of the maxillary central incisor (VCI), the vestibular surface of the first maxillary molar (VFM) and between the palatal surfaces of the maxillary central incisors (PCI) were compared between groups with a Mann-Whitney U test.
RESULTS: At rest, pressure on VFM was significantly lower in children with a skeletal Class III malocclusion (Md = 2.44g/cm^2) than in those with a Class I occlusion (Md = 6.38g/cm^2, $P = 0.009$). Pressure at PCI was also significantly lower in children with a skeletal Class III malocclusion (Md = 0.57g/cm^2) compared with Class I children (Md= 4.69g/cm^2, $P = 0.002$). No differences were found between the groups at VCI (Md= 0.79 and 1.73g/cm^2, respectively, $P = 0.190$). During swallowing, oral soft tissue pressure at VCI was significantly greater in the Class III children (Md = 84.60 g/cm^2) than in Class I subjects (Md = 53.33g/cm^2, $P = 0.002$). Pressure at PCI was significantly lower in the Class II malocclusion children (Md = 96.63 g/cm^2), than in the Class I children (Md = 158.55g/cm^2, $P = 0.001$). No statistically significant differences were found between the groups at VFM (67.78 and 79.26 g/cm^2, respectively, $P = 0.314$).
CONCLUSIONS: Children with a skeletal Class III malocclusion have, in general, lower soft tissue pressures than children with a Class I occlusion. This supports the theory that the soft tissues are one of the environmental factors that contribute to the development of a skeletal Class III malocclusion.

48 DOSIMETRY OF CONE BEAM COMPUTED TOMOGRAPY IN COMPARISON WITH CONVENTIONAL RADIOGRAPHS IN ORTHODONTICS

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AIM: To study the effective dose in the craniofacial area caused by cone beam computed tomography (CBCT) and compare it with a conventional set of orthodontic radiographs.
MATERIALS AND METHOD: Thermoluminescent dosemeters were placed at 19 different sites in the head and neck of a tissue-equivalent human skull (RANDO phantom). CBCT scans were made with the KaVo 3D eXam using three different scanning modes: portrait mode (17 cm scan height) and landscape mode (13 cm scan height) with a normal and fast scan time. As a routine set of orthodontic radiographs, a digital panoramic radiograph (Soredex Cranex Excel D), analogue lateral and postero-anterior cephalograms (Comet AG, Switzerland) were made. All measurements were undertaken with and without a neck shield. The effective doses in microSieverts (μSv) were calculated using the 2007 International Commission on Radiological Protection recommendations.
RESULTS: The effective dose of the three conventional orthodontic radiographs together (panoramic, lateral and postero-anterior) was 35.7 μSv. The highest dose of 21.8 μSv was obtained with the panoramic radiograph. The portrait

mode CBCT scan produced an effective dose of 131.7 μSv, but if the neck shield was used the dose reduced to 96.2 μSv. The landscape mode CBCT scan with a normal scanning time caused 91 μSv and with the fast mode 77.2 μSv.
CONCLUSIONS: Depending on the size of the scanned field, the effective doses with CBCT vary significantly. A scan with a height of 13 cm, which is sufficient in most growing patients, with fast scanning mode, results in a dose approximately twice that of a conventional set of orthodontic radiographs. Whole head scanning without a neck shield to allow the study of the cervical vertebrae was found to produce an almost four-fold increase in radiation compared with three routine orthodontic radiographs. Increased information obtained with CBCT has to be weighed individually with regard to the increased radiation dose in each case.

49 FIBRE TYPE DISTRIBUTION AND OXIDATIVE STATE IN MASTICATORY MUSCLES OF MDX-MICE

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AIMS: Duchenne muscular dystrophy (DMD) and its murine model, mdx, are characterized by muscle damage and increased oxidative stress. Furthermore, DMD patients have distorted dentofacial morphology that could be a result of changed masticatory mechanics due to muscular dysfunction. The aim of this study was to determine potential changes in masticatory mechanics identified by morphological abnormalities including nuclei localization, fibre diameters, collagen and myosin heavy chain (MyHC)-isoforms expression in control and mdx mice. In addition GSH (glutathione) content was analysed.
MATERIALS AND METHOD: Muscle sections were stained with haematoxylin/eosin and Sirius red. The mRNA and protein levels of the MHC-isoforms were studied using quantitative real-time polymerase chain reaction, Western blot analyses and histochemistry in masseter, temporal (TEM), tongue (TON) and soleus (SOL) of both mouse strains.
RESULTS: Mdx masticatory muscles contained 11–75 per cent fibres with centralized nuclei, numerous inflammatory foci and an accumulation of collagen, except TON. Furthermore, a significant increased mean fibre diameter was observed in all tested mdx muscles. In contrast to SOL, the MyHC type 1 isoform was not detectable in masticatory muscle tissues of control and mdx mice. In TEM and TON of mdx, MyHC type 2b and type 2x were significantly down regulated. A muscle specific lower content of GSH was found in mdx mice compared with the controls
CONCLUSIONS: The findings suggest that mdx masticatory muscles are differentially affected by the disease process. However, the observed down regulation of the MyHC isoforms may be responsible for the functional misbalance of masticatory muscles in DMD and could be cause dentomorphological changes. Additionally there was an increased oxidative stress in dystrophic masticatory muscles, which may be caused by their decreased working capacity.

50 INTERACTIVE VISUALIZATION OF CRANIOFACIAL GROWTH DATA – A GLIMPSE INTO THE FUTURE

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AIM: To develop a tool for interactive visual analysis of two-dimensional (2D) longitudinal craniofacial growth data in order to use data visualization in orthodontics.
MATERIALS AND METHOD: Longitudinal craniofacial growth data were obtained from lateral cephalograms of 32 untreated Caucasian subjects with ideal occlusion (aged 6 to 17 years). Cephalometric and tensor analysis were applied using Rostock's Growth Analysis Tool® (ROTA). An interdisciplinary project was established which aimed to transform craniofacial growth data into an image and thus make interactive data exploration and analysis of comprehensive multivariate datasets more efficient. To test the usefulness of interactive data visualization in orthodontics, data visualization was then exemplarily applied to growth data.
RESULTS: Rostock's Visual Analysis® (ROVA) was developed. It enables application of interactive visual data analysis to craniofacial growth data. Interactive selection of study subjects is possible and makes formation of study groups very efficient. Numerous combinations of selection criteria are feasible and provide an easy reformation of various study groups. Cephalometric parameters of interest can be chosen by the user or can be subjected to cluster algorithms and a self organizing map. The latter two enable the grouping of subjects automatically according to their similarity of multiple parameters. Seven visualization techniques are available to give visual representations of growth data and to help amplify cognition for recognition of correlations between different variables.
CONCLUSIONS: ROVA is an excellent tool for planning future studies based on similarities of subjects for multiple craniofacial parameters. ROTA provides longitudinal growth data of children with ideal occlusion that can be used as reference values for treatment planning and determining treatment timing.

51 SURVIVAL RATE OF AUTOTRANSPLANTED TEETH AFTER 10 YEARS

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AIM: To evaluate the survival rate of autotransplanted teeth after 10 years.
SUBJECTS AND METHOD: Sixty-two patients, aged between 13 and 33 years (average 20.29 years), with 77 autotransplanted teeth. The autotransplanted teeth (TX) and their contralateral control teeth (TC) were examined at least 10 years after surgery. The survival rate after 10 years and parameters such as sensibility (0 = no, 1 = yes), vitality (0 = no, 1 = yes), caries (0 = no, 1 = yes) and dental fillings (0 = no, 1 = yes), were investigated.
RESULTS: The survival rate of TX teeth after 10 year was 76.62 per cent. Sensibility was 52.54 (TX) and 83.05 (TC) per cent, and vitality 71.19 (TX) and 74.58 (TC) per cent. Carious lesions were found in 20.03 (TX) and 16.95 (TC) per cent, and dental fillings in 38.98 (TX) and 84.75 (TC) per cent of the cases.
CONCLUSION: The survival rate of autotransplanted teeth after 10 years was 76.62 per cent. No significant differences were found between autotransplanted teeth and contralateral teeth regarding vitality and caries. The greatest differences between TX and TC were in the incidence of dental fillings. The results confirm autotransplantation as a treatment option for young patients with a high survival rate.

52 CHARACTERISTICS OF JAPANESE BECKWITH-WIEDEMANN SYNDROME PATIENTS WITHOUT GLOSSECTOMY

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Beckwith-Wiedemann syndrome (BWS; MIM #130650) is a congenital disease accompanied by exomphalos, macroglossia, somatic gigantism, hypoglycaemia, adenocortical cytomegaly and malignant tumours. Macroglossia is a predominant oral characteristic and has a close association with oral function and maxillofacial morphology. However, previous studies on BWS included affected patients both with and without glossectomy.
To highlight the intrinsic characteristics of BWS, an analysis on 12 Japanese patients, including seven without glossectomy, was performed. It was noted that a large anterior cranial base and mandibular body were uniformly seen in all 12 patients. Without glossectomy, all seven patients exhibited an anterior open bite due to the under-erupted and proclined anterior teeth. However, a wide variation was seen in the gonial angle and mandibular plane angle. It is likely that the disorder of epigenetic regulation has a close association with this characteristic skeletal pattern in BWS. BWS patients frequently undergo glossectomy in order to correct speech and respiratory problems. This findings of this study highlight the importance of occlusion in considering the timing and surgical protocol of glossectomy.

53 RELIABILITY OF TOOTH AXIS ANGULATION ASSESSMENT ON PANORAMIC RADIOGRAPHS

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AIM: To compare tooth axis orientation between dental pantomograms (DPT) and computed tomographic (CT) scans, as the latter is the gold standard reflecting ‘true’ anatomy.
MATERIALS AND METHOD: The radiographs of 50 patients with full dentitions in the lower jaw were digitally evaluated (DPT: Sidexis, Sirona; CT: 3D Workstation Easyvision, Philips). On the DPT the tooth axis was defined as the connecting line between the apex and a specific point at the crown pulp and referenced to the plane at the lower border of the mandible. On the CT scans the mandibular plane was identified and the tooth axes were defined in the same way as for the DPT. The angular measurements of both imaging methods were compared and statistically analyzed. Descriptive statistics included the mean values and standard deviations of the measured angles.
RESULTS: The greatest differences were found in the left first premolar and the right canine region (tooth 34: mean 4.12°, tooth 43: mean 4.05°). The lowest values were found at the central incisors and first molars of both sides (tooth 31: mean 2.39°, tooth 41: mean 2.85°, tooth 36: mean 2.99°, tooth 46: mean 2.62°).
CONCLUSIONS: As tooth angulation cannot be accurately diagnosed on a DPT, caution is necessary in determining the tooth axes for bracket positioning and re-evaluation, especially in the canine and first premolar region of the lower jaw.

54 COMBINED GLUCOSAMINE AND CHONDROITIN SULPHATE SYSTEMIC SUPPLEMENTS ON ROOT RESORPTION AND TOOTH MOVEMENT

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AIM: Glucosamine sulphate (GS) and chondroitin sulphate (CS) are used as anti-inflammatory and chondroprotective agents in osteoarthritis and act by reducing the expression of the same inflammatory agents implicated in tooth movement and root

resorption. The aim of this study was to examine the effect of GS and CS on root resorption and tooth movement in response to heavy and light orthodontic forces.
MATERIALS AND METHOD: Eight female Wistar rats divided into two experimental and two control groups. Groups 1 and 2 received GS and CS in their diet and one maxillary first molar was moved mesially using a NiTi coil spring (Sentalloy GAC, New York, USA) applying light (10 cN) and heavy (150 cN) orthodontic forces respectively. Groups 3 and 4 received normal diet without any drugs and also light and heavy forces, respectively. The appliances were active for 2 week. After sacrifice the maxillary dentoalveolar segments were scanned using SkyScan 1072 microcomputed tomography and analysed with VGstudiomax 1.2v software. Tooth movement was assessed digitally by analysis of the distance between the first and second molars. The total volume of root resorption craters was estimated.
RESULTS: Root resorption craters were found to be concentrated at the mesio-cervical portion of the roots. The results showed that GS and CS had the effect of reducing root resorption but this was only marginally significant ($P = 0.077$) while they had no effect on tooth movement ($P = 0.60$). There was no difference in the amount of root resorption between the heavy and light force groups ($P = 0.85$). Heavy forces produced almost double the amount of tooth movement than light forces ($P = 0.012$).
CONCLUSIONS: Systemic administration of GS and CS may reduce root resorption incident to orthodontic tooth movement while not affecting the rate of tooth movement, although further research, especially with a longer experimental duration, is required to clarify the mechanism of action of these supplements on the periodontium.

55 THE APICAL FORAMEN DIMENSION ON THE VIABILITY OF PULPAL TISSUE AFTER CRYOPRESERVATION IN HUMAN IMMATURE THIRD MOLARS

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AIM: In a previous *in vitro* pilot study no influence of cryopreservation on the viability of isolated pulpal tissue could be found. However, the viability of pulpal tissue in a cryopreserved immature tooth has not yet been proven. The purpose of this study was to investigate a possible relationship between the dimensions of the apical foramen of an immature tooth and the viability of the entire pulpal tissue after cryopreservation. If a positive correlation could be found, the minimal dimension of the apical foramen required for the cryoprotective agent to penetrate into and protect the entire pulp, could be defined.
MATERIALS AND METHOD: Fifty-eight immature human third molars were frozen using standard cryogenic procedures. After thawing, the dimension of the apical foramen was measured. The pulp was isolated and divided into one, two or three horizontal segments (apical, middle, coronal) depending on the developmental stage of the tooth. The segments were cultured separately and growth capacity of the fibroblasts in the different segments was evaluated, resulting in a viability score for the entire pulpal tissue. The correlation between the dimension of the apical foramen and the viability score was determined.
RESULTS: After exclusion of 15 teeth (due to bacterial contamination), a strong global correlation between the dimension of the apical foramen and the viability score of the pulpal tissue was found for the remaining 43 teeth (Spearman correlation coefficient $rS = 0.664$; $P < 0.001$). Receiver operator curve analysis revealed that a dimension of 9.42 mm² corresponded with a positive predictive value of 90.9 per cent for a maximum viability of pulpal tissue after cryopreservation.
CONCLUSIONS: The larger the dimension of the apical foramen of an immature third molar, the higher the viability score of the pulpal tissue after cryopreservation. A minimum dimension of 9.42 mm² enables the cryoprotective agent to penetrate sufficiently into and protect the pulpal tissue from apex to crown.

56 EVALUATION OF FACTORS AFFECTING CLINICAL EXCELLENCE AT FINISHING USING PEER ASSESSMENT RATING INDEX

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AIMS: To evaluate factors affecting excellence at finishing using the Peer Assessment Rating (PAR) Index.
MATERIALS AND METHOD: Pre- and post-treatment dental casts representing a wide range of malocclusions of 306 patients (130 males, 176 females) treated by nine specialist orthodontists in a university clinic were evaluated using the PAR Index. The score reduction rates of the whole sample and those of individual specialists were calculated. Differences in pre-treatment PAR components of excellent (PAR score <5) and unacceptable (PAR score >10) finishing groups were evaluated. Descriptive statistics, ANOVA, *t*-test and Pearson correlation coefficient were used when necessary.
RESULTS: The pre- and post-treatment PAR scores were 24.5 and 4.4, respectively, with an overall reduction rate of 82.2 per cent. No significant correlation was found between the pre-treatment score and reduction with treatment. No statistically significant differences were observed among the post-treatment PAR scores and reductions achieved by different specialists ($P > 0.05$). Of the cases, 64.4 per cent were considered as excellent while 6.2 per cent were unacceptable at finishing

according to the PAR Index. Unacceptable scores at finishing seem to be a result of insignificant reductions in the overbite and centreline components within the unacceptable group ($P > 0.05$). Regarding intergroup differences, only the pre-treatment upper anterior segment and left and right buccal occlusion PAR components were significantly higher in the unacceptable finishing group compared with those of the excellent finishing group ($P < 0.05$).
CONCLUSIONS: Within the limitations of this study, the results suggest that increased pre-treatment upper anterior segment and left and right buccal occlusion components may be indicators of insufficient PAR score reductions with fixed appliance therapy and insufficient corrections in the overbite and centreline components with treatment may be the main contributors to unacceptable scores.

57 STIMULATION OF BONE FORMATION IN AN ORTHOPAEDICALLY EXPANDED SUTURE BY DIETARY BORON IN RABBITS

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AIM: Although the reason for early relapse is not fully understood, velocity and quality of bone formation in the mid-palatal suture during and after expansion may affect post-treatment relapse. It would be potentially beneficial therefore to accelerate bone formation in the mid-palatal suture after expansion to prevent relapse of arch width and to shorten the retention period. The aim of this experimental study was to evaluate the effects of dietary boron (B) on bone regeneration in response to expansion of the mid-palatal suture during different retention periods in rabbits.
MATERIALS AND METHOD: Twenty-eight, 12-week old, New Zealand white male rabbits, separated into four equal groups: Group I (B+10) and group II (B-10) had retention periods of 10 days, respectively, with or without any boron intake. Group III (with boron/B+20) and group IV (without boron/B-20) received 20 days retention, after a 5 day expansion period. For both B+ groups, boron was prepared in distilled water and given to the rabbits during the nursery phase (40 days), and expansion and retention periods, at a dose of 3 mg/kg daily by oral gavages. Bone regeneration at the mid-palatal suture was evaluated using the bone histomorphometric method and mineralized volume (Md.Ar), fibrosis volume (Fb.Ar), mineralized volume/fibrosis volume (Md.Ar/Fb.Ar), bone volume (B.Ar) and osteoblast number (N.Ob) parameters were evaluated.
RESULTS: Statistical analysis showed significant differences between groups for all investigated measurements. Md.Ar ($P < 0.01$), Md.Ar/Fb.Ar ($P < 0.001$), B.Ar ($P < 0.01$) and N.Ob ($P < 0.01$) parameters were increased and Fb.Ar ($P < 0.01$) was decreased in groups B+10 and B+20. No significant differences were observed during the further 10 day retention period in all groups ($P > 0.05$).
CONCLUSION: Boron has positive effects on the early phase of bone regeneration at the mid-palatal suture in response to expansion and may be beneficial in routine maxillary expansion procedures.

58 A VALIDATION STUDY OF RAPID PROTOTYPING TECHNOLOGY FOR ORTHODONTIC STUDY MODELS

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AIMS: Orthodontics is switching from plaster study models to virtual three-dimensional (3D) models. However, it is occasionally necessary to reproduce a physical model from this 3D data. This conversion is possible with the rapid prototyping technology. The aim of this study was to validate the clinical accuracy of different rapid prototyping technologies for the conversion of digital orthodontic models to physical models by comparing them with the gold standard – plaster models.
MATERIALS AND METHOD: The pre-treatment models of six patients, three with moderate crowding (arch-length discrepancy, ALD) and three without crowding but with a tooth-size discrepancy (TSD). The plaster models were digitized with a 3D laser scanner. The resulting 3D surface models were exported as STL models and sent to different 3D rapid prototyping companies where the 3D files were converted to physical models. The rapid technologies used for this study were: 3D printing (Z-Corp. and Polyjet), fused deposition modelling (Dimension), selective laser sintering (EOS) and stereolithography (Viper). Two orthodontists performed all measurements on the plaster models, the digital models and the reproduced physical models at two different time points with a two-week interval. The measurements consisted of clinical tooth crown height, height-width ratio, ALD (mm) and TSD in Bolton ratios. Statistical analysis was undertaken with ANOVA.
RESULTS: The intra- and interclass correlations of measurements were very high (>0.95). No significant difference was found between the plaster and digital models or between the digital and reproduced physical models. Significant differences existed only between the plaster and reproduced physical models in TSD ratios and height-width ratio of clinical crowns. However, the differences may not be clinically relevant. No significant difference seems to exist between the different techniques.
CONCLUSIONS: Rapid prototyping technologies seem to be reliable methods to reproduce orthodontic study models for diagnostic purposes.

59 COMPARING LATERAL TWO- AND THREE-DIMENSIONAL CEPHALOMETRY FOR LONGITUDINAL RESEARCH

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AIMS: Conventional two-dimensional (2D) radiographs are no longer obtained for certain patients, such as those requiring orthognathic surgery or with orofacial clefts and craniofacial anomalies where three-dimensional imaging may be used. However many of these patients have historical records. It is important to know whether lateral cephalograms derived from cone beam computed tomographic (CBCT) scans are comparable with conventional records when evaluating a longitudinal series.
MATERIALS AND METHOD: A conventional lateral cephalogram and a CBCT scan were obtained of 40 human skulls. A 2D lateral cephalogram and a three-dimensional (3D) model were constructed from the CBCT data. All images were analyzed five times by one operator with a time interval of 1 week.
RESULTS: No clinically relevant differences between conventional and CBCT-constructed 2D cephalograms were found. However, there was a clinically relevant difference between conventional radiographs and 3D models.
CONCLUSION: CBCT-constructed 2D radiographs are suitable for longitudinal research. Comparisons between conventional 2D cephalograms and constructed 3D-cephalometric models are not recommended.

60 EARLY ORTHODONTIC TREATMENT IN CHILDREN WITH UNILATERAL POSTERIOR CROSSBITE

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AIM: Tongue posture on the mouth floor is considered to be one of the most important factors in the aetiology of a unilateral posterior crossbite (UPCB). The aim of this study was to objectively assess tongue posture in children with a UPCB before and after orthodontic treatment and in children with a normal primary dentition (NDD) using three-dimensional (3D) ultrasonography.
SUBJECTS AND METHOD: An ultrasound system, Voluson 730 Expert, and a 3D convex transducer, RAB 2-5 MHz, were used in the study. Reference 3D ultrasound images for differently postured tongues were acquired and reconstructed in 10 adults. Twenty-seven children with a UPCB (mean age 5.4 ± 1 years) and 23 children with NDD (mean age 6.2 ± 0.4 years) were examined using a 3D ultrasound technique. The reference 3D ultrasound reconstructions were used for the assessment of the tongue posture in each child. The children with a UPCB were treated using an acrylic plate with a midline screw and both groups of children were ultrasonographically examined after one year.
RESULTS: Of the children, 81.5 per cent with a UPCB but only 34.8 per cent with a NDD demonstrated posture on the mouth floor. The difference was statistically significant (Fisher's exact test, $P < 0.005$). After one year 57.7 per cent of the treated children and 45 per cent of the children with NDD were found to have the tongue posture on the mouth floor. The difference was no longer significant ($P = 0.289$). The change in the children with a UPCB almost statistically significant ($P = 0.056$) while the change in the group of children with NDD was not statistically significant ($P = 0.355$).
CONCLUSIONS: 3D ultrasonography is a non-invasive and a relatively simple diagnostic tool that enables objective assessment of tongue posture. The tongue of children with a UPCB was, to a greater extent, postured on the mouth floor compared with children with NDD. Early orthodontic intervention significantly improves tongue posture in children with a UPCB.

61 PAIN AND DAILY ORAL IMPACT AND SATISFACTION OF PATIENTS TREATED WITH LABIAL AND LINGUAL FIXED APPLIANCES

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AIMS: To compare pain and daily oral impact experienced and satisfaction of patients treated with conventional labial fixed orthodontic appliances (CLFOA) and lingual fixed orthodontic appliances (LFOA).
SUBJECTS AND METHOD: A prospective case-control longitudinal study of adult patients treated with LFOA (case group) and CLFOA (control group) over a 3-month period. Patients rated their overall pain experience and pain experienced at different orofacial locations on 100 mm visual analogue scales at three time points: 1 week and 1 and 3 months after bracket placement. In addition, an assessment of daily oral impacts and treatment satisfaction was assessed by means of a structured questionnaire. Times series analysis was conducted to compare pain, daily oral impact experienced and satisfaction over the study period between the case and control group.
RESULTS: There was no significant difference in global ratings of pain between the two groups over the time period ($P > 0.05$). However, LFOA patients reported higher ratings of tongue pain than CLFOA patients ($P < 0.001$) whereas CLFOA

reported higher ratings of lip ($P < 0.001$) and cheek ($P < 0.001$) pain compared with LFOA over the study period. With respect to daily oral impacts, LFOA subjects reported more oral discomfort ($P < 0.001$), dietary changes ($P < 0.001$), difficulty swallowing ($P < 0.001$), speech disturbances ($P < 0.001$) and social disturbances ($P < 0.001$) than CLFOA patients. There was no significant difference in LFOA and CLFO ratings of satisfaction with treatment ($P > 0.05$).
CONCLUSIONS: Patients treated with CLFOA experience similar levels of overall pain as those treated with LFOA but experience pain at different orofacial sites. LFOA patients tended to experience more daily oral impacts compared with CLFOA patients. Both groups had similar levels of satisfaction with treatment.

Posters

62 COMPARATIVE THREE-DIMENSIONAL ANALYSIS OF THE CRANIAL BASE IN APERT SYNDROME, CROUZON SYNDROME AND ACHONDROPLASIA

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AIM: Cranial base anomalies have been reported for Apert syndrome (AS), Crouzon syndrome (CS) and achondroplasia (ACP). The aim of this study was to perform a comparative three-dimensional (3D) analysis of the cranial base in the three syndromes.
SUBJECTS AND METHOD: Twenty-two 22 subjects (AS: 8; CS: 11; ACP: 3). All were treated at the Craniofacial Unit at Copenhagen University Hospital (Rigshospitalet). During their clinical course, a total of 49 computed tomographic (CT) scans were performed; age range: 2 months-17 years. The CT data were available for the present study. 3D surface reconstruction of the craniofacial region and placement of landmarks were carried out using the software 'Landmarker' (Darvann, 2008). The landmarks were brought into standard orientation according to the Frankfort horizontal and the midsagittal plane. Linear variables for the cranial base were calculated and plotted as a function of age for each individual and syndrome.
RESULTS: The anterior part of the cranial base was shortest in CS. The middle part of the cranial base was shortest and most narrow in CS. The floor of sella turcica was extremely narrow in CS, less narrow in AS, and widest in ACP. The clivus was extremely short in ACP, less short in CS and longest in AS. Foramen magnum was clearly smallest, both sagittally and transversally, in ACP, followed by CS, whereas AS showed a larger foramen magnum. In general, the posterior cranial base was largest in AS, while it was narrow and compressed in both CS and ACP.
CONCLUSIONS: All three syndromes revealed anomalies of the cranial base. In ACP the anomalies could be explained by abnormal cartilage in the synchondroses and in CS and AS by varying degrees and onset of fusion of sutures and synchondroses of the cranial base. In general, subjects with CS had more severe anomalies of the cranial base than those with AS.

63 EFFECT OF AN ANTISEPTIC MOUTH RINSE IN PATIENTS WITH MUCOSAL INFLAMMATION UNDER HAWLEY RETAINER

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AIM: One of the problems for patients wearing a removable Hawley retainer is mucosal inflammation under the retainer. This is seen in both upper and lower arches, but most often in the maxilla. The purpose of this study was to determine the effect of Irsha (A.S) on inflammation of the oral mucosa under removable Hawley retainers.
SUBJECTS AND METHOD: Irsha (A.S) was used to treat 20 patients who had inflammation under a removable Hawley retainer. The mouth rinse was gargled for 30 seconds three times a day for a period of two weeks.
RESULT: Ninety-five per cent of the patients showed complete recovery but in 5 per cent there was no change after two weeks.
CONCLUSIONS: Using Irsha (A.S) correctly for the treatment of inflammation under removable Hawley retainer relieves the inflammation in the majority of patients after two weeks.

64 TEMPOROMANDIBULAR DISORDERS IN CONSECUTIVE PATIENTS REFERRED FOR ORTHOGNATHIC SURGERY

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AIM: To answer the question whether temporomandibular disorders (TMD) are more common in a group of individuals referred for orthognathic surgery than in a control group. The null hypothesis was that neither the frequency of signs and symptoms of TMD or diagnosed TMD would differ between the patient group and control group.

SUBJECTS AND METHOD: One hundred and twenty one consecutive patients referred for orthognathic surgery were interviewed and examined regarding signs and symptoms of TMD and headaches. A control group was formed of 56 age- and gender-matched individuals. TMD diagnoses were used according to Research Diagnostic Criteria for Temporomandibular Disorders (RDC/TMD).
RESULTS: The patient group showed more myofascial pain without limited opening, disc displacement with reduction, and arthralgia according to the RDC/TMD than the control group. The patient group also had more symptoms and signs of TMD in general.
CONCLUSIONS: The null hypothesis was rejected because patients who were to be treated with orthognathic surgery had more signs and symptoms of TMD and a higher frequency of diagnosed TMD compared with the matched control group.

65 CEPHALOMETRIC MORPHOLOGY OF TURKISH CHILDREN WITH CLASS II MALOCCLUSIONS
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AIMS: To investigate the morphology of Turkish children with a Class II malocclusion, to compare them with a Turkish Class I malocclusion sample, and to identify possible gender differences.
MATERIALS AND METHOD: Lateral cephalometric radiographs taken in centric occlusion of 100 Turkish patients with a Class II malocclusion (50 males, 50 females) and 100 Turkish patients with a Class I malocclusion (50 males, 50 females). The mean age of the patients was 12.2 ± 2.1 years for the Class II group and 12.3 ± 2.4 years for the Class I group. A cephalometric software system was used to perform lateral cephalometric evaluation. Independent-samples *t*- and Mann-Whitney tests were used for statistical evaluation of the data.
RESULTS: SNB angle, ANB angle, facial depth angle, condylion-gnathion length, corpus length, convexity, lower lip to aesthetic plane length, overjet and overbite showed statistically significant differences between the Class II and Class I patients. The mandibular incisors were more proclined in the Class II group. There was no significant difference in the vertical growth pattern between the groups. In the Class I group, FMA angle, lower face height angle, corpus length, condylion-gnathion length, condylion-A length and anterior and posterior face heights were found to be lower in females. In the Class II group SNA, SNB, maxillary depth, L1-NB and U1-SN were lower in males.
CONCLUSIONS: Class II patterns were due to mandibular retrusion and a mild dolichofacial growth pattern.

66 DETERMINATION OF THE RELIABILITY OF REFERENCE LINES FOR PHOTOGRAMMETRIC ASSESSMENT
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AIMS: To determine reliable reference lines for photogrammetric assessments on extraoral photographs.
SUBJECTS AND METHOD: One hundred healthy subjects (50 females, 50 males) with a mean age of 22.97 ± 2.98 years. Soft tissue parameters were measured laterally and frontally on each subject's face. Anthropometric values of three reference lines laterally [exocanthion-exocanthion (Ex-Ex), endocanthion-endocanthion (En-En), pupil centre-pupil centre) and two reference lines frontally [superaurale-subaurale, tragus-exocanthion (T-Ex)] were recorded. Extraoral photographs were then taken using a standardized method. Magnification errors were corrected. For each parameter, three different values frontally and two different values laterally were obtained according to the reference lines on the photographs. These values were tested with repeated measure ANOVA and compared with the actual values obtained from the subjects.
RESULTS: For males and females, all values according to the reference lines were statistically different from the actual values ($P < 0.05$), with the exception of three parameters (gonion-gonion and subnasale-stomion in males and pronasale-subnasale and subnasale-stomion in females). The most reliable reference line was T-Ex in both genders in the lateral view (86.2-96.9% for males, 80-91.5% for females). Whilst the most reliable reference line was En-En in males (77.1-96.2%), it was Ex-Ex in females (78.3-91.1%) in the frontal view. The values according to the Ex-Ex line were not statistically different from those according to the En-En line in both genders ($P < 0.05$).
CONCLUSIONS: T-Ex for lateral measurements and Ex-Ex and En-En lines for frontal measurements were the most reliable.

67 DENTOSKELETAL EFFECTS OF HERBST APPLIANCE TREATMENT AMONG DIFFERENT SKELETAL MATURITY GROUPS
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AIM: To evaluate skeletal and dentoalveolar changes produced by the splinted Herbst appliance in three groups of subjects with a Class II malocclusion treated at different stages of skeletal maturity as determined on the basis of cervical vertebral maturation (CVM).

SUBJECTS AND METHOD: The pre-peak group comprised eight subjects (5 females, 3 males) presenting with stage 2 CVM (mean age 9.8 ± 2.1 years), the peak group 14 subjects (8 females, 6 males) presenting with either stages 3 or 4 CVM (mean age 13.3 ± 1.5 years), and the post-peak group 15 subjects (6 females, 9 males) presenting with either stage 5 or 6 CVM (mean age 18 ± 2.4 years). Lateral cephalograms taken at the start and end of splinted Herbst appliance treatment were analysed.
RESULTS: The pre-peak and peak groups exhibited significant improvement (P <0.05) in overjet and significant advancement of the mandibular base (P <0.05) compared with the post-peak group.
CONCLUSION: The maturity of skeletal Class II patients based on CVM was associated with treatment responses to the Herbst appliance.

68 SHEAR BOND STRENGTH AND RESIDUAL ADHESIVE AFTER ORTHODONTIC BRACKET DEBONDING

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AIM: To compare the shear bond strength and to determine the area of residual adhesive on teeth after debonding of brackets bonded with two types of orthodontic adhesives: a resin-modified glass ionomer cement (RMGIC; Fuji Ortho LC, GC Corporation, Tokyo, Japan) and a resin applied as a precoated bracket (APC bracket, 3M Unitek GmbH, Seefeld, Germany).
MATERIALS AND METHOD: A total of 60 premolar teeth were randomly divided into two groups, and brackets were bonded according to the manufacturers' instructions. In group 1, the teeth were conditioned using 10 per cent polyacrylic acid and the brackets were bonded using Fuji Ortho LC in wet conditions. In group 2, the teeth were etched using 37 per cent phosphoric acid, and the APC brackets were bonded. Bond strength was measured using a testing instrument (2000S, Lloyds Instruments, Fareham, Hants, England) at a crosshead speed of 1 mm/minute, and the residual adhesive was quantified using a three-dimensional laser scanner.
RESULTS: The Mann-Whitney test showed that the median bond strength of group 1 was significantly lower than that of group 2 (P < 0.001). A Pearson chi-square test of the Adhesive Remnant Index revealed a significant difference among the groups tested. All the adhesive in group 1 failed at the enamel/adhesive interface (100%), whereas group 2 exhibited cohesive failure of the adhesive (90%).
CONCLUSIONS: The bond strength values obtained with the RMGIC were above the minimum values suggested in the literature to achieve a clinically effective adhesion in orthodontics.

69 BITE FORCE AS A PREDICTIVE VARIABLE IN THE TREATMENT EFFECTS OF ACTIVATORS IN CLASS II MALOCCLUSION CHILDREN

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AIMS: To investigate the changes in maximum molar bite force during treatment, as well as the value of pre-treatment maximum molar bite force, as a predictive variable in determining the treatment effects of activators in Class II malocclusion children.
SUBJECTS AND METHOD: Forty-three Class II division 1 children (23 males, 20 females), between the ages of 8.3 and 14.2 years (mean: 10 years 4 months) at the start of the study, were treated with activators for a period of 1 to 2 years (mean 1.7 years, SD 0.5). Before and after treatment, maximum bite force measurements, lateral cephalograms, and impressions for study models were taken. Maximum bite force was measured in the region of the first molars. Linear regression analysis was used to determine relationships between initial maximum molar bite force and dental or cephalometric changes during treatment.
RESULTS: Maximum molar bite force decreased significantly (P = 0.001) during treatment. A lower initial maximum molar bite force was associated with a larger overjet reduction (r = 0.335, P = 0.028), greater improvement in molar relationship (r = 0.346, P = 0.031), and greater augmentation in SNB (r = 0.358, P < 0.032) during treatment. When gender was included in the regression analyses as an independent variable, the only model still demonstrating statistical significance was that for SNB (r = 0.443, P < 0.027).
CONCLUSIONS: Maximum molar bite force decreases during activator treatment. Children with a weaker maximum molar bite force pre-treatment seem to show greater improvements in dental sagittal relationships. As regards skeletal variables, larger changes were also seen in these children in relation to SNB.

70 EXTERNAL APICAL ROOT RESORPTION OF INCISORS IN ANTERIOR DEEP BITE MALOCCLUSION SUBJECTS

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AIMS: To retrospectively evaluate and compare apical root resorption of both maxillary and mandibular incisors in patients who had a normal overbite with those who presented with a deep overbite.
SUBJECTS AND METHOD: Ninety-six subjects were randomly selected from 200 patients who had completed orthodontic treatment. The orthodontic records, including periapical radiographs of the maxillary and mandibular incisors before and after treatment, were available. The subjects were divided into two groups. The normal overbite group comprised 53 individuals (25 males, 28 females) with a mean age of 16.49 ± 5.36 years and the deep overbite group 43 individuals (17 males, 26 females) with a mean age of 15.79 ± 3.35 years. The crown and root lengths of the maxillary and mandibular incisors on the pre- and post-treatment radiographs were measured using a digital vernier calliper (Keiba™, Japan) and the amount of apical root resorption calculated (in millimetres). The percentage of root shortening was also determined. Wilcoxon's signed rank test was used to evaluate differences between the groups.
RESULTS: There was no significant difference in the amount of root resorption for the mandibular incisors, whereas the maxillary incisors in the deep overbite group were found to have significantly more root resorption when compared with the normal bite group ($P \leq 0.05$).

71 A COMPARATIVE *IN VITRO* STUDY OF THE FRICTIONAL CHARACTERISTICS OF AESTHETIC ORTHODONTIC BRACKETS

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AIMS: To compare, *in vitro,* the frictional coefficients of three aesthetic brackets with a conventional metal bracket. The effects of bracket slot size (0.018 and 0.022 inch) and bracket materials were also investigated.
MATERIALS AND METHOD: Three types of ceramic (one with a metal slot) and one stainless steel bracket were tested with stainless steel archwires. Testing was performed with two wire sizes, one (0.017 × 0.025 inch) in the 0.018 inch slot brackets and the other (0.019 × 0.025 inch) in the 0.022 inch slot brackets, using a modified CSM tribometer. A force of 150 g, which is equal to the average force applied by ligatures on brackets, was used during friction testing. A completely randomized design (one-way) ANOVA was used to test for significant differences among the four bracket types in the 0.018 and 0.022 inch slot sizes. This was followed by Tukey's HSD multiple comparison of means ranking at $P < 0.05$ to determine differences between the groups.
RESULTS: There were no significant differences between the brackets in the 0.022 inch slot groups. The stainless steel bracket had a significantly lower coefficient of friction than the ceramic brackets in the 0.018 inch slot groups, except for the metal slot ceramic bracket. The lowest coefficient of friction values were found for the 0.022 inch metal slot ceramic ($\mu = 0.179$) and stainless steel bracket ($\mu = 0.199$) groups, as expected from their metal slots. Coefficient of friction values of all 0.018 inch slot brackets were nearly two fold higher than their 0.022 inch slot size counterparts.
CONCLUSIONS: Brackets with a 0.022 inch slot with 0.019 × 0.025 inch stainless steel wire showed reduced frictional resistance in comparison with 0.018 inch slot brackets with 0.017 × 0.025 inch stainless steel wire.

72 FRICTIONAL BEHAVIOUR OF THIN FILM COATED ORTHODONTIC BRACKETS AND ARCHWIRES

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AIM: To investigate the *in vitro* coefficient of friction of two types of thin film coated metal brackets and two types of archwire combinations under fretting contact test conditions performed in a dry environment.
MATERIALS AND METHOD: Frictional forces were measured during the sliding of titanium nitride (TiN), aluminium oxide (Al_2O_3) and chromium nitride (CrN) coated 0.016 inch nickel titanium and 0.019 × 0.025 inch stainless steel archwires through the two brackets (M and V) coated with the same materials. A positioning jig was used to achieve parallel alignment of the archwire and bracket slot in a modified tribometer testing device. Although the wires were not ligated into the brackets during testing, coated (study groups) and non-coated bracket/archwire combinations (control groups) were all tested under a load of 150 g in order to simulate ligation forces. Contact surfaces of the archwires and bracket slots were examined by scanning electron microscopy (SEM).
RESULTS: The lowest frictional coefficients were found for the Al_2O_3 coated M bracket/non coated stainless steel archwire couple ($\mu = 0.15$); the highest values were seen with the V bracket/TiN coated stainless steel wire couple ($\mu = 0.81$). Al_2O_3 coated NiTi archwire/V bracket couple produced a lower coefficient of friction than the non-coated control group. Similar results were found for M bracket/wire combinations. SEM analysis revealed that abrasive wear occurred at the contact areas between the brackets and archwires, particularly at the corner of the slot bases. The surfaces of the coated slots and NiTi wires were significantly smoother than those of the non-coated samples.

CONCLUSIONS: Refinement of bracket slot and archwire surfaces by TiN and Al_2O_3 thin film coatings are effective in reducing the coefficient of friction *in vitro*.

73 RELIABILITY OF BASILAR PATHOLOGY DIAGNOSIS ON LATERAL SKULL RADIOGRAPHS

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AIMS: To explore how reliably one can identify, on lateral skull radiographs of unaffected individuals, those anatomical landmarks that are used to diagnose pathological relationships in the craniovertebral junction, for instance in patients with osteogenesis imperfecta and achondroplasia.
MATERIALS AND METHOD: Twenty lateral radiographs randomly selected from the Helsinki longitudinal growth study were separately analyzed and re-analyzed by two examiners. Both located seven cephalometric points, based on which five measurements were calculated. Similarly, three radiographs were analysed by 11 examiners. Differences in the results were compared to assess the inter- and intra-examiner errors.
RESULTS: Of the points defining the cranial base angle (to diagnose platybasia), nasion and sella were easier to locate than basion, which also marks anteriorly the foramen magnum line. Of the other points used to draw horizontal reference lines for detection of basilar impression and invagination, posterior nasal spine was easily located, whereas the lowermost point on the occiput, and opisthion, the posterior limit of foramen magnum, were less reliably located. Because they were distributed along horizontal anatomical structures, the variation in landmark location had little clinical significance on McGregor, Chamberlain and McRae values or on D-M distance, as long as dens point was vertically stable. Location of dens, the uppermost point of the odontoid process, showed little variation in the vertical direction.
CONCLUSIONS: Cephalometric analysis from traditional lateral skull radiographs is applicable in evaluating relationships between cranial base structures and cervical vertebrae as an initial screening method of pathology in the craniovertebral junction area.

74 BONE METABOLISM IN CEREBRAL PALSY AND NORMAL CHILDREN BEFORE ORTHODONTIC TREATMENT

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AIM: Bone metabolism is one of the major parameters contributing to bone matrix reaction and the effectiveness of orthodontic treatment. The aim of this study was to determine the need for densitometry during examination of cerebral palsy (CP) and 'normal' children before orthodontic treatment.
SUBJECTS AND METHOD: Eighteen CP (age 2-11 years, mean: 6.14; SD: 2.91) and 18 normal children (age 4-10 years, mean: 7.3; SD: 2.16) children were examined with the use of ultrasound densitometry. The following parameters were assessed: bone quality index (BQI), the velocity of the ultrasound wave transmission through the bone (SOS) and the broadband ultrasound wave attenuation (BUA). The groups were divided into subgroups based on age, and the mean values for each densitometry parameter were obtained. Pearson's test was used to determine correlations between age and each densitometry parameter in both groups. Differences between the CP and control group were assessed with a *t*-test.
RESULTS: The differences for each densitometry parameter were not significant between the CP and control groups. There was no correlation between the BQI and age in either group. This did not support the reported tendency for the BQI to reduce with age. BUA values had the greatest correlation with age in the control group ($r = 0.82$). SOS values had a moderate correlation in both groups, but they tended to be lower with age (–0.64 and –0.62, respectively).
CONCLUSIONS: Densitometry is informative in determining bone metabolism before orthodontic treatment in CP children. The findings show that there were no significant differences in bone metabolism between CP and normal children, although more investigations are needed to determine age dynamics for both groups.

75 EFFECT OF CHLORHEXIDINE ON NICKEL AND CHROMIUM ION RELEASE FROM SIMULATED FIXED APPLIANCES

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AIMS: To determine the effect of chlorhexidine (CHX; 0.2% w/v CHX digluconate) on nickel (Ni) and chromium (Cr) ion release from simulated fixed appliances, and to examine the effect on the surface topography of archwires (since CHX is sometimes used as an adjunct to oral hygiene during orthodontic treatment).
MATERIALS AND METHOD: One hundred and twenty eight simulated orthodontic fixed appliances (SOFA) were fabricated, comprising a first molar band and five brackets plus a section of stainless steel (SS) or nickel-titanium (NiTi)

archwire. Each SOFA represented one mouth quadrant. Each one was immersed in artificial saliva+CHX or artificial saliva alone. Elemental composition of the SOFA components was determined using energy dispersive spectroscopy. Ion release and surface topography (using inductively coupled plasma mass spectroscopy or scanning electron microscopy, respectively) were investigated at 1, 7, 28 and 56 days.
RESULTS: In the presence of CHX, Ni ion release increased when a SS archwire was ligated to the SOFA (day 1, median 42.65 ppb), but when the archwire was NiTi, Ni ion release reduced (day 1, median 23.1 ppb). Cr ion release was increased initially in the CHX+SS group after 7 days (day 1 median 46.6 ppb; day 7 median 9.38 ppb). However, by 28 days through to 56 days, the daily Cr ion release was minimal in both the CHX and non-CHX groups (medians 0.12-0.06 ppb). A similar pattern was seen for the NiTi archwire. The highest release rates for both ions were after one day. For surface topography, the only slight difference noted for any of the groups (test or control) was a minor increase in pitting corrosion in the 56 day NiTi archwire group.
CONCLUSIONS: Ni and Cr ion release rates from SOFAs (in the presence or absence of CHX) were insignificant when compared with daily dietary intake. No major differences could be detected in surface topography.

76 CEPHALOMETRIC EVALUATION OF VERTICAL DYSPLASIA IN PATIENTS WITH AN OPEN BITE AND BASAL CLASS II MALOCCLUSION

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AIM: To comparatively evaluate different vertical measurements in normal and long face subjects presenting a basal Class II malocclusion with an open bite.
MATERIALS AND METHOD: From 300 radiographs, 30 lateral teleradiographs were selected of 'normal' untreated Brazilian children of both genders aged between 8 and 13 years with a basal Class II malocclusion. All had a reduced overbite (<1 mm). The radiographs were selected according to facial type (Ricketts): group 1 (n = 15) normal face; group 2 long face (n = 15). From each teleradiograph the respective cephalogram were drawn. The following cephalometric measurements were carried out: lower face height, upper face height, total face height, palatal plane inclination, mandibular plane angle, mandibular arch, BaNa/palatal plane. The obtained data were statistically analyzed using a Student's *t*-test.
RESULTS: Only inferior face height, total face height, mandibular plane angle and the mandibular arch showed significant differences ($P < 0.05$) when the normal and long face subjects were compared.
CONCLUSION: The palatal plane did not influence bite opening in the studied sample. Clockwise jaw inclination had an influence on bite opening.

77 A LABORATORY INVESTIGATION OF THE FORCE DELIVERY OF ELASTOMERIC CHAINS

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AIMS: To evaluate, in a laboratory setting, the forces generated by orthodontic elastomeric chains, and to determine the extension required to produce varying amounts of force.
MATERIALS AND METHOD: Eight commercially available types of orthodontic elastomeric chain were stretched to 25 mm and maintained at this length, either in air or artificial saliva at 37°C, for six weeks. Force levels were measured using an Instron Universal testing machine at the start, after 24 hours, and weekly for six weeks.
RESULTS: Initial forces ranged from 4.38 to 7.97 N. After six weeks, the forces fell to a range of 1.61 to 2.98 N. To produce a force of 1 N throughout the six week period, a chain with a resting length of 12.5 to 15 mm should be stretched from between 1.3 and 2.6 mm, depending on its type.
CONCLUSIONS: All chains showed a decrease in force delivery over the six week period. The rate of force decay was greatest during the first 24 hours, and thereafter continued at a relatively constant rate. The greater the initial force, the greater the rate of force decay. Chains stored in saliva lost more force than those stored in air ($P < 0.001$). Chains manufactured by a die-cut stamping process produced more consistent forces than those that were injection moulded ($P < 0.05$).

78 A LONGITUDINAL THREE-CENTRE STUDY OF DENTAL ARCH RELATIONSHIP IN BILATERAL CLEFT LIP AND PALATE PATIENTS

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AIM: To retrospectively compare and longitudinally evaluate, in an intercentre, study the dental arch relationships from 4.5 to 13.5 years of age with the Bauru bilateral cleft lip and palate (BCLP) yardstick in a large sample of patients.

MATERIALS AND METHOD: Dental casts of 204 consecutive patients with complete BCLP from three centres with different treatment protocols were evaluated at 6, 9 and 12 years of age (585 models). All models were identified only by random identification numbers. Dental arch relationships were categorized with the Bauru BCLP yardstick. Increments for each interval (from 6 to 12, 6 to 9 and 9 to 12 years) were analyzed by logistic and linear regression models.
RESULTS: The mean score for the 6-year group was significantly better in centre B than in centre A ($P = 0.026$). Among the two older age groups there were no significant differences between the three centres. Linear regression showed that children treated in centre B had a statistically larger increase in yardstick score (giving a worse outcome) for the intervals 6 to 12 and 9 to 12 years. The differences with the reference category (centre C, boys) being 10.4 ($P = 0.041$) and 12.9 ($P = 0.009$) per cent, respectively.
CONCLUSIONS: Despite different treatment protocols, dental arch relationships in the three centres were comparable. Delaying hard palate closure and employing infant orthopaedics did not appear advantageous in the long term. Premaxillary osteotomy appeared to be associated with less favourable development of the dental arch relationship between 9 and 12 years.

79 TIMING AND DIAGNOSTIC INFORMATION IN ORTHODONTIC REFERRALS

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AIM: The goal of this study was three-fold: to investigate the age at which patients were referred, the waiting time between different treatment procedures, and the information in the referral letters from the general dentists.
MATERIALS AND METHOD: One thousand two hundred patient files were randomly selected from the whole cohort of 4000 patients registered at the Department of Orthodontics from 2003-2007. Data concerning the referral date, the date of the first consultation and start of the treatment were collected. Diagnostic items from each referral letter and from the orthodontists were collected and compared with Fisher's exact tests
RESULTS: Seven hundred and thirty four patients had a referral letter, within which 546 had one or more diagnoses mentioned. The ages of the study subjects varied from 7.8 to 63.2 years. Fifty-three per cent of patients were referred between the ages of 10 to 13 years. The waiting time between the referral date and the first consultation was 6.5 months, after which it took 4 to 6 months before the treatment started. The most often mentioned diagnoses were: crowding (44%) Angle Class II (35%), irregular tooth position (29%), large overjet (26%) and deep overbite (21%). The least mentioned were: Class III (3%), anterior crossbite (4%), open bite, impacted canine and midline shift. Good consensus existed between the diagnoses by general dentists and orthodontists in Angle Class II division 1, open bite, anterior crossbite, crowding and tooth impaction, and low consensus in the diagnosis of midline shift ($P < 0.05$).
CONCLUSION: More than half of the patients were referred between 10 and 13 years of age. The waiting time between the referral and the first consultation was 6 months. Crowding, irregular tooth position, large overjet and deep overbite were the most common reasons for orthodontic referral, which were also confirmed in the diagnosis by the orthodontists.

80 QUANTITATIVE LIGHT-INDUCED FLUORESCENCE TO MONITOR REMINERALIZATION OF WHITE SPOT LESIONS: A PILOT STUDY

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AIMS: (1) To evaluate the effect of casein phosphopeptide-amorphous calcium phosphate and fluoride paste (CPP-ACPF), when white spot lesions (WSL) are present after fixed appliance treatment. Changes in the size and depth were monitored using quantitative light-induced fluorescence (QLF) during a three month period, and (2) to study changes in microbial composition in relation to caries development.
SUBJECTS AND METHOD: Six adolescent orthodontic patients with WSL. Three patients used CPP-ACPF paste, and three received a placebo-paste. The buccal surfaces of the teeth were examined with QLF before and directly after debond (T0), at 6 weeks (T1) and 3 months (T2) thereafter. Integrated fluorescence loss was determined for every lesion. Bacterial counts where measured before debond and at T1 and T2.
RESULTS: Twenty-eight lesions in the CPP-ACPF group and 28 in the placebo group were found. Reduction of the lesions was seen for 71.4 per cent of the lesions in the CPP-ACPF group, and 43 per cent in the placebo group, while 25 per cent of lesions in the CPP-ACPF group and 50 per cent of lesions in the placebo group worsened. Total plaque colony forming units were stable over time (5.107). The proportion of *Streptococcus mutans* reduced in the CPP-ACPF group from 8 per cent just before debond to 4 per cent at T2 while the portion of *S. mutans* in the placebo group was 11 per cent throughout.
CONCLUSIONS: It is assumed that lesions developed during treatment tend to improve after appliance removal and bacterial counts tend to decrease. The findings of this pilot study show that without extra care the lesions seem to have an equal chance of improving or worsening. The use of CPP-ACPF paste however, may have a positive effect on decreasing lesion size and

depth after appliance removal and this is supported by the data. A randomized clinical trial should be performed to investigate the remineralisation effect of CPP-ACPF paste *in vivo* after fixed orthodontic appliance treatment on lesion reduction.

81 PREVALENCE OF CONGENITALLY MISSING TEETH IN AN EAST-BAVARIAN POPULATION
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AIM: To gain a greater insight into the prevalence of congenitally missing permanent teeth in East Bavaria.
SUBJECTS AND METHOD: Using a dental administration software tool, 1442 patients who presented for orthodontic treatment between 1994 and 2006 were identified. Cases with incomplete records (n = 89) were excluded. From the 1353 remaining patients, 1130 had no missing permanent teeth, 52 had cleft lips, 110 had 1–2 missing teeth, 34 hypodontia (<6 missing teeth), and 27 oligodontia. The present analysis focused on the type and number of missing teeth, gender effects and regional variations.
RESULTS: In the entire population (n = 1353) the following teeth were most frequently missing: 35 (5.9%), 45 (5.1%), 22 (4.0%), 12 (3.6%), 15 (3.1%) and 25 (3.0%). The absence of 1–2 permanent teeth or hypodontia was 1.28 times higher in females. Oligodontia was 1.22 times and cleft lip 1.14 times higher in males. The likelihood of suffering from hypo- or oligodontia was higher in the area surrounding Regensburg city, and was statistically significantly higher in the Passau region [odds-ratio = 3.53; (1.18–10.52)] and Landshut [odds-ratio = 3.65; (1.22–10.99)].
CONCLUSIONS: The prevalence of congenitally missing permanent teeth in the population of the countryside of East Bavaria was higher than reported in the literature for northern Europe. This fact underlines the need for treatment facilities in East Bavaria.

82 CONSIDERATIONS REGARDING DEVELOPMENT OF THE CONDYLE AND THE GLENOID FOSSA
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AIM: To investigate the correlations between the shape of the glenoid fossa (the inclination of the posterior slope of the articular protuberance) and the morphology of the mandible.
SUBJECTS AND METHOD: Fifty-one patients (41.17% males, 58.83% females) with an age range of 5–14 years, prior to orthodontic treatment. Each underwent a full clinical examination and standard orthodontic records (plaster models, extra- and intraoral photographs, panoramic and lateral cephalometric radiographs). The radiographic images were traced and digitized for computed evaluation. The data concerning the morphology of the condyle (shape, height, width of the condyle, condyle head angle) and the inclination of the articular protuberance related to Frankfort horizontal and the nasion-sella line was analysed.
RESULTS: A Class I skeletal pattern was present in 21.56 per cent, a Class II in 60.78 per cent and a Class III in 17.66 per cent (skeletal classification was based on the values of ANB angle, measured on the lateral cephalometric radiograph). The inclination of the articular protuberance correlated with the configuration of the condyle.
CONCLUSIONS: The characteristics of the glenoid fossa (the inclination of the articular protuberance) seems to influence growth of the mandible. An increase in value of the inclination of the articular protuberence correlates with more vertically directed condylar growth, and reduced values of the articular slope orientates condylar development more horizontally.

83 *IN VIVO* EVALUATION OF ENAMEL SURFACE APPEARANCE AFTER ORTHODONTIC DEBONDING
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AIM: Debonding after orthodontic treatment is a potential risk factor for enamel damage. The aim of the present study was to determine enamel surface appearance after debonding.
SUBJECTS AND METHOD: Thirty patients at the end of full fixed appliance treatment (24 ± 3 months). A total of 489 brackets were debonded using a standard protocol. Digital photographs were taken directly after debonding (T1) and directly after removing the remaining resin (T2), on which Adhesive Remnant Index (ARI) was recorded. Impressions from the upper anterior teeth (62 teeth) were taken for replicas at T1 and T2, from which scanning electron microscopy photographs were taken to evaluate the Enamel Surface Index (ESI). Three hundred and six bracket bases with residual adhesive were scanned for energy dispersive X-ray spectrometry to map the distribution of silicon and calcium (Ca).
RESULTS: An ARI of 3 (all resin retained with bracket imprint) was scored most frequently (41%) followed by 0 (no retained resin, 28.7%), 1 (<50% retained resin, 17.9%) and 2 (>50% retained resin, 12.4%). High frequencies of ARI 3 were found for the upper anterior surfaces and ARI 0 for the lower molars. All elements were scored for ESI of 1 or 2 and no ESI 0, 3 or 4 were scored. No correlation between ESI and ARI was found. Significant difference existed in Ca weight between the upper and lower canines, second premolars and second molars ($P < 0.05$), which contributed to the difference between the upper (14.0 ± 8.7%) and lower (11.2 ± 6.5%) dentitions ($P < 0.05$).

CONCLUSION: The higher ARI scores for the upper anterior teeth might be related to the fact that they can be more easily kept dry during bonding, and have relatively flat labial surfaces, contributing to a good bond strength between adhesive and enamel. Tungsten carbide burs at a low speed removed the remaining resin, resulting in ESI 1 or 2. The higher Ca weight in the maxilla might be related to the presence of more calculus prior to bonding.

84 MINISCREWS IN ORTHODONTIC TREATMENT: SUCCESS RATES AND GUIDELINES

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AIM: A systematic review of patients, implants, surgery, and loading-related effects on the stability of miniscrews. The aim was to analyze the reported success rates of miniscrews and define guidelines for their selection and application.
MATERIALS AND METHOD: Investigations published until September 2007 and designated as human clinical trials were considered if at least 30 miniscrews were used. Parameters under review were patient gender and age, location and method of screw insertion, screw length and diameter, time until loading, duration and amount of loading.
RESULTS: Fourteen clinical trials covered 452 patients and 1519 screws. The mean overall success rate was 83.8 ± 7.4 per cent. Patient gender showed no significant differences. In terms of age, one of five studies showed a significant difference ($P < 0.05$) in patients aged >30 years. Screw diameters of 1-1.1 mm resulted in significantly lower success than those of 1.5–2.3 mm. One study reported significantly lower success for 6 versus 8 mm long miniscrews (72 versus 90%). Screw insertion with or without a surgical flap showed contradictory results between publications. Three studies showed significantly higher success rates for maxillary than mandibular screws. Loading and healing period played no significant role in the success rates.
CONCLUSIONS: All 14 papers described success rates as sufficient for orthodontic treatment. Implantation protocols varied markedly and may require further investigation. Screws less than 8 mm in length and 1.2 mm in diameter should be avoided. Immediate or early loading up to 200 cN was adequate and showed no significant influence on screw stability.

85 CRANIOFACIAL AND DENTAL ABNORMALITIES IN PRX1-CRE SIP1$^{-/-}$MICE

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AIM: To investigate the function of Smad Interacting Protein 1 (SIP1) in mouse dentofacial development.
MATERIALS AND METHOD: SIP1 is a transcriptional repressor interacting with SMADs-intracellular TGFβ signal transducers. As targeted inactivation of SIP1 results in early embryonic lethality, tissue specific inactivation of Sip1 using Prx1-Cre mice was investigated. In those mice Cre is expressed in developing limbs and craniofacial elements. To analyze the craniofacial malformations, skeletal stainings were carried out. Various skull skeletal elements of wild type and Sip1 null mice were then analyzed morphometrically. The data were analysed with the Mann-Whitney U test. To carry out histological examinations, paraffin sections of the heads at different developmental stages were processed for staining with haematoxylin and eosin. Qualitative as well as morphometric analysis was subsequently undertaken.
RESULTS: The mandibles of Sip1 conditional null mice were hypoplastic, not curved and the alveolar process around the mandibular incisors was serrated. The mutants also had a longer ramus than the wild type littermates ($P < 0.05$). Additionally the mutant mice displayed other cranial phenotypes such as broadened sagittal and metopic sutures and non-fused coronal sutures. The mandibular mutant incisors were significantly shorter ($P < 0.001$), but there was no difference in tooth width. Some mutant incisors exhibited an aberrant form, presenting with an extra cusp.
CONCLUSIONS: Prx1-Cre SIP 1$^{-/-}$ mice display specific abnormalities in dental, periodontal and craniofacial development. It is anticipated that the identification and understanding of Sip1 during development will increase understanding of the molecular basis of specific craniofacial, dental and periodontal malformations in humans.

86 EVALUATION OF TOOTH MOVEMENTS DURING MOLAR DISTALIZATION USING THREE DIFFERENT TECHNIQUES

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AIM: The amount of molar distalization can be measured from lateral cephalographs, photocopies, or directly on plaster models. Recent technological improvements may now allow the models to be digitized and analyzed with software tools. The aim of this study was to evaluate the validity of measurements made on digital models.
MATERIALS AND METHOD: The initial and final maxillary casts and lateral cephalographs of 20 Class II patients (10 males, 10 females, mean age 16 years) whose maxillary first molars were distalized with a screw-supported intraoral

distalizer. The amount of posterior movement of the maxillary first molars, first and second premolars and anterior movement of the centrals were evaluated on lateral cephalographs, photocopies of plaster models and three-dimensional digitized models. To determine possible differences between the three measuring methods, Wilcoxon and Friedman tests were performed.
RESULTS: There were no statistical differences between cephalometric, manual and digital measurements for the amount of molar movement and anterior protrusion ($P > 0.05$).
CONCLUSION: Digital evaluation seems to be a valid alternative to measurements made on plaster models and cephalographs.

87 THE MULTIHARMONIOUS METHOD – A COMPUTATIONAL TOOL FOR CRANIOFACIAL EVALUATION

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AIM: Cephalometric angles and distances are commonly used in the diagnosis and development of orthodontic treatment plans. In particular, a well-balanced appearance requires that all cephalometric parameters be in harmony with each other. The aim of this research was to investigate a multivariate method ['the multi-harmonious method' (MHM)] that considers the relationship between all angles and presents them in a graphical format.
MATERIALS AND METHOD: MHM was applied to a data set of 134 Korean 'normal' individuals and to 87 patients with a skeletal Class III malocclusion. A multiple linear regression model was estimated on the basis of the normal population, in such a way that the value of each angle is predicted from all other angles. The graphical scheme visualizes the residual differences between the predicted and the observed values simultaneously for all angles and thus assists in identifying potential misalignments.
RESULTS: From the number and size of the residuals, the two populations could be separated almost completely, indicating a high potential for diagnosis with MHM. MHM can also show treatment by visualizing different treatment effects, thereby assisting the orthodontist in choosing the best course of treatment for each patient.
CONCLUSIONS: The MHM enables identification of specific cephalometric angles that show deviations from relationships that would be perceived as normal. It can be easily implemented on a personal computer and helps to graphically compare various potential treatments by visualizing their effects in a compact way.

88 FREQUENCY OF INTERDENTAL BRUSH USE DURING MULTIBRACKET APPLIANCE TREATMENT AFTER TRIAL CONDITIONING

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AIMS: To evaluate (1) whether patients treated with a multibracket appliances (MB) continued to use interdental brushes after participating in a clinical interdental brush trial, and (2) which factors influenced their decision.
SUBJECTS AND METHOD: One hundred and four MB patients who had taken part in a randomised controlled trial evaluating the effectiveness and handling of two interdental brushes at least 1 year previously. The brushes tested differed in size and shape of the handle and the cross-section of the brushhead. Every patient had used both brushes for 6 months in a split-mouth design with a crossover after 3 months. Using questionnaires, the patients were asked whether they continued to use interdental brushes during their remaining MB period after the end of the trial, which brush they chose, how frequently and why.
RESULTS: Ninety of the 104 subjects (87%) returned useable questionnaires, 76 of whom (84%) claimed to have continued using an interdental brush. Sixty-two per cent of these subjects stated that they used the brush at least once a day, 30 per cent at least twice a week and 8 per cent once a week or less. Sixty-eight per cent chose one of the two brushes tested in the trial. The main decisive factor (85%) was ease of use of the chosen brush. The main reasons for not continuing interdental brush use after the end of the trial were the subjective impression of achieving clean teeth without it and the fact that their use required too much effort.
CONCLUSIONS: The majority of patients continued to use an interdental brush after participating in a clinical trial. Most of them chose one of the trial brushes tested in the original trial because of ease of use.
This study was supported by GABA International.

89 MYOTONOMETRY OF PATIENTS WITH TRANSVERSE INCISOR OCCLUSION

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AIMS: To define the contractile capacity of the masseter muscles of patients with a transverse incisor occlusion (TIO).

SUBJECTS AND METHOD: Thirty patients, aged 13-15 years, with TIO divided into two groups: 1) physiologic occlusion (15 patients); 2) distal occlusion (15 patients). The tonus of the masseter muscle was studied using the myotonometry method. The epicentre of traction of the left and right masseter was registered during maximum bite closure. The following were measured: hardness masseters (left and right) when the lower jaw was in relative physiologic quiescence – relaxed muscle tonus (Tr); and during maximum dentition bite closure – the contracted muscle tonus (Tc); the muscles' capacity for neurility was defined by difference between contracted muscle tonus and relaxed muscle tonus (Tc–Tr).
RESULTS: In group 1 Tr and Tc did not have meaningful difference between the left and right and were within the norm. As a consequence, the difference between Tc and Tr corresponded to an average norm ($P > 0.05$). Mastication from left and right was equal. In group 2 Òr was insignificantly greater from the left, and Tc from the right. The difference between Tc and Tr had the maximum meaning from right ($P < 0.05$). Patients in this group usually masticated from the right, which explains the discrepancy.
CONCLUSIONS: Patients with TIO and a physiologic occlusion of the posterior teeth have the contractile capacity of masseters from the right and left corresponding to an average norm. Patients with TIO and distal occlusion of the posterior teeth have the contractile capacity of masseters which is insignificantly greater on the right, because it is a convenient side of mastication.

90 TREATMENT EFFECTS AND CHANGES IN ORTHODONTIC INDICES IN PATIENTS WITH ANTERIOR CROWDING

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AIM: To compare three phases of orthodontic alleviation of anterior crowding in adults, relative to one incisor extraction versus dental arch expansion.
MATERIALS AND METHOD: Sixty three dental casts of 21 patients aged 21 to 39 years, with lower anterior crowding treated either by extraction of one incisor (group A) or elongation of the dental arch perimeter (group B). The casts were obtained a three time points: before (T1) and after treatment (T2) and after at least 1 year of retention (T3). In order to avoid bias, each cast was analyzed twice. Three orthodontic measurements, taken with electronic callipers, were evaluated and statistically analyzed: Little's irregularity index, Lundström's index of diastemas/crowding and lower intercanine distance.
RESULTS: Insignificant differences for the space/crowding index were found at all intervals (from T1 to T3) with both treatment approaches (extraction versus expansion). Intercanine width remained stable during short-term retention, regardless of the treatment technique, although net post-treatment changes were statistically significant: T2 to T3 = 0.00 and T2 to T3 = 0.05 in groups A and B, respectively. Little's irregularity index varied initially and equalled at T1, 8.02 in group A and 2.96 in group B. This difference, as well as post-treatment intergroup variance (T2 to T3), was statistically significant.
CONCLUSIONS: Lundström's index seems not to be a parameter explicitly indicating the extraction/non-extraction option for mandibular anterior crowing. However, the irregularity index and intercanine distance variability may affect stability.

91 VIRTUAL MODEL ANALYSIS AS AN ALTERNATIVE APPROACH TO PLASTER MODEL ANALYSIS: RELIABILITY AND VALIDITY

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AIMS: A case-control study to assess the potential use of virtual models as an alternative to orthodontic plaster models in assessing inter- and intra-arch relationships.
MATERIALS AND METHOD: Virtual dental models of 80 randomly selected patients seeking orthodontic care. Two trained and calibrated examiners assessed virtual and plaster dental models by measuring (i) tooth width, (ii) overjet, (iii) overbite, (iv) intermolar width, (v) intercanine width, and (vi) midline discrepancy. Criterion validity of virtual model analysis was determined by the agreement between the measurement results from virtual and plaster models. Inter-examiner reliability was calculated by comparing the measurement results from virtual models between two examiners. Test-retest reliability was determined by measuring 10 virtual models one week later. Comparison analysis was assessed by calculating the mean and standardized directional differences. Correlation analysis was assessed by calculating the intraclass correlation coefficients (ICC).
RESULTS: Both intra- and inter-examiner reliability and test-retest reliability of virtual model analysis were acceptable in measuring intercanine, intermolar, overjet, overbite, midline discrepancy and space analysis and for tooth width measurement (ICC > 0.7). Good criterion validity was indicated by agreement between the results from plaster and virtual models (ICC > 0.8). There were substantial agreements for canine and molar relationship classifications ($\alpha > 0.70$)
CONCLUSIONS: Analysis performed on virtual models could be as accurate as those performed on traditional plaster models. Therefore, virtual models might be an alternative to plaster models in assessment of malocclusion, providing equally accurate information for orthodontic diagnosis and treatment planning.

92 RELATIONSHIP BETWEEN THE INDEX OF COMPLEXITY AND ORTHODONTIC NEED AND THE INDEX OF ORTHODONTIC TREATMENT NEED

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AIMS: A cross-sectional study using the Index of Complexity and Orthodontic Need (ICON) and the Index of Orthodontic Treatment Need (IOTN), to determine the orthodontic complexity and need in urban Iranian school children. A secondary aim was to assess the relationship between these indices.
SUBJECTS AND METHOD: Five hundred and two subjects (253 females, 249 males, aged 11–14 years), including those who were wearing an orthodontic appliance at the time of the survey (1 female, 5 males). ICON and IOTN [Dental Health Component (DHC) and Aesthetic Component (AC)] scores were recorded in those not undergoing treatment. Spearman rank correlation coefficients were used to explore the relationships between the ICON and the DHC and AC of the IOTN.
RESULTS: According to ICON, DHC IOTN and AC IOTN, 46.6, 36.1 and 17.9 per cent of the subjects were in need of treatment. An orthodontic appliance was being worn by 1.1 per cent. In terms of complexity, 26.4 per cent were considered 'difficult' or 'very difficult'. With regard to treatment need, statistically significant correlations existed between the ICON scores and DHC IOTN ($r = 0.93$, $n = 496$, $P < 0.0005$), and between the ICON scores and AC IOTN ($r = 0.96$, $n = 496$, $P < 0.0005$). ICON had a lower treatment need threshold compared with the IOTN. Fifty-two per cent of subjects classified as borderline according to the IOTN (DHC = 3), were in need of treatment according to ICON scores (ICON >43). No gender differences were found for treatment need (ICON >43, $P > 0.05$) or treatment complexity ($P > 0.05$).
CONCLUSIONS: According to the ICON, 46.6 per cent of Iranian school children were in need of orthodontic treatment. ICON is a good substitute for the IOTN.

93 THREE-DIMENSIONAL CRANIOFACIAL IMAGING IN ORTHOGNATHIC SURGERY PLANNING: A REVIEW OF THE LITERATURE

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AIM: Advances in basic scientific research within the field of computer-assisted simulations in orthodontics have enabled the introduction of features of these techniques into orthognathic surgery. This presentation aims to describe and discuss new three-dimensional (3D) imaging techniques used in orthognathic surgery planning.
MATERIALS AND METHOD: An extensive review was performed of the literature in English to November 2008 on the PubMed database using 3D imaging and orthognathic surgery treatment planning as key words, to evaluate different 3D imaging modalities.
RESULTS: For studying the craniofacial complex in orthognathic surgery, 3D imaging can be carried out by: (1) surface imaging techniques to capture hard and soft tissue surfaces (3D laser scanning and stereophotogrammetry), (2) advanced radiographic techniques (3D ultrasound, 3D magnetic resonance imaging, 3D computed tomography, cone beam computed tomography), (3) computer-aided manufacturing procedures (stereolithographic biomodelling) and (4) combinations of two or more of the above methods. When combined with application-specific software tools, these techniques can provide craniofacial practitioners with a complete solution for performing specific diagnostic and surgical tasks.
CONCLUSION: 3D imaging and additional manufacturing techniques provide extensive possibilities for detailed and precise analysis of the craniofacial complex, for virtual and real simulation of orthognathic surgery cases before treatment, as well as for manufacturing of surgical splints and transferring the computerized surgical plan to the operation and for detailed evaluation of the effects of treatment.

94 ADVANCEMENT OF THE PREMAXILLA WITH DISTRACTION OSTEOGENESIS

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AIM: To evaluate the effects of premaxillary advancement on skeletal, dental and soft tissues with distraction osteogenesis (DO) following anterior segmental osteotomy.
SUBJECTS AND METHOD: Premaxillary advancement with DO was carried out in 21 subjects (11 females, 10 males). A tooth-borne distraction appliance was used in all patients with an average chronological age of 16 years 4 months. After a latency period of one week, the screws were activated (0.8 mm/day). Dimensional and angular measurements were made on cephalometric radiographs that were taken before and after distraction, and at the end of the consolidation periods. The changes obtained through the repeated measurements were evaluated with analysis of variance.

RESULTS: The increase in the distances VRL-ANS (3.65 mm) and VRL-A (4.88 mm), and the increase of SNA (4.40°) and ANB (4.57°) were significant ($P < 0.001$). A decrease in the distances CFH-ANS (1.79 mm) and CHF-A (1.90 mm) was obtained. A 7.67 mm anterior movement of the upper incisor teeth and a 5.98 mm increase in overjet were significant ($P < 0.001$). Decreases in the distances of the upper (3.62 mm) and lower (1.24 mm) lips to the aesthetic planes were statistically significant ($P < 0.001$). A significant decrease in G^Sn^Pg angle (6.02°) was determined. A 10.76 mm increase in the existing arch length was statistically significant ($P < 0.001$).
CONCLUSION: The premaxilla was successfully advanced in the sagittal plane with DO. Furthermore, these changes were maintained after the consolidation period. Sufficient space was obtained for the treatment of maxillary anterior crowding. The facial features were positively affected.

95 ASSESSMENT OF APICAL ROOT RESORPTION WITH DIGITAL PANORAMIC RADIOGRAPHY

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AIM: To determine apical root resorption of the maxillary centrals, laterals and canines on digital panoramic radiographs compared with conventional periapical radiographs.
MATERIALS AND METHOD: Seventy-two teeth from 12 patients. After rapid canine retraction the upper anterior teeth were consolidated. Radiographs were taken before and after canine retraction, and after incisor retraction. Apical root resorption was measured directly on the radiographs.
RESULTS: Root resorption on the periapicals was 1.87 ± 1.34 mm for the centrals, 1.61 ± 1.08 mm for the laterals and 0.57 ± 1.18 mm for the canines. The mean resorption measured on periapical radiographs was significantly different from that measured on the digital panoramic radiographs for the laterals and canines ($P < 0.05$), but not for the centrals.
CONCLUSION: Although digitally supported panoramic radiographs showed similar results to periapicals for measurements of the central incisors, assessment of root resorption in the distal direction for the centrals with digital panoramic radiographs was unreliable.

96 ULTRASTRUCTURAL ANALYSIS OF INTERPROXIMAL ENAMEL SURFACES TREATED WITH DIFFERENT STRIPPING PROCEDURES

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AIM: To evaluate the ultrastructural morphology of interproximal enamel surfaces treated with different stripping procedures with the use of a scanning electron microscope. Conventional manual stripping techniques with diamond abrasive strips were compared with predefined grain files, with different granulometry, mounted on a handpiece.
MATERIALS AND METHOD: Fourteen premolars, extracted for orthodontic reasons and stored in pure formalin, were washed with distilled water and inserted in acrylic resin stubs. Each interproximal enamel surface was reduced by 0.3 mm using different types of abrasive strips. The materials used were: one abrasive strip Diamond Separating Strip Fine (Horico), one abrasive strip Mesio-Distal Interproximal Reducer Coarse Blades (TP) and a Dentacare-Orthofile kit consisting of five different predefined grain files (15, 25, 40, 60 and 90 μm) mounted on a handpiece. The prepared tooth crowns were vertically dissected, washed, dried at room temperature and rendered conductive by means of a lamination of gold particles. The prepared specimens were inserted in the microscope and scanned at × 50, 100, 200, 500 and 1000.
RESULTS: All specimens demonstrated a significant alteration of the surfaces. Incisions and depressions were clearly visible. Samples treated with Orthofile strips showed lesions proportional to the grain used, with more uniform grooves compared with those produced by the TP and Horico files, and a lower presence of enamel debris. Specimens treated with TP files had intermediate dimension grooves, while those treated with Horico strips showed intermediate dimension grooves in terms of width, but reduced depth.
CONCLUSION: This *in vitro* study offers indications on the effectiveness of different instruments useful for interproximal enamel reduction, and of the modifications created on the treated surfaces.

97 CONDYLAR MORPHOLOGY IN RELATION TO VERTICAL DIMENSION IN GROWING PATIENTS

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AIM: To evaluate condylar morphology in growing patients according to their different vertical patterns, and to analyze which condylar dimensions vary significantly in low, normal and high angle growing patients.
SUBJECTS AND METHOD: Ninety-six skeletal Class I patients (48 males, 48 females) divided into three equal groups according to measurement of their vertical dimension on lateral cephalograms (32 low, 32 normal, and 32 high FMA angle). Dental pantomograms (DPTs) were obtained at three different time periods: initial observation, after an average of

12 months and after 36 months. On each DPT, the condylar and mandibular ramus morphology of both sides was traced. Eleven linear and angular measurements were measured. Data were analyzed with Wilcoxon's signed rank and a paired *t*-test using the statistical package, Medcalc.
RESULTS: Different condylar characteristics were identified according to the vertical patterns. Differences were evident between males and females. The length of the mandibular ramus was longer in short face patients with respect to long face subjects.
CONCLUSION: DPTs allows the study of condylar morphology in growing patients. The linear and angular measurements chosen allow analysis of the vertical patterns of patients. There are significant differences among low, normal and high FMA angle subjects as regards condylar morphology, especially in females.

98 EFFECTS OF THERMOCYCLING ON THE DEGREE OF CURE OF TWO LINGUAL RETAINER COMPOSITES
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AIM: To evaluate the effects of thermocycling on the degree of cure (DC) of two lingual retainer composites.
MATERIALS AND METHOD: Fifty composite specimens with a diameter of 5 mm and a height of 2 mm, were equally divided and prepared with either Light Cure Retainer (LCR; Reliance, USA) or Transbond Lingual Retainer (TLR; 3M Unitek), and cured for 40 seconds with a conventional quartz tungsten halogen light unit between microscope slides, using a Teflon mould, to evaluate the DC. Five specimens in each group underwent 0, 5,000, 10,000, 15,000 and 20,000 complete cycles in distilled water between 5 and 55°C, with a dwell time in each bath of 30 seconds and a transfer time between baths of 15 seconds. Absorbance peaks were recorded using Fourier transform infrared spectroscopy. DC values were calculated. Data were analysed using Kruskal–Wallis, Mann–Whitney U and independent samples *t*-tests.
RESULTS: Statistically significant differences were observed under different thermocycling regimens in the TLR group ($P < 0.05$). For TLR composite, statistically significant differences were found between the DC values of the 20,000 thermal cycled group and the other groups ($P < 0.05$). The lowest mean DC value for the LCR group and the highest mean DC value for the TLR were achieved after 20,000 thermal cycles. The DC range in different thermocycling regimens for TLR and LCR was between 66.32 and 74.67 per cent and 83.00 and 86.83 per cent, respectively. Overall DC values of the TLR (68.38 ± 9.31%) were significantly lower ($P < 0.01$) than those of the LCR (84.37 ± 3.51%).
CONCLUSION: LCR is less affected than TLR composite after thermocycling below 20,000 cycles, and higher DC values were achieved by LCR composites.

99 ANTERIOR, POSTERIOR, AND TOTAL OCCLUSAL PLANE INCLINATIONS AND THEIR RELATIONSHIP TO DENTAL AND SKELETAL CLASSES
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AIM: To evaluate the association between the cant of the total, anterior, and posterior occlusal planes and the Angle classification (dental and skeletal).
MATERIALS AND METHOD: Casts and cephalometric tracings of 250 randomly selected individuals (age 19 ± 9 years; Class I: n = 66, Class II: n = 115, Class III: n = 69) were analyzed in terms of Angle Class, skeletal configuration [anteroposterior dysplasia indicator (APDI), Wits appraisal, overbite depth indicator (ODI)] and their relationship to the total occlusal plane (OP), the anterior occlusal plane (AOP), and the posterior occlusal plane (POP). OP, AOP, and POP were angular measurements referenced to sella-nasion and Frankfort horizontal lines.
RESULTS: The angulation of the AOP and POP differed significantly ($P < 0.001$). Univariate tests showed moderate correlations between Angle Classes and OP, AOP, and POP (r = 0.13 to 0.25). In the multivariate regression analysis, APDI, Wits, and ODI showed a significant influence on the occlusal planes while Angle Class did not show an influence on the inclination of OP, AOP, and POP.
CONCLUSIONS: The prevalence of dental Angle Classes cannot be explained by the cant of OP, AOP, or POP; significant influence can be deduced from skeletal sagittal and vertical measurements.

100 AGEING EFFECTS OF pH AND THERMOCYCLING ON THE SURFACE MORPHOLOGY OF THERMODYNAMIC NICKEL TITANIUM WIRES
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AIM: Surface topography can affect the behaviour between an orthodontic wire and the slot of the bracket. Using atomic force microscopy (AFM), this study evaluated three-dimensionally the surface morphological alterations of two nickel titanium (NiTi) thermodynamic wires on ageing due to immersion in artificial saliva and thermocycling.

MATERIALS AND METHOD: Fifty-two samples of each wire type [either NeoSentalloy NSA (3M Unitek, Monrovia, California, USA) or Thermalloy TA (Ormco Corporation, Glendora, California, USA)] were divided into two equal groups, each dipped into artificial saliva containing 1500 ppm fluoride ions with a pH of either 5.5 or 3.5 for 30 days. These two pH groups were then further divided into two subgroups of 13 wires each, one of which was subjected to thermocycling immediately after the end of the immersion period. Data on the roughness, skewness, and superficial area of the wires were recorded by AFM before and after immersion (and thermocycling, when present). Statistical analysis included a Friedman test followed by Dunn's *post hoc* test.
RESULTS: The two NiTi wires showed a different start surface topography. A significant increase in surface roughness was recorded at the lower pH. TA wires showed greater superficial changes with respect to NSA wires at the lower pH. Thermocycling had no significant effect on superficial morphological variations of either NiTi wires.
CONCLUSIONS: In spite of the similar chemical structures, the two NiTi wires showed differential corrosion resistance to low pH leading to variable surface roughness. Interestingly, surface roughness may increase the frictional forces between the slot and the wire itself implying slower arch-guided tooth movement. Further studies are required to determine any clinical implications.

101 ACCURACY AND RELIABILITY OF PALATAL SUPERIMPOSITION OF A THREE-DIMENSIONAL DIGITAL MODEL

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AIM: To evaluate the accuracy of the superimposition method using the palatal surface as a reference for measuring the changes in tooth movement on three-dimensional (3D) digital models.
MATERIALS AND METHOD: Maxillary plaster models of 20 patients. The right and left canines, premolars and molars were individually cut beneath the gingival margins and embedded with wax to enable individual tooth movement (T1). The teeth on the plaster models were then randomly moved within the clinical limit (T2). T1 and T2 plaster models were scanned to produce 3D digital models, and were superimposed using the palatal area as a reference via surface-to-surface matching software. The 3D tooth movements of the digital models were measured and compared with those of the plaster models. A paired *t*-test and correlation analysis were performed to determine whether or not the two measurement methods significantly differed.
RESULTS: The means of the antero-posterior (*X* axis), transverse (*Y* axis) and vertical (*Z* axis) tooth movements of the plaster and digital models did not significantly differ. Very high correlations were found between the plaster and digital models.
CONCLUSIONS: Superimposition of 3D digital models using the palatal surface can provide accurate and reliable measurement for the assessment of orthodontic tooth movement.

102 ASSESSMENT OF INTERRADICULAR SPACES FOR MINISCREW IMPLANT PLACEMENT IN DIFFERENT DENTOSKELETAL PATTERNS

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AIMS: To assess the influence of different dentoskeletal patterns on the availability of interradicular spaces for safe miniscrew implant placement.
MATERIALS AND METHOD: Pre-treatment lateral cephalometric and periapical radiographs, obtained with the paralleling technique, of 60 orthodontic patients with skeletal Class I, II and III malocclusion patterns. Cephalometric analysis and mesiodistal tooth angulations were assessed on the lateral cephalometric radiographs. The mesiodistal distances at 2, 4, 6, 8, and 10 mm from the alveolar crest, angle formed between the tooth axes, and areas in each interradicular site were measured on the periapical radiographs using custom-made software. Pearson correlation coefficients and one-way ANOVA was used to analyze the results.
RESULTS: Significant differences in interradicular spaces among the skeletal types were observed. Patients with skeletal Class II malocclusions showed significantly greater interradicular spaces in the maxillary arch, particularly between the maxillary first and second molars, followed by the skeletal Class I and III subjects ($P < 0.05$). In contrast, patients with skeletal Class III malocclusions showed significantly greater interradicular space in the mandibular arch compared with skeletal Class II and I subjects ($P < 0$ .01 and $P < 0.05$, respectively).
CONCLUSIONS: The dentoalveolar compensation observed in different skeletal discrepancies plays an important role on the availability of interradicular bone. For safe miniscrew implant placement, besides the safe site availability, the dentoskeletal patterns of the patients must be considered when miniscrew implants are planned.

103 TREATMENT EFFECTS AND LONG-TERM STABILITY OF ADULT CLASS II PATIENTS TREATED WITH THE STEPWISE ADVANCEMENT HERBST APPLIANCE

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AIM: To compare the treatment effects and long-term stability of the stepwise Herbst appliance and surgery (mandibular sagittal split osteotomy) in skeletal Class II adult patients.
SUBJECTS AND METHOD: Thirty-two subjects (16 patients in the Herbst group and 16 in the surgery group). Lateral head films were taken before treatment, after removing the Herbst appliance/surgery, after fixed appliance therapy and 3 years after treatment. All films were analyzed by the standard cephalometrics and SO analysis (analysis of changes in sagittal occlusion).
RESULTS: All the Herbst and surgery patients were treated successfully to Class I occlusal relationships with normal overjet and overbite. In terms of long-term stability, both groups achieved stable results and no significant difference occurred over time.
CONCLUSIONS: Stepwise advancement Herbst appliance therapy can treat borderline skeletal Class II adult patients with long-term stability.

104 SHORT- AND LONG-TERM EFFECTS OF INTRAORAL VERTICAL RAMUS OSTEOTOMY ON THE HYOID AND TONGUE POSITION

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AIM: Response of tongue position after mandibular setback surgery is clinically important for maintaining normal respiration. The hyoid bone position can be used as a marker for evaluating tongue position and pharyngeal airway. One of the frequently used surgical methods to correct mandibular prognathism is intraoral vertical ramus osteotomy (IVRO). However, there are limited studies on head posture, hyoid bone and tongue position after IVRO. The aim of this research was to evaluate changes in hyoid position, tongue, oropharyngeal airway and head posture after IVRO in skeletal Class III patients.
SUBJECTS AND METHOD: Sixty patients with a skeletal Class III malocclusion who had completed their growth. Forty-five patients had undergone combined Le Fort I osteotomy and IVRO and 15 patients IVRO only. Lateral cephalograms were taken before, immediately after, approximately 1 month after, and at least 1 year after surgery.
RESULTS: The hyoid bone moved inferiorly and posteriorly immediately after surgery and relapsed superiorly and anteriorly during the short and long-term observation periods. There was a strong correlation between cervical hyperflection and anterior movement of the hyoid bone during all stages. Thus, cervical hyperflection of the head helped maintain the post-surgical airway. However, the final position of the hyoid bone was significantly posterior compared with its pre-surgical position. The final position of the tongue was also significantly posterior compared with its pre-surgical position.
CONCLUSION: The immediate post-operative airway is maintained following IVRO but there is a possibility of airway narrowing long term. Precautions should be taken to prevent obstructive sleep apnoea and maintain an adequate airway in patients with narrow airways after orthodontic and IVRO treatment.

105 TREATMENT OF PATIENTS WITH THE LAUTROU ACTIVATOR: A STUDY OF MANDIBULAR INCISOR PROCLINATION

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AIM: To compare proclination of the mandibular incisor in two groups of patients treated with a Lautrou activator with a non-treated sample.
SUBJECTS AND METHOD: Two treated groups. One of 50 subjects (Tt1) with average age of 10 years 7 months and the other (Tt2) 50 subjects with average age of 10 years 5 months at the beginning of treatment, and an untreated group (Te) of 32 children with an average age of 10 years 4 month at the beginning of the observation period. All presented with a Class II division 1 malocclusion on a Class II skeletal base. A Lautrou activator (activator-headgear combination) was used in groups Tt1 and Tt2. In Tt1, the activator was constructed in maximal mandibular propulsion and in Tt2 in incisor edge-to-edge position. Cephalometric tracing and measurements were carried out with QuickCeph 2000 software and statistical comparisons were made at the beginning and end of the observation period.
RESULTS: For the skeletal beginning/end evaluation both treated samples had a significant reduction in their malocclusions compared with untreated group. The two treated groups (Tt1/Tt2), in despite of the different methodology in the activator construction, did not show any differences in Class II correction. Overjet reduction was highly significant in the treated subjects and non-significant in the untreated group. Concerning mandibular incisor proclination, no significant vestibular

change was observed between the beginning and end of the observation period; the difference in the construction of the activator did not affect the validity of the results.
CONCLUSIONS: The Lautrou activator does not seem to affect proclination of the mandibular incisors, a side-effect commonly observed with this type of appliance.

106 EXPERIMENTAL AND NUMERICAL ANALYSES OF THE BIOMECHANICAL CHARACTERISTICS OF ORTHODONTIC MINI-IMPLANTS

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AIM: Mini-implants are being utilised as anchor units in orthodontic treatment. Nevertheless, there seem to be influencing factors that interfere with their clinical performance. The aim of this study was to experimentally and theoretically examine four different parameters that may have an influence on the primary stability of orthodontic mini-implants. These were 1) implant type, 2) implant length, 3) implant diameter, and 4) insertion angle.
MATERIALS AND METHOD: A total of 90 mini-implants were inserted in fresh segments of bovine ribs. The implants were of two types, the Aarhus and the Lomas mini-implant, of two lengths (7 and 9 mm) and of two diameters (1.5 and 2.0 mm, Lomas only). A closed NiTi coil-spring was attached to each mini-implant. Half of the preparations were loaded with a low force of 0.5 N, the other half with a high force of 2.5 N. Mini-implant deflections during force application were non-invasively registered using a three-dimensional laser-optical system. A subsequent finite element analysis of the applied force systems and the resulting mini-screw deflections was performed.
RESULTS: In the low force group, implant displacements showed no statistically significant differences according to the investigated parameters. In the high force group the 9 mm mini-implants displaced significantly less (mean 10.5 ± 7.5 μm) than the 7 mm long (mean 22.3 ± 11.3 μm, $P < 0.01$), and the 2 mm wide significantly less (mean 8.8 ± 2.3 μm) than the 1.5 mm implants (mean 21.9 ± 1.5 μm, $P < 0.001$). The force level where significance occurred was found to be 1 N. The Lomas mini-implants rotated significantly more than the Aarhus mini-implants at all force levels. Intraobserver agreement showed good correlation between experimental and numerical findings.
CONCLUSIONS: Implant length and implant diameter become statistically significant, influencing parameters on implant stability only when a high force level is applied. The numerical results showed good correlation with the experimental results.

107 FLUORIDE RELEASE FROM ORTHODONTIC BONDING ADHESIVES *IN VITRO* AND ON FLUORIDE UPTAKE FROM ENAMEL *IN VIVO*

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AIM: To investigate, over a period of 2 months, the *in vitro* fluoride release from a glass ionomer orthodontic bonding system (Fuji I, radiopaque luting cement) as well as the extent of the *in vivo* enamel fluoride uptake from the same glass ionomer cement after 6 months, using a resin adhesive as a control.
MATERIALS AND METHOD: Using an ion-selective electrode, the *in vitro* release of fluoride was evaluated and compared with a composite resin (Transbond XT, Light Cure) as the control. Fluoride release was measured for adhesives bonded only to bracket bases and bonded with brackets to enamel at 1, 3, 7, 30 and 60 days, respectively. For the *in vivo* part of the study, 15 pairs of premolars were bonded with metal brackets using either the Fuji or Transbond adhesives. Six months later, after extraction of these teeth for orthodontic purposes, they were embedded in epoxy resin, sectioned bucco-lingually and the fluoride uptake of enamel was studied with scanning electron microscopy.
RESULTS: The 'burst-effect' pattern of fluoride release observed for the Fuji adhesive during the first month of the experiment became less pronounced with time, whereas the bonded to enamel specimens showed decreased fluoride release at the 30th and 60th day ($P < 0.05$). Enamel fluoride uptake was detected at the outer 2 m of the enamel surface for the Fuji group. At a distance of 100 μm from the dento-enamel junction, no traceable fluoride uptake was documented.
CONCLUSIONS: The short-term fluoride release and absence of documented enamel uptake, suggest that the glass ionomer orthodontic adhesive tested may only provide a protective action through the reservoir mechanism.

108 GENETIC PREDISPOSITION TO A SKELETAL CLASS II MALOCCLUSION IN A SOUTHERN CHINESE POPULATION

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AIM: To identify the genetic predisposing factors of skeletal Class II malocclusions in a southern Chinese population.

SUBJECTS AND METHOD: Southern Chinese volunteers, including 198 normal sagittal skeletal subjects and 162 skeletal Class II patients, were recruited for this case-control association study. Genomic DNA was isolated from whole blood. Fifty-eight single nucleotide polymorphisms (SNPs) from eight genes, which participate in the process of mesenchymal stem cell proliferation and chondrogenesis in the mandibular condyle, were genotyped using the Sequenom platform. Association testing was performed by chi-square test. The Hardy-Weinberg equilibrium test and linkage disequilibrium test were executed with Haploview software.
RESULTS: The increased susceptibility to a skeletal Class II malocclusion was found to be associated with one SNP in gene NOS3, rs3918188 (OR = 2.337 with 95% CI = 1.192-4.582 for AA, compared with CA and CC genotypes). Allele A in rs3918188 ($P = 0.019$, OR = 1.449 with 95% CI = 1.062-1.976) was significantly associated with the trait.
CONCLUSIONS: SNP rs3918188 is one predisposing factors for a skeletal Class II malocclusion in a southern Chinese population. Further studies on genetic markers may expand understanding of the genetic control in craniofacial morphological determinants and help in the prediction of craniofacial growth.

109 SHEAR BOND STRENGTHS OF DIFFERENT ADHESIVE SYSTEMS FOR BONDING ORTHODONTIC BRACKETS TO FLUOROTIC TEETH

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AIM: To measure and compare the shear bond strengths (SBS) of different adhesive systems for bonding orthodontic brackets to fluorotic and normal teeth.
MATERIALS AND METHOD: Thirty-six teeth classified as scores 3, 4 or 0 on the Thylstrup and Fejerskov's fluorosis index. Brackets were bonded to these teeth with different adhesive systems and the teeth were divided into six equal groups. Group 1 contained normal teeth treated with 37 per cent phosphoric acid and the System™ 1+, group 2 normal teeth treated with 37 per cent phosphoric acid and Unite™, group 3 normal teeth treated with 65 per cent phosphoric acid and Superbond C&B, group 4 fluorotic teeth treated with 37 per cent phosphoric acid and System™ 1+, group 5 fluorotic teeth treated with 37 per cent phosphoric acid and Unite™, and group 6 fluorotic teeth treated with 65 per cent phosphoric acid and Superbond C&B. All teeth were stored in distilled water at 37°C for 24 hours. Thermocycling was performed at 5°C and 55°C for 1,000 cycles. SBS were measured using a universal testing machine. The data were analyzed using ANOVA.
RESULTS: The mean SBS of the groups, in Megapascals (MPa), were: group 1 = 11.85 ± 3.71, group 2 = 13.39 ± 1.81, group 3 = 14.60 ± 1.76, group 4 = 3.86 ± 3.18, group 5 = 11.03 ± 4.14 and group 6 = 10.73 ± 4.24. The highest mean SBS for the normal teeth was in group 3 and for the fluorotic teeth, in group 5. The mean SBS of all adhesives used on normal teeth were significantly greater than those used on fluorotic teeth ($P < 0.001$). For fluorotic teeth, the mean SBS of the Unite™ and Superbond C&B were not significantly different, but both were significantly different from System™ 1+ ($P = 0.008$ and $P = 0.003$).

110 EFFECT OF THE ENVELOPE LINGUAL NOCTURNE ON ATYPICAL SWALLOWING: SURFACE ELECTROMYOGRAPHY AND COMPUTERIZED POSTURAL EVALUATION

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AIM: To show the effect of the Envelope Lingual Nocturne (ELN) in atypical swallowing patients (ASP) by surface electromyography (sEMG) and computerized postural evaluation.
SUBJECTS AND METHOD: On 20 ASP sEMG test was performed during swallowing and different tongue positions in 20 ASP subjects with and without ELN. Electromyographic activity was determined with 8 channels on four groups of muscles: temporalis, masseters, digastrics and sternocleidmastoids. After sEMG testing a computerised postural test was undertaken with and without the presence of ELN.
RESULTS: sEMG showed a significant difference in the activation of muscles in two situations. During swallowing without ELN there was increased activation of the digastric muscles without activation of AM and in the same patients, with ELN there was a physiologic activation of AM muscle at the same time as those of the digastric muscles with swallowing lasting on average 2 seconds. Postural evaluation showed that in all patients there was an alteration of the barycentre as well as an elevated oscillatory record. The pressure on foot was also evaluated to determine any variation when it was used. In the tests carried out during the presence of ELN, the values changed. The barycentre [X and Y (mm)], the oscillatory movement (i.e. trace area valued in mmq, oscillatory velocity calculated in mms, (length mm variations) and foot pressure (i.e. Kg variation) normalised.
CONCLUSIONS: sEMG shows how with ELN it is possible to normalize swallowing because the tongue achieves a physiologic position. During the swallowing, it is possible to have a low dental contact without a tongue impediment. Computerized postural tests show how tongue has a significant influence on body posture.

111 SALIVA ANALYSIS DURING ORTHODONTIC TREATMENT

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AIM: Surface-Enhanced Laser Desorption/Ionization Time-Of-Flight Mass Spectrometry (SELDI-TOF-MS) allows the generation of an accurate protein profile from minimal amounts of biological samples. The aim of this research was to compare the proteomic profile of saliva of patients in orthodontic treatment to the beginning of treatment and after three months using SELDI-TOF-MS technology.
SUBJECTS AND METHOD: Saliva was collected from 40 patients, between 11 and 17 years of age at the beginning and after three months of orthodontic treatment. Saliva (5 mL) was collected by spitting directly into a clean 15 mL conical tube. The samples were then aliquotted and stored at –80°C until use. The specimens were centrifuged (10 minutes, ×13000 g), Q10 ProteinChips were prepared according to the manufacturer's instructions and were loaded with the supernatants. A saturated solution of sinapinic acid was used as the energy-absorbing matrix. Analysis was performed in a m/z range from 2500 to 25000 Da, and the proteomic profiles were compared using specific data analysis software.
RESULTS: The profile of saliva of patients before orthodontic treatment presented a number of peaks which were different to those obtained after three months of treatment. The average intensities of the peaks at m/z 3372, 5232, 4045 and 10128 were significantly higher after three months than at the beginning of treatment in the same and among the patients. The ROC plot demonstrated high sensitivity and specificity.
CONCLUSIONS: Many differences were noted in salivary proteomic profile obtained using SELDI-TOF-MS technology. The results indicate that proteomic analysis of saliva is a promising new tool for the non-invasive study of oral mucosa and bone changes.

112 CONDYLE POSITION INDICATOR AND COMPUTERIZED OCCLUSAL EVALUATION OF TEMPOROMANDIBULAR JOINT INTRACAPSULAR DISEASE

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AIM: To demonstrate two types of analysis that allows understanding of the pathogenesis of temporomandibular intracapsular disease (TMD): the condyle position indicator (CPI) and T-Scan 2 system.
SUBJECTS AND METHOD: Fifteen patients (17–30 years of age) with TMD and a group of 10 healthy subjects. For each patient CPI and a T-Scan was carried out. Differences in condyle position during maximum intercuspation (MI) and centric relation (CR) on the CPI were evaluated. The CR bite registration technique developed by Roth was used. The T-Scan system is a computerized occlusal analyzer. The analytical software displays the centre of force (COF) and centre of force trajectory (COFT), and provides in-depth understanding of the overall balance of the occlusion. TMD subjects present joint sound during jaw opening movement while healthy controls have no joint sound. On each patient clinical muscles palpation and the appraisal of articulation noise was carried out.
RESULTS: Seven non-healthy subjects, on CPI, presented a symmetrical vertical condyle shift in MI. In these patients COF was not greater than 5 per cent, but an immediate posterior dental contact on T-Scan was observed. Eight non-healthy subjects presented sagittal and transverse condyle shifts. On these COF was greater than 5 per cent and COFT was out the two central ellipses and moved towards the side with a higher bite force value. In the healthy group no significant condyle position alteration or difference in COF/COFT was observed.
CONCLUSIONS: There is a great correlation between dental contact and condyle position.

113 FRICTIONAL FORCES OF CONVENTIONAL VERSUS SELF-LIGATING BRACKETS EVALUATED BY A NEW *IN VITRO* MODEL SYSTEM

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AIM: To compare frictional forces of different brackets-archwire ligatures using a new *in vitro* model system.
MATERIALS AND METHOD: The new model system comprised a stainless steel base plate with 10 slides, allocated in such a way to resemble a dental arch from the second right premolar to the second left premolar. Metal supports that resembled the teeth were locked in each of the slides. Each metal support had a small brass cylinder on its top, into which the bracket was seated and stabilized by additional adhesive. To reduce analysis variables, all 10 mechanical units had a 0 degree inclination with respect to the mesio-distal or bucco-lingual inclinations of the pillar screw. Three types of brackets were selected: Mini-Taurus (RMO, Ormco Corp., Glendora, California, USA), Careers Lx (Ortho Organizer, Carlsbad, California, USA) and Time II (American Orthodontics, Sheboygan, Wisconsin, USA). The Mini-Taurus brackets were associated with standard elastomeric ligatures. Three circular nickel-titanium superelastic wires (Orthonol, RMO, Ormco Corp.) with an ideal arch shape and sections

of 0.012, 0.014 and 0.016 inches, were engaged in the brackets. The tests were performed using a universal testing machine raising the canine bracket to either 3 mm (common clinical condition) or 6 mm (extreme experimental condition) at 5 mm/minute, and recording the maximum load force needed to implement those deflections.
RESULTS: Self-ligating brackets showed lower frictional values than conventional brackets. However, wire diameter was found to be critical in the response of active-passive brackets, with the frictional forces associated with the thicker wires not very different between the self-ligating and conventional brackets.
CONCLUSIONS: Self-ligating brackets are recommended in everyday clinical practice since they reduce frictional forces, especially when 0.012 or 0.014 inch wires are required, ultimately leading to more efficient force delivery to the teeth.

114 A STUDY OF THE HANDICAPPING LABIO-LINGUAL DEVIATIONS INDEX AND THE INDEX OF COMPLEXITY OUTCOME AND NEED IN THE USA

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AIM: California is among the states that have adopted the Handicapping Labio-Lingual Deviations Index (HLD) with the California modifications (CalMod)) to determine eligibility for public funding of orthodontic treatment. The Index of Complexity Outcome and Need (ICON) is the latest index to be developed and it is unique in that it has clearly defined thresholds for orthodontic treatment need and outcome. The purpose of this study was to determine the validity and reliability of the HLD (CalMod) and the ICON in identifying treatment need and handicapping malocclusion by comparing them with a panel of 13 Californian orthodontists.
MATERIALS AND METHOD: A set of 153 study casts representing all types of malocclusion were utilized. The casts were scored with the HLD (CalMod) and the ICON by an ICON-calibrated examiner. Each orthodontist individually evaluated the models and gave each a score on a 12-point scale. The mean score of the panel of the need for treatment was used as the 'gold standard'.
RESULTS: A high correlation between the ICON and the gold standard was observed. However, the gold standard threshold for orthodontic treatment was lower than that for ICON. With modification of the ICON cut-off point, its sensitivity improved from 58.7 to 80.8 per cent and specificity remained the same at 93.9 per cent. There was a high correlation between HDL (CalMod) and the gold standard. However, the cut-off point for HLD (CalMod) did not reflect the gold standard cut-off point as determined by classification and regression tree modelling. The gold standard threshold for handicapping malocclusions was significantly lower than the threshold set by HLD (CalMod).
CONCLUSIONS: ICON is a valid measure of orthodontic treatment need. HDL (CalMod) is not a valid measure of treatment need or handicapping malocclusion.

115 EFFECTIVENESS OF FUNCTIONAL ORTHODONTIC TREATMENT IN CLASS II DIVISION 1 PATIENTS – A SYSTEMATIC REVIEW

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AIM: The effectiveness of functional orthodontic treatment and the resulting skeletal response have always controversial. Therefore a systematic review on this subject was conducted, with special attention to mandibular growth.
MATERIALS AND METHOD: According to the recommendations of the Cochrane Collaboration, a literature research and meta-analysis was carried out. Three appliances for the period 1996 and 2008: the Herbst appliance (HA), the activator (AC) and the headgear-activator (HAC) were considered. Cephalometric parameters under review were: SNA, SNB, ANB, OLp-A, OLp-Pg, Co-Gn and PPL.
RESULTS: Eleven studies matched the predefined inclusion criteria and were considered in this review. The mean ages at the start of treatment for the three appliances were 10.7 (HA), 11.7 (AC) and 11.9 (HAC) years, weighted by the number of patients in each study. Maxillary changes in SNA and OLp-A were most prominent for the HAC (–2.11°; –2.6 mm, respectively). Mandibular changes in SNB and OLp-Pg were almost identical for all three appliances. Intermaxillary, the HAC showed the greatest effect (ΔANB = –2.46°), although this was mainly from a decrease in SNA. The largest increase in the vertical parameter, PPL, and the mandibular length, Co-Gn, were recorded for the AC (+2.25°; +4.26 mm, respectively).
CONCLUSIONS: The skeletal changes caused by the HA, AC and HAC when treating Class II division 1 patients were found to be statistically significant but clinically insignificant. Considering maxillary and vertical side-effects, treatment of Class II division 1 patients with functional appliances should be reconsidered. A one-phase therapy should be contemplated.

116 APPLICABILITY OF RICKETTS' NORMS TO MIDDLE EUROPEAN ADOLESCENTS

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AIMS: To evaluate skeletal status, particularly in Hungarian adolescents with malocclusions, and to analyse whether significant cephalometric differences exist between these measurements and Ricketts' standards for a Caucasian population.
MATERIALS AND METHOD: Standardized digital cephalometric radiographs of 700 children (342 males, 358 females, aged between 12.5 and 18.3 years, mean 15.3 years) with a diagnosed malocclusion in the early permanent and permanent dentition who had not undergone previous orthodontic treatment. A computer-aided cephalometric analysis was performed. The lateral cephalograms were measured using the same computer system and then the indices of craniofacial structures were analysed with Ricketts' method. Basic statistical analyses for different cephalometric variables were obtained using the Statistical Package for Social Sciences, version 11.0 for Windows. From 30 cephalometric parameters the values for facial convexity, facial axis, craniofacial deflexion, mandibular angle and conical angle were investigated.
RESULTS: Craniofacial deflection varied between 16.00 and 36.20 degrees (mean 26.89º). Facial convexity ranged from –10.6 to 10.7 mm (mean 0.1098 mm). Facial axis angle presented a minimum of 76.1 and a maximum of 101.8 degrees with an 89.44 mean. The mean mandibular angle was 20.5 degrees (minimum 0.2º, maximum 53.7º). This was decreased compared with the normal value of 27.2 ± 4.5 degrees.
CONCLUSION: The findings demonstrate normative values when compared with those of Ricketts.

117 EFFECTS OF RAPID MAXILLARY EXPANSION ON AIRWAY DIMENSION AND HEAD POSTURE IN CHILDREN WITH IMPAIRED NASAL BREATHING

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AIM: To evaluate the effects of rapid maxillary expansion (RME) on head posture, cranio-cervical angulations, nasopharyngeal airway adequacy and craniofacial morphology in children with nasopharyngeal obstruction.
SUBJECTS AND METHOD: Thirty children (8-14 years of age) with nasopharyngeal obstruction divided into two groups: group 1, 15 subjects treated with RME, and group 2 (control), 15 subjects followed for 8 months before beginning therapy. Both groups underwent a cephalometric evaluation, measuring six cranio-cervical angles and five linear dimensions that determined pharyngeal airway adequacy. Dental casts and lateral cephalograms in the natural head position were obtained at the first visit and 6 months later for all subjects.
RESULTS: In the group 1 there was a statistically significant increase in airway dimension at three levels (PNS-ad1, ve-pve, and uv-puv), and a decrease in the cranio-cervical angulations. No significant changes were seen group 2.
CONCLUSION: RME is an advantageous treatment procedure capable of increasing nasopharyngeal airway adequacy, that also leads to a decrease in cranio-cervical angulations and flexion of the head.

118 THREE-DIMENSIONAL EVALUATION OF CRANIOFACIAL MORPHOLOGY AND UPPER AIRWAY VOLUME IN PATIENTS WITH OBSTRUCTIVE SLEEP APNOEA

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AIM: To evaluate craniofacial morphology and upper airway volume in patients with obstructive sleep apnoea (OSA) by means of cone-beam computed tomography (CBCT).
SUBJECTS AND METHOD: Eighty subjects diagnosed by overnight polysomnography. Based on the apnoea-hypopnoea index (AHI) score, the subjects were divided into four groups; normal (AHI <5), mild (AHI: 5–15), moderate (AHI: 16–30), severe (AHI >30). CBCT records were taken in a supine position using a NewTom 3G FP scanner. The CBCT data were reconstructed and analyzed with Dolphin 3D software. Three-dimensional cephalometric and volumetric evaluations of upper airway space and craniofacial morphological characteristics were performed.
RESULTS: Patients with OSA had some spatial and morphological differences compared with healthy subjects.
CONCLUSION: CBCT is a useful tool for imaging and analyzing the soft and hard tissue structures of patients with OSA.

119 CONE BEAM COMPUTED TOMOGRAPHY IN TREATMENT PLANNING IN THE LATE MIXED DENTITION OF CLEIDOCRANIAL DYSPLASIA PATIENTS

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AIMS: To assess the reliability of cone beam computed tomography (CBCT) in the orthodontic evaluation of patients with cleidocranial dysplasia in late mixed dentition.
MATERIALS AND METHOD: CBCT was performed with the NewTom 3G scanner (QR s.r.l., Verona, Italy). This system allows exploration of a spherical field of view (FOV) with a diameter of 6, 9 or 12 inches: In this research FOVs of 6 and 12

inches were used together with the custom-made software QR NNT, provided by the manufacturer. This software allows evaluation of all sections of the scanned volume and reconstruction of the hard and soft tissue.
RESULTS: The scan with the FOV of 6 inches was completed within 36 seconds, with an exposure time of 7.2 seconds. The tube voltage was 110 kV and the tube current was 5.8 mA, with an absorbed radiation dose of 6.52 mGy. Seven hundred and thirty one axial sections were obtained, each with a thickness of 0.11 mm. The study reconstruction function was used to prepare a three-dimensional image of the acquired volume, which can be rotated in all directions to better visualize every possible perspective, thus permitting easy identification of supernumeraries and impacted teeth, their roots anomalies and their position in relation to the adjacent erupted teeth and to the surrounding anatomical structures. The scan with the 12 inch FOV was completed within 36 seconds, exposure time 5.4 seconds. The tube voltage was 110 kV and the tube current 1.4 mA, with an absorbed radiation dose of 0.92 mGy. With this scan it was possible to perform classic cephalometric analysis.
CONCLUSIONS: Use of a CBCT scan during orthodontic treatment planning of patient with cleidocranial dysplasia in the mixed dentition is recommended.

120 IMMEDIATE AND SUBSEQUENT CHANGES IN FACIAL GROWTH MORPHOLOGY CAUSED BY JUVENILE IDIOPATHIC ARTHRITIS

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AIM: To analyse the nature of immediate changes in facial morphology and subsequent changes in facial growth pattern caused by juvenile idiopathic arthritis (JIA) of the temporomandibular joint (TMJ).
SUBJECTS AND METHOD: Two girls with JIA. Both were followed longitudinally with cephalometric radiographs for orthodontic reasons from 8 years of age to adulthood. One girl developed bilateral TMJ affection at 10 years of age and the other unilateral TMJ affection at the age of 12 years. Thus, both girls were followed before, during and after TMJ affection. The radiographs were analysed using the TIOPS computer program (Bjørn-Jørgensen, 2005).
RESULTS: In both cases, normal facial morphology and growth were seen before TMJ affection. TMJ arthritis caused destruction of the condyle and the articular eminence, and the TMJ collapsed resulting in a change in the position of the mandible; the condyle moved forward and the mandible revealed backward rotation and retrognathia with downward movement of the symphysis. In the subject with unilateral affection, in addition, the mandible capsized in the frontal plane leading to facial asymmetry. The subsequent facial growth pattern revealed lack of condylar growth in the affected TMJs with further development of retrognathia; secondary changes were: ante-gonial notching, reduced posterior height of the maxilla and, in the patient with unilateral TMJ affection, maxillary asymmetry.
CONCLUSIONS: For the first time it has been possible to analyse the immediate changes in facial morphology and the subsequent changes in the facial growth pattern in JIA during and after affection of the TMJ. TMJ affection leads to collapse of the joint and change in facial morphology within a few weeks. Over time, changes were seen in the facial growth pattern caused by lack of condylar growth with secondary changes in mandibular form and maxillary development.

121 LINEAR ACCURACY OF CONE BEAM COMPUTED TOMOGRAPHIC DERIVED THREE-DIMENSIONAL IMAGES

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AIMS: To establish the accuracy of cone beam computed tomographic (CBCT) images rendered with commercially available orthodontic software. The effects of increased resolution and different scanning times were also investigated.
MATERIALS AND METHOD: Ten dry adult mandibles with no metallic restorations. Twelve glass markers were glued on the mandibles to avoid scattering associated with metallic markers. Two investigators (JD and ZF) measured the linear distance between the markers on the dry mandibles on three different occasions with a digital calliper. The mean values of the six measurements were considered to be anatomically accurate. The mandibles were scanned in a CBCT scanner (KaVo 3D eXam). A latex balloon filled with water was placed in the lingual area of the mandible to represent a degree of soft tissue attenuation. Each mandible was scanned at a resolution of 0.4 and 0.25 voxels on three different occasions. The CBCT images were stored in DICOM format and consequently rendered into surface models using the SimPlant Ortho Pro Beta 2.00 software (Materialise Dental, Leuven, Belgium). A total of 60 scans were made. Each scan was measured three times by the principal investigator (JD). Statistical analyses were performed which included a MANOVA to determine the effects of different scanning times and resolution size on the linear accuracy.
RESULTS AND CONCLUSION: The present study confirmed the linear accuracy of CBCT images rendered with the SimPlant Ortho Pro Beta 2.00 software. Different scanning times did not have a significant effect on accuracy. A resolution

of 0.4 voxels is sufficient for linear measurements. Increased resolution did not significantly improve the accuracy of linear measurements but is associated with increased radiation exposure.

122 LONG-TERM CHANGES OF NASAL PROFILE AFTER A LE FORT I OSTEOTOMY

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AIM: Changes in the nasolabial angle have often been reported as a side-effect of Le Fort I osteotomy. However, it still remains questionable whether or not the nasolabial angle can be considered as a good parameter to describe the complexity of changes in the nasal outline induced by surgery. The purpose of this study was to measure the long-term changes of the nasal profile that occur after superior and/or anterior maxillary repositioning, and to test the coherence between the planned surgery and the performed skeletal repositioning.
MATERIALS AND METHOD: The lateral cephalograms of 100 advancement/impaction adult patients treated with a conventional Le Fort I osteotomy were digitally analysed before surgery and at three different time points after surgery (immediately, and 6 and 12 months after surgery). Soft tissue analysis of the nasal profile was carried out using three angular and two linear measurements. The data were statistically evaluated.
RESULTS: Duplicate measurements showed a reliable measuring method. Except for nasolabial angle, the surgery had an obvious effect on all parameters. However, these profile characteristics seem to evolve towards their original values with time. No significant correlation was found long- term between the amount of impaction or advancement of the upper jaw and the five soft tissue parameters. The main relapse was observed during the first six months, but there were still small changes noticeable 12 months post-surgery. Only changes in the cant of the palatal plane seem to be associated with changes in nasolabial angle. The predictive value of the planned surgery for the effective skeletal outcome was weak.
CONCLUSION: Relapse tendencies for all parameters were clearly established. The nasolabial angle seems to be the poorest parameter for appreciating the extent to which the Le Fort I osteotomy alters nasal morphologic features.

123 ENDOTHELIAL GROWTH FACTOR CONCENTRATION IN GINGIVAL CREVICULAR FLUID UNDER DIFFERENT CONDITIONS

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AIM: To determine endothelial growth factor (EGF) concentrations in primary teeth during various physiological and pathological conditions and to study the response of the periodontal ligament (PDL) during physiological exfoliation, ankylosis and orthodontic treatment with intermittent forces.
SUBJECTS AND METHOD: Three groups each containing 12 subjects: group 1, ankylosis (primary teeth in ankylosis with a diagnosis of type 2 or 3 infraocclusion according to Tollaro diagnosed on dental pantomograms), group 2, physiological exfoliation (non-pathological primary teeth in physiological exfoliation) and group 3, physiological exfoliation and intermittent forces [unaffected primary teeth in physiological exfoliation stimulated by the occlusal bite of a functional bite generator (activated by swallowing)]. The subjects in groups 2 and 3 always had the permanent successor in stage D, E or F according to Nolla. Gingival crevicular fluid was collected through the application of strips (OraflowTM NY) applied for 30 seconds at a depth of 1 mm at the mesial and distal sites. Quantitative analysis was obtained with an electronic analyzer (Periotron 8000, Oraflow Inc., New York, USA). The strips were latter placed in a buffered solution of NaCl, stored at –80C° and analyzed by ELISA to measure EGF concentration. The data obtained were compared with a *t*-test with the level of significance set at $P < 0.01$.
RESULTS AND CONCLUSION: Particularly, the EGF concentration was higher, progressively decreasing from group 3 to 1 to group 2. From these data it can be assumed that the lower fibroblast presence in the PDL of ankylosed primary teeth caused a failure in feedback control in EGF receptor uptake. It can also be assumed that there is increased remodelling of the PDL of the primary teeth under intermittent orthodontic forces.

124 UPPER INCISOR PROTRUSION AND ORTHODONTIC RELAPSE

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AIM: To evaluate the relationship between relapse and incisor protrusion in individuals who had undergone non-extraction fixed orthodontic appliance treatment.
SUBJECTS AND METHOD: Twenty subjects, 14.6 ± 2.3 years of age, with an Angle Class I malocclusion with approximately 4-5 mm maxillary space insufficiency, in whom non-extraction fixed appliance orthodontic treatment with incisor protraction was planned. Hawley appliances were given to each patient in the retention phase. Cephalograms, taken at the initial phase (T1), final phase (T2) and 1 year after treatment (T3) and the irregularity index of each subject were evaluated. The

relationship between the measurements Mx 1-SN (°), Mx 1-Pal (°), Mx 1-NA (mm), Mx 1-NA (°) and irregularity indices (T1-T2 and T2-T3 differences) were evaluated.
RESULTS: Statistical analysis showed a correlation between T1-T2 irregularity index difference and the change in upper incisor inclination; but no such relationship was found between T2-T3.
CONCLUSION: Relapse depends on different factors such as retention procedure and the change in intercanine length and archform. Upper incisor protraction may be an additional factor affecting relapse.

125 NEUROMUSCULAR BALANCE IN PATIENTS TWO-YEARS AFTER FUNCTIONAL ORTHOPAEDIC THERAPY

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AIM: Evaluation of left and right masseter and anterior temporalis muscle activity in patients treated with Sander's functional orthopaedic appliance two-years after functional orthopaedic therapy.
SUBJECTS AND METHOD: Ten patients (5 females, 5 males) with an Angle Class II division 1 malocclusion, aged 9–13 years. All underwent an electromyographic (EMG) examination (Freely) before treatment, at the end of therapy, and 2 years post-therapy. To verify neuromuscular equilibrium, the electromyographic activities of both the right and left masseter and anterior temporal muscles were registered and analysed calculating: POC (index of the symmetric distribution of the muscular activity determined by the occlusion); TORS (index of presence of mandibular torque) and ATTIV (index suggesting the position of occlusal barycentre). Total muscular activity during maximum clenching was also calculated. The data were compared with a Student's *t*-test for paired data, with a significance level set at 5 per cent ($P < 0.05$).
RESULTS: The EMG results underlined the improvements in symmetrical distribution of muscle activity after orthopaedic therapy, which remained stable two years after treatment.
CONCLUSIONS: EMG evaluation allows quantification of occlusal impact on masticatory muscle activity.

126 MASTICATORY MUSCLE ACTIVITY TWO-YEARS AFTER ORTHODONTIC TREATMENT

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AIM: To evaluate neuromuscular balance two years after orthodontic treatment.
SUBJECTS AND METHOD: Sixteen patients (8 males, 8 females) aged 12–23 years. All had a Class I malocclusion with crowding, <6 mm in both arches, and were treated with the edgewise straightwire appliance. The patients under went electromyographic (EMG) examination before treatment, at the end of therapy and two years post-therapy. To verify neuromuscular equilibrium, the electromyographic activities of both the right and left masseter and anterior temporal muscles were registered and analysed calculating: POC (index of the symmetric distribution of the muscular activity determined by the occlusion); TORS (index of presence of mandibular torque) and ATTIV (index suggesting the position of occlusal centre of mass). Total muscular activity during maximum clenching was also determined. The data obtained were compared with a Student's *t*-test for paired data.
RESULTS: There were no statistically significant differences in EMG values at any of the three examinations.
CONCLUSIONS: The findings underline the importance of EMG analysis to control orthodontic results not only from an aesthetic but also from a functional point of view.

127 COMPARISON OF TWO DIFFERENT FORCE SYSTEMS DURING CANINE RETRACTION

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AIM: To compare the effectiveness of two canine retraction systems: the Hycon and lacebacks, in moderate anchorage cases involving upper first premolar extractions.
SUBJECTS AND METHOD: Thirty (21 females, 9 males) Class I patients with a mean age of 15.2 years (range 13–19 years). Maxillary canine retraction was achieved with the Hycon device on one side and a laceback on the other. The distalization force for canine retraction was limited to 8 weeks. Routine orthodontic records were taken before (T1) and after (T2) force application. Distances to the reference plane and inclinations of the upper molars and canines were measured on the lateral cephalometric tracings. The distance between the cusp tips of the upper canine and molar teeth was directly measured at T1 and T2 with a digital calliper. The same measurements were also undertaken on the orthodontic models. A Student's *t*-test was used to investigate any differences between the two canine retraction systems.
RESULTS: Statistically significant differences were found between the groups for the values measured on the models ($P < 0.05$), in the mouth ($P < 0.001$) and on the lateral cephalometric tracings ($P < 0.05$). The Hycon was found to be more effective for canine retraction than the laceback during the force application period.

CONCLUSION: Although intermittent force application with the Hycon resulted in faster canine retraction, lacebacks still proved effective clinically.

128 TOWARDS THE DEVELOPMENT OF A PRACTICE GUIDELINE FOR PREVENTION OF WHITE SPOTS DURING FIXED APPLIANCE TREATMENT

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AIM: Prevention of white spot lesions (WSL) needs permanent attention during treatment with fixed appliances. The aim of this study was twofold: (a) to develop digital orthodontic patient vignettes and (b) to describe a procedure for reaching consensus among a panel of professionals on the prevention of WSL in patients with fixed appliances.
MATERIALS AND METHOD: A patient vignette covers a clinical situation that represents a group of patients in relation to the development of WSL at the start or during treatment with fixed appliances. Patient vignettes were developed based on WSL causing variables derived from the literature. Each vignette was presented in a computer program by four intraoral photographs accompanied by a description of dental health status, oral hygiene and dietary habits. Statements on prevention of WSL development were shown below each patient's vignette. A panel of 11 professionals scored the statements on the patients' vignettes according to the modified Rand Delphi method.
RESULTS: In total 23 vignettes were developed for the questionnaire: six patients before and 17 patients during treatment with fixed appliances. Each professional rated 264 statements (60 pre-treatment and 204 during treatment) on preventive measurements. In total 2904 statements were scored. After the first round, consensus was reached on 1089 statements (37.5%) and on 868 of the remaining 1815 statements (47.8%) after the second round (Rand-Delphi method). Consensus on the remaining statements was reached among the professionals after a final consensus meeting.
CONCLUSION: The use of digital orthodontic patient vignettes in the modified Delphi Rand method was shown to be a suitable method to gain consensus among a panel of professionals. The results of this study can be used for the development of a practice guideline on the prevention of WSL in patients with fixed appliances.

129 A COMPARATIVE ANALYSIS OF DIAGNOSTIC CASTS OF PATIENTS WITH MANDIBULAR PROGNATHISM, TREATED ORTHODONTICALLY

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AIMS: To evaluate the post-treatment influence on diagnostic indices for Class III malocclusion patients with mandibular prognathism, based on their initial and final dental casts.
MATERIALS AND METHOD: Twenty fully documented cases of skeletal Class III patients, both females and males at the age of 14 and 39 years. Twenty pre- and 20 post treatment models were analyzed. The measurements included mandibular intercanine distance, maxillary and mandibular interpremolar distances, lower arch perimeter (the total length of the mandible) and Little's index.
RESULTS: Comparison of initial and final casts revealed a minor decrease in lower intercanine distance. Increases were observed in both maxillary and mandibular interpremolar distances. There was a minor decrease of the lower dental arch perimeter and a statistically significant decrease of Little's irregularity index. Occlusal correction was seen in the upper and lower jaws.
CONCLUSIONS: Despite insignificant differences in diagnostic indices before and after orthodontic treatment, comparative analysis of diagnostic initial and final casts showed the effectiveness of conservative treatment of patients with mandibular prognathism.

130 TRIANGULAR-SHAPED TITANIUM MINIPLATES FOR ORTHODONTIC ANCHORAGE: A COMBINED HISTOLOGICAL AND BONE DENSITY STUDY IN DOGS

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AIM: To assess bone density and to histologically analyse the bone tissue around screws supporting triangular-shaped orthodontic miniplates in two dogs.
MATERIALS AND METHOD: Sixteen triangular-shaped titanium miniplates were placed in two dogs, two anchors fixed in each jaw quadrant with titanium screws. After 12 days, a non-axial force of 2 g was exerted between two miniplates in

three quadrants with elastomeric chains for 12 weeks; the miniplates of the unloaded quadrant were considered as the controls. After sacrifice, the jaw quadrants were embedded in methylmethacrylate, scanned with peripheral quantitative computed tomography in order to assess bone mineral density (BMD) around the screws, and cut into transverse sections through the screws. The sections were microradiographed to evaluate bone implant contact (BIC) and stained to analyze the bone-implant interface. The quantitative data were analyzed with *t*-tests and significance set at $P < 0.05$.
RESULTS: At the end of experiment, 14/16 miniplates were clinically successful and 33/47 screws were osseointegrated, with a mean BIC of 33 per cent. Neither loading nor maxillary-mandibular location had any effect on the success rate. Osseointegration was weak (BIC 0-33%) for 16 screws, medium (BIC 34-66%) for 14 screws, strong (BIC 67-100%) for three screws. Both BIC and BMD were significantly higher around the occlusal than the mesial and distal screws ($P < 0.05$) and lower in the deepest than superficial sections ($P < 0.05$). BMD and BIC were significantly correlated ($r^2 = 0.1405$, $P < 0.05$), as confirmed by microscopic analysis, but BIC appeared more relevant than BMD for osseointegration evaluation.
CONCLUSIONS: The data confirm the essential role of the surgical procedure in miniplate stability. Osseointegration, in particular, mostly relies on the primary stability obtained in the outer part of the cortical bone. Furthermore, a particular osseointegration potential was observed according to the screw topography in the miniplate.

131 ENAMEL BOND STRENGTH OF A SELF-ADHESIVE RESIN CEMENT: LIGHT AND CHEMICAL CURING

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AIM: Wiechmann (2002) developed an innovative lingual customized bracket system (Incognito®) in which the brackets are individually cast in a gold alloy, covered with a layer of composite (Phase II® Reliance) and bonded with a hydrophobic adhesive, Maximum Cure® (MC) Reliance. The purpose of this *in vitro* study was to determine the suitability of using an alternative bonding system by comparing the adherence of the one-step self-adhesive resin cement MaxCem® (Kerr) according to three modalities and the referent adhesive used in the Incognito® system.
MATERIALS AND METHOD: Forty cylinders of composite (Phase II®) were prepared with cylindrical moulds. They were bonded to the enamel of 40 embedded teeth in self-cured acrylic resin: 10 were bonded with MC, 10 with MaxCem® (MCem), 10 with MaxCem® after phosphoric etching and with a light curing mode (HMCem*) and 10 with MaxCem® after etching with a chemical curing mode (HMCem). The shear bond strength of each sample was determined in a universal testing machine and the sites of bond failure were defined by the Adhesive Remnant Index (ARI). To determine significant differences between the different groups, a Mann-Whitney U test was performed for shear bond strength and a chi-square test was used for the ARI scores ($P < 0.05$).
RESULTS: No significant difference in adherence values was observed between MC (37 MPa) and HMCem (38 MPa). Significant differences were observed between MCem (15 MPa) and HMCem* (28 MPa). For the group bonded with MCem, a higher frequency of failure at the enamel-adhesive interface was observed. No significant differences in debond locations were found among the groups bonded with MC, HMCem* and HMCem.
CONCLUSIONS: HMCem (with etching and with a chemical curing mode) seems to be a viable alternative to the referent adhesive for bonding Incognito® brackets. Clinical studies are necessary to confirm these results.

132 AGE CHANGES IN THE SKULL PARAMETERS OF CLASS II DIVISION 2 CHILDREN

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AIM: To study age-related changes in the cerebral and facial parts of the skull of Angle Class II division 2 children in order to detect morphological skull structures differing from normal growth during the primary dentition period.
MATERIALS AND METHOD: Sixty-two teleroentgenograms of the head in lateral projection were obtained. Thirteen longitudinal and 14 vertical parameters of the facial and cerebral parts of the skull were measured for 30 children (7–12 years of age) during the primary dentition and for 32 older children (12–15 years of age).
RESULTS: The intensity of age-related changes of many longitudinal and vertical parameters of the skull differed significantly from normal.
CONCLUSIONS: Children with a Class II division 2 malocclusion should be treated as early as possible.

133 EVALUATION OF ORTHODONTIC TREATMENT NEED IN BOSNIAN SCHOOLCHILDREN

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AIM: To assess orthodontic treatment need among Bosnian school children.

SUBJECTS AND METHOD: Two hundred and ninety five subjects (143 girls, 152 boys), aged 12–15 years, from four primary schools in Sarajevo with no history of orthodontic treatment. All subjects were clinically examined by one examiner. Normative orthodontic treatment need was assessed using the Dental Health Component (DHC) of the Index of Orthodontic Treatment Need (IOTN). The Aesthetic Component (AC) was also evaluated.
RESULTS: Fifty-three per cent of the sample had an objective orthodontic treatment need (DHC grade 4 and 5), 13 per cent were considered borderline (DHC grade 3) and 33 per cent were diagnosed as no/little orthodontic treatment need (DHC grades 1 and 2). There was a statistically significant difference in orthodontic treatment need based on the DHC between male and female subjects. Using the AC, 4 per cent of subjects showed a treatment need, 2 per cent a moderate need and 94 per cent of subjects no need for orthodontic treatment. There was no statistically significant difference in orthodontic treatment need based on the AC between male and female subjects.
CONCLUSIONS: The percentage of subjects with an objective orthodontic treatment need is very high in comparison with similar surveys in the other European countries. The assessment of orthodontic treatment need only by the AC of the IOTN is not sufficient.

134 THREE-DIMENSIONAL ANALYSIS OF FACIAL MORPHOLOGY IN YOUNG ADULT CAUCASIANS

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AIM: To analyse facial morphology in young adult Caucasians in three-dimensions with emphasis on asymmetry and sexual dimorphism.
SUBJECTS AND METHOD: Twenty 'normal' males and 20 'normal' females, ranging from 20 to 36 years of age (mean: 24 years). All subjects had a full dentition and had not received orthodontic treatment. Eighty per cent of the males and 65 per cent of the females had a Class I molar occlusion. The remainder had a Class II malocclusion. The overjet varied between 1.5 and 8.0 mm (mean: 3.4 mm) in the males and 1.0 to 8.0 mm (mean 3.3 mm) in the females. For all subjects, three-dimensional facial imaging was performed using the 3dMD® facial scanner and 18 standard anthropometric landmarks were marked on the facial surfaces using the program 'Landmarker' (Darvann, 2008). Measurement error was calculated for each landmark.
RESULTS: The measurement errors were found to be within acceptable limits. For each subject, facial asymmetry was calculated at every spatial location in the face and as the mean and maximum asymmetry in six facial regions (eyes, nose, mouth, chin, upper cheek and lower cheek). Maximum asymmetry amounted, on average, to 3-4 mm. For all regions, males showed somewhat higher average maximum asymmetry than females. However, the difference was only significant for the nasal region. In general, the facial morphology in males was characterized by a more prominent nose and chin compared with females. The width of the nose was fairly similar in males and females, whereas the width and height of the chin region were increased in the males.
CONCLUSIONS: Facial asymmetry was present for both normal males and females. The asymmetry was found in all facial regions and the average maximum asymmetry was surprisingly high (3–4 mm). In general, the largest differences in facial morphology between males and females were observed in the regions of the nose and chin.

135 HERBST TREATMENT WITH REDUCED MANDIBULAR CAST SPLINTS – 'REVISITED'

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AIM: To analyse whether the amount of anchorage loss during Herbst appliance treatment using reduced mandibular cast splints (RMS = lower second premolar to second premolar) is comparable with total mandibular cast splints (TMS = lower molar to molar).
MATERIALS AND METHOD: Both before (T1) and after (T2) Herbst treatment, a standard cephalometric analysis as well as dental cast analysis were performed in 100 Class II RMS-Herbst patients (57 females, 43 males) with an average age of 14.6 years. Thirty-four Class II TMS-Herbst treated patients (15 males, 19 females) served as controls for the cephalometric data (Weschler and Pancherz, 2004).
RESULTS: The lower incisors proclined significantly ($P < 0.001$) more in the RMS (12.9°) than in the TMS group (9.3°). As result of this anchorage loss, an average space of 0.4 mm (maximum = 1.75 mm) opened between the lower second premolar and the first molar in 62 RMS patients. The amount of lower incisor proclination changes increased gradually from the pre-peak (11.9°) to the young adult RMS group (14.3°). Increased professional experience resulted in a relatively smaller incisor proclination (–1.7°, ns) associated with RMS treatment.
CONCLUSIONS: In contrast to the recommendations of von Bremen *et al,* (2007) and despite the fact that RMS-Herbst appliances are more economical, they cannot be recommended for further clinical use.

136 PREVALENCE OF DENTAL ANOMALIES IN THE PREMOLAR AREA

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AIMS: To investigate the prevalence of dental anomalies in the premolar area (congenitally missing premolars, impaction, transposition, ectopic premolars, labially or palatally without loss of space, supernumerary premolars) and their correlation with other dental and skeletal anomalies.
MATERIALS AND METHOD: Panoramic radiographs, lateral cephalograms and corresponding dental casts of 968 non-syndromic patients, aged 8 years 2 months to 24 years. Subjects with mesial migration of the posterior teeth following premature extraction of the primary teeth were excluded from the study.
RESULTS: Dental anomalies in the premolar area had a prevalence rate of 9.62 per cent, with the following gender distribution: 34 males (37.77%) and 56 females (62.22%). The prevalence of each dental premolar anomaly was: congenitally missing premolars 3.82 per cent, impaction 2.37 per cent, ectopic eruption 1.85 per cent, transposition 0.7 per cent, and supernumerary premolars 0.31 per cent. The second premolar was the tooth most affected by the congenitally missing premolar, impaction, ectopic eruption (palatal) and in the transposition (canine-premolar transposition) is involved the first upper premolar. Supernumerary premolars were found only in the lower premolar area. A congenitally missing premolar was associated with canine impaction, palatally displaced canine, other congenitally missing teeth, supernumerary teeth, retention of the primary teeth. The most frequent skeletal anomaly was Class II, mainly Class II division 2 for congenitally missing premolar and impacted premolar.
CONCLUSIONS: Dental premolar anomalies affect mainly female subjects, congenitally missing premolars (especially second lower left premolar) being the most frequent dental anomaly of the premolar area, associated with other dental anomalies and Class II division 2 malocclusion.

137 IS ORTHODONTIC TREATMENT ALONE SUFFICIENT FOR A BALANCED SMILE?

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AIM: To study smile aesthetics in orthodontically treated patients, as a criteria of excellence in orthodontics.
SUBJECTS AND METHOD: Forty patients (22 females, 18 males) who were orthodontically treated either with or without extractions. Photographs obtained during a posed smile were examined by three groups of examiners (orthodontists, dentists and lay people) using a score from 1 to 5. The correlation between the mean score, cephalometric values and vertical and transverse characteristics of the smile were determined.
RESULTS: The mean scores were: 3.7 ± 0.86 for orthodontists, 3.2 ± 0.72 for dentists and 3.85 ± 0.64 for lay people. There was a correlation ($P = 0.01$) between the score of the orthodontists and dentists. There was no statistical correlation between extraction/non-extraction treatment and score. The morphological aspects of the teeth (which can be modified by treatment, i.e. veneers, bleaching, periodontal crown lengthening) had a great influence in the scores of the dentists.
CONCLUSIONS: A balanced smile can be obtained with multidisciplinary treatment.

138 WHITE SPOT LESIONS DURING MULTIBRACKET APPLIANCE TREATMENT – A CHALLENGE FOR CLINICAL EXCELLENCE

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AIM: To investigate the incidence and course of white spot lesions (WSL) during multibracket appliance (MB) treatment.
SUBJECTS AND METHOD: All former MB patients finishing orthodontic treatment between 1996 and 2006 were screened. The first 400 patients (168 male, 232 female) meeting the inclusion criteria, all upper front (UFT) fully erupted and visible on before treatment photographs, no fillings or structural abnormalities, duration MB treatment >1 year, retention period >1 year, were selected. The average age of the patients was 13.7 years (SD 3.5) and the average MB treatment time 1.9 years (SD 3.6). A modification of the White Spot Index (Gorelick *et al*, 1982) was used to evaluate the labial surface of the four anterior teeth in the upper incisor area on intraoral photographs before (T0), after treatment (T1) and at the end of retention (T2).
RESULTS: At T0 32.3 per cent of the patients exhibited WSL on 19.7 per cent of the UFT. After MB treatment 73.5 per cent of the patients and 57.4 per cent of the UFT presented WSL. Thus, the incidence rate for WSL (T1-T0) was 41.2 per cent of the patients and 37.7 per cent of the UFT. The majority of the UFT (41.2%) had mild lesions while the remaining UFT were severely affected with (3.8%) or without (12.4%) cavitations at T1. Only 26.5 per cent of the patients were free of WSL at both T0 and at T1. At T3, 57.9 per cent of the UFT presented WSL, however the majority of the lesions (68.4%) were improved, 20.7 per cent were unchanged and 10.9 per cent had worsened. No gender differences were found. There was a tendency for increased WSL development during adolescence compared with the pre- and post-adolescent age groups.

CONCLUSIONS: Despite improved prophylactic measures, WSL developing on the upper anterior teeth during MB treatment is a frequent undesired site-effect affecting about 40 per cent of the patients and counteracting efforts for clinical excellence.

139 MONITORING INTRAORAL PRESSURE UNDER DIFFERENT BIOFUNCTIONAL CONDITIONS AT REST

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AIMS: Pressures of orofacial soft tissues, i.e. the lips, cheek and tongue, are reported to play a major role in normal and deviant development of the dentition. In open bite situations, vertical anomalies, and Angle Class II division 1 malocclusions, neuromuscular activity of soft tissues represents an important pathogenic factor. In contrast, physical phenomena and functional anatomical factors are rarely discussed. Thus a biofunctional multiple compartment model was developed to define different conditions of the oral cavity at rest.
SUBJECTS AND METHOD: Intraoral pressure monitoring was performed simultaneously at the palatal vault and vestibular compartments of 20 healthy subjects with a two channel handheld high precision manometer. Pressure curve characteristics were recorded for 30 seconds each under the following biofunctional rest conditions: 1) lips opened; 2) lips closed, pre-swallowing; 3) lips closed, post-swallowing.
RESULTS: There was a significant interaction between functional condition and the measured compartment for average plateau height ($P < 0.01$) and for average plateau duration ($P = 0.02$). Wilcoxon tests for individual compartment comparison (palatal; vestibular) revealed significant differences with the lips closed during post-swallowing for all pressure curve characteristics except average plateau height.
CONCLUSIONS: Depending on the biofunctional conditions, negative pressure formation as a result of swallowing can be regularly observed. At least two different intraoral functional dynamic compartments are formed, which are likely to have a major impact on the developing dentition as well as on the maintenance of the soft tissue equilibrium.

140 LONG-TERM EFFECTS OF RAPID MAXILLARY EXPANSION FOLLOWED BY FIXED APPLIANCES

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AIMS: To evaluate long-term changes in maxillary dental arch measurements, overjet and overbite in patients treated with rapid maxillary expansion (RME) followed by edgewise appliances.
MATERIALS AND METHOD: Study casts of 41 patients (19 males, 22 females) obtained on three different occasions: before treatment (T1), after RME (T2), after treatment (T3) and during follow-up (T4). A total of 164 articulated sets of study casts were obtained. All patients in the study sample were treated with a rigid acrylic bonded RME appliance at the start of orthodontic treatment, then with edgewise appliances. Upper intercanine, interpremolar, and intermolar widths and overjet and overbite were measured on each set of study casts. The mean age of the subjects at T1 was 13.2 ± 1.3 years (range 11.2-16.9 years), 15.5 ± 1.4 years (range 13.1-18.8 years) at T3 and 20.4 ± 1.6 years (range 17.9-24.8 years) at T4.
RESULTS: The net increase in intercanine, interpremolar and intermolar width, overjet and overbite was 1.4 ± 2.4, 4 5 ± 2.6, 4.2 ± 2.5, 0.1 ± 0.6 and 0.2 ± 0.6 mm, respectively, and the relapse rates were 77.8 per cent for intercanine width, 40.2 per cent for interpremolar width and 44.7 per cent for intermolar width at T4.
CONCLUSIONS: RME is an effective method to increase maxillary arch width. However, it must be borne in mind that a significant amount of relapse occurs in the long term, the greatest being in intercanine width. The alterations observed in overjet and overbite in the long term can be considered insignificant.

141 ASSESSMENT OF ORTHODONTIC PATIENTS' EXPECTATIONS

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AIMS: Conventional orthodontic treatment may affect facial appearance and may also have psychological effects. However, patients' attitudes, expectations and self-concept influence the result of treatment. The aim of this study was to evaluate the expectations and self-concepts of individuals referred to Shahid Beheshti Dental School and a private orthodontic office.
SUBJECTS AND METHOD: Two hundred and fifty two individuals (92 males, 160 females). To evaluate patients' expectations and self-concept, a questionnaire consisting of 13 closed and two open questions was prepared which was completed by the patients. The patients compared their dental similarity to 12 dental photographs and gave scores for their dental appearance on a visual analogue scale (scores 0 to 10). To determine whether the problems reported by the patients

were realistic, an orthodontist visited all patients and recorded the findings on a structured questionnaire. In addition, some variables that might influence the patients' evaluation of their own dental aesthetics were analyzed. Chi-square, *t*-test, ANOVA, Kappa statistic and a multivariate linear regression model were used to analyze the data.
RESULTS: The most common orthodontic disharmony reported was irregularity of the upper and lower anterior teeth (51.6%). Social problems were not common, but more than half the females had sometimes experienced shyness when laughing, due to their appearance. The patient's mean score of his/her own dental aesthetics was 6.4 ± 1.9. This score was related more to occlusal problems than to any of the other variables.
CONCLUSION: There was a difference between what the patient reports and what the orthodontist finds during clinical observations. Occlusal appearance, functional aspects and social demands affect an individual's concept of dental aesthetics. However, none had low self-esteem. Age had no effect on the self-concept of individuals regarding their dental aesthetics.

142 WOULD THE INDEX OF ORTHODONTIC TREATMENT NEED HAVE PERMITTED TREATMENT IN A COHORT OF PATIENTS UNDER ORTHODONTIC CARE?

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AIMS: Achieving a uniform evaluation of treatment need is important for planning health care services and the role of dental insurance. This study assessed the orthodontic treatment needs in Tehran Dental Schools and two private offices in 2004-2005 according to the Index of Orthodontic Treatment Need (IOTN).
MATERIALS AND METHOD: This cross-sectional descriptive study evaluated the study models and charts of 209 under treatment patients, 12-16 years of age, according to the IOTN grade and classification of malocclusions by age and gender. The variables studied were overjet, open bite, deep bite, crossbite, contact point displacement, presence of supernumeraries, missing, impacted and ankylosed teeth, cleft lip and palate, and facial asymmetry and deformity. The data obtained was compared with the findings of the IOTN of 22 educational areas of Tehran. Chi square and Fisher's exact tests and quality of ratios were used to evaluate data differences.
RESULTS: A very severe need for treatment (grade 5) was observed in 22.5 per cent of the patients, 33 per cent had a severe need (grade 4), 36.4 per cent a moderate need (grade 3) and 8.2 per cent a mild need (grade 2). Orthodontic treatment was undertaken more often in females than in males (66.5 versus 33.5%). The treated patients were mostly aged 12 years. The variables showing an orthodontic treatment needs were: contact displacement: 57.4 per cent, overjet: 22.5 per cent and deep bite: 17.7 per cent. The percentage of IOTN grades were similar in the 22 Tehran educational areas.
CONCLUSIONS: Most of the treated patients showed an actual need for orthodontic treatment. Although the decision for their treatment was not planned using IOTN, the results of the two assessments were the same, indicating a balance between IOTN assessment and the actual orthodontic need of the treated individuals.

143 BRACKET BOND STRENGTH ON DIFFERENT CONDITIONED CERAMIC SURFACES

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AIMS: To investigate the bond strength of orthodontic brackets on different composed and different conditioned ceramic surfaces. The hypotheses tested were: (1) there is no significant difference in bond strength between ceramic surfaces from different manufacturers and (2) different conditioning methods lead to comparable bond strengths.
MATERIALS AND METHOD: Eight ceramic products from different manufacturers were included, four metal and four all-ceramic. The specimens were fabricated in a dental laboratory. Six different conditioning options were used: two hydrofluoric (HF) acid products with different concentrations (4/9.6%), etching for 60/30 seconds. and two sandblasting products (Al_2O_3/SiO_2) were included. Nine hundred and sixty orthodontic brackets were bonded to the ceramic specimen surfaces (n = 20). Shear testing was carried out on a Zwingli testing machine. Bond strength in MPa was measured at fracture. Standard *t*- and chi-square tests were used for statistical calculations. Scanning electromyographic analysis was used for bond-surface interpretation.
RESULTS: Hypothesis 1: There was no significant difference between the bond strength of the tested ceramic surfaces. Hypothesis 2: There was no significant difference between the different conditioning procedures, except for the 9.6 per cent acid group. All procedures, except the 9.6 per cent acid group, produced bond strengths beyond 30 MPa.
CONCLUSIONS: Different ceramic surfaces can be conditioned with HF acid etching (4%) with a short time procedure (30 seconds) or sandblasting, resulting in comparable bond strengths. Due to restrictions on dental materials for oral use, only the sandblasting method could be used in the mouth for conditioning ceramic surfaces leading to high bond strengths for orthodontic bracket bonding.

144 THE EFFECT OF BRACKET BASE CONDITIONING

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AIMS: To compare the effect of a silicoating system, the influence of sandblasting, and the effect of a silane coupling agent after sandblasting on the shear bond strength (SBS) of stainless steel foil-mesh brackets. To simulate the oral environment all specimen were thermocycled (6000 × 5°C/55°C) in a mastication device before testing.
MATERIALS AND METHOD: Four different bracket groups were tested: group 1 consisted of 20 metal brackets which had the bases sandblasted; group 2, 20 brackets which were sandblasted and had a silane coupling agent applied and group 3, in which the surface of the bases of 20 metal brackets were treated using a tribochemical system. Group 4 served as the control. The brackets of group 1 were reconditioned after debonding by sandblasting and re-tested again (group 5). The brackets were bonded with a light-curing adhesive to extracted human third molars and the SBS and Adhesive Remnant Index were determined.
RESULTS: Sandblasting as well as tribochemical treatment of brackets improved the SBS of stainless steel brackets. The method of combined sandblasting and silane coupling did not result in increased *in vitro* strength.
CONCLUSIONS: The use of resins with tribochemically silicoated stainless steel brackets appeared to enhance the bond between adhesive and metal bracket. This treatment is indicated for low-compliance patients or for teeth that are difficult to bond.

145 ALTERATIONS OF THE HEADS OF THE MANDIBLE IN ADULT RODENTS AFTER A DECREASE OF THE OCCLUSAL VERTICAL DIMENSION

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AIM: To verify the morphologic and/or morphometric alterations of the heads of the mandible after a pathological decrease of the occlusal vertical dimension in adult rodents.
MATERIALS AND METHOD: Twenty-four adult mice (*rattus albinus wistar*), medium age 90 days, divided into three experimental groups. From each group of eight animals, three were separated and served as the controls. Occlusal and incisal reduction was undertaken that resulted in a significant decrease of the vertical dimension of the occlusion. The animals were sacrificed and their mandibular heads analysed and measured morphometrically and histologically under light microscopy at the following intervals: 7 days in group 1, 14 days in group 2 and 28 days in group 3. In order to quantify the degree of modification of the surface and verify the area of predominance of the alterations, their heights were measured.
RESULTS: Stereoscopically there were significant form and size alterations in comparison with the controls. The central area was the most affected. The 14 days group showed remodelling areas recovering their initial areas, while in the 28 day group the values were equal.
CONCLUSION: A pathological decrease of the vertical occlusal dimension in adult mice provoked morphologic and morphometric alterations on the heads of the mandibles followed, after an initial period of time, by a remodelling process.

146 EFFECTS OF CLENCHING AND MANDIBULAR POSTURING ON TEMPOROMANDIBULAR JOINT INTRA-ARTICULAR DISTANCES

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AIM: Mechanical loading of the temporomandibular joint (TMJ) can influence craniofacial growth. The aim of this study was to determine the effects of clenching on TMJ condyle-fossa distances by means of dynamic stereometry, as an indirect measurement of condylar loading.
SUBJECTS AND METHOD: Ten healthy subjects (5 males, 5 females; mean age 23.0 ± 1.2 years). TMJ magnetic resonance images were software-reconstructed and combined with the mandibular motion recorded by means of an optoelectronic jaw-tracker in order to determine the three-dimensional position of the entire condyle within the fossa. Intra-articular space width was assessed by calculating the minimum condyle-fossa distance [G_{min}; (Ettlin *et al*., 2008)] and as the vertical distance between the lateral TMJ pole and the glenoid fossa (V_{min}). Masseter activity was recorded by electromyography (EMG). Each subject had to perform the following oral tasks: tooth clenching in maximum intercuspation a) at maximum voluntary clenching (MVC); b) at 40 per cent MVC; c) at 10 per cent MVC; d) with minimum contraction effort; keeping the mandible in the e) habitual postural position and f) in the fully relaxed rest position (after EMG biofeedback). Data were analysed by repeated-measurements analysis of variance (ANOVA).
RESULTS: G_{min} and V_{min} differed significantly across the various conditions ($7.4 < F < 13.5$; $0.005 < P < 0.034$). *Post hoc* analysis revealed that the minimum condyle-fossa distances during the clenching tasks were smaller than with the mandible in the postured and fully relaxed positions ($P < 0.05$). The mean differences (± SD) of the minimum condyle-fossa distances

between low-level clenching and the postured as well as the fully relaxed position ranged from 0.5 mm (±0.25 mm) to 1.0 mm (±0.8 mm), respectively.
CONCLUSIONS: Low-level clenching is accompanied by a reduction of the minimum joint space and increased articular loading.

147 ULTRASONIC VERSUS CONVENTIONAL BRACKET REMOVAL AND ENAMEL CLEAN-UP: A PRELIMINARY STUDY
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AIM: To analyse the effectiveness of modern ultrasonic devices versus conventional methods in bracket removal and residual composite clean up.
MATERIALS AND METHOD: Forty-eight extracted teeth were randomly divided into three equal groups: group A: ultrasonic removal and ultrasonic clean-up (Satelec P Max with SP Newtron); group B: bracket removal with orthodontic pliers and ultrasonic clean-up; group C: bracket removal with orthodontic pliers and clean-up with finishing burs and disks. The teeth were polished with water and pumice, the brackets were bonded and the teeth were stored for 48 hours in 100 per cent humidity to ensure complete polymerization. All teeth were examined with an optical microscope and photographed, with and without fibre-optic transillumination, before bonding, after debonding and after clean-up. The tested variables were: time needed for debonding and for clean-up, Adhesive Remnant Index (ARI; Årtun and Bergland) and enamel damage after debracketing and after clean-up.
RESULTS: Debonding time was longer for group A, cleaning time was equal for all groups. ARI score A) 0-43,75% 1-31,25% 2-6,25% 3-18,75% B) 0-50% 1-50% 2-0% 3-0% C) 0-50% 1-31,25% 2-12,5% 3-6,25%. Microscopic analysis failed to detect signs of surface enamel loss or enamel fractures perpendicular to the tooth surface after bracket removal. When the ARI score was 0-1, clean-up with conventional polishing disks and ultrasonic tips were similar. When the ARI score was 2-3, traditional burs and disks were less time consuming and produced less enamel scratches than ultrasonic inserts while removing the considerable amount of composite left on the tooth.
CONCLUSIONS: Modern more powerful ultrasonic devices allow bracket removal, but they still have some drawbacks. Ultrasonic points can be indicated in cases where burs and disks are difficult to use, i.e. in the lingual technique.

148 NOTCH SIGNALLING IS REQUIRED FOR EPITHELIAL STEM CELL SURVIVAL AND PROLIFERATION.
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AIM: Together with other fundamental and conserved signalling pathways, the Notch pathway regulates stem cell fate decisions and is also involved in diverse processes including proliferation, polarity establishment, and a variety of events during tissue morphogenesis. Although members of the Notch pathway have been reported to be expressed in dental tissues, little functional information is available. The aim of this study was to determine the role of the Notch pathway in the regulation of stem cells in the continuously growing rodent incisor.
MATERIALS AND METHOD: A mouse incisor organ culture system was used to analyse the effect of the Notch pathway inhibition on the maintenance, proliferation and differentiation of the stem cells. Inhibitors of the presenilin/secretase complex, which are known to disrupt the Notch pathway, were added to the culture medium. The cultured explants, analysed by techniques including *in situ* hybridization for gene expression analysis, Tunel staining for apoptosis and BrdU incorporation for cell proliferation, were combined these with digital image analyses.
RESULTS: Inhibition of the secretase complex resulted in a reduction in expression of the Notch target gene, Hes1, in the stem cell niche, indicating that Notch signalling was inhibited. In the presence of the inhibitors a significant increase of apoptotic cell number was observed in the stellate reticular compartment, where only a small subpopulation of cells were proliferating after DAPT treatment, but this effect was reversible. In addition, analysis of Shh, and amelogenin expression suggested that the inhibition of Notch activity accelerated ameloblast differentiation.
CONCLUSIONS: The results underline the importance of Notch signalling as a positive regulator of epithelial stem cell survival in the labial cervical loop of the continuously growing mouse incisor, and suggest a regulatory role for the Notch pathway also in ameloblast differentiation.

149 MANDIBULAR GROWTH: CAN IT BE STIMULATED THROUGH FUNCTIONAL THERAPY?
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AIM: To evaluate the effect of functional therapy on mandibular growth in individuals with a Class II division 1 malocclusion.

SUBJECTS AND METHOD: Thirty patients with an initial mean age of 10.5 years, divided into two equal groups: a control group of 15 untreated children who were followed without treatment for 12 months, and a treatment group (activator, bionator and Fränkel I were used as functional appliances) treated for a mean period of 18 months. Lateral cephalograms were obtained for each patient at the beginning and end of the observation period and comparisons of the angular and linear skeletal measurements were made.
RESULTS: The size of the mandible was positively influenced in the functional group. The effective mandibular length (Co-Gn) increased 2.2 mm in the control group and 3.4 mm in the functional group. Ramus length (Ar-Go) increased more in the functional group (3.1 mm) than in the control group (1.7 mm), as a result of which posterior face height also increased. Maxillary position (SNA angle) was not significantly influenced by functional therapy. SNB increased in the functional group by 2.1 degrees compared with the control group (0.3º) and there was a reduction in the Class II sagittal discrepancy (ANB, Wits AoBo), while in the control group this remained unchanged. The facial convexity angle (NAPog) showed a greater reduction in the functional group (2.4º) compared with the control group where it remained the same or increased as a result of posterior mandibular rotation.
CONCLUSIONS: 1. Functional therapy resulted in a greater increase in mandibular length (ramus and body) compared with the control group. 2. Functional therapy changed the position of the mandible in an anterior direction. 3. There was a significant improvement in the facial profile in the treated group compared with the controls, where the profile remained unchanged or worsened.

150 USE OF A THREE-DIMENSIONAL OCCLUSOGRAM AND DIGITAL MODELS IN TREATMENT PLANNING AND MECHANICS DESIGN***

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AIMS: To evaluate and test a new software (T3do) capable of facilitating the generation of a three-dimensional (3D) VTO by taking advantage of 3D information implicit in the virtual models.
MATERIALS AND METHOD: The combination of hand tracing of profile radiographs and photographs of study casts was introduced by Björk (1968) in order to illustrate growth changes three-dimensionally. Marcotte (1976) used the same method when defining a treatment goal. Burstone (1979) proposed the use the computer to combine the headfilm and occlusogram in order to allow for the visualization of tooth movements necessary to reach a treatment goal. Software capable of producing accurate occlusograms with a considerable reduction of the execution times using scanned images of dental casts was introduced in 1999. The present version, introduces the O3D® virtual models.
RESULTS: When combining a headfilm with virtual models instead of a two-dimensional image of the occlusion, a true 3D visualization of all teeth is possible. The orthodontist must give information regarding the symmetry line of the arches, sagittal and vertical displacement of the anterior teeth, the dental arch shape and width, extraction/non-extraction approach, the interproximal reduction or increase of tooth size, which are all parameters that can influence the final treatment goal. Once determined, the 3D image of the treatment goal can be used as a basis for the definition of the force systems necessary to obtain the desired displacements. The average time of execution of a T3do project for a well-trained orthodontist is less than 15 minutes. The completed T3do results can be easily modified by changing any of the input parameters, thus allowing the analysis of multiple treatment scenarios.
CONCLUSIONS: As the T3do allows visualization of tooth displacements it can also be used as a basis for a custom-made appliance delivering a correct force system in all three dimensions.

151 PREVALENCE OF CONGENITALLY MISSING PERMANENT TEETH

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AIMS: To determine the prevalence of congenitally missing permanent teeth in the current Swiss population with great diversity in ethnicity.
SUBJECTS AND METHOD: Before the study, a power analysis was performed to identify the number of individuals required to reveal a significant difference in prevalence compared with the presently known 7.7 per cent, with a confidence level of 95 per cent. Analysis revealed that 2731 individuals were needed. The material consisted of 2770 dental pantomograms (DPTs) obtained in connection with the annual dental examination of 3rd grade schoolchildren (mean age 9.46 years, 1289 girls, 1481 boys) in the city of Winterthur, Switzerland during 1990-2005. The DPTs were studied by two researchers and the number of congenitally missing permanent teeth (excluding third molars) recorded.
RESULTS: One hundred and sixty individuals had hypodontia, a prevalence of 5.9 per cent. This prevalence was statistically significantly less than that found in the 1970 Swiss study. Eighty-two individuals had more than one missing tooth, therefore the overall number of missing teeth was 350. The prevalence was 7.0 and 4.9 per cent for girls and boys, respectively. Lower

second premolars were the most frequently missing teeth (140 out of 350, i.e. 40.0%) followed by the upper lateral incisors (60/350, 17.1%) and upper second premolars (51/350, 14.6%). Other teeth were missing considerably less frequently.
CONCLUSIONS: The findings suggest a decrease in the prevalence of congenitally missing permanent teeth over the last 30 years. At the same time a considerable mix in population ethnicity in the studied town has occurred, which may explain the significant finding. Despite an overall reduction, girls are still more often affected than boys, and lower second premolars, upper lateral incisors and upper second premolars are the most commonly missing permanent teeth.

152 VALIDATION OF FACIAL SOFT TISSUE MEASUREMENTS USING CONE BEAM COMPUTED TOMOGRAPHY

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AIM: The underlying principle of facial reconstruction is establishing adequate thickness of the soft tissues at specific landmarks on the face and scalp. In the past, several methods have evolved to measure facial soft tissue thickness (FSTT) in cadavers and live subjects. Conventional spiral computed tomography (CT) is mostly used to determine FSTT but is associated with high radiation doses *(*Kim *et al*., 2005). Cone beam (CB) CT is a relatively new system that focuses on the head and neck regions and has much lower doses. The aim of this study was to validate the use of CBCT scans to measure FSTT. If proven accurate, the scan will be useful in detecting different soft tissue thicknesses in different malocclusions.
MATERIALS AND METHOD: Ten soft tissue landmarks were identified on each of 10 cadaver heads and a punch hole was made on each landmark using a dermal biopsy punch. The 10 cadaver heads were scanned in the CBCT at 0.25 and 0.4 mm resolution. The FSTT at the 10 different sites (soft tissue landmarks) were measured using SimPlant-Ortho volumetric software (Materialize). These measurements were compared with the physical measurements at the same sites. All measurements were carried out by two observers and repeated four times on each measurement site. ANOVA was used for statistical analysis.
RESULTS: Intra- and interclass correlations of soft tissue and physical measurements were high (>0.99). There was no significant difference between the measurements made on the CBCT images and the physical measurements. Increasing the slice thickness from 0.25 to 0.4 mm resulted in decreasing image quality.
CONCLUSIONS: CBCT images of the face using routine scanning protocols are reliable for measuring FSTT and give a good representation of the facial soft tissues. For more accurate data collection, the 0.25 mm slice thickness should be used.

153 FORCES PRODUCED BY DIFFERENT NON-CONVENTIONAL BRACKETS OR LIGATURE SYSTEMS DURING ORTHODONTIC ALIGNMENT

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AIM: To analyze the forces of four types of passive stainless steel self-ligating brackets (SLBs; Carriere, Damon3, SmartClip, Opal), and of two non-conventional elastomeric ligature-bracket (Slide, Synergy) low-friction systems when compared with conventional elastomeric ligatures on stainless steel brackets during the alignment of apically or buccally displaced teeth.
MATERIALS AND METHOD: A model consisting of five brackets (from second premolar through to the central incisor) was used to assess the forces released by the seven different bracket-ligature systems with 0.012 inch superelastic nickel-titanium wire in the presence of different amounts of apical or buccal canine displacement (1.5, 3.0, 4.5 and 6.0 mm). The comparisons between the different types of bracket/wire/ligature systems were performed with three-way ANOVA and Tukey's *post-hoc* tests ($P < .05$).
RESULTS: For apical or buccal canine misalignments of 1.5 and 3.0 mm both low-friction and conventional systems released an adequate amount of force for bracket alignment. In the presence of larger amounts of apical or buccal canine displacement (4.5 or 6.0 mm) the low-friction systems produced a significant amount of force, while this amount dropped to zero for the conventional system.
CONCLUSIONS: Conventional ligature-bracket systems produced levels of force similar to those generated by low-friction systems in the presence of 1.5 or 3.0 mm of apical or buccal tooth displacements. No significant differences were found between SLBs and non-conventional elastomeric ligature-bracket low-friction systems.

154 TREATMENT OF CLASS II MALOCCLUSIONS IN ADULTS

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AIMS: To compare the skeletal and dentoalveolar effects, as well as consequences, for the profile of three different treatments for distoclusion.
SUBJECTS AND METHOD: Sixty young adults presenting with a Class II malocclusion: 20 in whom premolar extractions were followed by camouflage orthodontics to reduce the overjet; 20 in whom a fixed, functional orthopaedic appliance was

placed for bite jumping; and 20 who underwent surgery (mandibular bilateral sagittal split osteotomy). Treatment progress was documented cephalometrically.
RESULTS: A reduction in overjet was achieved in all patients. The effects on the mandible differed however between anterior repositioning of the bony chin, and an increase in mandibular length in the sagittal-diagonal plane was observed in the surgical and functional orthopaedic groups, but this was significant only in those treated with dysgnathia surgery. These subjects also exhibited the most obvious profile changes. Treatment with functional orthopaedic appliances resulted in a moderate reduction of convexity of the soft tissue profile. Following camouflage orthodontics, there was an opposite effect on the soft tissue profile, in particular of the nasolabial angle.
CONCLUSIONS: Fixed functional orthopaedic appliances may be an alternative to surgery in young adults but only in those with moderate Class II malocclusions. Significant convexity reduction for the profile can be achieved only subsequent to orthognathic surgery. When camouflage orthodontics is performed, adults have to be aware of increases in the nasolabial angle as a potential side-effect.

155 REGENERATION OF THE CONDYLE WITH THE USE OF A FUNCTIONAL APPLIANCE
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AIM: It has been stated that an injured condyle during adolescence is a causative factor for reduced mandibular growth and subsequent asymmetry of the mandible. The aim of this study was to examine the nature of mandibular growth after unilateral condylectomy, and to elucidate the effects of mandibular advancement with the use of a functional appliance in growing mice.
MATERIALS AND METHOD: Sixty growing mice were subjected to unilateral condylectomy and then half underwent treatment with a functional appliance. Four weeks after initiating the experiment, lateral and dorsoventral cephalograms were taken of all mice using a rat and mouse cephalometer, and morphometric analysis of the mandible was performed. The mandibular condyles were removed under general anaesthesia for histomorphometric analysis.
RESULTS: After 4 weeks, the unilateral condylectomy resulted in reduced growth of the mandible and a subsequent lateral shift to the affected side. However, the reduced growth and lateral shift of the mandible were eliminated by the functional appliance. Regeneration of the condyle was demonstrated in all the mice in the condylectomy and condylectomy/appliance groups. However, the shape of condyle was irregular in the condylectomy group. The four layers of the condylar cartilage, observed in the controls, were not detected in the condylectomy group. Furthermore, various tissues, such as bone, muscle and cartilage, were irregularly arranged in this group. On the other hand, the shape of the condyle in all the mice in the condylectomy/appliance group was equivalent to the controls. The four layers of the condylar cartilage were also clearly detected in the condylectomy/appliance group.
CONCLUSIONS: Mandibular advancement with a functional appliance provides the ability to regenerate cartilaginous tissues on injured condyles and recovery of reduced mandibular growth, leading to the correction of a lateral shift of the mandible.

146 STIMULATION OF ROOT FORMATION AND REGENERATION BY A NATURAL COMPOUND
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Root resorption is an accidental clinic problem after orthodontic treatment. As a clinical treatment, it is necessary to develop the technique of root regeneration. As it is has recently been reported that a new natural compound, harmine, stimulates the differentiation of osteoblasts cell line (MC3T3-E1) and bone formation during tooth development by kidney capsule transplantation, the effect of harmine against Hertwig's epithelial root sheath (HERS) and dental papilla in the process of root development was examined using a recently developed organ culture system capable of observing root formation and cell line (HERS-01a) derived from HERS of tooth germ at 5 days post-natally.
Harmine has the capacity to promote the root formation. BrdU labelling assay of the organ culture showed that harmine increased the number of proliferating cells in HERS and dental papilla. Additionally, harmine robustly stimulated cell-proliferation in HERS-01a.
Harmine could be developed as a new regenerative medicine by screening natural compounds stimulating bone formation. This agent may be effective and safe for regeneration in the case of root resorption.

147 CLINICAL COMPARISON OF MULTISTRANDED METALLIC WIRE AND DIRECT-BOND GLASS FIBRE REINFORCED RESIN COMPOSITE
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AIM: To compare the clinical reliability of resin composite retainers reinforced with silanised-treated glass fibres (Everstick® Ortho, StickTech ltd, Turku, Finland) with the reliability of multistranded metallic wire.
SUBJECTS AND METHOD: Seventy-two subjects (20 males, 52 females; mean age 24 years) divided into two groups: a fibre reinforced composite group (n = 36; FRC retainers) and a multistranded metallic wire splint group (n = 36; MMW). The clinical survival of the retainers was evaluated monthly. The study endpoint was from 12 to 48 months after initial bonding. Cox's regression model, Huber-White standard error and Kaplan Meier survival curves were used for statistical analysis.
RESULTS: The statistical analysis was subdivided in to two parts. In the first, the whole control period, different from patient to patient was considered, whereas, in the second the common follow-up (12 months) was considered. In the first analysis, the number of splints with at least one detachment was 51 (58.6%): 18 (45%) FRC and 33 (70.2%) MMW. For the common follow-up 12 FRCs were detached (30%), and 25 MMW (53.2%). The mean survival of FRC splints was 8 months, and for MMW 5 months. The difference was statistically significant ($P < 0.05$).
CONCLUSION: In terms of reliability of permanently fixed orthodontic retention, FRC appear to be superior to MMW retainers.

148 EARLY CLASS III MALOCCLUSION TREATMENT: A COMPARATIVE SHORT- AND LONG-TERM STUDY

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AIM: To retrospectively evaluate the interceptive fixed appliance versus the facemask appliance in the treatment of Class III malocclusions.
SUBJECTS AND METHOD: Sixty-nine children divided into two groups according to the interceptive treatment applied: 31 children in Group F (facemask) and 38 in Group M (interceptive fixed appliance). Data were collected at the start of the study (T0), after active treatment (T1) and 29 months after T1 (T2). Pancherz's cephalometric analysis was carried out on the lateral roentgenograms. Differences were evaluated by *t*- and chi-squared tests.
RESULTS: At T0 there were no differences between groups M and F except for facial divergence, which was greater in group M. At T1 comparisons in each group showed that (i) the overjet was significantly changed in both groups: the molar discrepancy was significantly changed in group F but not in group M, (ii) the alveolar discrepancy was not reduced significantly in either group and (iii) anteroposterior skeletal discrepancy was not reduced but was stabilized. In the vertical dimension, there was a slight opening in group F but no significant change in group M. T2 comparison (interceptive and post-interceptive stage i.e. 6 years) showed that (i) the overjet was corrected in both groups: the molar discrepancy was stable in both groups, (ii) the alveolar discrepancy was stable and (iii) the anteroposterior discrepancy was not improved in either group. At T2 there were no differences, either qualitatively or quantitatively between groups M and F.

149 ORTHODONTIC TOOTH MOVEMENT INTO THE MANDIBULAR ALVEOLUS AFTER TOOTH EXTRACTION

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AIM: Orthodontic tooth movement involves certain risks and complications. Root resorption, which is the most frequent and important, may arise due the use of the wrong force or tooth movement into dense or altered bone. This study aimed to determine the histological changes of tooth roots following movement into a jaw region treated with a synthetic bone substitute. A further objective was the examination of the animal model and the method of experimental tooth movement.
MATERIALS AND METHOD: The mandibular right second premolars were extracted from three animals (*Sus scrofa domesticus*) and the respective alveoli were filled with bone substitute. After wound closure, an orthodontic fixed appliance for tooth movement was attached. Tooth movement was performed for 90 days. Subsequently, the specimens were collected using a segmental osteotomy and prepared histologically. Unmoved teeth on the left side served as the controls.
RESULTS: Histological analysis showed clear lacuna-like alterations in the root surface areas of all specimens. These changes were largest in the apical area, while the mid-root region was less affected.
CONCLUSION: Due to deformations of the orthodontic appliance and, hence, force application, the marked resorption alterations of the root surfaces observed cannot be unequivocally attributed to the changed bone structure in an area treated with synthetic bone substitute. However, the clear defects of the root surfaces as compared with those usually occurring during tooth movement permit the assumption that orthodontic tooth movement into areas filled with bone substitute may be at increased risk of root resorption.

150 THE EFFECTS OF ORTHODONTIC INTRUSION UTILISING TWO NOVEL OSTEOGENIC COMPOUNDS ON PERIODONTAL BONE LEVELS

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AIM: Naringin and quercetin are commonly found in fruit. It was observed that they have potent local osteogenic effects and are active against periodontal pathogens such as *Actinobacillus actinomycetemcomitans* (Aa) and *Porphyromonas gingivalis* (Pg). It was found they may be useful compounds in patients with certain types of periodontal bone loss; specifically, in patients with teeth which have extruded following periodontal attachment loss. Orthodontic intrusion followed by periodontal regeneration surgery using either naringin or quercetin could result in increased periodontal bone levels. The aims of this research were to study their effects on the growth of Aa and Pg and to highlight the osteogenic effects of these compounds.
MATERIALS AND METHOD: Aa and Pg were grown in naringin and quercetin solutions and 0.2 per cent chlorhexidine (positive control) and 0.9 per cent sodium chloride (negative control) over 24 hours in an anaerobic incubator.
RESULTS: Aa: growth was inhibited at 3 hours and showed an inhibitory effect for 3-12 hours. Pg: complete inhibition by 24 hours. No significant difference was found between the chlorhexidine group and these solutions at 24 hours. Significant reductions in cell counts were observed in the NaCl group compared with the baseline sample.
CONCLUSIONS: Quercetin and naringin have an inhibitory effect on Aa and Pg.

151 EXTRA-ORAL COMPARATIVE EVALUATION OF MICRO SHEAR BOND STRENGTH OF ENAMEL TO DIFFERENT ORTHODONTIC ADHESIVE SYSTEMS

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AIM: To evaluate and compare *in vitro* study the micro-shear bond strength (SBS) of three different adhesive systems for orthodontic bracket bonding.
MATERIALS AND METHOD: Ninety extracted human premolars were randomly divided into three equal groups and stored at 37ºC in normal saline after bonding with one of the following adhesives: GI (control), enamel surface of samples prepared with the acid etch technique; G2 samples prepared with Transbond plus self-etch primer, and G3 with Adper prompt L-pop self-etch adhesive. Transbond XT was used over the prepared enamel in all groups. Each group was then randomly divided into two subgroups of 15. Micro-SBS testing was performed on a 1 mm bonding diameter after 24 hours (T1) and 3 months (T2). Bond failure mode was also evaluated after debonding. Two-way ANOVA, Tukey, Kruskal-Wallis and Mann-Whitney tests were used for data analysis.
RESULT: The difference in SBS for the three groups at the two time intervals was statistically significant ($P < 0.001$). The bond strength change between T1 and T2 was statistically significant ($P < 0.001$) with no changes over time in the three groups ($P = 0.091$). Adhesive Remnant Index (ARI) analysis showed mainly cohesive bond failures in G1 and adhesive failures in G2 and G3. There were significant differences in ARI scores between the groups.
CONCLUSIONS: The SBS of G1 was the highest, whilst G2 had a higher bond strength than G3. Less adhesive remnants were found for G2 and G3.

152 CONDYLAR GROWTH AND GLENOID FOSSA DISPLACEMENT BY CHIN CUP THERAPY

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AIM: To assess glenoid fossa changes and condylar growth as a result of chin cup therapy in Class III malocclusion subjects.
SUBJECTS AND METHOD: Twenty-three subjects with a Class III malocclusion associated with mandibular prognathism treated by chin cup therapy. The mean age of the chin cup group was 9.83 ± 2. 16 years. Twenty-three subjects with a mean age of 11.53 + 1.42 years with a Class I malocclusion comprised the control group. A chin cup force of 500 g was applied in a condylar direction. When a positive overjet was achieved, use of the appliance was terminated. The duration of treatment was 18 months. Measurements were made on lateral cephalograms taken before and after chin cup therapy. In addition to skeletal measurements, glenoid fossa position and condylar growth changes as a result of chin cup therapy were determined on the lateral cephalograms. Available data were evaluated by repeated measures ANOVA. The relationship between skeletal measurements and glenoid fossa and condyle positions were analyzed by Pearson's correlation test.
RESULTS: Significant improvements were achieved in both soft and hard tissues. The condyle and glenoid fossa grew in a downward and backward direction in both groups. Some significant correlations were found between skeletal and condyle and glenoid fossa parameters in the chin cup group.
CONCLUSIONS: Chin cup treatment results in a posterior and inferior displacement of the condyle and glenoid fossa.

153 A BONDABLE UPRIGHTING SPRING FOR CLASS II EXTRACTION TREATMENT WITH SELF-LIGATING BRACKETS

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AIM: To describe the reliability of an uprighting spring (the G-spring) for self-ligating brackets in extraction treatment by means of a preliminary clinical study.
SUBJECTS AND METHOD: Ten patients presenting with a full Class II malocclusion with a lower dentoalveolar discrepancy. The full fixed appliance used in the selected patients was the interactive In-Ovation-R self-ligating system with a bidimensional prescription (0.18 inch slot on the anterior teeth). All patients were treated by an extraction approach (upper first and lower second premolars). In order to maintain lower incisor inclination, the two-dimensional mechanics were applied and a 0.018 Australian wire uprighting spring was modelled, sandblasted and bonded on the buccal surfaces of the lower canines because of the absence of the vertical slot in the brackets. Lateral radiographs were obtained at the beginning (T0) and end (T1) of treatment.
RESULTS: In all patients the extraction sites were completely closed without loss of anterior anchorage and maintaining the correct incisor inclination. In some cases the IMPA increased, the mean value was 93 degrees at T0 and 97 degrees at T1.
CONCLUSIONS: The G-spring can be effectively used as a traditional uprighting spring in self-ligating brackets without a vertical slot in order to maintain the maximum anterior anchorage associated with traditional two-dimensional mechanics.

154 CHANGES IN GENE MATERIAL OF THE PIG MANDIBULAR CONDYLAR CARTILAGE IN RESPONSE TO MANDIBULAR PROTRUSION

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AIM: Adaptive remodelling of the mandibular condylar cartilage in response to mandibular protrusion constitutes forward displacement by appliances to develop growth modification. By investigating the expression of collagen (coll-1, coll-2, coll-10), matrix metalloproteinases (MMP-8, MMP-13) and vascular endothelial growth factor (VEGF), this study was designed to prove modification of condylar cartilage during adaptive remodelling and to compare it with that of natural condylar growth.
MATERIALS AND METHOD: Twenty pigs (*sus scrofa domesticus*), 10 weeks of age, were randomly allotted to two experimental groups, where condylar adaptation was created by forward repositioning of the mandible, and one control group where the condyles underwent natural growth. The trial was continued for 4 weeks. RNA was extracted from analysed tissues and reverse transcribed. Changes in mRNA content were measured by real-time polymerase chain reaction using specific primers.
RESULTS: The temporal pattern of expression of coll-1 and MMP-13 during condylar adaptation coincided with that during natural condylar growth. The amount of the expression of coll-10 during condylar adaptation was significantly lower ($P < 0.05$), whereas the expression of coll-2, MMP-8 and VEGF was significantly higher than during natural growth ($P < 0.05$).
CONCLUSION: Mechanical strain produced by mandibular advancement induces remodelling and revascularization in the posterocranial mandibular condyle. These findings confirm previously published histological and histomorphometric analyses regarding the condylar cartilage. It is suggested that condylar adaptation in growing pigs triggered by mandibular forward positioning is not only a passive adaptive but also a growth affected effect.

155 INFLUENCE OF BONE SUBSTITUTE ON RAT MUSCLE

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AIM: To research the synergistic effect between an ectopic bone substitute and surrounding muscle tissue.
MATERIALS AND METHOD: Changes of insulin like growth factors (IGF1, IGF2), myostatin (GDF8) and vascular endothelial growth factor (VEGF) mRNA content of the latissimus dorsi muscle of 12 Wistar-King rats with implanted poly-3-hydroxybutyrate (PHB) scaffold were examined after 6 and 12 weeks. At each time interval six rats were killed and the implants and surrounding tissues prepared for genetic evaluation. Eight rats without any implants served as the controls. RNA was extracted from homogenized muscle tissue and reverse transcribed. Changes in mRNA content were measured using real-time polymerase chain reaction with specific primers for IGF1, IGF2, GDF8 and VEGF.
RESULTS: When the level of VEGF mRNA in muscles after 6 and 12 weeks were compared with the controls, there was a significant increase of VEGF gene expression ($P < 0.05$) whereas the level of mRNA expression was higher after 6 than 12 weeks of treatment. Expression of IGF1 gene was also significantly increased when compared with the controls over the

observation period ($P < 0.05$). In the case of the IGF2 gene, the expression was significantly elevated after 6 weeks ($P < 0.05$), but not after 12 weeks ($P > 0.05$). A significant decrease in GDF8 gene expression ($P < 0.05$) was observed after retrieval of the implants at both 6 and 12 weeks. The mRNA level of GDF8 after 6 and 12 weeks was comparable.
CONCLUSION: PHB implants in rat latissimus dorsi muscles interact with the surrounding muscle tissue.

156 DAILY ACTIVITY OF RABBIT JAW MUSCLES DURING POSTNATAL DEVELOPMENT
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AIM: To investigate the daily habitual activity profiles of various jaw muscles during postnatal development from weaning to puberty.
MATERIALS AND METHOD: An implantable radiotelemetry device was used in eight juvenile male rabbits to continuously record the intramuscular electromyograms (EMG) of the masseter, temporalis and digastric muscles between 7 and 20 weeks of age. The EMGs of two predefined days per week were analysed to quantify the relative duration of muscle activity (duty time), numbers and lengths of bursts per day in relation to multiple activity levels (5, 10, 20, 30, 40, 50, 60, 70, 80 and 90% of the peak activity of the day).
RESULTS: The mean duty times of the masseter, temporalis and digastric muscles ranged from 9.46, 22.47 and 11.35 per cent, respectively, at the 5 per cent activity level to less than 0.005 per cent at the 90 per cent activity level in all muscles examined. The mean burst numbers in the masseter, temporalis and digastric muscles ranged from 96741, 206752 and 106584, respectively, at the 5 per cent activity level to 362, 92 and 480 at the 9 per cent activity level. The mean burst lengths of the masseter, temporalis and digastric muscles ranged from 87.3, 85.6 and 95.9 ms, respectively, at the 5 per cent activity level to 22.1, 25.9 and 22.6 ms at the 90% activity level. Although the duty times and the burst numbers were significantly higher ($P < 0.05$) in the digastric than in the temporalis muscle at activities between 20 and 70 per cent of the peak activity during the entire experimental period, the mean burst lengths of the three muscles examined did not differ significantly at any activity level ($P > 0.05$). The duty times, burst numbers and burst lengths did not change significantly at any activity level in the three muscles examined over the time course of the experimental period ($P > 0.05$).
CONCLUSIONS: The amount and pattern of jaw muscle activation is established already before weaning and remains largely unchanged until puberty.
Supported by a European Orthodontic Society Research Grant

157 ADAPTATION OF MASTICATORY MUSCLE ACTIVATION TO VARYING FUNCTIONAL DEMANDS
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AIM: To study adaptive changes in the activity profiles of jaw-closing muscles after altering their functional demands during development.
MATERIALS AND METHOD: A radiotelemetry device was used to continuously record the intramuscular electromyograms (EMG) of the masseter and temporalis muscles in male rabbits between 7 and 20 weeks of age. Starting at 8 weeks of age, the experimental animals (n = 7) were fed pellets requiring a significantly lower force to break the pellet (10 N) in comparison with standard pellets (120 N) fed to controls (n = 7). EMGs were analysed to quantify the relative duration of muscle use per day (duty time) in relation to multiple activity levels (5, 10, 20, 30, 40, 50, 60, 70, 80 and 90% of the peak-EMG of the day).
RESULTS: The mean duty times of the masseter muscles ranged from 9.46 per cent at the 5 per cent activity level to 0.0052 per cent at the 90 per cent activity level in the control group and from 7.37 per cent at the 5 per cent activity level to 0.0006 per cent at the 90 per cent activity level in the experimental group. Those of the temporalis muscles ranged from 22.43 per cent at the 5 per cent activity level to 0.0001 per cent at the 90 per cent activity level in the control group and from 10.37 per cent at the 5 per cent activity level to 0.0008 per cent at the 90 per cent activity level in the experimental group. The mean duty times of the temporalis muscles did not differ between the groups at any activity level or at any time ($P > 0.05$). In contrast, those of the masseter muscles were significantly lower in the experimental group than in the control group at activity levels up to 20 per cent of the peak-EMG in the 2 weeks following the change in food consistency ($P < 0.05$).
CONCLUSIONS: A reduction in masticatory demands causes a transient decrease in the duty times of the jaw-closing muscles that are mainly associated with force production. This decrease is limited to the 2 weeks following the change in food consistency and to activity levels that reflect muscle contractions during chewing.
Supported by a European Orthodontic Society Research Grant

158 EFFECTS OF FLUOROSIS AND SELF-ETCH PRIMERS ON SHEAR BOND STRENGTHS OF ORTHODONTIC BRACKETS

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AIM: To evaluate the effects of fluorosis and self-etch primers (SEPs) on shear bond strength (SBS) of orthodontic brackets.

MATERIALS AND METHOD: Forty-eight (24 fluorosed, 24 non-fluorosed) non-carious human premolar teeth freshly extracted for orthodontic reasons and without any caries or visible defects. The fluorosed teeth were selected according to the modified Thylstrup and Fejerskov Index, which is based on the clinical changes in fluorosed teeth. Twenty-four non-fluorosed teeth were randomly assigned to two groups of 12 (groups I and II). Twenty-four fluorosed teeth were also randomly assigned to two groups of 12 (groups III and IV). In groups I and III, orthodontic brackets were bonded using a standard etching protocol and light cure composite resin (Reliance Orthodontic Products, Inc., Illinois, USA). In groups II and IV, orthodontic brackets were bonded to fluorosed and non-fluorosed enamel using self etch primer, Transbond™ Plus SEP (3M Unitek, California, USA) and a light cure composite resin (Transbond XT Light Cure Adhesive, 3M Unitek). All brackets were cured with a halogen light (Vivadent ETS, Schaan, Liechtenstein). After bonding, the SBS of the brackets were tested with a universal testing machine.

RESULTS: Analysis of variance (ANOVA) indicated a significant difference between groups ($P < 0.001$). The SBS in group III was significantly lower than in the other groups.

CONCLUSIONS: When a standard etching protocol was used, enamel fluorosis significantly decreased the bond strength of orthodontic brackets. SEPs were found to be effective in increasing the bond strength of orthodontic brackets to fluorosed enamel.

159 COMPARISON OF MAXILLARY DISTRACTION OSTEOGENESIS WITH A LE FORT I OSTEOTOMY IN CLEFT LIP AND PALATE PATIENTS

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AIM: To cephalometrically compare treatment outcome and stability 1 year following maxillary distraction osteogenesis (DO) and a Le Fort l osteotomy (LF) performed on growing children with a cleft lip and palate (CLP).

SUBJECTS AND METHOD: Thirteen children (5 girls aged 12.8 ± 1.2 years and 8 boys aged 13.6 ± 1.3 years) with unilateral (n = 6) or bilateral (n = 3) CLP and with a cleft palate (n = 4) were osteodistracted using a RED appliance and compared with gender- and cleft background-matched controls (girls aged 14.5 ± 1.6 years and boys aged 13.2 ± 1.6 years) who were treated with a LF. The landmarks on lateral cephalometric radiographs were digitised and dentoskeletal measurements were compared with a Student's *t*-test to assess the differences in DO and LF between pre- and post-surgery and post-surgery and 1 year follow-up.

RESULTS: Pre-operative measurements showed that the sagittal jaw relationship was similar in both groups. The mean face height (N–Me) was significantly greater in the DO group than in the LF group. Vertical overbite was greater in the DO than in the LF group. During osteotomy, the maxilla was horizontally advanced significantly in both groups. However, in the DO group, maxillary advancement was significantly greater according to Ba-ANS distance and ANB angle. In the DO group the upper jaw was mainly moved forward with a slight posterior and downward rotation of the palatal plane, while in the LF group the upper jaw was significantly rotated anteriorly downwards. This caused a significant mandibular backwards autorotation in the LF group. The soft tissue followed the underlying hard tissue and the soft tissue changes for both maxilla and mandible were greater in the DO group. At the 1 year follow-up no significant relapse was noted in either group.

CONCLUSION: Maxillary advancement can be obtained using DO. Although a significantly greater magnitude of maxillary advancement in both hard and soft tissue was produced with DO, it appeared to remain as stable as LF at the 1 year follow-up.

160 CHANGES IN ORAL HEALTH-RELATED QUALITY OF LIFE DURING FIXED ORTHODONTIC APPLIANCE THERAPY

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AIM: There is an increasing interest in Quality of Life (QoL) issues in the orthodontic field. This study aimed to investigate the changes in Oral Health Related Quality of Life (OHRQoL) among adult patients during their fixed orthodontic treatment.

SUBJECTS AND METHOD: Two hundred and thirty two adult patients enrolled from a consecutive sample seeking orthodontic treatment in a university dental hospital. Their OHRQoL was assessed by two standardized QoL instruments [short form Oral Health Impact Profile (OHIP-14), and the United Kingdom UK-OHRQoL)] at four time points: before

treatment (T0) and 6 (T1), 12 (T2) and 18 (T3) months after bonding and banding. Friedman two-way ANOVA and Wilcoxon signed rank test were adopted to compare the relative changes of OHRQoL among different time points.
RESULT: Of the 232 subjects who met the selection criteria, 201 (86.6 %) completed OHRQoL assessments at the four time points. Significant changes in both OHIP-14 summary score and OHQoL-UK score were observed during fixed orthodontic treatment. There were significant OHRQoL deteriorations at T1 and T2 compared with T0, which were reflected by both OHIP-14 and OHQoL-UK summary scores, as well as some of their domain scores. However, at T3 OHIP-14 suggested deterioration in OHRQoL remained but OHQoL-UK did not.
CONCLUSION: Changes in OHRQoL occur during fixed orthodontic appliance treatment. In the early phase of treatment the greatest deterioration in OHRQoL occurs. With on-going treatment the detrimental effects to OHQRoL reduce and there is a suggestion that OHRQoL may even improve during treatment.

161 VIRTUAL MODELS AS AN ALTERNATIVE APPROACH TO PLASTER MODEL ASSESSMENT OF TOOTH DIMENSION
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AIM: A case-control study to assess the potential use of virtual models as an alternative to orthodontic plaster models.
MATERIALS AND METHOD: Assessment of tooth widths was conducted on 80 plaster models, which were measured to the nearest 0.01 mm with digital callipers, and their virtual models by two trained and calibrated examiners. Agreement of tooth width was assessed with paired *t*-test analysis. Intra- and interexaminer reliability of assessments were investigated.
RESULTS: Both intra- and interexaminer reliability and test-retest reliability of plaster and virtual model analysis were acceptable in measuring tooth sizes. There were no significant differences between measurements of 24 teeth on the plaster and virtual models. The mean directional differences (MDD) were less than 0.20 mm. The MDD for tooth width measurements was less than 0.10 mm. Intraclass correlation coefficients of assessments of tooth width obtained from plaster and virtual models were >0.80.
CONCLUSIONS: Virtual models can be as accurate as the traditional method of digital callipers and plaster models. Therefore, virtual models can be used as an alternative to plaster models.

162 INFLUENCE OF FEEDING METHOD ON OCCLUSION IN THE PRIMARY DENTITION
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AIM: To investigate the effect of infant feeding on the development of occlusion in the primary dentition.
SUBJECTS AND METHOD: One hundred and fourteen children. A questionnaire was completed by the parents regarding infant feeding and health history, following which a paedodontist recorded the child's primary dental occlusion. The data was analyzed with Fisher's exact test.
RESULTS: Of the participants, 40/35 per cent were bottle-fed and 59/65 per cent were breast fed. The predominance in bottle feeding was associated with the development of a pacifier habit. Children who used a pacifier were more likely to develop a non-mesial step occlusion and overjet >3 mm.
CONCLUSIONS: Bottle-feeding can change a normal occlusion in the primary dentition.

163 INITIAL FORCES DELIVERED BY THERMOPLASTIC APPLIANCES ON AN UPPER CENTRAL INCISOR DURING TIPPING
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AIMS: To quantify the forces delivered by thermoplastic appliances manufactured from three different materials, with the same thickness, on a central upper incisor during tipping.
MATERIALS AND METHOD: Five identical appliances were manufactured from three different materials (Ideal Clear® 1.0 mm, Erkodur® 1.0 mm, Biolon® 1.0 mm). For measuring the forces, an isolated measuring tooth, as part of a standardized resin model incorporated in a newly developed measuring device, was tipped in nine arcminute (degree) steps from 0 degrees in the vestibular and palatal directions around a rotational axis through the virtual apex, after positioning an appliance on the model. For statistical analysis, the force components, Fx/tipping and Fz/intrusion at a displacement of ±0.151 mm from the incisor edge, were calculated. Means and standard deviations were determined. The Kruskal-Wallis test for overall effects and the Wilcoxon two-sample test for individual group pairings were used ($P < 0.05$ was considered significant).
RESULTS: The mean Fx forces ranged from –2.82 N (SD 0.62) to 5.42 N (SD 0.56). The mean Fz forces were between –0.14 N (SD 0.52) and –2.3 N (SD 0.43). The highest intrusive forces were measured during vestibular displacement of the

measuring tooth. The forces delivered by the Biolon® appliance were found to be significantly greater ($P < 0.01$) than those of the other materials.
CONCLUSIONS: The forces delivered by the investigated materials were mostly too high compared with those stated in the literature as being ideal.

164 FLAT-PANEL VOLUME COMPUTED TOMOGRAPHY COMPARED WITH MULTISLICE COMPUTED TOMOGRAPHY FOR IMAGING THE MID-PALATAL SUTURE

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AIM: To compare the image quality of flat-panel volume computed tomography (fpVCT) and multi-slice computed tomography (MSCT) of sutural structures.
MATERIALS AND METHOD: Bone samples were taken from the mid-palatal suture of five young (16 weeks) and five old (200 weeks) *Sus scrofa domestica* and fixed in a formalin solution. A fpVCT prototype and a MSCT were used to obtain images of the specimens. The facial reformations were assessed by four observers using a 1 (excellent) to 5 (poor) rating scale for the weighted criteria visualisation of the suture structure. A linear mixed model was used for statistical analysis. $P < 0.05$ was considered to be statistically significant.
RESULTS: Visualisation of the suture of young specimens was significantly better than that of older animals ($P < 0.001$). The visualization of the suture with fpVCT was significantly better than with MSCT ($P < 0.001$).
CONCLUSIONS: Compared with MSCT, fpVCT produces superior results in the visualisation of the mid-palatal suture.

165 EVALUATION OF THREE-DIMENSIONAL MAXILLARY GROWTH PATTERNS IN ROMANIAN CHILDREN WITH UNILATERAL CLEFT LIP AND PALATE

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AIM: To visualize and measure maxillary growth in patients with a unilateral cleft lip and palate (UCLP), and to identify the morphological pattern resulting from dimensional changes in the first 6 years of life.
SUBJECTS AND METHOD: The first group contained 55 patients with a UCLP (36 boys, 19 girls), aged from 2 months to 6 years, operated on by the same surgical team, and the second group 60 patients, (26 girls, 34 boys) with normal facial development. Maxillary impressions were taken in both groups. The maxillary casts were three-dimensionally scanned. The maxillary alveolar arch lines, the four Stilmann points and the maxillary interincisive point were identified and marked. The coordinates of these points were imported into a computer-aided design system and four direct measurements were made: anterior and posterior width of the alveolar maxillary arch, its length, and the depth of the palate. Student's *t*-tests, simple and bivariate, were performed with SPSS 13.0.
RESULTS: In the UCLP group the posterior width of the maxillary alveolar arch varied from 22 to 38 mm, anterior width from 17 to 31 mm, and length from 21 to 35.08 mm. Palatal depth had a mean value of 10.74 mm. The bivariate *t*-test showed a reduced anterior and posterior width of the maxillary alveolar arch in UCLP children and a shorter length $P = 0.059$). The posterior width of the cleft maxillary arch grew from 2 to 6 years ($P = 0.048$), the anterior width from 0 to 5 years after all surgical procedures ($P = 0.009$) and the length from 2 to 6 years of age.
CONCLUSIONS: UCLP patients have narrower and shorter maxillary alveolar arches and a flattened palate. The three-dimensional technique used allowed representation of the normal and UCLP maxillary alveolar arch from 0 to 6 years of age, and visualisation of the differences.

166 NEED FOR AND EXPERIENCE OF ORTHODONTIC TREATMENT IN A GROUP OF 15-YEAR-OLDS IN NORWAY

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AIMS: To explore timing of orthodontic treatment, and to assess residual treatment need with two different treatment need indices in a group of adolescents in Norway.
SUBJECTS AND METHOD: All 15-year-olds (n = 114) living in a rural municipality in the north of Norway were invited, and a total of 30 boys and 36 girls agreed to participate. The mean age was 14.8 years (SD 0.32). Impressions for dental casts were taken of all participants except of those under active treatment. Treatment need was assessed on dental casts using the Dental Health Component (DHC) of the Index of Orthodontic Treatment Need (IOTN) and the Need for Orthodontic Treatment Index (NOTI). Information on timing and treatment experience was obtained from the dental records.

RESULTS: The participation rate was 57 per cent. Of the 66 participants, 53 per cent had not undergone orthodontic treatment. Of the treated subjects (n = 31), 55 per cent had finished treatment, and 45 per cent were still under active treatment. According to the DHC, a definite treatment need (DHC 4-5) was found in 14 per cent, a moderate/borderline need (DHC 3) in 25 per cent and little/no need (DHC 1-2) in 62 per cent (n = 52). According to NOTI, 4 per cent had a great need (score A or B), 14 per cent an obvious need (score C) and 83 per cent little/no need for treatment (score D). The DHC recorded significantly more subjects to the treatment need categories compared with the NOTI ($P < 0.01$). According to the DHC, the non-treated subjects had a tendency towards a higher treatment need compared with the treated ($P = 0.05$), while NOTI showed no difference between the two groups. All subjects were treated with fixed appliances. The median age at the start of treatment was 12.7 years (SD 1.78), which was higher than in other Scandinavian countries.
CONCLUSIONS: The DHC of the IOTN seems to be more sensitive than the NOTI in assessing treatment need. The relatively high median age at the start of treatment reflects the predominance of fixed appliances in orthodontic treatments in Norway.

167 PREVALENCE OF CLEFT LIP, PALATE, AND CLEFT LIP AND PALATE IN AN IRANIAN POPULATION
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AIMS: To assess the prevalence of different types of clefts and to determine any related aetiologic factors in the city of Tehran.
MATERIALS AND METHOD: Five hospitals in five different economic parts of the city were selected. The files of mothers (n = 45081) who had delivered a live baby were studied. Gender, type and side of the cleft, age of the mother and the number of children were determined.
RESULTS: Forty infants had one type of the cleft. A cleft lip was seen in 47.5 per cent of cleft cases, with females having a lower incidence, whereas a cleft palate was observed in only 20 per cent with a greater prevalence of females (1.7 times). A cleft only in the soft palate region was found in 7.5 per cent, with a greater incidence in males (×2). In 12.5 per cent of the infants the cleft was more extensive and involved the soft and hard palate. A cleft lip and palate was observed in 32.5 per cent. Statistically, 1 in 1127 new born infants had a different type of cleft.
CONCLUSIONS: The prevalence of different kinds of cleft lip, palate and cleft lip and palate was less than in other countries.

168 DO INTERMOLAR WIDTH AND THE POSITION OF THE FIRST MOLARS CHANGE BETWEEN 7 AND 32 YEARS OF AGE?
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AIM: To study, longitudinally, growth changes in maxillary and mandibular arch width at the first molars and changes in the position of the first molars during 25 years.
SUBJECTS AND METHOD: Children included in a longitudinal Finnish sample examined at the ages of 7, 10, 12, 15 and 32 years. Alginate impressions for study casts had been taken at each age level. The main criteria for inclusion to the present study were a normal Class I occlusion, and no orthodontic treatment. These criteria limited the sample to 33 subjects (18 females, 15 males). Intermolar distances between the mesiolingual cusps, the distolingual cusps and at the gingival level of the first molars were measured to the nearest tenth of a millimetre with a sharp pointed sliding calliper. The mean value of two separate measurements was used as a basis for further analysis.
RESULTS: The means of all maxillary dimensions increased slightly from 7 to 32 years of age; the increase being greatest at the gingival level (1.8 mm in females, 2.3 mm in males). The increase was greater at the distolingual cusps than at mesiolingual cusps. Mandibular dimensions at the age of 32 years were smaller than at 7 years, with the exception of the distolingual distance, which was slightly greater (0.5 mm in females, 0.7 mm in males). All increases in width dimensions took place between 7 and 15 years of age. From 15 to 32 years of age the dimensions decreased. However, individual variations were great.
CONCLUSIONS: Differences in the changes of intermolar width at the three measuring points chosen may indicate distolingual rotation of the first molars in both jaws and uprighting of the maxillary first molars. Both dental arches are slightly narrowed in adulthood.

169 NEUROSENSORY FUNCTION 3 YEARS AFTER SAGITTAL SPLIT OSTOEOTOMY
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AIMS: To investigate the rate of sensory disturbances in the facial skin and lips 3 years after surgery, and to analyse correspondence between patients' reports in questionnaires and two clinical methods for sensory testing. Additional objectives

were to examine distress due to disturbed sensation and to analyse whether impaired sensation affected the subject's satisfaction with the overall treatment outcome.
SUBJECTS AND METHOD: Two hundred and twenty three patients (93 males, 130 females) who had undergone a bilateral sagittal split osteotomy (BSSO). At the 3 year follow-up examination the patients completed a questionnaire addressing aspects of sensory function and satisfaction with the result. Sensory function was assessed clinically by light touch and two-point discrimination tests. Association between variables was analysed by chi-square test and Spearman correlation coefficient.
RESULTS: The frequency of impaired sensation was 75 per cent for light touch and 62 per cent for two-point discrimination, with 73 per cent of the patients reporting impaired sensation. Although good agreement between the methods was observed, disturbed sensation was both over- and under-reported in the questionnaires. Disturbances increased significantly with increasing age at surgery ($P < 0.05$). Moderate and severe distress was reported by 9 per cent of the patients, and distress was significantly correlated with the size of the affected area and to the discrimination distance ($P < 0.001$). Overall patient satisfaction was not significantly related to sensory impairment. However, patients expressing dissatisfaction with the treatment result more frequently reported distress due to the impairment ($P < 0.01$).
CONCLUSIONS: A high frequency of sensory disturbance 3 years after BSSO was observed in the present sample. Disturbances increased with increasing age at the time surgery, and distress was related to the extent of impaired sensation.

170 INFLUENCE OF THE TYPE OF RETENTION APPLIANCES ON ORTHODONTIC POST-TREATMENT CHANGES

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AIM: There are still many uncertainties concerning retention after orthodontic therapy. One question is whether a dental open bite can be created post-treatment with Essix retainers that do not cover the entire dental arch. The use of this retainer could have a bite-raising effect. The aim of this study was to evaluate the influence of the type of retention appliance on overbite and other orthodontic variables.
MATERIALS AND METHOD: Dental casts of 46 patients treated with a multibracket appliance. Casts were taken before (T0) and after (T1) treatment and 10 months to 2 years in retention (T2). The patients were divided into two groups, the Hawley group (n = 22) had a Hawley plate in the upper and lower dental arch and the Essix group (n = 24) had an Essix retainer (from canine to canine) in the lower jaw and a removable retainer in the upper arch. The following parameters were measured: overbite and overjet on the upper and lower casts: the intercanine distance, intermolar distance and irregularity index. The combined method error for double registrations was assessed. The quantitative data were analyzed with *t*-tests with significance set at $P < 0.01$.
RESULTS: In both groups most of the tested parameters changed significantly during treatment (T1-T0). On the other hand, the changes in the post-treatment period (T2-T1) were not significant. There were no statistically significant differences between the Essix and Hawley groups concerning overbite or the other tested variables.
CONCLUSION: Use of a canine-to-canine Essix retainer in the lower arch compared with the use of a Hawley retainer does not influence overbite or any of the other variables. However, further investigation with other retention devices (i.e. fixed retainers) is recommended.

171 ACCURACY OF CONE BEAM COMPUTED TOMOGRAPHY IN DETERMINING LOWER ANTERIOR LABIAL ALVEOLAR BONE LEVEL

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AIMS: To study the accuracy of cone beam computed tomography (CBCT) to determine labial alveolar bone level in the lower anterior area.
SUBJECTS AND METHOD: Two patients (15- and 17-year-old females) who had a lower canine exposed because of ectopic eruption. At surgery the distance from the incisal edge of the lower incisors to the lowest point of the labial alveolar bone was measured twice with a digital calliper. A CBCT (3D Accuitomo, J. Morita Corp., Japan) was also obtained of the patients with a slice interval of 0.125 mm. Comparable measurements as in the clinical situation were made twice on the computerized scans. Mean values for the clinical and radiographic measurements were calculated for each incisor, and the differences between the values provided by both methods were analysed. Concordance correlation coefficient was used. Repeatability of the measurements within each method was evaluated by the interclass correlation coefficient (ICC).
RESULTS: Mean difference between the measurement methods was 0.092 mm (SD 0.307, minimum –0.369, maximum 0.600). Concordance correlation coefficient was 0.9771. ICC was 0.998 for the CBCT and 0.994 for the clinical measurements.

CONCLUSIONS: The repeatability study showed that the clinical and CBCT measurements could be repeated with acceptable accuracy. Compared with clinical measurements, which can be considered as the gold standard, the CBCT method showed sufficient accuracy to study the thin labial alveolar bone level in the lower anterior area. Therefore, future studies can use the CBCT technique to determine associations between the position of lower incisors and alveolar bone level and changes following treatment.

172 THE ROLE OF SALIVARY FACTORS IN PERSISTENT ORAL CARRIAGE OF *CANDIDA* IN ORTHODONTIC PATIENTS

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AIM: *Candida albicans* is commensal oral yeast is observed in some 34 per cent of the healthy population. It has been shown that insertion of orthodontic appliances increase the *Candida* count in the majority of patients. However there is a wide variation in patient response. It is of importance to understand why different individuals react differently to the insertion of orthodontic appliances. In addition, there are no studies investigating the anti-candidal salivary constituents of healthy individuals with varying or nil candidal carriage rates. The aim of this study was to compare the composition and anti-candidal activity in stimulated whole saliva of healthy 'consistent' oral *Candida* carriers with *Candida*-free individuals undergoing orthodontic treatment.
SUBJECTS AND METHOD: A sub-sample of 22 consistent, *Candida*-free individuals and 10 consistent *Candida* carriers were recruited from a longitudinal study investigating oral *Candida* carriage in 97 healthy subjects. Unstimulated and stimulated saliva samples were collected. The salivary attributes including flow rate, pH, level of inhibition of blastoconidial viability, blastospore germination, lysozyme, lactoferrin and IgA concentrations of both groups were measured.
RESULTS: Saliva from the *Candida*-free individuals showed a 20 per cent higher inhibition of blastoconidial viability ($P < 0.05$) of a reference strain of *Candida albicans*. No significant differences between the other salivary attributes of the two groups were found.
CONCLUSIONS: The saliva of *Candida*-free individuals significantly inhibited the blastoconidial viability compared with saliva from carriers; this may help to explain the microbiological findings from the effect of the orthodontic appliances.

173 DUTCH PATIENTS' AND PARENTS' EXPECTATIONS OF ORTHODONTIC TREATMENT

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AIM: To examine patients' and their primary care-givers' expectations of orthodontic treatment in the Netherlands. Comparisons were made between males and females, as well as between Dutch and English data. A questionnaire developed by Sayers and Newton (2007), which was used to examine the expectations of patients and parents in the United Kingdom, was translated into Dutch and used in the present study.
MATERIALS AND METHOD: Prior to their first consultation, the questionnaire was completed by all participants during the period October 2007 to January 2008, resulting in a sample of 168 subjects (84 patients, 84 parents). The patients were aged 10 to 14 years with no history of orthodontic treatment. Expectations of patients and parents, males and females, and Dutch and English subjects were compared.
RESULTS: Patients and parents shared similar expectations of orthodontic treatment, with the exception of expectations of having an appliance fitted at the first appointment, orthodontic treatment involving headgear, any problems with orthodontic treatment, frequency of appointments and concerning reactions from the public ($P < 0.05$). Among the child participants, males and females only differed in their expectations of orthodontic treatment involving jaw surgery ($P < 0.05$). Differences between Dutch and English participants were found regarding the first visit, type of orthodontic treatment, reactions from the public and pain and problems with orthodontic treatment. The expectations also differed with regard to future prospects ($P < 0.05$).
CONCLUSIONS: Consensus was found between Dutch patients and their parents, and between Dutch males and females. However, a number of differences were found between Dutch and English subjects. Further investigation is required to explain these differences.
Sayers M S, Newton J T 2007 Patients' expectations of orthodontic treatment: part 2-findings from a questionnaire survey. Journal of Orthodontics 34: 25-35

174 HISTOLOGICAL EVALUATION OF THE PERIODONTIUM DURING ORTHODONTIC MOVEMENT IN ALLOXAN-INDUCED DIABETIC RATS

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AIM: Diabetes mellitus is the most common metabolic disorder characterized by elevated levels of blood glucose and abnormalities in carbohydrate, lipid and protein metabolism. It affects almost 10 per cent of the general population. Nowadays orthodontic treatment is frequently performed in older patients and those with special care needs. The aim of this research was to evaluate periodontal tissues alterations during orthodontic movement in rats with alloxan-induced diabetes.
MATERIALS AND METHOD: Thirty-six rats divided into two equal groups: control and diabetic. The diabetic animals received a single dose of alloxan monohydrate (40 mg/kg) intravenously in the penile vein, and their glucose level was verified before sacrifice. All rats were submitted to an orthodontic force (10 cN) using steel closed coil spring between the lower first molar and lower incisor, and passive after 7, 14 and 21 days. The periodontal region and the distance between the first and second lower molars were examined histologically and histomorphometrically analysed. The histomorphometric results were submitted to ANOVA analysis of variance and Tukey test.
RESULTS: Bone loss, the inflammatory process, the quantity of dental plaque and external root resorption were more intense in the diabetic animals when compared with the control group. Furthermore, hypercementosis and infected and necrotic bone tissue, also called bone sequestration, were well evidenced in the diabetic animals. The distance, between the first and second lower molars, was significantly increased in the diabetic group ($P < 0.05$) than in the controls after the 14- and 21-day periods.
CONCLUSIONS: Periodontal disease was greater in the diabetic animals when compared with the control group. The level of orthodontic force used in 'normal' patients should not be used in diabetic individuals.

175 OUTCOME OF ORTHODONTIC CARE IN A FINNISH MUNICIPAL HEALTH CENTRE

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AIM: To assess the objective and subjective outcome of orthodontic care in one municipal health centre, where orthodontic treatment was provided by one general practitioner under the supervision of a specialist orthodontist.
SUBJECTS AND METHOD: The sample consisted of one age-cohort of adolescents born in 1989 (n = 67). Of them, 97% (38 boys, 27 girls) participated in a clinical examination carried out by one specialist orthodontist. Of the participants, 42 per cent had received orthodontic treatment. The occlusions were evaluated by applying the Occlusal Morphology and Function Index (OMFI). Residual treatment need was assessed with the Dental Health Component and the Aesthetic Component of the Index of Orthodontic Treatment Need. All adolescents completed a questionnaire concerning satisfaction with the function and appearance of their dentition and self-perceived orthodontic treatment need. They also scored their own dental appearance on a visual analogue scale.
RESULTS: The morphological criteria of the OMFI were met by 58 per cent of the orthodontically treated and by 49 per cent of the untreated adolescents, and the functional criteria by 67 and 57 per cent, respectively. Residual treatment need was registered in two of the treated adolescents (7%) both of whom had discontinued treatment. Among untreated adolescents, residual treatment need was registered in five (14%). Orthodontically treated adolescents were more often satisfied with their dental appearance than untreated adolescents ($P < 0.05$). In both groups, satisfaction with function was high (93%). Self-perceived treatment need was reported equally, by 4 per cent of the treated and 5 per cent of the untreated adolescents.
CONCLUSIONS: Orthodontic treatment may improve both occlusal morphology and function. The high satisfaction with dental appearance among orthodontically treated adolescents is of note.

176 IMMEDIATE SHEAR BOND STRENGTHS OF TWO NEW SELF-ETCHING PRIMERS

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AIM: To measure the immediate shear bond strength (SBS) of two new self-etching primers (SEP).
MATERIALS AND METHOD: Sixty non-carious and non-restored human molars were randomly divided into four equal groups. Each tooth was mounted vertically in self-cure acrylic, pumiced, washed and dried prior to bonding. Each tooth was bonded with a stainless steel button (GAC International) according to the manufacturer's instructions with two new 7th generation bonding systems: iBond (Heraeus Kulzer) and G-Bond (GC America) and compared with Transbond Plus SEP (3M Unitek) and Transbond XT (3M Unitek) (control). Immediate SBS was measured and recorded using a Universal testing machine (Zwick) with a crosshead speed of 0.5 mm/minute. The amount of adhesive resin left on the enamel after debonding was evaluated using the Adhesive Remnant Index (ARI). The results were analyzed using one-way ANOVA ($\alpha = 0.05$) and multiple comparison tests.
RESULTS: Transbond XT (11.22 ± 1.99 MPa; cv = 18%) had a significantly higher SBS when compared with Transbond Plus SEP (5.32 ± 1.81 MPa; $P < 0.001$; cv = 34%), iBond (6.69 ± 1.78 MPa; $P < 0.001$; cv = 27%) and G-Bond (8.30 ± 2.42

MPa; $P < 0.01$; cv = 29%). The tests revealed that G-bond had a significantly higher SBS compared with Transbond Plus SEP ($P < 0.01$). Comparison of G-Bond with iBond yielded no significant difference. The results of the ARI chi-squared comparisons indicated a significant difference between the four groups.
CONCLUSIONS: SBS of the new SEP, G-Bond, showed significantly higher immediate SBS than the other SEPs. Immediate SBS of the new SEPs have SBS values adequate to support immediate archwire insertion.

177 VALIDITY OF CONE BEAM COMPUTED TOMOGRAPHY BASED VIRTUAL DENTAL ANALYSIS

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AIM: Three-dimensional dental models can be created by cone beam computed tomography (CBCT) based data sets, which can be analysed in a virtual environment. The aim of this study was to test the validity of these virtual measurements.
MATERIALS AND METHOD: Thirty CBCT based data sets were analysed virtually and the measured values were compared with the corresponding values obtained by analysing a conventional plaster cast of the same patient.
RESULTS: The mean deviation between the virtual and real plaster cast based values was less than 0.2 mm, a dimension which is clinically acceptable.
CONCLUSIONS: Virtual dental analysis is an efficient and effective alternative to conventional analysis of plaster casts.

178 INVESTIGATION ON ORTHODONTIC MINI-IMPLANT DISPLACEMENT – A QUANTITATIVE STUDY IN HUMAN CADAVER BONE

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AIM: Primary stability and resultant movement of orthodontic mini-implants depends on a number of factors, and influences clinical success or failure. However limited data is available that quantitatively assesses the micro-movement upon load application. The purpose of this pilot study was to isolate and measure the effect of load related movement of mini-implants using repeated load application.
MATERIALS AND METHOD: Orthodontic mini-implants (n = 39) were inserted in the alveolar process of human cadaver maxillae (n = 10) and insertion torque was recorded. Increasing horizontal forces (up to 2.5 Ncm) were applied and implants were loaded three times with an 8 minute force exposure time. Force related displacement of the implants (0.5 Ncm intervals) was measured and recorded using an optical image correlation technique based on photogrammetric principles. Data were subjected to a non-parametric multivariate analysis. Additionally, peri-implant parameters (e.g. cortical and gingival thickness) were assessed based on microcomputed tomographic volume data of the specimens.
RESULTS: Following the first load cycle (median 19 ± 57 μm) no further increase in displacement was observed in subsequent measurements. Displaced implants did not return to baseline values following load application (median 7 ± 34 μm; $P < 0.01$). No significant correlation between insertion torque and primary stability was found, while insertion depth was related to displacement.
CONCLUSIONS: The findings underline the importance of optimal screw placement and the influence of load application on permanent displacement of orthodontic mini-implants. This might play a decisive role when attaching orthodontic devices for tooth movement. Excessive forces may be harmful to the surrounding bone tissue reducing the overall stability of the mini-implants and manipulation should therefore be minimized.

179 ORAL HEALTH IN PATIENTS WITH JUVENILE IDIOPATHIC ARTHRITIS

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AIM: To compare oral health in a group of patients with juvenile idiopathic arthritis (JIA) with that of a control group of healthy subjects.
SUBJECTS AND METHOD: Thirty-two patients with JIA and 28 controls. In both groups the plaque index (PI), gingival index (GI), probing depth (PD), clinical attachment loss (CAL) and decayed missed filled teeth (DMFT) index were determined. In addition, the caries risk test was used to determine the amount of *mutans streptococci* and *lactobacilli* in saliva by means of selective culture media. Temporomandibular joint (TMJ) screening according to Ahlers and Jakstat was recorded to diagnose TMJ dysfunction.
RESULTS: The respective values for the JIA and the control group were: PI (mean ± SD) 0.52 ± 0.24 versus 0.46 ± 0.31; GI: 0.28 ± 0.19 versus 0.14 ± 0.12. There were significant differences in the prevalence of sites with CAL >3 mm (8.76 ± 7.53

versus 4.46 ± 3.92) in the patients and controls. The number of DMFT was not significantly greater in the JIA children compared with the controls (8. 06 ± 4.37 versus 6.68 ± 4.67). The number of colony forming units of *S. mutans* and *lactobacilli* was similar in both groups. Subjects with JIA showed more signs of TMJ dysfunction and symptoms than the healthy controls.
CONCLUSIONS: The JIA patients in this study had inferior oral health compared with the control group. Since JIA patients often require orthodontic treatment with fixed (Herbst) appliances to release their TMJs, special attention must be paid to their oral hygiene to avoid further impairment.

180 COMPARISON OF OCCLUSAL OUTCOMES IN PATIENTS WITH COMPLETE UNILATERAL CLEFT LIP AND PALATE AFTER ONE- AND TWO-STAGE TREATMENTS

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AIM: To evaluate and compare, in a pilot study, dental occlusions in the mixed dentition stage in two groups of patients, with unilateral complete cleft lip and palate (UCLP), who differed in the timing of lip and palate closure.
SUBJECTS AND METHOD: Fourteen patients with UCLP divided into two groups. Five patients underwent a one-stage operation for lip and palate closure (mean age 12.2 ± 1.9 months) and nine patients had the lip and palate closures carried out at two different stages (mean age for lip closure 5.3 ± 2.6 months, palate closure 18.4 ± 10.3 months). Study models were measured to determine anterior arch width, posterior arch width, anterior overjet, anterior crossbite, and lateral or posterior crossbite. The outcomes from the one- and two-stage operations were compared.
RESULTS: No statistically significant differences were found between the two groups.
CONCLUSIONS: There was no difference in the development of the occlusal relationship between one- and two-stage surgery in patients in the mixed dentition.

181 EFFECTS OF LOW-LEVEL LASER THERAPY WITH CORTICISION ON TOOTH MOVEMENT AND ALVEOLAR REMODELLING IN BEAGLES

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AIM: To investigate the combined effects of low-level laser therapy (LLLT) concomitant with corticision, as an intentional surgical injury to induce the regional acceleratory phenomenon on the rate of tooth movement and alveolar remodelling in dogs
MATERIALS AND METHOD: Twenty-four maxillary second premolars from 12 dogs were randomly divided into four groups: group A, provided with only orthodontic force; B, with force plus corticision; C, with force plus LLLT; D, with force plus corticision and LLLT.
RESULTS: The ratios of second premolar/canine movement at week 8 were 2.23-fold greater in group B, and 2.08-fold greater in group C than in group A. On the other hand, the ratio in group D was 0.52-fold less than in group A. As a result of immunohistochemical analysis, catabolic activity, as measured by tartrate-resistant acid phosphatase-positive multinucleated osteoclasts on the compression side, and anabolic activity, as measured by the ratio of PCNA-positive osteoblasts on the tension side were all significantly increased in group C but decreased in group D. Histomorphometric analysis showed that the mean apposition length during 8 weeks was significantly increased in groups B and C. In group D, bony apposition length was slight, while intra-trabecular remodelling and lamellation process was found to be active.
CONCLUSIONS: Periodic LLLT applications after corticision around the moving tooth decreased the rate of tooth movement and alveolar remodelling activity.

182 ORTHODONTIC RIDGE AUGMENTATION IN IMPLANT THERAPY

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AIM: To assess alveolar bone remodelling after orthodontic movement in atrophic extraction sites in adult patients.
SUBJECTS AND METHOD: Ten adult patients presenting with atrophic extraction sites in the premolar area. Orthodontic treatment was performed with full fixed self-ligating appliances and lasted a mean period of 8 months. The residual premolar was moved by application of light forces and low friction mechanics in the atrophic extraction sites to produce new alveolar bone both in the vertical and transverse dimension. All patients underwent a computed tomographic (CT) scan and study models were obtained pre- and post-treatment.
RESULTS: New bone formation allowed implant insertion in all patients without further surgical ridge expansion. The CT scan and study models at the end of treatment showed sufficient bone augmentation in the transverse and vertical dimensions.
CONCLUSIONS: In the case of single missing teeth, orthodontic ridge augmentation could represent a valid atraumatic and predictable alternative to traditional surgical expansion.

183 MANDIBULAR POSITION AND POSTURE OF THE BACK – A THREE-DIMENSIONAL STUDY

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AIMS: As a new scientific method, digital fringe projection is useful for three-dimensional (3D) surface reconstruction of the human body. It is commonly used for documentation and biometric analysis of shape changes of the back, this means the spine in correspondence with the position of the mandible. In this pilot study two back scanner systems were used (ABW-Scanner, GeBioM; Formetric, Diers®).
SUBJECTS AND METHOD: Five females were evaluated with the two scanners. The mandible was scanned in seven different functional positions: rest position, habitual intercuspation and provocation of contact using cotton rolls in the right and left molar regions, the right and left premolar regions and the incisor region.
RESULTS: All parameters showed a significant change (Kruskal-Wallis test; $P = 0.001$). Most changes were seen when a contact was provoked in the premolar region with both scanners. Changes in body posture were noted, especially in shoulder height, their rotation, the height of the pelvis and the torsion of the shoulder compared with the pelvis.
CONCLUSION: The 3D shape of the spine is influenced by several different mandibular positions. The quality and quantity is correlated with localisation of occlusal contacts. The two scanner systems are useful for this documentation.

184 EXAMINATION OF THE CORRELATION BETWEEN A UNILATERAL CROSSBITE AND BODY POSTURE

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AIM: To investigate if there is a correlation between a unilateral crossbite and body posture. The main interest was directed towards the impact of deviation of the spine and pelvis.
SUBJECTS AND METHOD: Twenty untreated patient in the mixed dentition with a unilateral crossbite. Their mean age was 8 years (range 7 to 10 years). The orthodontic findings were generated from clinical investigation and standardized plaster model analysis. Collection of the orthopaedic data was based on the use of a three-dimensional (3D) backscan (Formetric, Diers). This 3D backscan provides analysis of the surface curvature by applying light-line projections.
RESULTS: There was a statistically significant correlation between a unilateral crossbite in the mixed dentition and spine asymmetry.
CONCLUSION: A unilateral crossbite in the mixed dentition might influence body posture. Thus, it could be reasonable to evaluate the extent to which orthodontic correction of a crossbite has a positive effect on body posture in terms of the structure of the spine.

185 CHANGES AND STABILITY OF APICAL BASE DIAMETERS THROUGH FUNCTIONAL TREATMENT WITH REMOVABLE APPLIANCES

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AIM: The amount and stability of apical base diameters are important for treatment outcome in growing children. The increase depends on different factors, such as age, gender, individual disposition and also the type of appliance used for developing the apical base of the jaws. The aim of this retrospective study was to evaluate the amount of apical growth during functional removable appliance treatment
MATERIALS AND METHOD: Alabaster models of 27 female and 23 male orthodontic patients. The average treatment time using a minimized activator appliance was 3 years 6 month.
RESULTS: The average change in apical base diameter was 1.8 mm. This was less than the average change in crown diameter (2.7 mm). There was a strong relationship between age at the start of treatment and the achieved increase in the apical base.
CONCLUSIONS: A larger increase in apical base diameter will be followed by more stability of the treatment result. An earlier treatment start means more growth in the apical base of the jaws. As the absolute increase of apical base diameters is less than that of crown diameters, relapse is possible.

186 ORTHODONTIC TOOTH MOVEMENT ACCELERATION BY GENETIC ENGINEERING:

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AIM: To investigate, in depth, the biomolecular and genetic basis of orthodontic tooth movement. This experiment was undertaken by means of osteoclast and osteoblast biomolecular selective stimulation. It was hypothesized that experimental

gene transduction of RANKL would control osteoclastogenesis leading to orthodontic tooth movement acceleration with clinical and statistical repercussions. This was compared with two other alternative methods.
MATERIALS AND METHOD: To test the hypothesis, experimental tooth movement was undertaken in 35, ten-week-old Wistar rats either with or without a local injection of biomolecular agents. The animals were divided into four groups: G1 (control), G2 (viral transduction), G3 (corticotomy) and G4 (local BMP2). A split mouth analysis was undertaken between the four groups in order to measure the acceleration of orthodontic movement after local injection of two selective biomolecular bone modifiers. Both were applied with and without surgery. The animals were sequentially killed in order to gather immunohistochemical, histological and radiological evidence.
RESULTS: 1) RANKL protein plays a central role in clinical bone and orthodontic biology. 2) There is inmunohistochemical evidence of functional RANKL protein delivered by viral transduction during at least 5 days. 3) Viral RANKL trasnduction has more potent effects on orthodontic tooth movement than either surgery or local BMP2 injection. 4) There is a significant and clinical increase in biological acceleration of orthodontic tooth movement of almost 40 per cent.
CONCLUSIONS: Genetically engineered local transduction of RANKL was used to investigate clinical and inmunohistochemical functional efficiency on experimental animals.

187 EXCESS ADIPOSE TISSUE RATHER THAN ABNORMAL CRANIOFACIAL MORPHOLOGY OR MALOCCLUSION IS ASSOCIATED WITH SLEEP DISORDERED BREATHING

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AIM: To evaluate the determinants of sleep disordered breathing (SDB) in children.
SUBJECTS AND METHOD: A representative population sample of 219 children (98 girls, 121 boys) 6-7 years of age. Occlusion was registered clinically according to the modified method of Björk *et al.* (1964). Craniofacial morphology was recorded by visual observation. Sleeping habits and the quality of sleep were evaluated by a questionnaire given to the parents. SDB was defined as witnessed apnoea or loud or frequent snoring. Body fat percentage was assessed by the bioimpedance method. The determinants of SDB were analyzed by multiple logistic regression analysis.
RESULTS: Thirteen per cent of the children had symptoms of SDB, which were more prevalent in boys than in girls ($P = 0.035$). Body fat percentage was higher in girls than in boys ($P < 0.001$). Profile was convex in 30 per cent and anterior face height was increased in 23 per cent and decreased in 5 per cent of the subjects. Distal molar occlusion was observed in 28 per cent, a crossbite in 14 per cent and an open bite in 4 per cent of the children. Higher body fat percentage ($P = 0.025$) and male gender ($P = 0.024$), but none of the occlusal or skeletal craniofacial features, were associated with SDB.
CONCLUSIONS: Excess adipose tissue and male gender rather than deviant craniofacial morphology or malocclusion predispose to SDB in children aged 6-7 years.

188 CANINE INVOLVEMENT IN ORTHODONTIC PATHOLOGY

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AIM: To evaluate canine involvement in orthodontic pathology in terms of frequency, anomaly type, and specificity.
SUBJECTS AND METHOD: Six hundred and fifty patients (females: 60.9%, males 39.1%) treated during the period 1 January 2007 to 1 January 2008. Treatment was preceded by evaluation of canine anomaly frequency in relation to the total number of patients diagnosed with dentomaxillary anomalies, the separate prevalence of impaction, ectopia and transposition, as well as several coordinates (the affected maxilla, gender and clinical forms).
RESULTS: Approximately 10 per cent of the patients showed orthodontic pathology and canine anomalies located in the upper arch, of which more than 50 per cent were ectopia. Less frequent was transpositions. Buccal ectopia was more frequent than oral ectopia, while the ratio was *vice versa* for inclusions. With regard to transposition, a canine-premolar transposition prevailed in the lower jaw. One particular aspect of the inclusion was represented by the transmigration (lower impacted canine) anomaly found in one patient.
CONCLUSIONS: Canine involvement in orthodontic pathology is obvious. Due to its importance in the function of the stomatognathic system (especially aesthetics) and transmission of forces, it requires increased attention during growth.

189 DEBONDING CHARACTERISTICS OF THREE CERAMIC BRACKETS

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AIM: To compare the bond strengths and debonding characteristics of three ceramic brackets.

MATERIALS And METHOD: One hundred fifty human upper premolar teeth divided into three groups. In group A, InVu Readi-base ceramic brackets (TP Orthodontics, La Porte, Indiana, USA) and in group B adhesive coated Clarity brackets (3M Unitek, Monrovia, California, USA) were used. In group C, Inspire Ice brackets (Ormco, Glendora, California, USA) were bonded with Blugloo adhesive (Ormco). For etching 37 per cent phosphoric acid was used for 30 seconds in all groups. In groups A and B, Transbond XT (3M Unitek) and in group C, Ortho Solo (Ormco) primers were applied. The adhesive was light-cured for 10 seconds from above the brackets in all groups. Twenty-five samples of each group were subjected to shear bond strength (SBS) testing after 1000 thermocycles. The remaining 25 samples of each group were debonded using debonding pliers as specified by the manufacturers. One-way analysis of variance was used to determine whether there were any significant differences in SBSs ($P < 0.05$). Kruskal–Wallis and Mann–Whitney U non-parametric tests were used to determine whether there were any significant differences of the Adhesive Remnant Index scores ($P < 0.0033$).
RESULTS: The SBS of group A (10.84 MPa) showed a significant difference from group B (19.25 MPa) and group C (19.3 MPa) ($P < 0.001$). ARI scores of plier debonding did not present any significant differences among the groups ($P > 0.0033$). In all groups a pronounced number of ARI scores of 3, i.e., all adhesive left on the tooth surface, was observed.
CONCLUSION: For the majority of plier debonded samples the entire residual adhesive remained on the enamel surface. This type of debonding pattern has the advantage of protecting the enamel surface.

190 MEASUREMENT OF THE DISTORTION OF THE TEMPOROMANDIBULAR JOINT

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AIM: Maxillofacial surgery can lead to distortions of the mandibular joint, bone resorption and finally articulatory dysfunctions. Bimaxillary surgical correction in high angle absolute mandibular retrognathic patients may provoke condylar resorption. The aim of this presentation is to report an *in vivo* measurement method to evaluate mandibular joint distortion and to determine its correlation with possible clinical symptoms during long-term observation of these patients.
SUBJECTS AND METHOD: Cone beam computed tomographic (CBCT) images were obtained for seven patients (2 males, 5 females) with an average age of 30 years (range: 16 to 48 years) before and after functional craniofacial surgery. A fuzzy three-dimensional (3D) implementation of focussed mutual information was developed, in which the operator only needs to approximately indicate the anatomical structure on the pre-image. Changes in the left mandibular joint were studied from the alignment focussing on the left mandibular ramus. An analogous procedure was applied to the right mandibular ramus. The superimposed images were subtracted.
RESULTS: The subtraction image revealed a clear change in geometry in seven of the 14 joints. The rotation in the horizontal plane ranged from –11.2 to 8.8 degrees, with $\mu = -0.7$ degrees, and $\sigma = 4.6$ degrees. The rotation in the frontal plane ranged from –6.8 to 9.5 degrees, with $\mu = 0.4$ degrees, and $\sigma = 4.8$ degrees. The displacement of the caput with respect to the fossa ranged from 0.2 to 3.5 mm in the horizontal plane, with $\mu = 1.3$ mm, and $\sigma = 1.1$ mm. Minimal distances lower than 1 mm were observed.
CONCLUSIONS: Better-controlled studies are required to fully understand the relationship between condylar resorption and orthognathic surgery. The semi-automatic alignment method based on focussed mutual information allows for superimposition of 3D CBCT images and makes it possible to accurately measure distortion of the mandibular joint immediately after surgery.

191 A CEPHALOMETRIC APPRAISAL OF THE ORTHOPAEDIC EFFECTS OF HIGH-PULL *EN MASSE* RETRACTOR

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AIM: To investigate the orthopaedic effect of a maxillary splint and high-pull headgear on the maxillary complex.
MATERIALS AND METHOD: Lateral cephalometric radiographs of 26 patients (11 males, 15 females, with a mean age of 11.3 years) treated with a maxillary splint and high pull headgear were compared with a similar control group of 26 individuals (11 males, 15 females with a mean age of 12.6 years). The relationships of the outer arm of the facebow to the centre of resistance of the both maxilla and its dentition and the direction of the pull was regulated for each patient.
RESULTS: The treatment group more closely approximated Class I cephalometric values after treatment, whereas the Class II skeletal pattern did not necessarily become 'less Class II' because of growth. Point A, however, was held efficiently in the treatment group (S-A = 0.4 mm) whereas in the control group it relocated downward and forward 2.00 mm along sella-point A (S-A) line. The relocation of point A in the horizontal (x-axis) and vertical (y-axis) planes also confirmed these findings. No rotational changes of the palatal plane were observed in the treatment group. Mandibular skeletal changes were similar to the control group. The maxillary dentition was relocated more posteriorly.

CONCLUSIONS: A maxillary splint with high pull headgear held the maxilla in position without any rotational changes of the palatal plane. Establishment of a Class l occlusion in the treatment group was achieved through a combination of maxillary dental retrusion, maxillary alveolar growth inhibition, and a normal expression of mandibular growth.

192 EVALUATION OF MAXILLARY TOOTH SIZE IN SUBJECTS WITH BUCCAL CANINE ECTOPIA

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AIM: A buccally displaced canine (BDC), erupted or unerupted, is a commonly encountered orthodontic problem. This has been strongly associated with crowding and altered dental development. The aim of this investigation was to evaluate tooth dimensions of 12-20 year old patients with a BDC compared with subjects with a normally erupting maxillary canine.
SUBJECTS AND METHOD: Sixty individuals divided into two groups: group 1 (case) subjects with BDC and group 2 (control) subjects with normal canine eruption (15 girls and 15 boys in each group). Initial study models and dental pantomograms were selected from the records of three orthodontic clinics. The mesio-distal and bucco-lingual widths of the permanent teeth (central and lateral incisors, first and second premolars, and first molars) was measured using a digital dial calliper (accuracy = 0.02 mm). The data was analyzed by Kolmogrov-Smirnov test and the results with a Student's *t*-test under SPSS software.
RESULTS: The overall findings supported the concept of larger-than-average teeth in the BDC group. The total mesio-distal size of the teeth was larger in female subjects ($P < 0.05$), but in the male group there were no significant differences. In the female group the discrepancy was statistically significant for the first and second premolars ($P < 0.05$).
CONCLUSION: As the maxillary canine is the last tooth to erupt in the upper arch with a primary predecessor, it is more susceptible to environmental influences of crowding. Therefore, a longitudinal prospective study, excluding environmental factors could resolve some of the mysteries of the ectopic maxillary canine.

193 TREATMENT OF CLASS III MALOCCLUSIONS USING MINISCREWS AND ORTHOPAEDIC TRACTION

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AIM: Several types of device have been used to correct Class III malocclusions due to maxillary deficiency. However, no study has been conducted regarding the use of miniscrews and orthopaedic forces in the correction of maxillary deficiency. The purpose of this study was to evaluate the dentoskeletal effects resulting from orthopaedic forces from mandibular miniscrews to upper removable appliances in growing Class III malocclusion subjects due to maxillary deficiency.
SUBJECTS AND METHOD: Eighteen patients with maxillary deficiency and a normal mandible. Nine patients (mean age 9.4 years) were treated with a reverse chin cup (control group). The reverse chin cup was applied for 13 ± 2 months. Nine other patients (mean age 12.9 years) were treated with miniscrews and Class III traction (experimental group). Miniscrews were inserted bilaterally between the mandibular canines and first premolars under local anaesthesia. All patients in the experimental group had a removable appliance in the upper arch. Class III elastics were connected from the mandibular miniscrews to hooks on the Adams' clasps on the first molars of the upper removable appliance. This orthopaedic force (500 g) was applied immediately after screw insertion and continued for 10 ± 2 months. Dental pantomograms, lateral cephalograms, and photographs were taken at the beginning and end of treatment in both groups and the data were compared statistically using the Statistical Package for Social Sciences.
RESULTS: SNA, overjet, ANB and soft tissue profile were improved in both groups ($P < 0.05$). IMPA decreased significantly in the control group but there were no significant change in the experimental group.
CONCLUSION: The use of miniscrews and application of traction force from miniscrews to an upper removable appliance is a new method for correction of a Class III malocclusion due to maxillary deficiency. This appliance may be suitable for patients where the wearing of extra oral appliances is not feasible.

194 RELATIONSHIP BETWEEN POGONION ADVANCEMENT AND POSTERIOR MAXILLARY IMPACTION

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AIMS: Controversy exists concerning the relationship between the amount of posterior maxillary impaction and pogonion advancement. The aims of the present study were to: 1) propose a formula to predict the amount of pogonion advancement due to posterior maxillary impaction surgery; 2) predict the amount of posterior maxillary impaction by means of a formula in order to achieve the best facial harmony; and 3) identify the compatibility between proposed formulas and the actual resultant mandibular position following posterior maxillary impaction surgery.

SUBJECT AND METHOD: To obtain the formulas, two cephalograms were taken of one patient, in centric occlusion and in the rest position. The mandibular rotational centre was then obtained by superimposing the cephalograms, thus providing the two formulas. In order to check the reliability of the formulas, the pre- and post-surgical cephalograms of 10 patients (mean age 21 ± 1.5 years) who had undergone posterior maxillary impaction were selected. These cephalograms were superimposed in order to find the centre of mandibular rotation. Pearson's correlation coefficient was used to evaluate the relationship between the suggested formulas and the clinical data.
RESULTS: There were significant correlations between maxillary impaction and pogonion advancement with both formulas and in clinical evaluation. This correlation was ($r = 0.993$, $P < 0.001$) based on the formulas and ($r = 0.806$, $P < 0.005$) based on the tracing.
CONCLUSIONS: The amount of anterior facial height reduction and pogonion advancement were almost the same. Anterior face height was reduced 1.5 times more than the amount of maxillary impaction.

195 AGED GINGIVAL FIBROBLASTS PRODUCE HIGHER LEVELS OF REACTIVE OXYGEN SPECIES THAN YOUNG CELLS

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AIM: To report changes that occur in reactive oxygen species (ROS) generation of rat gingival fibroblast (rGF) with ageing, and to explain phenotype changes in aged gingival fibroblast.
MATERIALS AND METHOD: Six-week-old (n = 5), 12-month-old (n = 5) and 20-month-old (n = 5) rats were allocated to 'young', '1-year-old', and 'old' groups and the interleukin-1α activated proliferative capacity of each group were compared. The changes in proliferative capacity, superoxide generation, lipid peroxidation and mitochondrial DNA damage were also measured after treating them with antioxidant, pyrrolidine dithiocarbamate (PDTC) and N-acetyl-L-cysteine (NAC).
RESULTS: Decreased proliferative capacity was observed in the aged cells. When the aged cells were treated with interleukin-1α, superoxide generation significantly increased. However, when antioxidant was added, the generation of superoxide completely disappeared. The activity of antioxidant superoxide dismutase protein in the aged cells was rarely observed. The density of glutathione, which acts as a buffer against the ROS, was significantly lower in the aged cell. MDA level, which represents cell damage caused by oxidation, was 1.8 fold higher in the aged cells and 34 per cent of DNA amplification decreased leading to mitochondrial DNA damage. The decreased proliferative capacity was reversed when the aged cells were treated with PDTC and NAC.
CONCLUSIONS: As cells age, ROS play a major role in phenotypic changes in gingival fibroblasts, resulting in regressive changes in the periodontal tissue.

196 RELATIONSHIP BETWEEN THE LINGUAL FRAENULUM AND CRANIOFACIAL MORPHOLOGY IN ADULTS

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AIMS: To determine the relationship between the length of the lingual fraenulum and craniofacial morphology, and to test the hypothesis that a skeletal Class III malocclusion is related to a tongue-tie tendency.
SUBJECTS AND METHOD: One hundred and fifty subjects (71 males, 79 females; mean age: 24.9 years). The samples were divided into skeletal Class I ($0° < ANB < 4°$), Class II ($ANB > 4°$) and Class III ($ANB < 0°$) groups. Two types of measurements were used to quantify the length of the lingual fraenulum. The first utilized direct measurement of the median lingual fraenum length with a lingual fraenum ruler; the second measured the maximum opening of the mouth with the tip of the tongue touching the incisive papilla. A lateral cephalogram was taken for each subject and a computerized cephalometric analysis was used to assess cranial morphology. ANOVA was used to compare the differences among the three groups. Pearson's correlation analysis was used to determine any relationship between the median lingual fraenum length and cephalometric variables.
RESULTS: The median lingual fraenum length was significantly longer in the skeletal Class III subjects compared with the skeletal Class I and II subjects. The maximum opening of the mouth was significantly reduced in the skeletal Class III subjects compared with the Class I and II subjects. Significant correlations were also found between the median lingual fraenum length and cephalometric variables such as SNB, mandibular length, APDI, ANB, and Wits appraisal.
CONCLUSIONS: The findings support the hypothesis that a skeletal Class III malocclusion is related to a long median lingual fraenum or a tongue-tie tendency. Patients diagnosed with a tongue-tie may have a tendency towards a skeletal Class III malocclusion.

197 SUCCESS RATE OF ANTERIOR OPEN BITE ORTHODONTIC-SURGICAL TREATMENT

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AIM: To evaluate the short-term success-rate of combined orthodontic-orthognathic surgical correction of an anterior open bite (AOB).
SUBJECTS AND METHOD: Forty-one consecutive open bite cases planned for treatment by means of a combined orthodontic-orthognathic surgical approach. Twenty-six patients were not treated for various reasons. The remaining 15 Angle Class I, II or III open bite patients (15–28 years) were examined retrospectively. Lateral cephalograms from before (T1), after (T2) orthodontic-surgical treatment and, on average, 18 months (10–26 months) after treatment (T3) were evaluated. The overbite (OB) was classified as normal (2–3.5 mm), borderline (0–1.5 mm) and relapse (<0 mm) and the overjet (OJ) as normal (2–3.5 mm) and relapse (≥4 and ≤1.5 mm).
RESULTS: The average OB was –3.2 mm (T1), 1.8 mm (T2) and 1.3 mm (T3). During active treatment (T1-T2) the OB and OJ were normalized in 53.3 and 66.7 per cent, respectively. At T3 one patient (6.7%) showed a negative OB whereas a borderline OB was found in 53.3 per cent of the subjects. OJ relapsed in 40 per cent of the subjects. An incisal contact was found in 53.3 per cent (T2) and 46.6 per cent (T3), respectively. Forty per cent of the patients exhibited completely successful treatment with incisal contact, normal OJ and OB. ML/NSL increased in 40 per cent of the subjects (T1-T3): half of these patients had a stable, 33.3 per cent a borderline, and one a negative OB (16.7%). The IsL/IiL at T3 was largest in patients with a stable OB (140.83°) and lowest those with OB relapse (84°).
CONCLUSIONS: Orthodontic-surgical treatment of AOB patients improves the OB but an excellent treatment outcome with a normal OJ, incisal overlap and incisal contact was only found in 40 per cent of the subjects. The treatment goal in AOB patients should be adjusted accordingly.

198 DOES HYOID BONE RESECTION INFLUENCE CRANIOFACIAL GROWTH?
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AIM: To evaluate the influence of hyoid bone resection at an early age due to a thyroglossal duct cyst on craniofacial growth.
MATERIALS AND METHOD: Lateral cephalograms of 10 patients (2 females, 8 males) having had hyoid bone resection according to Sistrunk due to thyroglossal duct cysts were retrospectively analyzed. Surgery was carried out at a mean age of 4.4 years (range = 0.37–9.8 years), while the cephalograms were taken several years later before the start of orthodontic treatment (mean: 17.1 years, range: 8.6–31.9 years). To evaluate craniofacial growth, the data of each patient was compared individually to corresponding standard values (age and gender) from the Bhatia und Leighton sample.
RESULTS: Sagittal: SNB angles were, by trend, too small and ANB angles too large. However, the ratio, mandibular to maxillary length, showed that the patients had a too large a mandible or too small a maxilla, respectively. Vertical: Large deviations from normal values in both directions (hyper- to hypodivergent pattern) could be detected when analysing NSL/ML', NL/ML', and NSL/NL. Dental: The majority of the patients had retroclined upper (IsL/NL, IsL/N-A) and lower (IiL/ML, IiL/N-B) incisors.
CONCLUSIONS: Several vertical and horizontal skeletal and dental cephalometric parameters were found to be different by trend when compared with control values. A possible negative impact on craniofacial growth potential and direction due to hyoid resection at an early age cannot be excluded.

199 EFFECT OF $NAHCO_3$ AND PROPHYPEARLS ON HEALTHY ENAMEL, DENTINE AND INITIAL CARIOUS LESIONS
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AIM: Patients with fixed orthodontic appliances often require professional prophylaxis. Various air-polishing systems have been shown to be effective; however with conventional sodium bicarbonate these devices are particularly aggressive towards dental hard tissue. The aim of this study was to compare, *in vitro,* the abrasiveness of two powders ($NaHCO_3$ and Prophypearls, a novel low air-polishing powder).
MATERIALS AND METHOD: Permanent bovine incisors were ground flat and polished with up to 4000 grid SiC disks on a polishing machine. One-third of these teeth were subjected to a very cariogenic environment in an artificial oral cavity for 17 days in order to produce initial carious lesions. In addition, further teeth were sanded down until dentine was exposed at a depth of 0.6–0.8 mm from the enamel-dentine junction. Subsequently, surfaces measuring 2×7 mm were air-polished with an Airflow EMS-handy 2 (EMS, Munich, Germany) at a distance of 1 5 mm and maximum water setting. As prophylactic powder, either Prophypearls (KaVo) or $NaHCO_3$ (EMS) was used. All groups were abraded in a perpendicular manner; in addition Prophypearls was also applied at a 45 degree angle. Except for the initial caries group (5 seconds) the specimen were abraded for 60 seconds for each group: n = 10. Following air-polishing, the loss of hard tissue and the resulting surface roughness were determined with a Perthometer (Perthen, Göttingen, Germany).

RESULTS: Except for the initial caries (for Prophypearls at a 45° angle and for $NaHCO_3$ at a 90° angle), Prophypearls produced, on dentine and enamel, significantly rougher surface conditions and more tissue loss than $NaHCO_3$.
CONCLUSIONS: Prophypearls is significantly more abrasive than $NaHCO_3$.

200 EARLY VERSUS CONVENTIONAL LOADING OF PALATAL IMPLANTS: PRELIMINARY REPORT OF A MULTICENTRE RANDOMIZED CLINICAL TRIAL

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AIM: To analyze the clinical performance of two loading concepts on second-generation palatal implants (Orthosystem, Straumann, Basel, Switzerland) in a prospective multicentre randomized controlled clinical trial.
SUBJECTS AND METHOD: At the time of this interim analysis, 35 patients had been randomized on a 1:1 basis to one of two treatment groups. Group 1 (18 patients) received conventional loading of palatal implants after a healing period of 12 weeks (gold standard) while in group 2 (17 patients) early implant loading was carried out within 1 week of implant insertion. All patients required stationary anchorage for their orthodontic treatment. Direct (pendulum or distal jet appliances) as well as indirect forms of anchorage (conventional or modified transpalatal arch) were used. The initial results at 6 months after functional loading are reported. The primary outcome parameter is implant success (no implant mobility, no implant loss).
RESULTS: The implants in both groups were initially stable at the time of insertion and all were eligible for randomization. The magnitude of orthodontic force ranged between 1 to 6 N. Twenty-nine implants (15 early-loaded and 14 conventional-loaded palatal implants) have been functionally loaded for over 6 months. No implant loosening or implant loss has been registered in either group.
CONCLUSIONS: These preliminary data support the principal feasibility of early loading on palatal implants with forces to 6 N.

201 PREVALENCE OF DENTAL ANOMALIES IN ORTHODONTIC PATIENTS

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AIM: To determine the prevalence of dental anomalies (hypodontia, hyperdontia, impaction, peg-shaped upper lateral incisors) of permanent teeth in an orthodontic population.
SUBJECTS AND METHOD: One thousand two hundred and forty orthodontic patients (760 females, 480 males, mean age 15.1 years) evaluated over a five year period. The dental anomalies were diagnosed using pre-treatment dental casts, clinical examination, and radiographs.
RESULTS: The prevalence of congenitally missing teeth (third molars excluded) was 12.26 per cent (10.42% in males, 13.42% in females) with no statistically significant difference between the genders. The most commonly missing teeth were the lower lateral incisors, followed by the lower second premolars and upper second premolars. The total prevalence of supernumerary teeth was 1.45 per cent, most frequently in the upper anterior area. Supernumerary teeth were found to be more prevalent in males than in females. The prevalence of permanent impacted teeth was 4.27 per cent, and the most frequent impacted tooth was the upper canine (2.9%). The prevalence of a peg-shaped upper lateral incisor was 2.50 per cent.
CONCLUSION: This relatively high prevalence of dental anomalies emphasizes the importance of dental examinations in childhood with radiographic screening for dental anomalies as standard public oral health policy. The findings warrant further investigation of the orthodontic treatment strategies to prevent oral health impairment as a result of dental anomalies.

202 R151L MUTATION IN *TBX22* UNDERLIES CLEFT LIP AND PALATE WITH ANKYLOGLOSSIA

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AIM: Mutations in TBX22 have been known to cause a cleft palate (CP) with ankyloglossia syndrome. The mode of transmission is x-linked semi-dominant. This study was performed to identify whether mutations in TBX22 would be associated with isolated orofacial clefts with or without ankyloglossia, isolated ankyloglossia, and isolated hypodontia in affected individuals.
SUBJECTS AND METHOD: Sixty-four patients [6 CP, 4 CPe with ankyloglossia, 17 cleft lip and palate (CLP), 4 cleft lip, 2 CLP with ankyloglossia, 2 CLP with hypodontia, 1 CLP with ankyloglossia and hypodontia, 1 CLP with left oblique facial

cleft, 21 isolated ankyloglossia, and 6 hypodontia]. Genomic DNA was extracted from whole blood samples using the inorganic salting out procedure. The coding regions and flanking intronic sequences of TBX22 were amplified with polymerase chain reaction using specific primers. Directed sequencing was performed. The sequence was analyzed using Sequencher (version 4.8), and compared with human TBX22 reference sequence from Genbank.
RESULTS: A transversion (G to T) in exon 3 (452G→T) was found in one patient affected with CLP with ankyloglossia. This mutation leads to an arginine to leucine substitution at an amino acid position 151 of the polypeptide (R151L). This mutation occurred within DNA binding domain at highly conserved region of TBX22 gene in several species.
CONCLUSION: The 452G→T mutation has previously been reported once in a Thai patient affected with cleft soft palate, whereas the affected patient in the present study had a CLP with ankyloglossia. This indicates that 452G→T mutation is a pathogenic mutation that can cause various phenotypic anomalies of craniofacial development. The findings demonstrate for the first time that CLP with ankyloglossia is caused by mutation in TBX22.

203 DEVELOPMENT OF SYMMETRY IN NON-ORTHODONTICALLY TREATED SUBJECTS

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AIM: To measure the development of symmetry in occlusion from the early mixed dentition to adulthood in subjects with no orthodontic treatment.
SUBJECTS AND METHOD: Thirty-three 33 adults (15 males, 18 females). The inclusion criteria was a Class I occlusion, no asymmetric malocclusion, and no history of orthodontic treatment. Dental casts were available at the ages of 7, 10, 12, 15 and 32 years. Bilateral canine asymmetry and midline deviation was measured with a modified method of Pirttiniemi *et al*. (1994), using standardized photographs of each cast in every age group. The difference between the left and right canine relationship was calculated. The method for measuring bilateral canine relationship had earlier been found to be reliable.
RESULTS: Asymmetry of bilateral canine relationship was higher in adolescents compared with 32 years of age, asymmetry being highest at the age of 12 years and lowest at the age of 32 years. Midline asymmetry was highest at 10 years of age and lowest at 12 years of age but increasing to the age of 15 and 32 years. Values of asymmetry correlated significantly with bilateral canine relationship and midline at the ages of 12 and 32 years.
CONCLUSIONS: Asymmetry in bilateral canine relationships at a young age decreases to adulthood. Dental midline asymmetry shows more fluctuation, being highest 10 years of age, decreasing by the age of 12 years and accelerating at 15 and 32 years.

204 DETECTION OF HIF-1α IN THE RAT MANDIBULAR CONDYLE

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AIM: HIF-1α is a transcription factor that mediates adaptive responses to reduced oxygen availability. It has been shown that HIF-1α is a critical regulator of endochondral bone development in the growth plate. The purpose of this study was to examine whether HIF-1α is expressed in the mandibular cartilage of growing rats.
MATERIALS AND METHOD: Forty-eight 21-day-old male Wistar rats were housed in well-ventilated stainless steel cages with a 12-hour light-dark cycle with a maximum of three rats per cage. The rats were provided with food and water *ad libitum*. Six animals were sacrificed on days 3, 7, 10, 14, 17, 21, 24 and 28. The right temporomandibular joints were dissected, fixed in 10 per cent neutral formalin for 24 hours, demineralised for 10 days in 5 per cent formic acid, embedded in paraffin (4 μm thick sections) and processed for immunohistochemical staining of HIF-1α.
RESULTS: Detection of HIF-1α was evident in the mandibular cartilage.
CONCLUSIONS: HIF-1α is expressed in the mandibular cartilage of growing rats. The physiologic importance of HIF-1α expression for the development of the region remains to be clarified.

205 MANDIBULAR TRABECULAR CHANGES AFTER ORTHOGNATHIC SURGERY WITH FRACTAL ANALYSIS

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AIM: To evaluate trabecular change using fractal analysis and to demonstrate transient osteopenia related to rapid orthodontic tooth movement after orthognathic surgery.
MATERIALS AND METHOD: Panoramic radiographs of 26 patients who underwent bilateral sagittal split ramus osteotomy. The radiographs taken before and 1 month after surgery were overlapped and 40×40 pixel-sized square regions of interest were selected near both mandibular canines and first molars. After image processing procedure, fractal dimension was calculated using a box-counting method.

RESULTS: Fractal dimension was decreased after orthognathic surgery, showing a statistically significant difference ($P < 0.001$). The change of fractal dimension on the canine side compared with that on first molar side was statistically significant.
CONCLUSION: Bone density is decreased after orthognathic surgery due to a regional acceleratory phenomenon. This finding may provide guidance for orthodontic tooth movement after surgery.

206 EVALUATION OF THE INFLUENCE OF THIRD MOLAR ERUPTION ON CONTACT TIGHTNESS IN THE LOWER DENTAL ARCH

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AIM: To investigate if erupting third molars result in an increase in contact tightness (CT) in the lower dental arch.
SUBJECTS AND METHOD: Thirty-two volunteer dental students (7 males, 25 females) with a mean age of 21.1 ± 1.3 years at the beginning of the study. Selection criteria were: no congenitally missing teeth in the lower arch except third molars, no diastema, crowding, proximal caries or restorations in the lower posterior dentition and no previous orthodontic treatment. Twelve subjects had bilaterally missing lower third molars (group I) and 20 bilaterally present lower third molars in various stages of eruption (group II). CT measurements were made with a tension transducer connected to a metal strip that was placed interproximally and then pulled at a speed of 3 to 5 mm per second. The readings were taken from six contact points in the lower dental arch: 36-35, 35-34, 34-33, 46-45, 45-44 and 44-43. The measurements were made at baseline (T0) and after 6 (T1) and 12 (T2) months.
RESULTS: There were statistically significant increases in CT values from T0 to T2 in group I for all contact points measured except 35-34. In group II, there were significant increases in CT values from T0 to T1, T1 to T2 and T1 to T3 for all measured contacts. CT values for 46-45, 45-44 and 44-43 in group II at T1 and T2 were significantly higher than those in group I. There was no significant difference between the two groups with respect to CT values measured at 36-35, 35-34 and 34-33 at any time intervals.
CONCLUSION: Within a time span of 12 months, CT increased significantly in both groups. Hence, the higher CT values in lower right posterior contacts of individuals in group II cannot be readily attributed to the presence of erupting third molars.

207 DENTINOGENESIS IMPERFECTA AND CAUSATIVE GENE MUTATIONS

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The aim of this presentation is to provide information about gene mutations that cause dentinogenesis imperfecta (DGI) in humans and to present three clinical cases.
Dentine is a highly mineralized tissue that serves two causes, covering and protecting the pulp and supporting the overlying enamel and cementum. DGI is a genetic disorder of dentine development. This condition causes teeth to be discoloured and translucent. The pulp chamber is obliterated by abnormal dentine. The enamel, although unaffected, tends to fracture, resulting in rapid attrition of the dentine, leading to a marked shortening of the teeth. The teeth are also weaker than normal, making them prone to rapid wear, breakage, and loss. These problems can affect both primary and permanent teeth.
DGI is classified according to Shield in to three types I, II, III. Type I is a syndromic situation of osteogenesis imperfecta and DGI and it is caused by mutations in two genes encoding type I collagen (COL1A1, COL1A2). DGI II and III are non-syndromic situations and they are caused by mutations in the DSPP gene. Unravelling the mechanisms that affect the normal dentine formation and function could advance diagnosis, treatment prognosis and prevention of such malformations.

208 SHEAR BOND STRENGTHS AND FAILURE MODES OF THREE SELF-ETCHING ADHESIVE SYSTEMS IN ORTHODONTIC BRACKET PLACEMENT

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AIM: To compare both the shear bond strength (SBS) and failure modes of three self-etching and one conventional phosphoric acid etching adhesive in orthodontic bracket placement. The failure modes were assessed from the failure sites and the amount of residual adhesives on debonded enamel surfaces after debonding.
MATERIALS AND METHOD: One hundred and twenty eight maxillary and mandibular premolars extracted for orthodontic reasons from 32 patients (age range 12-19 years). The samples were divided into four groups of 32 teeth each, using a randomized block design. The brackets in the control group were bonded to the enamel surface using the conventional phosphoric etching adhesive system. In the experimental groups three self-etching adhesive systems were used: XenoIII, ED PrimerR and AdheSE. The mean SBS of the control and three experimental groups were 9.45, 1.48, 3.98 and 1.74 MPa,

respectively. The three experimental groups had a lower mean SBS than the control group ($P < 0.001$). Failure sites in all groups were mostly at the adhesive/enamel interface, and not within the enamel or brackets. The XenoIII group had more failures at the adhesive/enamel interface than the ED Primer and control groups ($P < 0.001$, $P = 0.001$). The mean rank of the amount of residual adhesive on the debonded enamel surfaces after debonding in the control and three experimental groups was 84.89, 41.33, 78.09 and 53.69, respectively. The control group had greater amounts of residual adhesives on the debonded enamel surfaces than the XenoIII and AdheSE groups ($P < 0.001$, $P = 0.001$). The ED Primer group had greater amounts of residual adhesives than those two groups ($P < 0.001$, $P = 0.008$).

209 DEVELOPMENT OF SUSTAINED FLUORIDE RELEASE FROM ORTHODONTIC ELASTOMERIC RINGS

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AIM: Enamel decalcification around fixed appliances may occur during orthodontic treatment in patients with poor oral hygiene. When dealing with non-compliant patients, controlled fluoride release would be beneficial in preventing demineralization by providing fluoride ions into the oral cavity. The purpose of this study was to develop a novel approach for controlled release of fluoride from elastomeric rings.
MATERIALS AND METHOD: FDA approved biocompatible polyethylene co-vinyl acetate (PEVA) was used as the target elastomer. Samples (n = 3) were prepared by adding different amounts of NaF ranging from 0.02 to 0.4 to 4.2 g PEVA/20mL THF solution, either in aqueous or powder form. After NaF addition, the mixture was sonicated for 2 hours, poured into a Petri dish and bench-dried to form a thin film. Another solution of 4.2 g of PEVA pellets in 20 mL THF without NaF was also prepared. NaF incorporated polymer samples were dipped into this solution and vacuum-dried. After the sample was dried, it was inserted into 50 mL of buffer solution and fluoride ion concentration was measured with an ion selective electrode over a 40 day period. In order to determine the temperature effect, the fluoride release was tested both at 21 and 37°C. Fluoride release profiles were compared with the target release profile generated by an optimal dose of 0.7 µgF/elastomeric ring/day.
RESULTS: At day 40, the total amount of fluoride released at 37°C was measured as 30.50 ± 2.14 µg/ring for the group that had 0.4 g powdered NaF. This was the only experimental group that exhibited fluoride release profiles similar to the target profile. A marked increase in the rate of fluoride release was observed at the higher temperature tested ($P < 0.05$).
CONCLUSIONS: This novel controlled fluoride delivery system presents great potential for the prevention of white spot lesions during orthodontic treatment.

210 DIFFERENCES IN CROWN-ROOT ANGLE IN UPPER INCISORS IN DIFFERENT MALOCCLUSIONS

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AIMS: Variability in tooth morphology is an important factor in orthodontic treatment. Morphological features of the permanent maxillary central incisor could limit treatment; this includes root torque which may lead to perforation of the cortical plate by the apex of incisor. This study was conducted to determine the variation of the crown-root axial angle in permanent maxillary central incisors in different malocclusions subjects from 1999 to 2005.
MATERIALS AND METHOD: Sixty lateral cephalograms divided into four equal groups, containing Class I, Class II division 1, Class II division 2 and Class III, randomly selected subjects. The cephalograms were traced and then root length, crown length, axial angle and labio-palatal thickness were measured using a ruler and protractor. Data were statistically analyzed (SPSS and ANOVA) and the results were compared between the four groups.
RESULTS: Only for the Class II division 2 group were the results significant. In that group axial angle and root length decreased while crown length increased. The findings for labiopalatal crest thickness in the four malocclusion groups were not significant.

211 EFFECT OF DIFFERENT PREMOLAR EXTRACTIONS ON TOOTH SIZE DISCREPANCY AMONG MALOCCLUSION PATIENTS

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AIMS: To determine the mean overall tooth ratio of Koreans, the effect of premolar extractions on tooth size discrepancy (TSD) based on Bolton analysis, and whether any tooth extraction combinations create a more severe discrepancy.
MATERIALS AND METHOD: The data were derived from systematically collected pre-treatment dental casts and post-treatment models of 70 patients with malocclusions from 2004 to 2006 who were orthodontically treated.

RESULTS: The overall ratio was 90.6 per cent and the standard deviation 6.15 per cent. The difference between the pre- and post-treatment overall ratio was statistically significant. Regarding tooth extraction combinations, only all four first premolars extraction cases and two upper first premolars and two lower second premolars extraction cases showed a statistical difference before and after treatment. Although the TSD of all four first premolar extraction cases was increased, those of two upper first and two lower second premolar extraction cases were decreased. On the other hand, two upper second and two lower first premolar extraction cases and all four second premolar extraction cases demonstrated an increase in TSD. With regard to Angle classification, whilst the overall ratio in the Class I and II subjects was found to be statistically different before and after treatment, the differences in TSD in all three groups were insignificant.
CONCLUSION: The findings provide a point of view to the question of which teeth to extract with respect to tooth size in Korean patients with malocclusions.

212 A CEPHALOMETRIC STUDY OF NON-ORTHODONTICALLY TREATED FEMALES WITH TEMPOROMANDIBULAR JOINT DISC DISPLACEMENT
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AIM: To investigate the changes in dentofacial morphology of non-orthodontically treated female patients with temporomandibular joint (TMJ) disc displacement.
SUBJECTS AND METHOD: Twenty-five Korean female patients with TMJ disc displacement. On the basis of magnetic resonance imaging (MRI) of the bilateral TMJs, the patients were diagnosed as having disc displacement. Baseline (T1) and follow-up (T2) lateral cephalograms were analyzed. The mean age of the sample at T1 was 18.1 ± 3.5 years (14.2–25.8 years) and at T2, 21.1 ± 3 5 years (16.2–28.0 years). The mean observation period was 3.0 ± 1.9 years. Descriptive statistics for each variable were calculated at T1 and T2, and during the observation period (T2-T1).
RESULTS: Skeletal changes were found in 64 per cent of the non-orthodontically treated female patients with TMJ disc displacement (T2-T1). L1 to the mandibular plane increased significantly by 0.8 mm ($P < 0.01$), but there were no significant differences in other dental variables (overjet, overbite, U1 to palatal plane) during the observation period. Most patients with skeletal changes showed backward rotation of the mandible. The ratio of the rotation was a decrease of SNB by 0.43 degrees per increase of FMA by 1 degree (Spearman's rho = –0.660, $P < 0.01$). A few patients showed a distal shift of the mandible without rotation and significant changes in vertical dimensions.

213 POSTERIOR ANCHORAGE LOSS DURING *EN MASSE* RETRACTION OF THE UPPER ANTERIOR TEETH
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AIM: To compare the amount of posterior anchorage loss during *en masse* retraction of the upper anterior teeth between orthodontic mini-implant (OMI) and conventional anchorage reinforcement (CAR) such as headgear and/or transpalatal arch.
SUBJECTS AND METHOD: Fifty-two adult female patients treated with sliding mechanics [MBT brackets, 0.022 inch slot, 0.019 × 0.025 inch stainless steel wire (3M-Unitek, Monrovia, California, USA)]. They were allocated into group 1 (n = 24, Class I malocclusion (CI), upper and lower first premolar (UP1LP1) extraction and CAR); group 2 (n = 15, Cl, UP1LP1 extraction and OMI) and group 3 (n = 13, Class II division 1 malocclusion, upper first and lower second premolar extractions and OMI). Lateral cephalograms were taken before and after treatment. Eleven anchorage variables were measured. Analysis of variance was used for statistical analysis. There was no significant difference in treatment duration and anchorage variables at T0 among three groups.
RESULTS: Groups 2 and 3 showed a significantly larger retraction of the upper incisor edge (U1E-sag, 9.3 mm:7.3 mm, $P < 0.05$) and less posterior anchorage loss (U6M-sag, 0.7~0.9 mm:2 mm, $P < 0.05$; U6A-sag, 0.5 mm:2 mm, $P < 0.01$) than group 1. The ratio of the amount of retraction of the upper incisor edge per one millimetre of anchorage loss in the upper molar showed a significant difference between groups 1 and 2 (4.6 mm:7.0 mm, $P < 0.05$). Group 3 showed a relative distal inclination of the upper molar ($P < 0.05$) and intrusion of the upper incisor and first molar (U1E-ver, $P < 0.05$; U6F-ver, $P < 0.05$) than groups 1 and 2.
CONCLUSION: Although OMI did not reduce treatment duration, it provided better maximum posterior anchorage than CAR.

214 FACTORS THAT AFFECT MAXILLARY THIRD MOLAR ERUPTION AFTER MAXILLARY SECOND MOLAR EXTRACTION
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AIM: To evaluate eruption of the maxillary third molars after maxillary second molar extraction.

MATERIALS AND METHOD: Panoramic radiographs, lateral cephalographs and diagnostic models of 80 patients. Positional changes of the maxillary third molars were observed by developmental stages, initial angulation, and the position of the maxillary third molars.
RESULTS: 1. There was a 99.2 per cent success rate of maxillary third molar eruption after the extraction of the maxillary second molar. 2. The average eruption time of the third maxillary molars was 4.5 ± 1.8 years after maxillary second molar extraction. 3. The maxillary third molars in Nolla's developmental stage 8 or higher took less time to erupt; however the occlusal position after eruption was less than ideal. 4. The distance from Ptm to the maxillary first molar had an influence on the final occlusion but the initial angulation, vertical and horizontal position of the maxillary third molar did not have any influence on final occlusion.
CONCLUSION: Most maxillary third molars erupted after maxillary second molar extraction, however 33 per cent did not show a good occlusion. Therefore, maxillary third molar position may need adjustment after maxillary second molar extraction.

215 EXPERIMENTAL EVALUATION OF THE ROTATIONAL RESISTANCE OF SURFACE-TREATED MINI-IMPLANTS AFTER LOADING

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AIM: To evaluate stability and the resistance of early-loaded sand blasted, large grit, and acid etched (SLA) surface treated mini-implants in relation to the rotation moment.
MATERIALS AND METHOD: A randomized complete block design was used in 12 skeletally mature male beagle dogs. Ninety-six same size orthodontic mini-implants, except those surface treated (SLA and machined) were inserted and rotational moments of 150 g were generated for a period after 3 weeks healing period and then the success rates, maximum torque value, angular momentum, and total energy absorbed by bone were compared. All values were subjected to mixed model analysis (procedure mixed) to evaluate the influence of surface treatment, rotational force direction, and implantation sites on the three dependent variables.
RESULTS: The maximum insertion torque and angular moment of the SLA group were significantly lower than those of the machined group ($P = 0.034$, $P = 0.039$). For total removal energy, the SLA group had a significantly higher value than the machined group ($P = 0.046$). However, there were no significant differences in total insertion energy, maximum removal torque, and removal angular moment between the SLA and machined groups. There was no significant difference between clockwise and counterclockwise rotation for any measurements.
CONCLUSIONS: SLA mini-implants showed relatively lower insertion torque values and angular moments, but higher total energy during removal, than the machined group, inducing higher osseointegration at the early stage of insertion. With a sufficient healing period, partial osseointegration adequate to resist against the force irrespective of the surface treatment, jaws (maxilla or mandible), or direction of rotation.

216 ALVEOLAR BONE LOSS AROUND INCISORS IN SURGICAL SKELETAL CLASS III PATIENTS

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AIM: To test the hypothesis that there is no difference in vertical alveolar bone levels and alveolar bone thickness around the maxillary and mandibular central incisors in surgically treated skeletal Class III malocclusion patients.
SUBJECTS AND METHOD: Twenty Korean patients with a skeletal Class III malocclusion and an anterior crossbite and open bite (9 males, 11 females, mean ages 24.1 years). Three-dimensional cone beam computed tomographic images were taken at least 1 month before orthognathic surgery. Sagittal slices at the labio-lingually widest point of the maxillary and mandibular right central incisor were evaluated. Measurement of the amount of vertical alveolar bone levels and alveolar bone thickness of the labial and lingual plate at the root apex was undertaken using the SimPlant Pro 12.0 program (Materialise Dental NV, Leuven, Belgium).
RESULTS: The mandibular incisors showed a reduction in vertical alveolar bone levels compared with the maxillary incisors, especially at the lingual side. Alveolar bone thickness was significantly greater at the lingual side of the maxillary incisors, while the mandibular incisors showed an opposite result ($P < 0.05$). The percentage of vertical bone loss to root length was statistically significantly different between the upper and lower labial alveolar bone, and also between the upper and lower lingual alveolar bone, showing more bone loss in the lower incisors ($P < 0.001$).
CONCLUSIONS: The hypothesis is rejected. For skeletal Class III patients undergoing orthognathic surgery, care should be taken to prevent or avoid aggravation of pre-existing alveolar bone loss in the anterior teeth, especially in the mandible.

217 ANTERIOR GUIDANCE OF THE MANDIBLE IN ORTHOTROPIC TREATMENT

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AIMS: During orthotropic treatment, after frontal expansion of the maxilla by stage 1, advancement of the mandible by stage 3 (S3) is very distinctive. The purpose of this study was to verify the effect of the S3 appliance.
SUBJECTS AND METHOD: Before (BT), end of active treatment (AT) and retention period (RP) lateral radiographs of 10 patients with an Angle Class II division 1 malocclusion treated by stage 3 appliances were measured. Maxillary protrusion cases were selected to study the position of the mandible. The mandibular position was measured as the length between pogonion to the McNamara line (a line perpendicular from nasion to the Frankfort line). The measured values of BT, AT and RP were compared with S3. Corpus length, overjet, overbite, and the Indicator line were also measured and compared.
RESULT: The average measured values for each stage were: BT: –13.61 ± 4.24 mm, S3: –9.56 ± 2.31 mm, AT: –11.28 ± 3.08 mm and RP: –10.00 ± 3.75 mm. The difference in average value between BT, AT and RP and S3 was 4.05, –1.72 and –0.44 mm, respectively. The value between S3 and RP was almost the same.
CONCLUSIONS: The S3 appliance is a key part of orthotropic treatment to improve oral posture. The result of this study show that the mandible was in almost the same position after active treatment and retention. The effect of S3 was verified. Using the Biobloc appliance, the mandible will be guided anteriorly resulting in a improvement in the position of the mandible to coordinate with the maxilla. The position of the mandible is predictable, as the positions at S3 and RP were similar.

218 ORAL SCREEN EFFECTS ON INTRA-ORAL ATMOSPHERIC PRESSURE CURVE CHARACTERISTICS

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AIM: To quantify the impact of oral screen application on intra-oral atmospheric pressure characteristics in three malocclusion groups.
SUBJECTS AND METHOD: Fifty-six randomly recruited participants who met the inclusion criteria of either neutral occlusal relationships, Angle Class II division 1 or Class II division 2 malocclusions, were assigned by dentition to group I (n = 31), Group II/1 (n = 12) or Group II/2 (n = 13). Two 3-minute intervals of intra-oral pressure monitoring were conducted on each participant, using two different oral end fittings connected to a piezo-resistive, relative pressure sensor: a flexible oral screen or a small-dimensioned air-permeable end cap which was placed laterally in the premolar region, thus recording intra-oral pressure independent of the influence of the oral screen. Pressure curve characteristics for both intervals and between the malocclusion groups were evaluated with reference to the frequency of swallowing peaks, duration and altitude of negative pressure plateau phases, and the area under the pressure curve.
RESULTS: Median numbers of two peaks (median height: 20.9 mbar) and three plateau phases (median height: 2.3 mbar) may be regarded as normative for normal occlusion subjects during a 3-minute interval, at rest. Oral screen application raises the median average duration and height of intra-oral negative pressure plateau phases in Angle Class II/1 subjects, exceeding those of group I, but less than plateau duration in group II/2. Median peak heights were distinctly lower in groups I and II/1 during oral screen application.
CONCLUSIONS: Additional training for extension of intra-oral pressure phases may be a promising approach to pre-orthodontic Class II division 1 treatment.

219 OESTROGEN AND DIETARY LOADING ON TYPE-II COLLAGEN PRODUCTION IN RAT TEMPOROMANDIBULAR JOINT CONDYLAR CARTILAGE

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AIM: To examine the effect of altered loading and decrease of oestrogen level on the expression of type-II collagen in the condylar cartilage in the rat temporomandibular joint (TMJ).
MATERIALS AND METHOD: Thirty-six female rats divided into four groups of nine animals: one experimental group fed with normal food and one with soft food, control groups fed a normal and soft diet. At 60 days of age the experimental groups underwent ovariectomy. Seven days after surgery the rats were sacrificed. The right and left TMJs were prepared for immunohistochemistry of type-II collagen. The condylar cartilage area, which was clearly expressed by type-II collagen, was measured and compared with the whole cartilage area.
RESULTS: The amount of type-II collagen was lowest in control group fed with soft food and highest in the ovariectomized group fed with soft food; the difference was statistically significant ($P < 0.001$). The proportional area of type-II collagen was significantly higher ($P = 0.002$) in the experimental soft diet group than in normal diet control group. In the soft diet control group the proportional area of type-II collagen was larger ($P < 0.02$) than in the normal diet controls.

CONCLUSION: A lack of oestrogen seems to increase the amount of type-II collagen in the condylar cartilage and together with a soft diet to increase the proportional amount of type-II collagen. Dietary loading and systemic oestrogen affects the synthesis of type-II collagen in the condylar cartilage.

220 CERVICAL VERTEBRAE ANOMALIES IN ORTHODONTIC PATIENTS. A GROWTH-BASED SUPERIMPOSITIONAL APPROACH

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AIMS: To propose a growth-based structural superimposition method for assessment of cervical vertebral fusion, and to evaluate variations and abnormalities of the upper cervical vertebrae.
MATERIALS AND METHOD: Standardized lateral cephalograms of 156 patients (69 males, 87 females, age range 6 to 20 years), representing a skeletally heterogeneous orthodontic population. Primary criterion for sample selection was the existence of at least two lateral cephalograms, one taken before orthodontic treatment, which depicted the first four cervical vertebrae. The abnormalities of the vertebrae were estimated by visual assessment and structural superimposition. Lateral cephalometric analysis was conducted in order to correlate vertebral anomalies to skeletal pattern.
RESULTS: Four patients (2.6%) were found to have secondary ossicles in close relation to the first cervical vertebra, whilst in 7.4 per cent the vertebral arteries of the atlas were surrounded by a complete ring-shaped osseous structure. Three cephalograms showed atlas posterior arch dehiscence. After visual examination, 14 patients were provisionally identified as presenting fusion between the second and third cervical vertebrae. However, growth based superimposition of the radiographs disclosed that no patient showed actual fusion, even though lateral cephalometric analysis revealed sufficient extreme skeletal patterns, which have been previously related to vertebral fusion.
CONCLUSION: The findings of this study demonstrated a low percentage of atlas anomalies. It was not possible to correlate skeletal pattern to fusion of cervical vertebrae, because no fusions were found. Subjective visual examination of single cephalograms may result in false positive findings of fusion, and growth-based superimposition is recommended.

221 SHEAR BOND STRENGTH OF AUTO-MIXING RESIN-REINFORCED GLASS IONOMER CEMENT

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AIM: To determine shear bond strength (SBS) of a newly developed auto-mixing resin-reinforced glass ionomer cement (auto-mixing RGIC) when used to bond mesh-backed brackets to bovine teeth.
MATERIALS AND METHOD: Ninety bovine mandibular incisors were used. Progressively finer polishing of the enamel surface was performed with 120 to 2400 grit waterproof abrasive paper. Three bonding agents were used: auto-mixing RGIC (Fuji Ortho Paste Pak Automix, GC Corp., Japan), conventional resin-reinforced glass ionomer cement (conventional RGIC, Fuji Ortho, GC Corp.) and bis-GMA based composite resin (Transbond XT, 3M Unitek, USA). All bonding agents were handled according to manufacturers' instructions. Each bracket was exposed for 20 seconds to the light-curing unit at the incisal and gingival margins. After storage at 37°C for 24 hours and thermal cycling from 5°C to 55°C and back 2000 times, bond testing was performed. A universal testing machine (Shimadzu Co. Ltd., Japan) was used to measure SBS.
RESULTS: Composite resin showed significantly higher bond strength than both auto-mixing RGIC and conventional RGIC. There was no significant difference between auto-mixing RGIC and conventional RGIC. No significant difference was seen in bond strength between 24 hours and thermal cycling.
CONCLUSION: This newly developed auto-mixing RGIC was shown to have retentive strength similar to a conventional RGIC. Auto-mixing RGIC appears to be adequate for clinical use.

222 ASSESSMENT OF THE DYNAMICS OF ALVEOLAR EXPANSION DURING TREATMENT WITH THE QUADHELIX APPLIANCE

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AIM: Evaluation of the changes in maxillary bone tissue during treatment of patients with crossbites using the quadhelix appliance.
SUBJECTS AND METHOD: Ten patients, aged 12 to 19 years, with a lateral crossbite treated with the quadhelix appliance, which was activated every 4 weeks by approximately 5 mm. A control group was formed comprising 15 subjects (12 to 19 years of age) with a 'normal' occlusion. The following were carried out: 1. Measurement of the width of the upper dental arch before (T1) and after 3 months (T2) of treatment/observation; 2. Evaluation of the serum concentration level of two bone turnover markers i.e. bone formation marker, osteocalcin, bone Gla protein (BGP) and the marker of bone resorption rate, carboxy-terminal telopeptide of type I collagen, serum CTx at T1 and T2. Assessment was also performed in the control group at the same time points.

RESULTS: Measurement of the width of the upper dental arch at T2 indicated its expansion from 2 to 5 mm in nine patients (mean increase 3.2 mm). No expansion was noted in one patient. At T2 the mean concentration of osteocalcin decreased by 23.37 ng/ml and there was a 2229.20 pM increase in the concentration of type I collagen C-telopeptide (CTx). The results indicated an ongoing process of bone remodelling. At T2, in the control group only, was a slight increase noted in the concentration levels of bone turnover markers, which was linked to physiological transformation of bone tissue.
CONCLUSIONS: Not all the patients with a crossbite respond equally to treatment with a quadhelix appliance. Bone turnover markers demonstrated that this was related to varied progress of maxillary alveolar process remodelling in individual patients.

223 ANGLE´S CLASSIFICATION AND FUNCTIONAL DISORDERS OF THE CRANIOMANDIBULAR SYSTEM
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AIM: To demonstrate the value of Angle's classification in functionally orientated interdisciplinary orthodontics.
SUBJECTS AND METHOD: Three hundred and eleven orthodontically untreated children and juveniles were diagnosed by manual techniques and cast analysis; handheld and in mounted in centric relation.
RESULTS: The sagittal occlusal relationship can be described well using Angle's classification. Even though changes in occlusal relationship between centric occlusion and maximal intercuspation were found in children and juveniles ($P < 0.001$), Angle's classification is helpful to determine differences in daily practice. No statistical relevance was found for functional orientated parameters of the craniomandibular system. Using molar and canine relationship to calculate correlations with pain, changes in mobility of the lower jaw, joint sounds and some general medical symptoms, no relationship was found.
CONCLUSIONS: Angle's classification should continue to be used to describe occlusal sagittal relationships in daily practice because of its simplicity. For scientific investigations that are functionally or occlusally orientated, Angle's classification can no longer be recommended because of its poor correlation with the functional status of the craniomandibular system. The findings of the present study indicate the use of millimetric scales to describe morphological findings and irregularities in all three dimensions. Furthermore the findings indicate that not only static but also dynamic dimensions of the occlusion should be taken into account for every patient from 6 years of age.

224 INFLUENCE OF CLENCHING ON THE TEMPOROMANDIBULAR JOINT SPACE – A MAGNETIC RESONANCE IMAGING STUDY
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AIM: Sometimes, orthodontic treatment causes the patient to clench. Such clenching may cause temporomandibular disorders (TMD). The aim of this study was to analyse the influence of clenching on the temporomandibular joint (TMJ) space, including the relationship of the occlusion.
MATERIALS AND METHOD: Magnetic resonance images of 10 adult male volunteers with a normal occlusion and no symptom of TMD. The dynamic scan images (20 phases taken within 10 minutes during each subject clenching) of the TMJs obtained with a Signa Horizon LX 1 5 T® (GE, Milwaukee, USA) were used for this analysis. On these images, the distance of the joint space in every phase was measured. The Occluzer FPD-707 (Scimolex, Yamanashi, Japan) was used for analyzing the occlusion. The area size of the contact area and the occlusal forces of each subject in the incisor, canine-premolar and molar region was measured with the Occluzer. The data were assessed to determine the coefficient of correlation.
RESULTS: In subjects that had a large contact area and occlusal force in the molar region the distance of the joint space during clenching did not decrease. On the other hand, the joint space of subjects with a large contact area decreased during clenching.
CONCLUSIONS: The distance in TMJ space was influenced by the occlusion in the molar region during clenching. The orthodontist should guide the occlusion of patients to obtain a large contact area and occlusal force in the molar region which will avoid narrowing of the joint space.

225 IMPRESSION TASKING FOR A FIXED OVERDENTURE IN PATIENTS WITH FIXED ORTHODONIC TREATMENT
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AIM: To demonstrate the management precise impression taking in the sub gingival region for a fixed overdenture, in patients with planned orthodontic-prosthodontic rehabilitation during fixed orthodontic treatment.
SUBJECTS AND METHOD: Twenty patients (14 females, 6 males), from 20 to 60 years of age, requiring an individual fixed overdenture during or after fixed orthodontic treatment. The procedure consisted of the following steps: cleaning of the

oral cavity, removing the part of the arch and the appliances in the region prepared for the fixed overdenture, preparation of planned teeth as abutments for the fixed overdenture, preparation of the gingival sulcus, choosing appropriate impression trays, placing protective wax on the remaining fixed orthodontic parts and taking one-phase impression (with double mixing of the materials or with the virtual method of mixing). This method helps eliminate the unwanted consequences during taking impressions, for example intruding of impression material in the space between the arch and braces.
CONCLUSION: The advantages of the new management method are elimination of deformations in the impression and partial damage of the fixed orthodontic device.

226 GROWTH OF THE FACIAL SKELETON IN PATIENTS WITH A UNILATERAL CLEFT LIP AND PALATE

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AIMS: To compare sagittal and vertical growth of the facial skeleton in patients with a unilateral cleft lip and palate (UCLP) with the standards of a non-cleft population of the same ethnicity, and to find a correlation between the skeletal characteristics and breathing pattern and resting posture of the oral cavity.
SUBJECTS AND METHOD: Forty consecutive patients born between 1989 and 1994 with non-syndromic UCLP treated using the same protocol. The lateral cephalograms taken after eruption of the permanent dentition were evaluated.
RESULTS: The mean values showed a retrusive position of the upper and lower jaw and a vertical growth pattern. The mean SNA was 75.6 degrees, SNB 75.5 degrees, upper face angulation (NL-NSL) 8.8 degrees and lower face angulation (ML-NSL) 35.5 degrees. According SNA, the maxilla was in a normal anteroposterior position in 24 per cent, retrognathic in 70 per cent and prognathic in 6 per cent of the subjects. The mandible (SNB) was in a normal position in 64 per cent, retrognathic in 21 per cent, and prognathic in 15 per cent of cases. Fifty per cent of the patients had a normal anteroposterior intermaxillary relationship (ANB), 40 per cent a mesial and 10 per cent a distal relationship. Twenty per cent had a mouth and nose breathing pattern and signs of incorrect oral posture.
CONCLUSIONS: A large variety of growth patterns are present in UCLP subjects, many of which are balanced but different to those in the non-cleft population.

227 MORPHOLOGICAL ASSESSMENT OF TEMPOROMANDIBULAR JOINT PARAMETERS IN CLASS II AND CLASS III PATIENTS

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AIMS: The condyle and fossa might differ in shape and relationship in subjects with different malocclusions and may be a reason for differing condyle positions within the fossa. Assessment of the skeletal morphology of the temporomandibular joint (TMJ) could be important in treatment planning and prediction of the stability of the treatment result. The aims of this study were to assess condylar parameters, to investigate condyle position within the glenoid fossa of the TMJ, and to compare the results between patients with skeletal Class II and Class III malocclusions before orthodontic treatment.
SUBJECTS AND METHOD: Fifteen patients with severe skeletal Class II (mean age 18.0 years) and 14 patients with severe skeletal Class III (mean age 19.2 years) discrepancies who required combined orthodontic and orthognathic treatment. A multislice computed tomographic examination was performed, and images reconstructed using internal auditory canal review and transparent bone programmes to quantify the following condylar and glenoid fossa parameters: glenoid fossa width and height; tuberculum articulare angle; anterior, superior and posterior joint space; height and width of the condyle, and height of the condylar process. The mean values were calculated separately for the left and right sides. Differences in the mean values were determined using a paired *t*-test.
RESULTS: There were statistically significant differences ($P < 0.05$) between the two study groups for all spatial measurements on both sides. The height of the condylar process also varied between groups and this was statistically significant. Unilateral differences were detected for the width of the glenoid fossa and the height of the condyle.
CONCLUSIONS: There is a tendency for a smaller condyle and wider spaces between the condyle and walls of the glenoid fossa when comparing TMJ parameters of Class II with Class III patients. In both groups the condyles were more anteriorly positioned. Even in patients without clinically evident asymmetries, asymmetries in joint structures were detected.

228 LONG-TERM EFFECT OF EARLY HEADGEAR TREATMENT ON THE SHAPE OF THE MAXILLA

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AIM: To assess maxillary shape changes using elliptical Fourier function (EFF) analysis in a group treated with early headgear (HG) and a control group.
SUBJECTS AND METHOD: Sixty-eight children (40 males, 28 females) aged 7.6 years (SD 0.3 years) were randomly divided into two groups of equal size. In the first group, HG treatment was initiated immediately while in the control group only minor interceptive procedures were performed during the follow-up period. Fixed appliance treatment, if needed, including extraction of permanent teeth due to crowding, was carried out after completion of early treatment. Forty-two landmarks describing the maxillary outline were digitized on the scanned lateral cephalometric radiographs taken before and after 2, 4 and 8 years of follow-up. Then digitized points were fitted with EFF. Two sets of data were obtained for the analysis. In one set the maxillary outline was standardized for size by scaling the bounded area to a constant value and 'shape only' data were produced. The other set was left unchanged so the original 'shape and size' information was saved.
RESULTS: There were no significant maxillary shape changes between the HG and control groups when comparing the results at the start and after 2 and 4 years of follow-up. In the control group the anterior part of the maxilla was located more upwards when compared with the HG group at the last follow-up. The change in the shape was a result of the successive treatment that had been carried out in adolescence essentially in the control group.

229 DENTAL MOVEMENT IN THE CORRECTION OF CLASS II DIVISION 1 MALOCCLUSIONS IN ADULTS WITH AND WITHOUT OSTEOTOMY

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AIM: To compare the extent of tooth movement in surgical and non-surgical orthodontic correction of Class II division 1 malocclusions in adults, and to compare pre- and post-surgical dental movement. The hypothesis tested is that less dental movement is necessary and a more ideal incisor position is attainable in the surgical group.
MATERIALS AND METHOD: Pre- and post-treatment and pre-surgical cephalometric variables were assessed in 64 adult Class II division 1 patients, 21 underwent only orthodontic and 43 surgical-orthodontic correction, including 38 cases with a bilateral sagittal split osteotomy and five with only Le Fort I osteotomy. The initial overjets ranged from 4.1–15 mm and overbite from 0.1–11 mm. After treatment no significant differences were found for skeletal and dental cephalometric variables. Incisor position was analyzed by measuring eight dental variables.
RESULTS: Incisor position changes during treatment showed a large range but no significant differences. An average decrease was found for the measurements, lower incisor to menton and upper incisor to NA in both groups as well as for upper incisor to the ANS-PNS plane in the non-surgical group. Proclination of the lower incisors occurred in both groups. The extent of the change of lower incisor to menton and upper incisor to NA took place in the pre-surgery phase, while that of the upper incisor to ANS-PNS plane and lower incisor to NB was equal both pre- and post-surgically. Pre- and post-surgical changes showed a complex pattern; mean tooth movements were small but ranges and frequencies showed that 24 per cent tooth movement occurred in opposite directions. Orthognathic surgery did not lead to a more ideal incisor position.
CONCLUSIONS: The surgical group showed no less tooth movement and no more ideal incisor position compared with the non-surgical group. A large variation was found in pre- and post-surgical tooth movement involving more conflicting tooth movement in orthognathic surgery cases.

230 DENTAL STABILITY AFTER CORRECTION OF CLASS II DIVISION 1 MALOCCLUSIONS IN ADULTS WITH AND WITHOUT OSTEOTOMY

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AIM: Comparison of the stability of tooth position after surgical and non-surgical correction of Class II division 1 malocclusions in adults, hypothesizing more stability after surgery.
SUBJECTS AND METHOD: Sixty-four adult Class II division 1 patients, 21 underwent only orthodontic treatment with full fixed appliance while 43 also had surgery, including 38 with bilateral sagittal osteotomy and five with only Le Fort I osteotomy. The initial overjets ranged from 4.1–15 mm and overbite from 0.1–11 mm. After treatment no significant differences were found for skeletal and dental cephalometric variables. Pre- and post-treatment and long-term cephalograms eight years after treatment were analyzed by measuring eight dental and three skeletal variables.
RESULTS: On average, post-treatment changes were small with a large range. A significant difference was found only for upper incisor to ANS-PNS plane showing an increase of 0.7 mm in the non-surgery group. Post-treatment overjet changes were small in both groups, although large changes occurred more frequently in the non-surgical group. Overbite increased by a mean of 1.5 mm in both groups. Eighty-five per cent of lower incisor to menton remained stable in both groups. Both groups showed a

comparable decrease of lower incisor to NB and of upper incisor to NA (mean: –0.5 mm, –1.0°) without substantial post-treatment anterior movement of the lower incisors. Fifty per cent of both groups showed a post-treatment decrease of lower incisor to NB. Upper incisor to NA increased in 40 per cent of the surgery group and decreased in 60 per cent of the non-surgery group. The upper incisors showed more stability in the surgery group. Regression and correlation analyses revealed a complex relationship between post-treatment vertical and sagittal skeletal and dental changes in both groups.
CONCLUSIONS: Orthognathic surgery does not seem to provide greater incisor stability after correction of Class II division 1 malocclusions.

231 CAVEOLIN-1, CAVEOLIN-3 AND VASCULAR ENDOTHELIAL GROWTH FACTOR EXPRESSION IN MASTICATORY MUSCLES OF MDX MICE

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AIMS: Duchenne muscular dystrophy (DMD) and its murine model, mdx, are characterized by Ca2+ induced muscle damage and muscle weakness. The disease is caused by mutations in the gene encoding dystrophin. There is evidence that caveolins, dystrophin-associated proteins, are involved in the pathogenesis of DMD, because increased caveolin-3 levels have been found in mdx tibia muscle. DMD patients have reduced mouth opening and lower bite force values. The aim of this study was to examine the expression of caveolin-1 (cav-1), caveolin-3 (cav-3) and vascular endothelial growth factor (VEGF) in control and mdx mice.
MATERIALS AND METHOD: The mRNA and protein levels of cav-1, cav-3 and VEGF were studied using quantitative real-time polymerase chain reaction, Western blot analyses and histochemistry in the masseter, temporalis and soleus muscles and tongue of both mouse strains.
RESULTS: No changes in transcript and protein levels of cav-1, cav-3 and VEGF were found in mdx temporalis muscles and tongue. These findings are in contrast to the results for the mdx soleus muscle, which showed significantly increased levels of cav-1 and cav-3 and reduced levels of VEGF. Only mdx masseter muscle showed significant increased cav-1 and cav-3 expression compared with the control. Using immunohistochemistry, strong cytoplasmic staining of cav-3 in regenerated muscle fibres was found, the localization of which correlated with the localization of smooth muscle actin. Furthermore, immunohistochemistry with the cav-1 antibody showed an increase in the number of blood vessels in areas with regenerating muscle fibres and CD45 positive cells.

232 COMPARISON OF THE SOFT TISSUE PROFILE BETWEEN SUBGROUPS OF SKELETAL CLASS III MALOCCLUSION SUBJECTS

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AIM: To compare the soft tissue profiles of patients with skeletal Class III malocclusions originating from maxillary retrusion, mandibular protrusion, or a combination of maxillary retrusion and mandibular protrusion.
SUBJECTS AND METHOD: Lateral cephalometric radiographs of 66 subjects divided into three groups according to the Nperp-A and Nperp-Pg variables: group 1, maxillary retrusion (n = 23; mean age: 13.44 years); group 2, mandibular protrusion (n = 22; mean age: 13.31 years), and group 3, combination of maxillary retrusion and mandibular protrusion (n = 21; mean age: 13.04 years). Besides the descriptive parameters of Class III subgroups, 13 soft tissue measurements (Gl-Sn, Sn-Me, ULL, St-Me, Sn-LLV, LLV-Me, interlabial distance, upper lip, lower lip, chin, Gl-Sn/Sn-Me, Sn-St/St-Me and Sn-LLV/LLV-Me) were determined to evaluate possible differences between the Class III subgroups. The differences between all Class III groups were evaluated using analysis of variance (ANOVA) and Duncan's test.
RESULTS: Chin measurement (distance between soft tissue pogonion to vertical reference line) showed the highest value in group 1 (5.14 ± 2.93) compared with groups 2 (2.94 ± 2.15) and 3 (3.05 ± 1.98) ($P < 0.01$). Although the differences in Sn-Me and LLV-Me were insignificant among the groups, these parameters representing the lower anterior soft tissue heights had the highest values in group 3. The other parameters did not show statistical significance between the groups.
CONCLUSION: Mandibular soft tissue excess (chin measurement) in the maxillary retrusion group (group 1) and increased vertical mandibular soft tissue heights in the combined group (group 3) should be taken into consideration during orthodontic and orthognathic treatment planning.

233 FACIAL ANALYSES AS A COMPLEMENT TO CEPHALOMETRIC ANALYSIS FOR ORTHODONTIC DIAGNOSIS AND TREATMENT PLANNING

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AIMS: The establishment of a correct diagnosis is fundamental for elaboration of an adequate treatment plan and consequently, for occlusal correction. One aim of orthodontic treatment is to provide a good relationship between the occlusion and the diverse structures of the face. The purpose of this study was to carry out subjective facial analysis, to compare with the cephalometric analysis, and to evaluate the balance between both.
SUBJECTS AND METHOD: Seventy-five randomly chosen subjects with an average age of 16 years 6 months. Three evaluators participated with each evaluator undertaking subjective facial analysis of the individuals, according to the criteria of facial standard, profile and harmony. Subsequently, verification of the cephalometric measurements: FMA, SN.Gn, H.NB and H-nose was undertaken. The values obtained for facial and cephalometric analysis were transferred to a computer and compared.
RESULTS: In the majority of cases, there was no balance between the data obtained from the subjective facial analysis and the cephalometric analysis with regard to the facial standard and mainly with facial harmony. For facial profile, a balance was found between the two analyses in 77 per cent of cases.
CONCLUSIONS: Cephalometric values are references and not absolute values.

234 ORAL AND DENTAL HYGIENE PROTOCOL FOR CHILDREN WITH CLEFT LIP AND PALATE
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AIM: To develop a protocol for oral hygiene for children with clefts of the lips and palate for specialists and an informative brochure for the child's parents.
MATERIALS AND METHOD: A thorough review of the literature was undertaken by consulting databases such as the Cochrane Library and PubMed. Articles from 2000 to 2008 were selected. The therapeutic and surgical procedures adopted in the Department of Maxillofacial Surgery of Pediatric "Spedali Civili of Brescia" that reflects the same process presented in the systematic review were also investigated: Interventions for the Management of Submucous Cleft Palate prepared by The Cochrane Collaboration (2008).
RESULTS: Analysis of the literature showed that maintaining careful oral hygiene in patients with a CLP is important and facilitates improvement in the quality of life.
CONCLUSIONS: A protocol was developed.

235 CROWN HEIGHTS IN THE PERMANENT TEETH OF 47,XXX FEMALES
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AIM: To determine permanent tooth crown heights in 47,XXX females or females with one extra X chromosome. Their mean height is bigger relative to 'normal' females mainly due to the length of their legs, while head circumference, most facial dimensions and cranial base angle are reduced. The enamel of the tooth crowns is thicker and the roots, especially in the mandible, and later developing maxillary teeth are longer than those in normal females. The purpose of this study was to further determine the influence of the X chromosome on the development of human tooth crown height.
SUBJECTS AND METHOD: Seven 47,XXX females, their five female relatives, 51 population control females and 51 population control males from the Kvantti research project. Tooth crown height measurements were made on panoramic radiographs of available permanent teeth (except third molars) with a digital calliper according to established procedures on both sides of the jaws.
RESULTS: Permanent tooth crown heights of 47,XXX females were larger relative to normal females in both jaws and similar to those of the mandible in normal males. The maxillary tooth crown heights were slightly smaller.
CONCLUSIONS: The earlier found tendency in permanent tooth root lengths of 47,XXX females, that the size in mandible is bigger in comparison to maxilla, was also found in crown heights. These results indicate that the increasing effect of the X chromosomal genes on root development and crown height are similar.

236 TEMPERATURE VARIATIONS IN THE ORAL CAVITY OF ELASTIC AND SUPERELASTIC ORTHODONTICS WIRES
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AIM: To evaluate the effects of temperature variations in the oral cavity on the properties of elastic and superelastic orthodontics wires. To this end, thermo-mechanical testing, calorimetric investigation and thermal measurements in the oral cavity were carried out.

MATERIALS AND METHOD: The wires used were: Gum Metal (Toyota Central R & L Labs. Inc.), TMA (Ormco), copper NiTi (SDS Ormco) and Thermalloy Plus (Rocky Mountain). Thermo-mechanical testing was carried out with a dynamometer and a Peltier pump for heating and cooling between 19 and 55°C. Calorimetric testing consisted of a heating ramp from –20 to 80°C, a cooling step from 80 to –20°C and a further heating step from –20 to 80°C. Thermal measurements in the oral cavity of a patient with an upper palatal splint were acquired during respiration, conversation and the consumption of hot and cold drinks.
RESULTS: Mechanical testing suggested that the elastic modulus of Thermalloy Plus and copper NiTi wires was strongly dependent on temperature variation in the oral cavity, while Gum metal and TMA wires showed a constant elastic modulus in the considered temperature range. Calorimetric findings were consistent with the mechanical results and showed that the Thermalloy Plus and copper NiTi wires undergo martensite-austenite transition, while Gum Metal and TMA wire do not undergo thermal flux variation. Thermal measurements in the oral cavity showed that the oral cavity undergoes temperature variations that are frequent and considerable.
CONCLUSIONS: A novel deformable orthodontic wire which develops more than half the force of TMA is now available; Gum Metal represents an opportunity for clinicians to exploit levels of force which are half that developed by TMA. The properties of Thermalloy Plus and copper NiTi wires are sensitive to temperature variations that occur in the oral cavity.

237 *AXIN2* MUTATION CAUSES CHARACTERISTIC CHANGES IN HUMAN TOOTH CROWN MORPHOLOGY

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AIM: Tooth agenesis is a common human anomaly typically inherited as an autosomal dominant trait. While the genetic background of a lack of one or a few teeth has remained unknown, mutations in the regulatory genes *MSX1*, *PAX9*, *EDA*, and *AXIN2* are known to cause severe tooth agenesis (oligodontia). The relationship between tooth agenesis and smaller dimensions of teeth as well as a reduction of size and number of certain cusps is well known. So far the description of the tooth phenotypes in association with the reported mutations causing tooth agenesis has mainly focused on the number and patterning of missing teeth, while little attention has been paid to tooth morphology. An *AXIN2* mutation causing dominantly inherited oligodontia and colourectal cancer has previously been reported in a Finnish family. In this study the molar tooth morphology of this family is described.
MATERIALS AND METHOD: Dental casts were made from eight affected and six unaffected family members. The dental casts of healthy Finnish children with full dentitions served as controls. The teeth were scanned using a Nextec Hawk three-dimensional laser scanner.
RESULTS: In most cases only one permanent molar was available for analysis in each tooth quadrant of the affected family members. Most of the maxillary molars lacked a distobuccal cusp (hypocone) and 6/9 of the mandibular molars exhibited a unique morphology in which two or three extra cusps were situated anteriorly to the normal cusps.
CONCLUSION: *AXIN2* in an intracellular attenuator of Wnt signalling. Mutation in *AXIN2* leads to failure of regulation of Wnt signalling which, besides causing severe tooth agenesis, affects tooth morphology. The results suggest that the abnormal signalling leads to anteriorization of molar morphology that in mandibular molars creates a unique structure. The exceptional tooth morphology of molar teeth of family members with *AXIN2* mutation may serve as a diagnostic tool when distinquishing oligodontia patients with different genetic backgrounds.

238 DENTAL ARCH SUPERIMPOSITION USING THREE-DIMENSIONAL CONE BEAM COMPUTED TOMOGRAPHY AND THREE DIMENSIONAL DIGIT MODELS

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AIM: It is important to estimate the three-dimensional (3D) changes in tooth movement after orthodontic treatment. Many studies have reported on the stability of the maxillary palatal rugae as reference points for pre- and post-treatment comparison, resulting in 3D superimposition of the maxillary arch using 3D model scanning technology. However there are no well-known, stable reference points or areas on the mandibular arch that allows evaluation of the amount of orthodontic tooth movement. The purpose of this study was to introduce a reproducible method using 3D cone beam computed tomography (CBCT) and 3D digital models that make superimposition possible in the mandibular arch.
MATERIALS AND METHOD: The proposed superimposition system consisted of six main procedures; (1) acquisition of CBCT data; (2) acquisition of 3D dental model data; (3) integration of CBCT data and virtual model data; (4) superimposition of pre- and post-treatment integrated CBCT image; (5) extraction of mandibular dentition; (6) evaluation of tooth movement in the mandibular arch. Two different registration methods of superimposition were designed to evaluate the possibility of

practical application and estimate the reproducibility of (1) 'surface superimposition'; (2) anatomical structure orientated 'plane superimposition'.
RESULTS: Statistical analysis showed that the method designated as surface superimposition was more reproducible with relatively smaller variances and smaller distances from the mean values of marked registration points after 30 trials.
CONCLUSION: It is possible to superimpose the mandibular dental arch using the basal bone as the reference area that is not on the soft tissue of alveolar bone that could be altered throughout orthodontic treatment. The method designated as surface superimposition showed statistically higher reproducibility with acceptable amount of errors for clinical application.

239 REMOVAL TORQUE VALUE OF PARTIAL OSSEOINTEGRATION BASED MINI-IMPLANTS IN ORTHOGNATHIC SURGERY PATIENTS

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AIM: Because most orthodontic mini-implants are retained by mechanical locking, it is difficult to apply multidirectional orthodontic forces. Accordingly, many methods to increase retention rate have been examined and mini-implants for inducing osseointegration as the main retention have been studied. The purpose of this research was to examine the stability and success rate of sand blasted with large grit, and acid etched (SLA) mini-implants by measuring the removal torque value (RTV) and scanning electron microscopy (SEM) evaluation.
MATERIALS AND METHOD: With 74 mini-implant (diameter 1.8 mm and length 8.5 mm C-implant) samples, failure rate and RTVs of C implant, which were placed according to panoramic radiographs, were evaluated. The removed C implants were evaluated by SEM.
RESULT: The mean failure rate was 10.5 per cent. The success rate was not significantly different between the pre- and post-surgery group. The mean treatment duration of the post-surgery group was 13.11 months and of the pre-surgery group 7.69 months. All C implants were safely removed. The mean RTVs was 17.01 Ncm. The mean RTVs of the lower left side was significantly different between the pre- and post-surgery groups. Gender was not related to RTV. Partial osseointegration was noted for all removed C implants.
CONCLUSIONS: Surface-treated mini-implants can be used for multidirectional orthodontic forces and intermaxillary fixation with small number. In the case of pre-surgery, the use of self-drilling mini-implants can be considered.

240 CEPHALOMETRIC EVALUATION OF AB TO MP ANGLE IN ORTHODONTIC DIAGNOSIS

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AIM: To investigate the orthodontic diagnostic merit of AB to MP angle by comparing and classifying malocclusions according to the angle.
SUBJECTS AND METHOD: Two hundred female patients between the ages of 14 and 17 years. Using 16 hard tissue landmarks: 21 angular, one linear and one ratio measurement were calculated. The samples were classified into three groups according to the average and standard deviation of AB to MP angle. ANOVA and multiple comparison tests with Scheffe were performed to statistically verify differences among the groups.
RESULTS: The middle angle group appeared to have a higher Björk sum, FMA and SN-MP angle and smaller facial height ratio (FHR) than the obtuse angle group. These two groups did not show a clear statistical difference in the anteroposterior relationship. The obtuse group showed a higher cranial base saddle angle, a smaller Björk sum, FMA, SN-MP angle and larger FHR than the acute angle group. Moreover, the former had higher Wits and ANB values and a smaller PP-AB angle than the latter. These two groups showed statistical differences in ANB, Wits and the PP-AB angle.
CONCLUSIONS: The AB to MP angle is able to indicate the vertical and anteroposterior relationship of lower anterior face.

241 TREATMENT EFFECTS OF A FACEMASK IN THE MIXED DENTITION IN SKELETAL CLASS III MALOCCLUSION SUBJECTS

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AIM: To investigate the effects of facemask treatment on growth during a post-treatment period of one year.
SUBJECTS AND METHOD: Eight female patients (mean age of 7.9 ± 1.2 years). All showed an anterior crossbite at the start of treatment, and appropriate intraoral appliances were used followed by protraction using a facemask. At the end of active treatment, a positive overjet was obtained in all patients. Lateral cephalograms were taken at the beginning of

treatment, at the end of protraction, and after approximately one year of retention. The mean active treatment period was 9.1 ± 4.2 months, and that of retention 1 year 1 month ± 1 month.
RESULTS: The maxilla was successfully protracted (1.98 ± 1.33 mm anteriorly and 2.15 ± 1.23 mm inferiorly). The mandibular plane angle was slightly opened (1.18 ± 1.01°) during the period of active treatment. During one year of retention, the maxilla continued to grow anteriorly and inferiorly, but the rate was decreased. Pogonion and point B grew in an anterior direction, while the mandibular plane angle was relatively stable.
CONCLUSIONS: Maxillary protraction using a facemask is an effective treatment modality in maxillary deficient Class III growing patients. However after treatment, maxillary growth decreased and mandibular growth caught up during one year of retention. Long-term follow-up is recommended.

242 CEPHALOMETRIC SUBSTANTIATION OF ORTHODONTIC DIAGNOSES

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AIM: One of the aims of orthodontic treatment is to achieve optimal facial aesthetics. Planning of facial beauty is difficult, especially if it concurs with the correction of malocclusion. Sometimes correction of a malocclusion may not improve but may worsen facial aesthetics. Treatment planning based on dentoskeletal analysis allows approaching aesthetic problems in such cases. However, the soft tissues that cover bones and teeth can vary significantly so that dentoskeletal parameters are not always a valid guide for evaluating facial disharmony. The aim of this clinical trial was soft tissue cephalometric analysis and creation of an analytic database of mean normal parameters for the Russian population.
SUBJECTS AND METHOD: Forty-two subjects (20 males, 22 female), central Russian natives. All had a normal occlusion and harmonious facial pattern. Examinations were performed in the natural head position and correct condylar position. To identify soft tissue landmarks of the middle face that are normally not visible on a standard cephalogram, metallic markers were used. These markers were positioned on the alar base of the nose, orbital ridge, zygomatic bone and subpupillary point.
RESULTS: Dental, skeletal and soft tissue normal parameters for a central Russian population were determined.
CONCLUSIONS: Arnett's soft tissue cephalometric analysis is useful for orthodontic diagnosis and can be used as a criterion for decision making between orthodontic and surgical treatment modes.

243 CORROSION BEHAVIOUR OF DIFFERENT ORTHODONTIC METALLIC BRACKETS

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AIM: Metallic alloys used in the manufacture of orthodontic appliances when exposed to the oral environment are subjected to chemical, mechanical and physical alterations, which could lead to a corrosion process. The metallic ions released from this process may induce adverse effects in the organism leading to hypersensitivity and cytotoxicity reactions. With the purpose of decreasing or even eliminating the corrosion process, brackets coated with a thin layer of titanium nitride are being commercialized. The aim of this study was to compare the *in vitro* corrosion process of three types of metallic brackets.
MATERIALS AND METHOD: Stainless steel, manganese steel, and manganese steel brackets coated with titanium nitride and immersed in artificial saliva for 42, 63 and 84 days. After these time periods, the saliva extracts were removed and submitted to atomic absorption spectrophotometry to determine and quantify the metallic ions released. Surface alterations on the brackets were evaluated by scanning electron microscopy.
RESULTS: In spite of the bracket alloy composition, all had undergone corrosion after the 84 day period of immersion in artificial saliva. However, the stainless steel brackets presented more surface alterations, indicative of corrosion sites than the other brackets. The greatest nickel ion concentration was detected in the stainless steel (3.60 g/mL) bracket extracts after the 84 day period of immersion in artificial saliva. Manganese steel brackets, with or without titanium nitride coating, were found to be less prone to corrosion than stainless steel brackets.

244 INFLUENCE OF SMILE ATTRACTIVENESS IN ADOLESCENTS ON SOCIAL PERCEPTIONS BY PEERS

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AIM: Studies have documented the importance of facial attractiveness in influencing social acceptance among adolescents. Previous investigations have examined the effects of dental and overall facial appearance in children and adults. The purpose of this study was to determine whether smile attractiveness influences the perception of adolescents when judging a peer's athletic, social, leadership, and academic abilities.

MATERIALS AND METHOD: Smiling photographs of 10 adolescents (age 10-16 years) were altered to produce straight and crooked teeth versions of each. One photograph of each subject ('straight' or 'crooked') was included in each of two parallel surveys. One control subject had the same crooked smile in both surveys. Two hundred and twenty six peer evaluators were asked to complete one of the digital surveys rating each photograph using a 100 point visual analogue scale for perceived athletic, social, leadership, and academic skills. The evaluators were not aware that smile appearance was the variable of interest. Differences in ratings between straight and crooked smiles, and differences based on other subject and evaluator characteristics were analyzed using repeated measures mixed model analysis.
RESULTS: There were no differences in evaluator characteristics ($P > 0.05$) or ratings for the control subject ($P > 0.05$) between the two parallel surveys. Ratings for straight smiles were consistently higher for all perceived abilities and were significant for athletic ($P = 0.01$), social ($P < 0.0001$), and leadership ($P < 0.0001$) abilities but not for academic skills ($P = 0.055$). Additionally, subject ($P < 0.0001$) and evaluator ($P = 0.02$) gender influenced ratings for athletics. Evaluator race ($P = 0.04$) affected ratings for perceived social ability.
CONCLUSIONS: Smile attractiveness has a significant influence on the perceptions of adolescents regarding peers' athletic, social, and leadership skills but does not significantly influence perceptions of academic ability. Gender and race characteristics affected perceptions in some areas.

245 MANDIBULAR MORPHOLOGY IN LOWER INCISOR HYPODONTIA

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AIM: To examine whether cranial morphology and the inclination of the incisors is altered in patients with aplastic lower anterior teeth.
MATERIALS AND METHOD: The data of 11 patients (7 females, 4 males) aged 8 to 13 years with missing lower anterior teeth were analysed. One tooth was missing in six children, and two teeth were missing in the other five children. Eleven patients (6 females, 5 males) aged 8 to 12 years without aplasia served as the controls. The lateral cephalograms of both groups were analysed and compared for cranial morphology and incisor inclination.
RESULTS: Incisor and symphyseal inclination were steeper in the hypodontia group as compared with the controls. Symphyseal width was also reduced in the test group, and the chin was positioned more anteriorly.
CONCLUSION: Differences in cranial morphology and incisor inclination were noted in the hypodontia group compared with individuals with a complete dentition.

246 CHANGES IN MOLAR POSITION IN FEMALES WITH LOSS OF TEETH: LONG-TERM ASPECTS

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AIM: To analyse changes during a 10–12 year period: a) in tipping of molars with mesial space due to missing tooth/teeth and b) of over-eruption of molars with no supporting antagonist.
MATERIALS AND METHOD: Panoramic radiographs from a study of the health of females performed in Gothenburg in 1968/69 – 2004/2006. For the present study, panoramic radiographs of 312 of the 50-year-old female group were selected with respect to either of the following criteria: 1) a molar in the upper or lower jaw with a mesial space due to missing tooth/teeth and 2) a molar in the upper or lower jaw with no antagonist. The panoramic radiographs were scanned and a digital image was created. The digital images were analysed by a computer program (Facad, Illexis AB). Changes in tipping and over-eruption of molars were measured. Subjective evaluation was also performed to determine the frequency of over-eruption and tipping, as well as changes over time.
RESULTS: Tipped teeth were slightly more common in the lower jaw compared with the upper jaw and the degree of tipping was also more severe in the lower. There were no statistically significant changes in tipping movements of the molars, although the subjective assessments revealed an increased frequency of tipped molars during the observation period. However, the majority of the cases showed no increased tipping of the molars. Over-erupted molars were more common in the upper than in the lower jaw and there was a statistically significant increase in over-eruption of molars in the upper jaw during the observation period. The molars in most cases though, did not become more over-erupted during the observation period.
CONCLUSIONS: Molars continue to tip and over-erupt in some adults although in the majority of subjects these changes are small.

247 THE SOFT TISSUE FORM OF THE SUBMENTAL AND NECK REGION OF PATIENTS WITH A CLASS III MALOCCLUSION

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AIM: To analyze the soft tissue form of the submental and neck regions of patients with a Class III malocclusion.
MATERIALS AND METHOD: Profile photographs and lateral cephalograms of 20 patients with a Class III malocclusion taken in the natural head position. The following values were measured before orthodontic-orthognathic treatment: submental length, the distance between soft tissue pogonion and neck-throat point R; four facial angles: 1) between the vertical and submental tangents (SM/N); 2) between the horizontal component of the neck and the lower face (LF/SM); 3) between the horizontal component of the neck and upper face (UF/SM) and 4) between the horizontal component of the neck and a line joining soft tissue glabella and pogonion (gl-pg/SM); the ratio of lower face height to submental length and position of hyoid bone. The measurements obtained were compared with standard data.
RESULTS: Data analysis showed that in patients with a Class III malocclusion the following angles were reduced: SM/N, LF/SM, UF/SM and gl-pg/SM. Correlations of each angular measurement, submental length and cephalometric values, position of hyoid bone were found.
CONCLUSIONS: The form of the contour of the submental and neck region changes with alteration in head position. The form of the submental and neck region in subjects with a Class III malocclusion does not depend on the position of the hyoid bone. Patients with a Class III have complex aesthetic problems including soft tissue disturbances of the submental and neck region.

248 APPLICATION OF BRACKETS FOR DEEP BITE CORRECTION

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AIMS: To analyze the influence of bite turbo brackets in levelling of the curve of Spee in patients with a deep bite, and to determine morphometric changes during orthodontic treatment.
MATERIALS AND METHOD: Lateral cephalograms, taken in the natural head position, of 40 patients with a deep bite treated with the continuous archwire technique and Bite Turbo brackets. Standard cephalometric landmarks were used to construct the reference lines. The following values were measured before and after orthodontic treatment: 1. The angles defining the direction of jaw growth (NSAr, SArGo, ArGoMe, NGoMe, NGoAr); 2. Dentoalveolar heights (U1-PP, L1-MP, L4-MP, L6-MP) and the depth of the curve of Spee as the perpendicular distance from the tooth cusp of the most erupted premolar to the line joining the highest cusp tip of L6 to the tip of L1; 3. The angle between Frankfort horizontal and a line joining the tip of the upper lip and soft tissue pogonion (Z); 4. Facial height index (FHI); 5. The occlusal plane position (PP/OccL, MP/OccL). The measurements obtained were compared with standard data.
RESULTS: Increases in anterior and posterior face heights were statistically significant ($P < 0.05$), but there was no change in FHI. Post-treatment data analysis showed extrusion of the molars and premolars that lead to levelling of the curve of Spee.
CONCLUSIONS: The continuous archwire technique and bite turbo brackets are effective in levelling of the curve of Spee but do not result in incisor intrusion and do not influence mandibular rotation.

249 SECULAR TRENDS IN SKELETAL MATURATION IN DANISH CHILDREN FROM 1939 TO 1994

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AIM: Recent studies have suggested a trend towards earlier sexual maturation in the USA, and in some European countries. Likewise secular changes in body height and growth velocity have been reported, but only a few studies have evaluated potential secular changes in skeletal maturation. In orthodontics, the timing of orthopaedic treatment in relation to the pubertal growth spurt is pivotal for treatment outcome, and earlier skeletal maturation would necessitate an earlier start of treatment. The aim of this study was to evaluate the secular trend in skeletal maturation and body height.
MATERIALS AND METHOD: Hand wrist radiographs and standing height measurements in two Danish cohorts of 196 and 375 healthy children, respectively, separated by at least 30 years (1939–1964 and 1992–1994). Skeletal age was determined from hand wrist radiographs using an unbiased, computerised, automatic methodology (BoneXpert).
RESULTS: The children in the most recent cohort had a significantly advanced skeletal age compared with the children in the older cohort. The mean difference was 0.4 years ($P = 0.0006$) for girls and 0.8 years ($P = 0.0002$) for boys. In addition, the children in the most recent cohort were significantly taller than those in the older cohort. At 12 years of age, the mean difference was 4.4 cm ($P = 0.0001$) for girls and 4.6 cm ($P = 0.0004$) for boys. In a general linear model, age, skeletal age, gender and cohort were all significant predictors for height, with skeletal age being the strongest.
CONCLUSIONS: A significant secular trend towards earlier skeletal maturation during the two study periods (1939–64 and 1992–94) has been demonstrated. The findings emphasize the usefulness of computerised bone age determination in population studies of a large number of subjects, as this method is completely devoid of inter-rater variability.

250 RHINOMANOMETRIC RESULTS IN CHILDREN TREATED WITH RAPID MAXILLARY EXPANSION
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AIM: To evaluate the improvement in rhinomanometric (RAA) measurements in children treated following rapid maxillary expansion (RME).
SUBJECTS AND METHOD: Eighteen oral breathing patients aged 6–11 years with maxillary transverse contraction who had not undergone previous pharmacological or surgical treatment. Otorhinolaryngologic and active rhinomanometric anterior examinations were carried out prior to RME. A further rhinomanometric assessment was undertaken 3 months after the start of RME to determine the improvement in breathing.
RESULTS AND CONCLUSION: Eighty-nine per cent of patients showed an improvement in breathing and 94 per cent also an improvement in orthodontic problems. RME results in a significant improvement of the clinical situation of these patients.

251 THE EVOLUTION OF ORTHODONTIC DISTALIZATION – SKELETAL SUPPORTED DISTALIZERS
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AIM: Bodily distalization is accepted as one of several space gaining methods. As an alternative to extraoral anchorage systems, intraoral non-compliance distalizers were introduced, for example the K-pendulum avoided most reactive tipping and rotation, and bodily movement of molars was achieved. Still anchorage loss of the anteriors, in fact protrusion, occurred. Combining these biomechanics with skeletal anchorage may result in clinically excellent distalizers. The aim of this presentation is to introduce a skeletally supported device which combines the advantages of the Pendulum and mini-implants.
MATERIALS AND METHOD: The distalizers are borne by two mini-implants in the anterior palate. Both are connected by an abutment to a distalization screw, which has a removable connection, to a modified transpalatal bar. The transpalatal bar contains loops, toe in, expansion and uprighting bends. The anterior teeth from 15 to 25 stay free of any attachment which permits simultaneous alignment. Fifty-eight patients in all stages of the dentition were treated. Both beginning and finishing of distalization were examined by cephalometry and three-dimensional scans of plaster models. Anchorage loss and the pattern of bodily molar distalization were investigated. The results were then compared with the classic tooth supported design.
RESULTS: Distal movement of the molars was, on average, 5.8 mm and significantly higher compared with the conventional group. During posterior molar movement, no anchorage loss was observed in the mini-implant borne group, while in the dental borne group 26.5 per cent anterior anchorage loss occurred. Molar tipping could be reduced by the biomechanics according to the K-Pendulum to less than 5 degrees in both groups.
CONCLUSIONS: In the evolution of orthodontic distalization, the mini-implant borne pendulum-appliance seems to be a solution of clinical excellence and may be the last evolutionary step of pendulum devices.

252 EVALUATION OF FACIAL ATTRACTIVENESS THROUGH FACIAL PHOTOGRAPHS
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AIM: A system to evaluate facial aesthetics has to be simple and applicable in daily clinical practice, and probably the most complete system is the simultaneous visualization of a frontal, smiling and lateral photograph. The aim of this study was to determine if there are differences between qualifying facial aesthetics by analyzing the photographs one by one or simultaneously.
SUBJECTS AND METHOD: Ninety-one Caucasian dental students. For each individual, photographs were taken in three different views: front, smile and profile. A panel of 51 students evaluated the photographic sets. Ratings of facial aesthetic were performed on a scale with values from 1 (very unattractive) to 5 (very attractive). Three exhibitions were held: one where they were shown the three photographs of every individual, one which showed only a photograph when smiling smile and the frontal view and another in which only the profile was shown. Means and standard deviations of the ratings for each set of photographs were calculated for each of the 91 individuals for every assessment.
RESULTS: No statistically significant differences were found when qualifying facial aesthetics ($P < 0.01$). A correlation was found between the qualification of the three photographs shown simultaneously and the qualification of the profile photography ($r = 0.933$).
CONCLUSIONS: No statistically significant differences were found when profile photography was qualified with other views.

253 RADIOGRAPHIC EVALUATION OF THE MANDIBULAR RAMUS AND CONDYLE IN PATIENTS WITH JUVENILE IDIOPATHIC ARTHRITIS
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AIMS: To evaluate the prevalence of skeletal asymmetries in children with juvenile idiopathic arthritis (JIA) in comparison with unaffected children, and to investigate whether a possible correlation exists between asymmetry and the destruction of the temporomandibular joints (TMJs).
MATERIALS AND METHOD: Panoramic radiographs of 152 patients with JIA (mean age 12.48 ± 3.77 years). A classification of TMJ involvement and Kjellberg's asymmetry index were applied. The results were compared with gender- and age-matched healthy controls (n = 152).
RESULTS: Within the study group, the asymmetry index was 48.36 ± 5.5 per cent. These percentages represent an average relationship between the condyle and mandibular height. Independent of symmetry or bony involvement, the TMJs of both sides showed comparable values. There was no significant difference between the two groups. Ninety children with JIA showed destruction of one or both TMJs. The JIA patients were statistically significantly more often and more severely affected than the subjects in the control group. In general, the observed degenerative changes were at a moderate level. Multiregression analysis demonstrated no relationship between the asymmetry index and the level of destruction. It was not possible to demonstrate a relationship between the asymmetry index or the joint findings with age.
CONCLUSION: Patients with JIA showed more often and more severe joint abnormalities than control subjects. However, differences in terms of asymmetry could not be detected between the two groups.

254 DOES ORTHODONTIC TOOTH MOVEMENT CAUSE AN ELEVATION IN THE SYSTEMIC INFLAMMATORY MARKERS?

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AIM: To evaluate the effects of orthodontic treatment on systemic levels of the inflammatory markers C-reactive protein (CRP), tumour necrosis factor-α (TNF-α) and interleukin-6 (IL-6).
SUBJECTS AND METHOD: Seventeen subjects (11 girls and 6 boys, mean age 13.1 years) treated with fixed appliances and distalising headgear. Venous blood samples were taken from the cubital vein before treatment and then at three further time points during treatment of each subject two months apart. The sera from these blood samples were analysed using enzyme-linked immunosorbent assay technology for CRP, TNF-α and IL-6 concentration levels.
RESULTS: There was no significant elevation of any of the three inflammatory markers at any time point.
CONCLUSIONS: This research provides evidence that conventional orthodontic treatment has no systemic immune response and is therefore immunologically safe.

255 ORTHODONTIC TREATMENT ATTITUDE VERSUS ORTHODONTIC TREATMENT NEED

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AIMS: To evaluate orthodontic treatment attitude and the objective level of orthodontic need in 6–16-year-old Italian school children on the basis of gender, socio-economic status (SES) and geographical context.
SUBJECTS AND METHOD: School children from elementary and middle schools of five Italian regions: Abruzzo, Calabria, Lazio, Puglia and Friuli-Venezia-Giulia were examined. The level of orthodontic need was assessed using the Risk of Malocclusion Assessment (ROMA) Index while SES was assessed using parental job activities. The propensity towards orthodontics was evaluated using some questions from the Child Orthodontic Attitude Survey previously validated for Italian-speaking children. Univariate analysis was performed using the chi-square test in order to find differences between the groups for nominal variables. Multivariate analyses were conducted using logistic regression models. Statistical significance was set at $P < 0.05$.
RESULTS: The final sample comprised 2284 school children, 1140 (49.9%) females and 1144 males (50.1%). Twenty-five per cent of the total sample were undergoing orthodontic treatment. The overall mean age was 10.50 years. An inverse statistical association was found between SES and the ROMA Index ($P = 0.003$): subjects with a higher SES had a lower orthodontic treatment need. There was a statistically significant association between either SES and the ROMA Index and the place of abode ($P < 0.001$). Chi-square testing showed a statistically significant association between SES and subjects undergoing treatment ($P < 0.001$). Logistic regression analysis showed that females, older children, in-treatment subjects and children from the Puglia region were more likely to have orthodontics.
CONCLUSIONS: Orthodontic treatment attitude largely depends on gender, age, SES and geographical context, but is not influenced by the real level of orthodontic treatment need.

256 EVALUATION OF CRANIOFACIAL DEVELOPMENT IN COELIAC DISEASE PATIENTS

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AIM: Coeliac disease is a genetically inherited disease that can affect child growth from dietary gluten introduction to gluten withdrawal following diagnosis. Data on the craniofacial development in coeliac children are not available. The aim of the present retrospective study was to evaluate craniofacial development in patients diagnosed with coeliac disease.
MATERIALS AND METHOD: Lateral and postero-anterior (PA) cephalograms of 10 patients (mean age 8.2 ± 2.2 years) with diagnosed coeliac disease. The lateral and PA cephalograms were traced and evaluated for size and position of the cranial base, maxilla, maxillary dentition, mandible, and mandibular dentition, as well as for vertical and transverse relationships. Comparisons with 10 children (mean age 8.9 ± 2.6 years) without coeliac disease were undertaken. Data were analysed using the Wilcoxon's paired *t*-test.
RESULTS: No significant skeletal or dental differences were found in the coeliac patients when compared with untreated normal individuals ($P > 0.05$).
CONCLUSIONS: Within the limitations of this study, the results indicate that the craniofacial morphology of patients with coeliac disease is unaltered in childhood.

257 EVALUATION AND QUANTIFICATION OF CRANIAL BASE GROWTH DURING PUBERTAL GROWTH
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AIM: To evaluate and quantify growth of the cranial base in the stages of acceleration, transition and deceleration of cervical vertebrae and its sexual dimorphism.
MATERIALS AND METHOD: Lateral cephalometric radiographs of 21 females and 15 male Brazilian subjects followed for a period of 5 years. For evaluation of the total length, and anterior and posterior regions of the cranial base, the following were used: Ba-Na, Se-Na, CC-Na; Se-Ba, CC-Ba and CF-Po.
RESULTS: The total length of the cranial base (Ba-Na) showed significant growth in all studied periods for males, while females had significant growth only in the stages of acceleration and transition. For anterior cranial base, no significant growth was observed in males for Se-Na while for CC-Na there was significant growth between the periods of acceleration and transition. Females had significant growth for all anterior cranial base measurements (Se-Na and CC-Na). For posterior cranial base measurements (Se-Ba, CC-Ba and CF-Po), males showed significant growth between the periods of acceleration and transition while females demonstrated significant growth in all periods for Se-Na. There was no significant growth increase for CC-Ba and CF-Po. Comparison of the measurements did not show significant gender differences.
CONCLUSION: There were similarities in timing and the amount of growth for almost all cranial growth measurements. Measurements that included Se point showed different results for different periods of time. No significant difference between the genders was found.

258 DETERMINATION OF GROWTH PATTERN WITH DIFFERENT CRANIOFACIAL PARAMETERS
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AIM: To estimate the influence of different factors and variables on craniofacial growth.
MATERIALS AND METHOD: Lateral cephalometric head films of 120 subjects, aged 8–14 years: 30 with a Class I malocclusion, 30 with a Class II division 1 malocclusion, 30 with a Class II division 2 malocclusion and 30 with a mesiocclusion. The following angular and linear parameters were included in the investigation: SNA, SNB, ANB, SN/MPL, sum of NSAr, SArGo and ArGoMe; facial axis angle (BaN/PtGn); and anterior (n-me) and posterior (s-go) face heights and their relationship. The results were statistically analysed – Pearson test.
RESULTS: Seventy-two per cent of the Class II division 2 subjects had a facial axis angle of less than 90 degrees, i.e. vertical growth, 63 per cent of the Class II division 1 had a horizontal growth pattern, 50 per cent of the Class I subjects a combined growth pattern, while predominantly horizontal growth was found in the Class III subjects. SN/MPl indicated that a vertical type of growth was present in 36 per cent with a Class I; 40 per cent with a Class II/1, 36 per cent with a Class II/2 and 10 per cent with a Class III malocclusion. Low angle individuals were dominant in the mesiocclussion group (71%), moderately dispersed in the Class I (44%) and 29 and 28 per cent respectively in the Class II/1 and Class II/2 subjects. There was a high positive correlation between the sum of the angles (Björk's polygon) with inclination of the mandibular plane in all examined groups and high negative correlation between the type of facial rotation and facial axis with the exception of the Class I subjects, which is probably a result of more individuals with a combined growth pattern.
CONCLUSIONS: Prediction of the potential and magnitude of craniofacial growth is valuable in diagnosis, planning and evaluation of the outcomes of orthodontic and orthopaedic treatment.

259 ASSOCIATION BETWEEN TRANSVERSE DENTOSKELETAL DIMENSIONS AND CLASS II SEVERITY

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AIM: To study the possible relationship between transverse dentoskeletal dimensions and the severity of a Class II division 1 malocclusion judged in terms of ANB angle, Wits appraisal and mandibular plane angle. It was hypothesized that maxillary transverse and upper molar width decrease with increasing severity of the Class II.
MATERIALS AND METHOD: Pre-treatment postero-anterior (PA) and lateral cephalograms (n = 224, 126 males and 98 females; mean age 10.4 years). Inclusion criteria: healthy subjects, Caucasians, at least a three-quarter unit Class II molar relationship on both sides and ≥ 4 mm overjet. The patients were randomly selected with a wide range of overjets (4 to 15 mm, mean 8.55 mm). The cephalograms were traced and the reference points defined and digitized using Numonics AccuGrid. Nine transverse, four sagittal and two vertical linear and angular measurements were computed. Power analysis and two-tailed Spearman's rank correlation analysis were used to study the relationship between age, overjet, overbite, dental and skeletal measurements. The combined error of tracing, landmark location and digitization was evaluated by repeating the procedure with 25 randomly selected PAs and lateral cephalograms and using the interclass correlation coefficient (ICC).
RESULTS: There was no correlation between the transverse dimensions and the severity of the Class II malocclusion. A positive correlation was found between skeletal age, chronological age and gender and the transverse measurements, with the exception of lower molar width. Repeated measurements showed excellent repeatability of the measurements (ICC: 92.2–99.6%).
CONCLUSIONS: Transverse measurements positively correlate with severity of skeletal pattern and chronological age and gender. The hypothesis that the transverse widths negatively correlate with the severity of the Class II malocclusion judged in terms of ANB angle, Wits appraisal or mandibular plane angle was rejected with a power of 95 per cent.

260 CEPHALOMETRIC ANALYSIS OF GROWTH PATTERN AND INCISOR POSITION IN PATIENTS WITH A CLASS II DIVISION 2 MALOCCLUSION

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AIM: To evaluate and compare incisor position and growth pattern in patients with a Class II division 2 malocclusion.
MATERIALS AND METHOD: One hundred and sixty six lateral cephalograms obtained from patients with a Class II division 2 malocclusion (90 females, 76 males). The sample was divided into three groups according to the dental and skeletal age of the patients: patients in the mixed dentition (aged 8–13 years), growing patients in the permanent dentition (aged 13–18 years) and non-growing patients in the permanent dentition (aged 18–30 years). Criteria for cephalometric analysis of incisor position were: angle between the long axis of the upper central incisors and palatal plane (I/SpP), angle between the long axis of the lower central incisors and the mandibular basal plane (i/Mp) and interincisal angle (I/i). The sum of the posterior angles according to Björk: sella (NSAr), articular (SArGo) and gonial (ArGoMe) were used to determine the rotation of jaw bases and growth pattern. In addition to standard descriptive statistical calculations (mean and standard deviation), analysis of variance was used to determine the differences between the groups.
RESULTS: There was a decrease of the sum of the posterior angles according to Björk with age. The values for I/SpP showed an increase with age, those for i/SpP changed during growth, and showed the highest values for the youngest and oldest groups of patients, while I/i was significantly greater in the older subjects compared with the younger groups of patients.
CONCLUSIONS: In all groups of patients with a Class II division 2 malocclusion a tendency to a horizontal growth pattern was present which became more pronounced with age. Retroclination of the upper and lower incisors, as well as higher values for interincisal angle were also more noticeable in the older patients.

261 RADIOGRAPHIC ASSESSMENT OF ALVEOLAR BONE GRAFTING IN PATIENTS WITH DIFFERENT TYPES OF CLEFT

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AIMS: To radiographically assess secondary and late alveolar bone grafts performed for the first time depending on the patient's age and the type of cleft, as well as determination of the percentage of successful bone grafts in patients representing different results.
MATERIALS AND METHOD: Ninety-six good quality radiographs taken at least 6 months after the grafting procedure. In order to assess the radiographs, the scale of Witherow *et al*. (2002) was used. The scale has six categories, depending

on the extent of the accepted bone graft and the position of successfully healed bone tissue in relation to the teeth adjacent to the cleft.
RESULTS: In 75 patients grafting achieved positive results. A negative outcome was observed in 21 patients. The best results were obtained in patients with a unilateral cleft and the poorest results in those with a bilateral cleft. Category A was identified in 13.34 per cent of patients; category B in 17.34 per cent, and category C in 38.66 per cent. Category D constituted 6.67 per cent, category E 16.00 per cent, and category F 8.00 per cent.
CONCLUSIONS: A relationship was found between the age and quality of the grafted bone tissue. The best results were obtained in patients under 12 years of age, where the percentage of successfully healed bone grafts was above 86 per cent. The best quality of performed grafts was observed in patients with a cleft lip and cleft alveolar process, whereas the poorest results were noted in those who had a total bilateral cleft.
Witherow H, Cox S, Jones E, Carr R, Waterhouse N 2002 A new scale to assess radiographic success of secondary alveolar bone grafts. Cleft Palate-Craniofacial Journal 39: 255–260

262 A NEW TECHNIQUE FOR PAIN-FREE MINISCREW INSERTION

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AIM: To test the efficacy of a periodontal anaesthetic gel for pain free miniscrew insertion.
SUBJECTS AND METHOD: Twenty patients who required a temporary anchorage device. All had good oral hygiene and were treated with different mechanics. Twenty-eight Spider Pins (length 8 mm, diameter 1.33 mm) and 10 Absoanchor miniscrews (length 7 mm, diameter 1.2 mm), were inserted in the inter-radicular spaces of the premolars or between the canine and first premolar. The anaesthetic gel used for drill free insertion was the Oraquix® (Dentsply Ltd, UK), a periodontal gel comprising 25 mg Prilocaine and 25 g Lidocaine per gram. The gel is packed in cartridges of 1.7 g and an Oraquix® dispenser is provided with a blunt-tipped applicator. The gel was applied in all patients in the mesial periodontal space of the first premolar, in the distal periodontal space of the canine, and on the buccal mucosa. After waiting for four minutes for the gel to solidify, drill free insertion of miniscrew was carried out. The patients were provided with a questionnaire to determine their impressions of the procedure.
RESULTS: All 38 miniscrews were successfully inserted and only two patients referred to pain on the questionnaire. No patient requested that the surgical procedure be stopped because of pain.
CONCLUSIONS: Oraquix® injected in the periodontal spaces of the teeth proximal to the insertion site seems to be an alternative to traditional anaesthetic procedures.

263 FLEXURAL STRENGTHS OF CONVENTIONAL AND NANOFILLED FIBRE-REINFORCED COMPOSITES: A THREE-POINT BENDING TEST

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AIMS: To evaluate the effect of the introduction of nanofillers on the mechanical properties of fibre reinforced composites (FRCs). In particular, the aim of the research was to determine the force levels of two sizes (diameter 0.6 and 0.9 mm) of both conventional and nanofilled FRCs.
MATERIALS AND METHOD: The FRCs (EverStick, StickTech, Turku, Finland) samples were divided into four groups, each consisting of 20 specimens. The first two groups were conventional FRCs commercially available with glass fibres preimpregnated with PMMA. In the other two groups, the impregnating solution contained 32 per cent of nano-filled resin (Nanocryl; Hanse Chemie). Two FRCs sections were evaluated: 0.6 and 0.9 mm in diameter. Each sample was polymerized with the same halogen curing unit (Optilux 501; SDS Kerr, Danbury, Connecticut, USA) and then evaluated with a three-point bending test on a universal testing machine after 48 hours dry storage. Ten specimens of each group were tested at 1 mm deflection and the other 10 at 2 mm deflection.
RESULTS: ANOVA indicated significant differences among the two groups consisting of nanofillers and the other two with a traditional composition, especially considering both the diameter of the glass fibres bundle and the deflection used in the test ($P < 0.001$).
CONCLUSIONS: Nanofilled FRCs have significantly higher load values than conventional FRCs. Higher flexural strength values were obtained with 1 mm deflection. Moreover the introduction of nanofillers in FRCs increases the load values if the FRCs diameter size is 0.6 mm.

264 EFFECTS OF NANOFILLERS ON THE MECHANICAL PROPERTIES OF FIBRE-REINFORCED COMPOSITES

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AIMS: To evaluate the effect of the introduction of nanofillers on the mechanical properties of fibre reinforced composites (FRCs). A further aim was to determine the influence of hand light-curing (Optilux 501; SDS Kerr, Danbury, Connecticut, USA) and of a secondary oven polymerization (Targis Power, Ivoclar Vivadent AG, Schaan, Liechtenstein) on the mechanical properties of two sizes (diameters 0.6 and 0.9 mm) of FRCs.
MATERIALS AND METHOD: The FRC (EverStick, StickTech, Turku, Finland) samples were divided into four groups, each consisting of 20 specimens. The first two groups were conventional FRCs commercially available with glass fibres pre-impregnated with PMMA. In the other two groups, the impregnating solution contained 32 per cent of nano-filled resin (Nanocryl; Hanse Chemie). Two FRCs sections were evaluated: 0.6 and 0.9 mm in diameter. Ten samples of each group were hand light-cured with the same curing unit for 40 seconds, while the other 10 were also polymerized for 25 minutes in a light-curing oven. Each sample was evaluated with a three-point bending test on a universal testing machine after 48 hours of dry storage.
RESULTS: ANOVA indicated significant differences between the two groups consisting of nanofillers and the other two with a traditional composition ($P = 0.012$). This difference was also evident when considering the influence of glass fibre diameter size ($P = 0.0083$) and polymerization type ($P = 0.01$).
CONCLUSIONS: Nanofilled FRCs have significantly higher load values than conventional FRCs. Among nanofilled FRCs, higher flexural strength values were obtained with additional post-curing instead of hand light-curing. The introduction of nanofillers in FRCs increases the load values, especially in FRCs with a diameter of 0.9 mm.

265 CLINICAL AND COMPUTERIZED EVALUATION OF TEMPOROMANDIBULAR JOINT INTRACAPSULAR DISEASE

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AIM: To present three types of analysis that allows immediate understanding of the pathogenesis of temporomandibular joint intracapsular disease (TMID). Neuroocclusal clinical evaluation (NOE), T-Scan 2 system (TS2) and surface electromyography (sEMG) can be used to assess TMD.
SUBJECTS AND METHOD: Twenty patients, 25–30 years of age, with TMID and a control group of 10 healthy subjects. NOE was calculated considering the lateral mandibular excursion angle [the masticatory functional angle (MFA)]. TS2 is a computerized occlusal analyzer that displays the centre of force (COF) and centre of force trajectory (COFT) and provides in-depth occlusal analysis. Surface electromyographic (sEMG) assessments in the resting position and during maximum clenching were performed.
RESULTS: TMID patients had lower MFA on the side of the affected joint. In the healthy controls there were no AFM differences. In the TMID group the difference between the two MFAs was greater than 6 degrees. TS2 showed that in the control group there was no difference in COF and if there were differences these were no greater than 5 per cent. In the TMID group the difference were greater than 5 per cent (COF: mean 70.74 affected TMJ side/29.26 in balance side). In the controls COFT was always localized among the two central ellipses while in the TMID group COFT was always out of the two central ellipses and moved towards the side with higher bite force value. sEMG test showed that in the TMID group there was significant asymmetric activation of the masseter muscles.
CONCLUSIONS: The most common symptoms of TMID are muscle and ligament pain on palpation, limitation of mandibular mobility and joint sound. Patients with TMID presented the same results: asymmetric activation of masseters, TS2-COF higher on the working side, COFT deviation towards the working and lower FMA on the working side.

266 ARE TONGUE FUNCTIONAL MAGNETIC RESONANCE IMAGING FINDINGS MORE RELIABLE THAN DIAGNOSTIC?

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AIM: To evaluate if there are differences between tongue functional findings of experienced speech therapists in comparison with magnetic resonance imaging (MRI) based findings.
SUBJECTS AND METHOD: Fifty-six subjects were analyzed according to Kittel (1984). Their tongue position at rest and the deglutition process were determined clinically by three speech therapists using MRI analysis (T1 spin echo images and two dimensional FIESTA sequences) and by two examiners.
RESULTS: The interrater reliability of the three speech therapists showed moderate concordance except for one parameter, which evaluated the tongue at rest. The interrater reliability of the two MRI examiners showed the highest reliability when describing the tongue at rest, whereas the reliability of deglutition findings showed moderate concordance. Although the

logopaedic examination according to Kittel (1984) is a frequently used method to diagnose tongue dysfunction, the reliability values of speech therapists in this study did not show satisfactory concordance. Since different error sources can be presumed concerning the examination method used by speech therapists, MRI analysis was used to find more reliable diagnostic parameters. On MRI the tongue movements and its position at rest can be evaluated four-dimensionally. Nevertheless, the reliability values of the two MRI examiners did not show satisfactory results either. The diagnosis of the tongue at rest obviously provided more reliable results than the evaluation of the deglutition process. This is due to motion artefacts during MRI recording, the fact that swallowing varies intraindividually, and that the paramedian tongue structures were not evaluated.
CONCLUSIONS: Neither experienced speech therapists nor MRI examiners diagnose the deglutition process reliably.

267 CAN YOU GUESS THE FACIAL BIOTYPE JUST BY LOOKING AT A LATERAL PHOTOGRAPH OF A PATIENT?

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AIM: To determine whether it is possible to distinguish the cephalometric skeletal biotype from a digital lateral photograph.
MATERIALS AND METHOD: Twenty-eight orthodontists were shown a computer presentation of 100 lateral photographs of patients whose facial biotype had been previously diagnosed by lateral cephalometric analysis (standard pattern). Each picture was numbered to avoid confusion and there was no time limit to complete the questionnaire. Participants were asked to classify the facial biotype according to Ricketts (Vert) just by observing the photographs. Lateral photographs of each subject were taken with a digital camera (Reflex Olympus E-330). The photographs were obtained in profile with the right side of the face toward the experienced orthodontist that took the photographs. The Frankfort plane was approximately parallel to the floor. The radiographs were digitised and processed using the cephalometric software (Nemoceph®). Data expressing the percentage of concordance with respect to the standard pattern were shown as the mean ± the standard error of the mean. Data were analyzed using a one-way repeated measure ANOVA with Bonferroni *post hoc* adjustment for multiple testing using the program, Prism 3.0. $P < 0.05$ was considered statistically significant.
RESULTS: Only 32.75 ± 1.20 per cent of participants correctly identified the facial biotype of the patients with respect to the Ricketts (Vert) pattern. A brachifacial biotype was significantly the most difficult to determine (19.95 ± 2.36%; $P < 0.001$) versus dolichofacial (49.15 ± 3.69%) as well as versus mesofacial (43.18 ± 1.95%).
CONCLUSIONS: Although lateral photographs of patients can be helpful, it seems that it is not possible to determine their skeletal facial biotype. Dolichofacial and mesofacial patterns were easier to discriminate, while brachifacial was significantly the most difficult to guess.

268 DO THE NEOCLASSICAL CANONS STILL DESCRIBE THE BEAUTY OF FACES? AN ANTHROPOMETRIC STUDY OF 50 CAUCASIAN MODELS***

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AIM: To determine if the neoclassical canons still describe the beauty of female faces.
MATERIALS AND METHOD: Frontal and profile photographs of 50 models participating in an Italian beauty contest were taken and printed at a ratio of 1:1. The neoclassical canons and ratios were calculated for each model on the frontal and lateral photographs: 1) special head height equal to special face height; 2) division of face in equal thirds; 3) division of face in equal quarters; 4) nose length equal to ear length; 5) nasal bridge inclination equal to ear inclination; 6) intercanthal distance equal to nose width; 7) intercanthal distance equal to eye fissure length; 8) mouth width equal to 150 per cent of nose width; 9) nose width equal to one-quarter of face width; 10) division of the lower face in three equal portions; 11) division of the lower face in four equal portions. One-way ANOVA was performed to compare the mean values of each measurement. When more than two groups were considered, Tukey's p*ost hoc* test was performed in order to determine the statistical significance between couples of groups. The level of significance was set at $P < 0.05$.
RESULTS: The middle face third is reduced when compared with the upper and the lower thirds and the two upper quarters of the face are significantly decreased when compared with the two lower quarters ($P < 0.01$). Nose height was smaller than ear height and nose width smaller than one-quarter of facial width. In 72 per cent of cases the ear axis was steeper than the nose. The intercanthal width was smaller than nose width and eye width ($P < 0.05$). A tendency for the mouth width to be greater than 150 per cent of nose width was also found.
CONCLUSIONS: Some of the neoclassical canons can be considered still valid, while others have changed over centuries. In particular a reduction in nose dimensions and in the distance between the eyes has occurred.

269 PREVALENCE OF MALOCCLUSION IN PATIENTS WITH TURNER SYNDROME

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AIM: To assess the frequency of orthodontic malocclusions in patients with Turner syndrome.
SUBJECTS AND METHOD: Thirty Turner Syndrome patients aged 8–18 years (mean: 14.7 years). The sample was subdivided according to karyotype.
RESULTS: A malocclusion was found in 70 per cent of patients with Turner syndrome. A Class II division 1 malocclusion was most frequently observed (30%). Crowding and a bilateral crossbite were found in 6.7 per cent of the subjects. A unilateral crossbite was present in 13.3 per cent whereas an open bite was observed in only 3.3 per cent. The most significant differences were found between 45X patients and mosaic and isochromosome for the long arm of X karyotypes. The prevalence of a Class II division 1 malocclusion was the most frequent anomaly in 45X patients whereas in patients with mosaic karyotypes a Class II division 2 malocclusion was more prevalent.
CONCLUSIONS: Patients with structural and/or numerical aberration of the X chromosome, develop a specific pattern of malocclusion with deviations in the sagittal, vertical and transverse directions. Early diagnosis of oral anomalies and timely orthodontic treatment of patients with Turner syndrome should be carried out.

270 FINITE ELEMENT ANALYSIS OF THE POSITION OF THE CENTRES OF RESISTANCE FOR MAXILLARY TOOTH GROUPS

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AIM: The position of the centre of resistance (CR) is an essential parameter regarding the planning of orthodontic tooth movement. As a result of using temporary anchorage devices (TAD) at various positions, the three-dimensional (3D) position of the CR is becoming more important. The objective of this study was to determine, using the finite element (FE) method, the position of the CR of four incisors, six anterior teeth and the maxillary dentition.
MATERIALS AND METHOD: Based on a commercially available 3D data set of a maxilla, as well as known and earlier determined material parameters, FE models of the 14 maxillary teeth and their surrounding tooth supporting structures were generated. In the FE system, the model of each tooth group was fixed by rigid wire and loaded horizontally and vertically.
RESULTS: The CR of the four anterior teeth was located 13.5 mm apical and 12 mm distal from the incisal edge of the central incisors. For the six anterior teeth, the CR was placed 13.5 mm apical and 14 mm distal from the incisal edge of the central incisors. For the maxillary dentition, CR was located 11 mm apical and 26.5 mm distal from the incisal edge of the central incisors.

271 TORQUE STABILITY OF PLASTIC BRACKETS FOLLOWING MULTIPLE STRESS

M Möller[1]; R Sadat-Khonsari[2]; V Schlegel[3]; B Kahl-Nieke[1]; A Klocke[1], [1]University Hamburg, [2]University Göttingen and [3]Technical University Hamburg, Germany

AIM: To compare the torque stability of various types of plastic brackets under torque stress. The intention was to establish if repeated torsion stress would cause material fatigue regarding the play of the wire in the slot of the bracket, the elasticity, and applicable torque stress.
MATERIALS AND METHOD: Ten brackets each, made of pure polycarbonate, ceramic reinforced polycarbonate, fibreglass reinforced polycarbonate, ceramic reinforced polycarbonate with a metal slot, fibreglass reinforced polycarbonate with a metal slot, polyurethane, and polyurethane with a metal slot were artificially aged according to ISO 10477 and put under torque stress five times up to 20 degrees torsion. Torque stress was applied continuously using a testing machine (Zwicki Z2.5, Zwick, Ulm, Germany). The resulting torque and torsion were digitally recorded. The control group comprised 10 stainless steel brackets.
RESULTS: The play of the wire in the metal slot varied widely from 1.36 to 12.09 degrees. The slot on all polycarbonate brackets without a metal lining, was bent open after being pressured once. Elasticity differed from 2.28 to 0.63 Nmm/°, average 1.41 Nmm/°. All brackets lost torque after single tension up to 20 degrees. Pure polyurethane only lost 5 per cent whilst ceramic reinforced polycarbonate lost most at 28.5 per cent. The average loss for the other brackets was 17 per cent. Subsequent stress did not significantly increase the loss.
CONCLUSION: All bracket materials showed significant loss of torque if stressed again after the initial exposure to torque. In practice, each bracket material requires a specific torsion value in order to transfer comparable torque forces to the tooth. Compared with steel brackets, only plastic brackets with a metal slot are suitable for clinical application. Reinforcement by ceramic or fibreglass has no advantage regarding torque stability of polycarbonate brackets. Polyurethane shows no significant difference to polycarbonate under torque stress.

272 EFFECTS OF LIP THICKNESS ON ALVEOLAR BONE GRAFT OUTCOMES IN PATIENTS WITH COMPLETE UNILATERAL CLEFT LIP AND PALATE – A PILOT STUDY

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AIM: To define the effects of lip thickness on alveolar bone graft outcome in patients with complete unilateral cleft lip and palate (UCLP).

MATERIALS AND METHOD: Topographic occlusal radiographs and lateral cephalograms, at 1 month and 1 year after secondary alveolar bone grafting of 10 patients with complete UCLP. Grafted bone heights were measured on the topographic occlusal radiographs and lip thickness on the lateral cephalograms. Distortion correction was attempted by determining the ratio of the radiographic length of the cleft to that of the maxillary central incisor adjacent to the cleft. Regression analysis was carried out to determine correlations between lip thickness and the amount of grafted bone remaining one year after surgery.

RESULTS: There was a statistically significant correlation between lip thickness and post-surgical alveolar bone graft height: the less lip thickness, the less alveolar bone graft height remaining.

CONCLUSIONS: Lip thickness is a factor affecting alveolar bone graft outcome. Further investigations are needed to validate this conclusion using a larger sample.

273 EVALUATION OF FACEMASK AND QUADHELIX THERAPY IN CLASS III PATIENTS

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AIM: To evaluate the skeletal and orthodontic effects of facemask/quadhelix therapy.

MATERIALS AND METHOD: Pre- and post-treatment lateral cephalograms of 30 patients with a Class III malocclusion treated with a Delaire-type facemask with a quadhelix appliance for activation of the circummaxillary sutural system. This group was compared with 18 Class III untreated subjects.

RESULTS: The protraction group showed a significant change in SNA and ANB angles ($P < 0.01$). ANB had a mean increase of 4.5 degrees, and posteroanterior measurement changed significantly ($P < 0.01$) with an increase of 3.8 mm. There were no statistically significant changes in SNB ($P > 0.05$). P-B measurement decreased by 0.2 mm ($P > 0.05$). The relationship between SN-NL and SN-ML was statistically significant ($P < 0.05$), with a decrease of 3.6 degrees in SN-NL angle, and an increase of 1.98 degrees in SN-ML angle. Orthodontic effects included an increase in overjet of 5.2 mm and a decrease in overbite of 2 mm ($P < 0.01$).

CONCLUSIONS: The changes were a combination of normal growth with the effects derived by the facemask/quadhelix therapy. Facemask therapy for a mean period of 13 months can displace the maxilla anteriorly and increase the overjet. SNA, P-A, SN-NL measurements showed forward and upward displacement. Movements of the maxilla and mandible decrease the overbite, suggesting an open bite tendency. Orthopaedic treatment should be carried out as early as possible. Treatment of Class III malocclusions with maxillary expansion and a facemask induces favourable changes in patients with a small or retruded maxilla.

274 TREATMENT OF DENTAL ASYMMETRIES WITH MIDLINE DEVIATIONS USING AN ALIGNER

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AIM: To illustrate the use of the Invisalign™ technique in patients with a midline discrepancy due to loss of lateral or posterior teeth or to severe localized crowding.

SUBJECTS AND METHOD: Twenty adults patients, aged 25 to 35 years, presenting Class I and Class II malocclusions with significant midline discrepancies (mean: 3 mm) due to severe localized crowding and/or loss of lateral and posterior teeth. All patients were treated by means of the Invisalign™ technique. Midline evaluation was undertaken on extra and intraoral photographs and on plaster casts at the beginning (T0) and end (T1) of treatment.

RESULTS: The mean treatment time was 12 months. At T1 the anterior dentoalveolar asymmetry was completely corrected with acceptable root parallelism and good functional and aesthetic balance. The midline was completely centred at T1.

CONCLUSIONS: The Invisalign™ technique is an effective treatment option in patients with severe midline discrepancies.

275 IMPLANT SITE DEVELOPMENT BY ORTHODONTIC TISSUE REGENERATION

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AIMS: To illustrate a non-surgical technique for increasing the amount of available bone for implant placement in adult patients presenting teeth with a poor prognosis.

SUBJECTS AND METHOD: Seven adult patients with advanced periodontal vertical disease (mean probing depth from 7 to 9 mm) of the central and lateral incisors. For each patient, the treatment initially involved orthodontic extrusion using fixed appliances to facilitate a vertical increase of available bone. Panoramic and dental radiographs were taken pre-treatment and at the end of orthodontic extrusion. The height of available bone was measured from the crest of the alveolar ridge to the adjacent tooth. The patients were examined every 2 weeks to reduce the precontact on the incisal surface, to control inflammation and to observe progress. Orthodontic extrusion was performed in a mean time of 15 weeks.
RESULTS: The available bone formation for the implant site was achieved in all patients and fixture placement could be achieved without surgical ridge expansion.
CONCLUSIONS: Implant site development with orthodontic tissue regeneration of teeth with a poor prognosis could represent a valid atraumatic and predictable alternative to the traditional surgical expansion technique.

276 CHANGES IN PALATAL DIMENSIONS AFTER RAPID MAXILLARY EXPANSION WITH BONDED SPLINT APPLIANCES

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AIM: During rapid maxillary expansion (RME), transverse expansion of skeletal and dentoalveolar structures can be accompanied by changes of the cross-sectional area, the height and the sagittal dimension of the palatal vault. The aim of this study was to determine, using a three-dimensional (3D) laser scan technique, the dimensional changes before and after RME.
SUBJECTS AND METHOD: Twenty-four children (aged 6–10 years) with a crossbite. All were treated with an identical bonded splint expander with three turns (1st-3rd day) followed by two turns a day until the maxillary molar palatal cusps were in contact with the mandibular molar buccal cusps. The splint device was then used as a retainer for 6 months. Study casts were taken before RME and after the retention period and then recorded using a laser scanner and combined to complete a 3D image. On this image, cross-sections in the frontal plane localized at 53–63, 55–56 and 16–26 were constructed, exported as coordinates and calculated using the finite element method to quantify their dimensions. The measurements were taken on three occasions by one author with at least a 1 week interval between the recordings. The average values of the three ratings were used.
RESULTS: 1. *t*-test (paired samples): The average palatal widths (6.53–6.79 mm) and cross-sectional areas (20.39–20.46 mm²) revealed highly significant ($P < 0.001$) increases after expansion. Small but significant reductions could be seen for height (–0.49 mm only at 55–65; $P < 0.001$) and length (–0.54 mm; $P < 0.01$). 2. Linear regression analysis: There was a highly significant ($P < 0.001$) and direct correlation between the width and the cross-sectional areas. Age did not exert an influence on any area. 3. Intraclass correlation coefficient for the reliability of all three measurements was above 0.99 ($P < 0.001$) for all tested parameters.
CONCLUSION: RME increased the mean palatal widths and cross-sectional areas and reduced, to a small extent, its height (55–65) and maxillary length.

277 FACIAL GROWTH FROM 14–22 YEARS IN PATIENTS WITH UNILATERAL COMPLETE CLEFT LIP AND PALATE

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AIM: To compare facial growth and changes in incisor inclination from 14 to 22 years of age in patients with unilateral complete cleft lip and palate (UCLP) with a non-cleft sample.
SUBJECTS AND METHOD: The UCLP group consisted of 60 individuals (35 males, 25 females) with cephalograms at three stages: 14–17 years (after orthodontic completion), 16–20 years and 20–22 years. All patients had received comprehensive orthodontic treatment. The non-cleft material was taken from the Oslo University Craniofacial Growth Archives and consisted of 50 individuals (25 males, 25 females) with cephalograms in the same three age groups. The individuals in the non-cleft group had not had any orthodontic treatment. The cephalograms were traced by one investigator using standard cephalometric variables (10 angular, 11 linear measurements). The radiographs were analysed by Facad digital tracing software. A Student's *t*-test was carried out to determine the difference in changes between the two groups.
RESULTS: Statistically significant differences between the groups were found for four angular and five linear variables: the prominence of the maxilla (SNA) and the mandible (SNB) reduced over the years in females with UCLP compared with non-clefts. For both genders the intermaxillary angle was less reduced in the UCLP group compared with the non-clefts. UCLP males showed a significantly smaller increase in the length in the distance condylion to point A. The distance of the lips to the E-line reduced significantly more in non-cleft males than in males with UCLP. The lower incisors in both genders and the upper incisor in males in the UCLP group were slightly proclined relative to the APg line.

CONCLUSIONS: Significant, but small changes in facial growth and incisor inclination were found between the UCLP group and the non-cleft group between 14 and 22 years of age.

278 NICKEL TITANIUM WIRE IN THREE-DIMENSIONAL THREE-POINT BENDING

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AIM: The well-known mechanical characteristics of nickel titanium (NiTi) wire, such as its plateau force level and hysteresis on the force-deflection graph, are those obtained from a two-dimensional three-point bending test. The purpose of the present study was to examine mechanical characteristics expressed by the NiTi wire when it undergoes three-dimensional three-point bending.
MATERIALS AND METHOD: Using a modified three-point bending system (Kasuya *et al*., 2007), an experimental model was set up to imitate a clinical situation of initial orthodontic levelling and aligning of three incisor crowding with a 0.016 inch NiTi wire inserted into a friction free 0.022 inch slot bracket (Damon 3™) bonded on each of the three rods. The bracket on the centre rod was positioned at four different heights: 0, 1, 2 and 3 mm higher than the other two on both sides. The NiTi wire inserted into the three brackets was bent back and forth three times for the respective heights at the speed of 10 μm/seconds for the four different deflections: 1, 2, 3 and 4 mm to examine the horizontal component of the force generated from the wire on the force deflection graph.
RESULTS: Whatever the bracket height difference, the NiTi wire expressed a stainless steel-like force deflection relationship, namely a slope of the returning line with a deflection of 1 mm. When the bracket height was increased, the plateau region of the returning line began to tilt more positively and tended to return sooner to zero force, similar to a stainless steel showing a plastic deformation on the return. The plateau region of the returning line tended to tilt increasingly as the amount of deflection decreased with all bracket height differences, except for 0 mm.
CONCLUSION: NiTi wire may not be simply yielding a typical plateau force level in the clinical situation.
Kasuya S, Nagasaka S, Hanuyda A, Ishimura S, Hirashita A 2007 The effect of ligation on the load deflection characteristics of nickel titanium orthodontic wire. European Journal of Orthodontics 29: 578–582

279 LEACHING OF NICKEL IN NICKEL-TITANIUM ORTHODONTIC ARCHWIRES: AN *IN VITRO*

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AIMS: To investigate leaching of nickel (Ni) ions from commonly used nickel titanium (NiTi) archwires.
MATERIALS AND METHOD: Five 0.014 inch and five 0.017 × 0.025 inch NiTi and heat activated NiTi archwires from eight different orthodontic companies (3M/Unitek, American Orthodontics, Forestadent, GAC, G&H, Ormco, Ortho Organizers and TP Orthodontics) underwent a Ni leaching test. Statistical analysis was undertaken to test for any evidence of a significant association between wire type (conventional NiTi versus heat activated NiTi), wire size, company and Ni leaching.
RESULTS: Conventional NiTi leached significantly more Ni (60.0%) than heat activated NiTi archwires (37.6%; $P < 0.05$). No association was found between the two different wire sizes. There was a very highly significant association between the archwire manufacturer and leaching of Ni ions with certain companies having much higher levels of leaching than others ($P < 0.05$). This association was however complicated by the type of wire (if the wire was conventional or heat activated NiTi). Both wire type and manufacturer were, therefore, highly significant predictors of Ni leaching with, in many situations, the archwire company overriding wire type both positively and negatively. Logistic regression analysis confirmed that company remained highly significantly associated with leaching, after controlling for wire type and wire size (= 195.24, 7 df, $P < 0.001$); wire type remained highly significantly associated with leaching, after controlling for company of origin of the archwire and wire size (= 51.99, 1 df, $P < 0.001$); and wire size remained unassociated with leaching, after controlling for company of origin of the archwire and wire type (= 3.10, 1 df, NS).
CONCLUSIONS: There is greater leaching of Ni in conventional versus heat activated NiTi wires. Leaching is dependent on the company supplying the archwires, while size is not a factor.

280 A NEW SYSTEM FOR ANALYZING THE DENTOALVEOLAR MORPHOLOGY OF SKELETAL ASYMMETRY

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AIM: To develop a new system for analyzing dentoalveolar compensations of skeletal asymmetry.
MATERIALS AND METHOD: A new analyzing system was developed as follows: 1) plaster models of orthodontic patients with skeletal asymmetry were digitized using a three-dimensional (3D) laser scanner; 2) to define a 3D coordinate system,

anatomical parameters such as cusp points and cervical points were input; 3) 3D coordinate transformations were performed using several algorithms to obtain a coordinate system for estimating asymmetrical dentoalveolar morphology; and 4) features of the calculating algorithms and the clinical applicability of the analyzing system were investigated.
RESULTS: The 3D coordinate system using only anatomic landmarks had certain geometric biases for clinical use. To eliminate these biases, the 3D coordinate system was corrected using some peripheral areas of the anatomical landmarks, and the calculating algorithm was improved. This system can analyze images of dentoalveolar morphology both totally and sequentially by creating the cross-sectioned outline at any point. Superimposition on the contralateral outlines enabled the quantitative evaluation of the dentoalveolar compensations.
CONCLUSIONS: This system provides clinical efficiency for accurate diagnoses of facial asymmetry patients.

281 DO MASTICATORY FUNCTIONAL CHANGES INFLUENCE CONTRACTILE PROTEIN GENE EXPRESSION IN THE MASSETER MUSCLE OF ADULT RATS?

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AIM: To investigate potential changes in muscle contractile protein gene expression following alterations in masticatory function in adult rats.
MATERIALS AND METHOD: Thirty-six 21-day-old male Sprague-Dawley rats divided into two groups. Twelve received ordinary (hard) food during the whole experimental period (normal group). The remaining 24 received a soft diet to develop a hypofunctional masticatory system. These were divided after 21 weeks into two groups: one continued on a soft diet (hypofunctional group), and the other changed to an ordinary (hard) diet with the aim of functionally rehabilitating their masticatory system (rehabilitation group). After 6 weeks all animals were sacrificed and biopsies from deep masseter muscle were taken. The levels of expression of the myosin heavy chain isoform genes MYH 1+2 (fast), 3 (embryonic) and 7 (slow) were compared using quantitative reverse transcriptase polymerase chain reaction analysis.
RESULTS: Gene expression of MYH 3 was significantly higher in the rehabilitation group compared with the normal group ($P = 0.008$). There were no significant differences in comparison of the three groups regarding gene expression of MYH 1+2, but the levels after six weeks were the same for the normal and rehabilitation groups. Analysis showed that there were distinct differences in gene expression of MYH 7 between the rehabilitation and normal group ($P = 0.000$) and the rehabilitation and hypofunctional group ($P = 0.001$), where the levels were highest in the rehabilitation group and lowest in the normal group.
CONCLUSIONS: A six week period of masticatory function rehabilitation in deep masseter muscle of adult rats made it possible for fast (MYH 1+2) isoforms to normalize and slow (MYH 7) isoform levels to increase; an adaptation to the increased mechanical load. The increased level of embryonic (MYH 3) isoform can be due to the need for creation of new MYH isoforms.
This research was supported by a European Orthodontic Society Grant

282 INCIDENCE OF WHITE SPOT LESIONS DURING FIXED ORTHODONTIC TREATMENT AND CORRELATION WITH VARIOUS ORAL HYGIENE PARAMETERS

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AIMS: To investigate the incidence of enamel demineralization around brackets in the Romanian adult population and to establish correlations with different dental and gingival health parameters to oral hygiene and to fluoride application during orthodontic treatment.
SUBJECTS AND METHOD: Sixty orthodontically treated adult patients. The incidence of white spot lesions (WSLs) was graded using the classification of Gorelick *et al*. from intraoral photographs taken before and after treatment. All images were analyzed by three observers using image-processing software. The evaluated parameters were: plaque index, oral hygiene index, papillary bleeding index, gingival recession, sulcus probing depth and fluoride use.
RESULTS: Of the evaluated teeth, 88.6 per cent were free of WSLs before and 57.5 per cent after treatment. New WSLs were present in 31.1 per cent of the teeth after orthodontic treatment; more commonly on the upper anterior teeth (34.1 per cent), molars (30.6 per cent) and premolars (24.3%). WSLs correlated with the plaque, oral hygiene and papillary bleeding indices and fluoride-use scores.
CONCLUSIONS: For the Romanian population, enamel demineralization during fixed orthodontic treatment is still an important problem. The results emphasize the need for good instruction, motivation and control of the patient's hygiene during treatment.

283 TOOTH SIZE DISCREPANCIES AMONG ROMANIAN CHILDREN

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AIMS: To determine tooth size discrepancies (TSD) in a sample of Romanian schoolchildren, and to compare TSD between females and males.

MATERIALS AND METHOD: Seventy-four pre-treatment plaster models were scanned with an optical three-dimensional scanner (Activity 101, Firma Smart Optics Sensortechnik GmbH, Germany). The mean age of the subjects was 14.7 years. The inclusion criteria were: all permanent teeth (except third molars), no interproximal caries, restorations or stripping, no missing or supernumerary teeth, no evident tooth wear and no previous orthodontic treatment. The models were analyzed using software and the anterior and overall Bolton rations were determined. Statistical analysis (*t*-test) was performed.

RESULTS: The mean values for anterior and overall TSD were 78.2 and 91.9 per cent, respectively. The percentages of subjects with clinically significant TSD (values outside 2 SD from the Bolton's mean) of the anterior ratio was 21.8 per cent, and for overall ratio 8.6 per cent.

CONCLUSIONS: There were no statistically significant differences in anterior and overall tooth size ratios between females and males, with small differences for males where the TSD ratios were larger.

284 DENTAL AGE IN A SAMPLE OF ROMANIAN CHILDREN AND ADOLESCENTS

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AIMS: To investigate the regional characteristics of dental eruption in a group of Romanian children and adolescents in order to develop a scale for future radiographic investigations of dental age, and to produce a clinically useful analysis form.

MATERIALS AND METHOD: In order to assess the dental age of healthy Romanian children and adolescents (age between 5–17 years) a cross-sectional study was undertaken by evaluating 150 panoramic radiographs. Inclusion criteria were: Romanian origin, varying socio-economic status, patients attending the Department of Paedodontics-Orthodontics at Timisoara. Patients with agenesis of one or more teeth, distinctive retardation in dental development (except third molars) or different systemic diseases were excluded. Dental age was determined according to the method of Demirjian *et al*. All radiographs were evaluated by one examiner after an initial training period. The parameters birth date, date of radiograph, gender and developmental stages of the teeth and the score tables from 1978 were used to calculate the mean values for score sum and chronological age.

RESULTS: A dental maturity measurement was produced for this population that allowed direct conversion of the score sum to dental maturity age. Statistical analysis revealed correlations between chronological age and score sum for females and males. A logistic function was determined as a result of correlation between two parameters: score sum and chronological age. Two gender specific equations for calculating dental age were developed. Girls showed more accelerated dental development.

CONCLUSIONS: Because dental age distribution in this Romanian sample was not significantly correlated with that of Demirjian *et al*., it is necessary to produce regional standards of dental development using their scoring system.

285 PHOTOGRAPHIC SOFT TISSUE PROFILE ANALYSIS OF 7-YEAR-OLD ROMANIAN CHILDREN

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AIMS: To develop a simple and fast method for quantification of the soft tissue profile on frontal and lateral photographs, and to collect data of normal 7 year old healthy children, of both genders and with different dental Classes. The definition of normal values is important in the clinical assessment of orthodontic patients.

MATERIALS AND METHOD: Frontal and lateral left-side profile photographs were obtained of 129 'normal' children aged 7 years ± 6 month with an Angle Class I, II or III dental canine and molar relationship. To ensure anonymity and blind assessment of facial morphology, all photographs were coded for the gender of the subject (m1 or f1) and no further reference to name or dental Class was made. Linear distances and angles were measured. The association between the different codes and dental Classes was carried out only after all calculations. Comparisons were made using two-way factorial analysis of variance (ANOVA) with replicates. Statistical significance was set at 5 per cent.

RESULTS: Facial heights did not differ between boys and girls, but they were significantly modified by dental Class. On average the children with an Angle Class II dental relationship had the longest faces, children with a Class III had intermediate values and those with a Class I had the shortest faces.
CONCLUSIONS: Non-invasive orthodontic diagnosis at the age of 7 years can be used for early treatment planning.

286 OCCLUSION AS AN IMPORTANT FACTOR TO INFLUENCE BODY BALANCE

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AIM: To find correlations between dental occlusion and body balance by experimentally induced changes in the stomatognathic system.
SUBJECTS AND METHOD: All subjects had complete dentitions and normal occlusions. In order to prove the hypothesis, a force platform was used. The body balance of 62 subjects (41 females, 21 males) was analysed in six different situations: 1. habitual occlusion, 2. intercuspation, 3. cotton rolls between the left and right premolar area, 4. a cotton roll in the left premolar area, 5. a cotton roll in the right premolar area and 6. a cotton roll in the anterior region. The results were compared using a Student's *t*-test.
RESULTS: During habitual standing and with a cotton roll on the left side, there was a significant decrease of the amplitude of the centre of gravity in the frontal ($P = 0.006$) and sagittal ($P = 0.05$) direction.
CONCLUSIONS: There is a connection between occlusion and body balance during standing. The change of occlusion, with the help of cotton rolls, showed a change in the patterns of standing regarding a displacement of the centre of gravity. Since occlusion seems to be an important factor for body posture, the stomatognathic system should not be considered separately but as a part of the holistic posture.

287 USE OF A THREE-DIMENSIONAL FACE SCANNER WITH REGARD TO AESTHETIC PARAMETERS OF FACIAL MEASUREMENT

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AIM: To identify in which areas of orthodontic treatment and clinical diagnostics a three-dimensional (3D) face measurement can be utilized.
MATERIALS AND METHOD: 3D images were created with a face scanner (Primos Body Company, GFMesstechnik, Germany). The system is based on the triangulation and fringe projection method. Forty-two faces were scanned (27 females, 15 males, age: 24–61 years), and a non-smiling and smiling image of each was captured. For better evaluation, three markers were affixed to defined areas of the volunteers before scanning. Subsequently, five different angles were included in both captured facial images for comparison of symmetrical characteristics.
RESULTS: Faces do not become more symmetric during smiling. In fact they fit the changes of a normal Gaussian distribution. The angle 'bipupilar line - nose-axis' showed the largest deviation from the axis of symmetry through the facial centre, while the angle 'bipupillar line - external angle of the eye' showed the least. The same conclusion was reached regarding the angles while smiling as well as the dispersion of the measurements. Significant differences concerning the bipupilar line - chin angle existed between males and females. In females, in both situations, smiling and not smiling, this angle was closer to the axis of symmetry (Mann-Whitney U test, $P = 0.02$).
CONCLUSIONS: A 3D facial scan is suitable to measure aesthetic facial parameters using angular measurements and can, therefore, be potentially used in orthodontic treatment.

288 THE FEASIBILITY OF AUTOMATIC RECOGNITION OF THE AESTHETIC COMPONENT OF THE INDEX OF ORTHODONTIC TREATMENT NEED

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AIMS: To investigate whether the Aesthetic Component (AC) grade of the Index of Orthodontic Treatment Need (IOTN) can be correctly identified using a three-dimensional (3D) template.
MATERIALS AND METHOD: A 3D image of each set of dental casts was obtained using two 3D laser scanners. The digital dental casts were subsequently trimmed and aligned using a reverse modelling software program. A 3D image of a set of casts representing AC 1 was selected as the template model. Images of 29 pairs of dental casts (shells) were obtained and related to the template model. Images were aligned to the occlusal and mid-sagittal planes and to a vertical plane distal to the lower canines. The images were cropped to the upper and lower gingival margins and distal to the upper and lower canines. Absolute and signed distance changes were recorded between the 29 upper and lower 3D model shells in relation to the upper and lower 3D template model shells using reverse modelling software. To examine the strength of association between the AC grades and the 3D parameters derived from the ideal template, correlation analyses were carried out.

RESULTS: There was a weak association between the AC and each of these variables: the average distance between the lower shells and the template, the average distance between the upper shells and the template, the maximum distance between the lower shells and the template, and the average total distance between the shells and the template. There was a stronger association between the AC and each of these variables in turn: maximum distance between the upper shells and the template, and the maximum total distance between shells and the template.
CONCLUSIONS: The AC grade of IOTN could not, in this research at least, be correctly identified using a 3D template.

289 ARE CEPHALOMETRIC RADIOGRAPHIC MEASUREMENTS RELIABLE IN ORTHODONTICS

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AIMS: To evaluate and compare a three-dimensional (3D) imaging system with a traditional two-dimensional (2D) cephalometry for reliability in recording the anatomical reality as defined by physical measurements with a calibrated calliper.
MATERIALS AND METHOD: Cephalograms and computed tomographic (CT) images of 13 dry human skulls. Anatomic landmarks were determined and marked with clay before the CT images were taken, and the same landmarks were marked with metallic balls and stainless steel wires for lateral and frontal cephalograms. Actual physical measurements, lateral/frontal cephalometric measurements and 3D image measurements were compared.
RESULTS: The 3D CT image measurements were more precise and approximately the same as the actual measurements. Lateral and frontal cephalometric measurements showed some differences from the actual and 3D CT image measurements.
CONCLUSIONS: Radiographs do not always identify the 'real' landmark.

290 The MANDIBULAR HINGE AXIS IN SKELETAL CLASS III SUBJECTS WITH A POSTERIOR UNILATERAL CROSSBITE

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AIMS: A posterior unilateral crossbite (PUXB) may induce skeletal remodelling of the temporomandibular joint (TMJ), leading to permanent asymmetry of the mandible. Analysis of mandibular motion found that the centre of rotation was located in the condylar head of the mandible (Lemoine *et al.,* 2005). However, few previous studies have evaluated the change in the axis of mandibular hinge movement associated with skeletal asymmetry. The aim of this study was to investigate the relationship between the inclination of the mandibular hinge axis and PUXB.
SUBJECTS AND METHOD: Ten adult subjects with a skeletal Class III malocclusion were divided into a PUXB (n = 5) and non-PUXB (n = 5) group. Mandibular hinge axis, determined with the use of computerized axiography (Cadiax®), was duplicated on posteroanterior (PA) and submentovertex (SMV) cephalometric radiographs. Morphological asymmetry was evaluated for both the skeletal and dental components and positional deviation of the mandible (Kecik *et al*., 2007). Moreover, the inclination of the mandibular hinge axis formed by the midsagittal plane (Forsberg *et al*., 1984) and the line connecting the centre of mandibular rotation was compared between the two groups. A Mann-Whitney U-test was used for statistical analysis ($P < 0.05$).
RESULTS: Both the PA and SMV radiographs showed significant differences for both the skeletal and dental components between the two groups, including the difference in the bilateral mandibular lengths in association with the deviation in the region of the mental foramen. The mandibular hinge axis passed through the bilateral condyles in all subjects, and inclination to the shifted side was larger in the PUXB group. Furthermore, the mandibular first molar on the shifted side was more posterobuccally positioned in the PUXB group than in the non-PUXB group.
CONCLUSIONS: Morphological asymmetry of the mandible and the altered mandibular hinge axis by positional deviation of the TMJ is involved in PUXB in adults.

291 INFLUENCE OF OESTROGEN DEFICIENCY AND DIETARY LOADING ON THE EXPRESSION OF MATRIX METALLOPROTEINASE-3 IN THE CONDYLAR CARTILAGE

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AIM: To measure the influence of oestrogen deficiency and different dietary loading levels on the expression of matrix metalloproteinase-3 (MMP-3) in condylar cartilage. MMP-3 activity has been associated with cartilage matrix breakdown.
MATERIALS AND METHOD: Thirty-six female rats divided into four groups: The rats in the first experimental group were ovariectomized and fed with a normal diet, while the rats in the second experimental group were ovariectomized and fed

with a soft diet. The rats of the two control groups did not undergo ovariectomy and were fed correspondingly with normal or soft diets. The ovariectomy was performed at 60 days of age. Seven days after ovariectomization all the rats were sacrificed, and their right and left temporomandibular joints (TMJ) were prepared. From each rat one TMJ was taken for immunohistochemistry staining using antibody specific to MMP-3. The number of MMP-3 positive cells was measured in the central region of the condyle.
RESULTS: The number of MMP-3 positive cells was statistically significantly higher in the condylar cartilage of ovariectomized rats than in non-ovariectomized control rats, both in the normal and soft diet groups ($P < 0.001$).
CONCLUSIONS: Changes in oestrogen level have a significant effect on MMP-3 expression in the condylar cartilage. It seems that MMP-3 has an important role in condylar cartilage remodelling.

292 COMPARISON BETWEEN CONVENTIONAL AND COMPUTER ASSISTED SURGICAL PLANNING PREDICTION METHODS IN ORTHOGNATHIC SURGERY
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AIM: Prediction of orthognathic surgery outcome is important in treatment planning. Recently technologic advancements induce using computer in planning and prediction of orthognathic surgery treatments. The aim of this study was to determine the proximity between predictions performed with conventional, software imaging and real outcomes before and after surgery.
SUBJECTS AND METHOD: Lateral cephalograms, study models and occlusograms before treatment and before and after surgery of 12 skeletal Class II long face subjects. With the manual method using occlusograms combined with lateral cephalographs, predictions of pre- and post-surgical outcome were performed .For each patient, the manual prediction, software prediction before and after surgery and the real outcomes of treatment were compared with each other. A paired *t*-test was computed for paired comparison of the tracings.
RESULTS: Manual prediction of post-surgical outcome and post-surgical real outcome showed that all variables, except for SNB and L1 /MeGo, were statistically significant ($P < 0.01$). Software prediction of post-surgical outcome and post-surgical real outcome were not significant ($P > 0.05$) except for SNA and N.Perp to A. When manual and software prediction of post-surgical outcome were compared, except for SNB and L1/A.Pog, other variables were not statistically significant ($P > 0.05$).
CONCLUSIONS: Pre-surgical orthodontics and orthognathic surgery predictions for long face Class III patients usually do not have sufficient accuracy. Software imaging has a good accuracy for predictions of pre- and post-surgical outcome of long face Class III samples.

293 POROSITY OF SURFACE DENTAL ENAMEL ETCHED FOR VARYING PERIODS OF TIME
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AIM: Although the enamel etching technique is an accepted orthodontic procedure for bonding of brackets, there is a need to improve this method to maintain bond strength while minimizing the risk of caries development: The objective of this study was to quantitatively determine the porosity of sound dental enamel before and after acid etching. Specifically, the aim was to characterize specific surface area, pore size, pore volume and pore distribution of surface dental enamel before and after etching for variable times.
MATERIALS AND METHOD: A specific surface area of enamel from 15 sound premolars was analyzed by Multipoint Brunnauer, Emmett and Teller nitrogen adsorption prior to, and after, etching for 15, 30 and 60 seconds. Pore size and pore volume were calculated using the Barrett-Joyner-Halenda method. The 15 samples were divided into three equal groups in which enamel samples were exposed to either 15, 30 and 60 seconds of etching with 37 per cent phosphoric acid. All measurements were undertaken on the same samples before and after etching.
RESULT: Repeated measures ANOVA showed statistically significant differences in specific surface area, pore size, and pore volume amongst the different sample groups with variable etch times. A comparison of porosity before and after etching showed that specific surface area, pore volume and pore size increased after etching, although not significantly.
CONCLUSIONS: Defining the porous enamel structure is central to improving acid-etching protocols. It is anticipated that this research will lead to a better understanding of both dental enamel and the effects of acid etching.

294 IMMEDIATE SHEAR BOND STRENGTH PERFORMANCE OF TWO DIFFERENT ADHESIVE SYSTEMS WITH DIFFERENT LIGHT CURING TIMES
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AIM: There are a number of factors that can affect bond strength between the enamel and the bracket base, including the type of the enamel conditioner, acid concentration, length of etching time, bracket material and base design. Other important

factors that can affect bond strength are the time between bonding and force application, and the light cure time used for composite polymerization. The purpose of this *in vitro* study was to investigate the immediate shear bond strength (SBS) of two different adhesive systems with different light-cure times.
MATERIALS AND METHOD: One hundred and twenty extracted human premolar teeth were collected and stored in pure water. The teeth were cleaned, polished, and separated into two groups. In group 1; Transbond (3M Unitek) and in group 2; Grengloo (Ormco) adhesive systems were used to bond the premolar brackets. The samples in each group were then randomly separated into three subgroups using 10, 15 and 25 seconds light emitting diode curing times. After bonding, each sample was stored in 37°C water for one minute, and then the bonded bracket/tooth assembly was tested under a shear debonding force.
RESULTS: Analysis of variance (ANOVA) showed statistically significant differences between the groups ($P < 0.001$). When 10, 15 and 25 second light curing times were separately evaluated, no significant differences between the mean bond strength values of the two bonding agents were found. However within each main group, 25 second light-curing application gave a significantly higher SBS than those of the other subgroups (10 and 15 seconds).
CONCLUSIONS: If immediate force application is needed after bracket bonding, a bonding material with high SBS and an extended light cure time should be used.

295 AN *IN VIVO* COMPARATIVE STUDY CONVENTIONAL VERSUS SELF-ETCHING PRIMER
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AIM: To comparatively assess the failure rate of brackets bonded with two different enamel surface preparation techniques: self-etching primer (SEP) versus orthophosphoric acid and Transbond bonding agent.
SUBJECTS AND METHOD: Fifty-five (38 girls, 17 boys) patients with complete permanent dentitions. A total of 972 MBT smart-clip brackets with 0.022 inch slots were bonded using a split-mouth design. For each patient, the SEP and conventional technique were used in alternate quadrants so that they were distributed equally on the left and right sides. The brackets were bonded to the teeth by the same investigator (MO) after pumicing and rinsing.
RESULTS: The number of bracket failures was recorded for 14 months. In the SEP group there were eight failures and in the conventional group five failures. For the SEP group, the number of failures in the first three months was four, in the second three months it was three, and between 6 and 12 months, one. For the conventional group there were no bracket failures up to month 6, four brackets failed between 6 and 12 months and one after month 12.
CONCLUSIONS: SEP was as successful as the conventional technique. When SEPs are applied after pumicing the enamel surfaces, they appear to be clinically successful.

296 MAXILLARY MOLAR DISTALIZATION WITH SCREW-SUPPORTED MOLAR DISTALIZATION APPLIANCES: A SYSTEMATIC REVIEW
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AIM: To evaluate the effects of screw-supported molar distalization appliances by means of a systematic review of the literature.
MATERIALS AND METHOD: A systematic review of the literature was performed on articles written in English to November 2008. The survey was conducted on the Medline database, with subsequent hand searches of major orthodontic journals. The MeSH terms ‘molar’, ‘distalization’ and ‘screw’, and ‘anchorage’ were used in the search. Eleven studies were pertinent to the inclusion criteria.
RESULTS: According to the pertinent studies, screw supported distalization systems efficiently distalized maxillary molar teeth with a tipping component, without any cooperation problems. Sagittal movements of incisors were protrusive or retrusive depending on the type of appliance used. The post-treatment skeletal, vertical, and sagittal dimensions remained virtually unchanged in almost all the studies. Most temporary anchorage devices were stable during treatment.
CONCLUSION: Screw supported molar distalization appliances are a valid clinical option for the distalization of the maxillary first molars when efficient anchorage is desired. The advantages of this treatment approach are elimination of compliance-dependent intra- or extraoral anchorage aids, relatively predictable outcomes, favourable aesthetics, possibility of immediate force application, different activations on each side, and active uni- or bilateral molar distalization.

297 BOND STRENGTH AND MICROLEAKAGE DURING ORTHODONTIC BONDING TECHNIQUES AFTER THERMOCYCLING
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AIM: To evaluate the microleakage of a tooth-adhesive-bracket complex and shear bond strength (SBS) of brackets bonded with a direct and an indirect bonding technique after thermocycling. The mode of bond failure was also observed.
MATERIALS AND METHOD: Fifty non-carious human premolars divided into two equal groups. In the direct bonding group a light-cured, highly filled orthodontic adhesive, Transbond XT (3M/Unitek Corporation, Monrovia, California, USA) was used and in the direct bonding group Transbond XT Light Cure Adhesive Primer (3M/Unitek). Transbond XT was also used in the indirect bonding group for the adhesive but with Sondhi Rapid Set A/B Primer (3M Unitek, ABD), a filled resin primer. After photopolymerization, the teeth were kept in distilled water for 1 month and thereafter subjected to thermal cycling (500 cycles). Specimens were further sealed with nail varnish, stained with 0.5 per cent basic fuchsin for 24 hours, sectioned and examined under a stereomicroscope, and scored for marginal microleakage for the adhesive-tooth and bracket-adhesive interfaces from the occlusal and gingival margins. A universal testing machine was used to determine the maximum load necessary to debond the brackets; the SBS values and the adhesive remnant index (ARI) scores were recorded. Data were analyzed using Mann-Whitney U, chi-square and Fisher's exact test. The level of significance was set at $P < 0.05$.
RESULT: There were no statistical differences in SBS or microleakege between the two bonding techniques. However, the ARI score in the indirect bonding group was significantly lower. Bracket failures were between the enamel-resin interfaces.
CONCLUSIONS: Indirect bonding did not cause more microleakage than direct bonding or affect SBS values.

298 CRANIOFACIAL MORPHOLOGY AND OCCLUSION IN OVERWEIGHT AND NORMAL WEIGHT PATIENTS WITH SLEEP DISORDERED BREATHING

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AIM: To evaluate whether there are any differences in craniofacial morphology or in occlusion between overweight and normal weight patients with sleep disordered breathing (SDB).
SUBJECTS AND METHOD: The participants, recruited from patients referred due to suspected SDB, were divided into two groups based on their body mass index (BMI). The overweight group (BMI >27) consisted of 58 males and 19 females and the normal weight group (BMI <27) 33 males and 15 females. The mean age of the overweight patients was 51.9 years (SD 8.8) and of the normal weight group 50.5 years (SD 9.9). All patients underwent an overnight diagnostic cardiorespiratory recording. The mean apnoea-hypopnoea index was 9.7 (SD 3.2) for the overweight patients, and 8.8 (SD 7.0) for the normal weight patients. Occlusion and features of craniofacial morphology were recorded by visual observation.
RESULTS: There were several significant differences in occlusal features in the subgroups; distal molar occlusion and crossbites were more common, and overjet and overbite were increased in the normal weight patients compared with the overweight patients. Furthermore, the profiles of the normal weight patients were more often convex and their mandibles were more retrognathic than those of overweight patients ($P < 0.001$ and $P = 0.001$, respectively).
CONCLUSION: Normal weight patients demonstrate some features of the craniofacial bony structure, such as a convex profile and retrognathic mandible, which may act as predisposing factors for the development of SDB. However, in overweight patients, the craniofacial anatomy was more normal, suggesting that the increased deposition of adipose tissue may be the predisposing factor for the development of SDB. Overweight and normal weight patients with SDB may be characterized by different pathogenesis.

299 FRONTAL CHARACTERISTICS AND TREATMENT CHANGES IN LOWER FACIAL PROPORTIONS AFTER SAGITTAL SPLIT RAMUS OSTEOTOMY

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AIM: To compare the differences in the aesthetic properties of the lower facial proportion and treatment changes after sagittal split ramus osteotomy (SSRO) in Class III malocclusion subjects.
SUBJECTS AND METHOD: Thirteen Class III patients who underwent a SSRO. Twelve linear and five angular measurements together with the lip perimeter and area were measured on clinical photographs before and after SSRO. The results were compared using unpaired and paired *t*-tests.
RESULTS: Full face width, nose to chin, lower lip to chin length, upper vermillion height, upper vermillion left, upper vermillion right, bow tip to tip length and vermillion area were significantly decreased after SSRO. However, upper lip height was significantly greater post-operatively than pre-operatively.
CONCLUSIONS: It is recommended to use these measurements as guidelines for improving facial aesthetics in treatment planning of Class III malocclusion patients.

300 EXPRESSION OF INFLAMMATORY MEDIATORS IN THE MARGINAL PERIODONTIUM AFTER APPLICATION OF BRACKETS AND BANDS

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AIM: To examine, *in vivo,* the immune response in the area of the marginal periodontium after application of brackets and bands.

MATERIALS AND METHOD: Within a split-mouth design, brackets and bands were randomly allocated to premolars (n = 32) that were to be extracted after three months for orthodontic reasons. In addition to clinical parameters (plaque index, gingival index, periodontal pocket depths) and the detection of differences in interluekin-1 beta (IL-1β) concentration within the collected gingival crevicular fluid (GFC) using enzyme-linked immunoassay, gingival biopsates were obtained to determine the expression of inflammatory mediators [IL-1β, tumour necrosis factor (TNF)-α and IL-10] using real-time polymerase chain reaction.

RESULTS: For the clinical parameters and for IL-1β expression within the GFC as well as for the IL-10 expression in the biopsates, no significant differences between teeth with brackets and those with bands could be found. However, IL-1β and the TNF-α expression in the biopsates from teeth with bands were statistically significantly higher ($P = 0.024$ and $P = 0.049$). Significantly high correlations between the evaluated clinical parameters and analysis of GFC as well as from the biopsates were found.

CONCLUSIONS: Even in patients with acceptable oral hygiene, brackets and bands cause an inflammatory reaction. This has to be considered when the expression of inflammatory mediators is investigated during tooth movement. The evaluated differences in IL-1β and TNF-α expression verify that bands evoke a higher inflammatory reaction in comparison with brackets.

301 TORUS PALATINUS IN TURNER SYNDROME (45,X) FEMALES

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AIM: To determine the expression of torus palatinus (TP) in Turner syndrome (45,X) females. TP is located in the midline of the hard palate and is the most common of oral exostoses. The aetiology of TP is suggested to relate to masticatory stress and continued growth of the palatal processes; both environmental and genetic factors influence its occurrence. The incidence of TP varies between different ethnic groups and genders. Data about the expression of TP in Turner syndrome, X chromosome monosomy, is limited.

SUBJECTS AND METHOD: The study population consisted of 95 Turner syndrome females and their female (n = 78) and male (n = 39) relatives as well as unrelated female (n = 128) and male (n = 86) controls from the Kvantti project. The study subjects were classified into two groups by age, subjects under and over 16 years of age. The assessment of the expression of TP was by finger palpation during the clinical examination.

RESULTS: The occurrence of TP in 45,X females (50%) was statistically significantly less than in female relatives (75%; $P < 0.01$) and female controls (69%; $P < 0.01$) at the age of 16 years and older. The occurrence of TP between 45,X females and male groups did not differ to a statistically significant extent. The occurrence of TP increased with age in all female groups, including females with X chromosome monosomy. TP was more common in female than in male relatives of 45,X females ($P < 0.05$) and there was a similar trend to female predominance among unrelated controls.

CONCLUSIONS: The occurrence of TP is decreased in females with X chromosome monosomy compared with females with normal chromosomal constitution and similar to that in normal males.

302 COMPUTED TOMOGRAPHY, TWO-DIMENSIONAL RECONSTRUCTION AND STANDARD RADIOGRAPHS FOR THE DIAGNOSIS OF IMPACTED CANINES

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AIMS: To compare a computed tomographic examination with two-dimensional (2D) reconstruction in subjects with impacted canines and the utility of this examination in treatment planning versus conventional radiographs.

MATERIALS AND METHOD: Twenty-four subjects with impacted canines: 12 were analysed with oblique transverse and paraxial sections (0.2-0.5 mm) using a spiral computed tomograph (Siemens Emotion) and 2D reconstructions in the panoramic view, and 12 with standard radiographs.

RESULTS: The data from standard radiographs do not sufficiently establish the position of the impacted canines, or the method of orthodontic and surgical approach. 2D reconstruction allowed greater visualization of the position of impacted canines and their relationships with the other teeth and neighbouring anatomical structures of the dento-maxillo-facial complex. With 2D reconstruction correct orthodontic treatment management can be achieved.

CONCLUSIONS: Spiral computed tomography with 2D reconstruction offers advantages compared with standard radiographs.

303 ASSESSMENT OF TRABECULAR PATTERN IN PERIAPICAL AND PANORAMIC RADIOGRAPHS

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AIM: This methodological study aimed to determine whether mandibular trabecular bone assessment on panoramic radiographs, using a visual index, corresponds to the evaluation obtained from periapical radiographs.
MATERIALS AND METHOD: Panoramic and corresponding periapical radiographs of the lower premolar/molar region were collected from each of 32 patients, with a mean age of 18.5 ± 5.5 years. Two calibrated observers randomly assessed the interdental sites between the first molar and second premolar and between the two premolars, on all radiographs using a visual index. Evaluations were repeated three times, the second and the third time after 60 and 120 days, respectively. The results of the first and second evaluations were used to assess intra- and inter-observer agreements, employing Kappa statistics. The results of the third evaluation were used to determine correlation between assessments of panoramic and periapical radiographs (Spearman's correlation). Seventy-nine interdental sites were evaluated on the panoramic and periapical radiographs.
RESULTS: Visual analysis of periapical radiographs revealed an intra-observer agreement of 0.85 for observer 1 and 0.93 for observer 2, and an inter-observer agreement of 0.82. Intra-observer agreement for panoramic radiographs was 0.81 and 0.83, for observers 1 and 2, respectively, with inter-observer agreement of 0.78. Spearman's coefficient showed a correlation between both radiographic evaluations ($r = 0.736$, $P = 0.001$).
CONCLUSIONS: Panoramic radiographs can be used for assessment of trabecular bone pattern with the aid of a visual index. Training in the method is recommended to obtain high reproducibility of the results.

304 CORRELATION OF CRANIOFACIAL STRUCTURE AND SPINAL COLUMN POSTURE

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AIM: The relationship between occlusion, cephalometry, spinal column and posture, is still controversial, due to the fact that it is not known which and how many factors are involved. The aim of this research was to compare cranial bones and posture in a group of professional football players and in a group of professional skiers to find out if there are significant skeletal or postural differences.
SUBJECTS AND METHOD: Sixteen professional football players and 12 skiers (seven days/week of training, mean age 17 ± 2 years) underwent the following diagnostic examinations: cast models, latero-lateral and postero-anterior teleradiography and cephalometry, dental arch radiographs, clinical and gnathology form, Spinal mouse® (IdiagAG). Statistical evaluation of the results was performed using the non-parametric Mann-Whitney U test for independent groups and Spearman correlation test.
RESULTS: There were significant differences in both latero-lateral cephalometry and body posture. Cephalometry showed a difference in Frankfort horizontal plane orientation (SpP^F) ($P < 0.0001$). Posture showed differences in the sagittal plane inclination of the spinal column ($P < 0.001$). Spearman correlation test was significant for the Frankfort horizontal plane and the inclination of the spinal column.
CONCLUSIONS: Using the Frankfort horizontal plane as an indicator of both cranial structure and mandibular posture shows a correlation with the posture of the spinal column.

305 SELLA TURCICA – MORPHOLOGY AND SIGNIFICANCE IN DIAGNOSIS AND ORTHODONTIC TREATMENT

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AIM: The sella turcica is an anatomical structure of importance in clinical and radiographic diagnosis. Appropriate reference points enable assessment of the correlation between the position of both jaws and the structures of the cranium. The centre of sella turcica (point S) is one of the most important landmarks. The length, depth and diameter are taken into consideration as parameters for the evaluation of the sella turcica structure. Normal vertical dimensions of sella turcica range from 4 to 12 mm and anteroposteriorly from 5 to 16 mm. The aim of the present study was to determine the correlation between the morphology of sella turcica and malocclusion type, age and gender of 56 randomly selected patients aged 7 to 20 years.
SUBJECTS AND METHOD: Randomly selected patients with anteroposterior disturbances (Class II or Class III). Fifty-six lateral cephalograms were analysed, using the Steiner method. Sella turcica morphology was evaluated according to three

parameters: length, depth and diameter (posteroanterior dimension). Length was measured from the dorsum sellae to tuberculum sellae; sella depth from a line perpendicular to sella length, reaching to the deepest point of the hypophyseal fossa and sella diameter from a line measured from the tuberculum sellae to the furthest point on the distal, internal wall of the hypophyseal fossa.
RESULTS: The average sella turcica length, depth and diameter was 7.4, 9.11 and 11 mm, respectively. The lowest value of all three parameters was observed in Class II patients and the highest value in Class III patients. No correlation between age, gender and morphology of the sella turcica was found.

306 CRANIAL AND CRANIAL BASE DIMENSIONS OF CHILDREN OF MOTHERS WITH THE M. 3243A>G MELAS MUTATION

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AIM: Mitochondrial encephalomyopathy, lactic acidosis and strokelike episodes (MELAS) is one of the maternally inherited mitochondrial diseases, which are biochemically characterized by a decreased capacity to produce adenosine triphosphate in the cell. MELAS is most commonly caused by the m. 3243A>G mutation in mitochondrial DNA. The mutation leads to disturbed synthesis of the subunits of the respiratory chain. Clinically MELAS is characterized by multiorgan involvement, and often organs with high aerobic energy metabolism are affected, including the nervous system, muscle and heart. Many adult patients are small in height and low in weight. The aim of this study was to determine whether cranial and cranial base dimensions of children in MELAS families differ from those of unaffected children.
SUBJECTS AND METHOD: Nine children (5 girls, 4 boys) born to mothers harbouring m. 3243A>G mutation were examined. The median age was 11.6 years (range 7.5-15.3 years). The controls consisted of an age- and gender-matched group of children with normal craniofacial structures. None of the children had undergone orthodontic treatment. Standardized lateral cephalometric radiographs were taken in the natural head posture.
RESULTS: Children of mothers with m. 3243A>G differed significantly from the controls in the cephalometric values describing cranial structures. Frontal sinus width ($P = 0.008$; Wilcoxon test) and length ($P = 0.028$) was larger, frontal bone width ($P = 0.021$) was thicker and cranium length ($P = 0.028$) was smaller in the subjects than in the controls. There were no significant differences between children of MELAS mothers and controls in cranial base dimensions.
CONCLUSIONS: Children of mothers with 3243A>G MELAS differed from the controls in cranial dimensions. It is suggested that these findings are due to aberrant endocrinological conditions caused by changes in mitochondrial energy metabolism in bone. However, the results show that mainly the endochondrally growing cranial base seems to develop relatively normally.

307 CEPHALOMETRIC EVALUATION OF CHILDREN WITH NOCTURNAL BREATHING DISORDER

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AIM: To assess the cephalometric features in children with sleep-disordered breathing (SDB).
SUBJECTS AND METHOD: Seventy children (mean age 7.3, standard deviation 1.72, range 4.2-11.9 years) with habitual snoring and symptoms of obstructive sleep disorder for more than six months. On the basis of polysomnographic findings, the subjects were further divided into subgroups of 26 children with diagnosed obstructive sleep apnoea (OSA), 17 children with signs of upper airway resistance syndrome (UARS) and 27 snoring children. A control group of 70 non-obstructed children matched for age and gender were selected. Lateral skull radiographs were taken and cephalograms were traced and measured.
RESULTS: Children with SDB were characterized by an increased antero-posterior jaw relationship ($P = 0.001$), increased mandibular inclination in relation to the palatal line ($P = 0.01$), increased total ($P = 0.019$) and lower ($P = 0.005$) anterior face heights, a longer ($P = 0.018$) and thicker ($P = 0.002$) soft palate, smaller airway diameter at multiple levels of the naso- and oropharynx, larger oropharyngeal airway diameter at the level of the base of the tongue ($P = 0.011$), lower hyoid bone position ($P = 0.000$), and larger cranio-cervical angles (NSL/CVT; $P = 0.014$; NSL/OPT; $P = 0.023$) when compared with the non-obstructed controls. When divided into subgroups according to the severity of the disorder, OSA children significantly deviated from the control children especially in pharyngeal variables. Children with UARS and snoring symptoms also deviated from the controls, but obstructed subgroups were not confidently distinguishable by cephalometric measurements.
CONCLUSIONS: Lateral cephalogram may be used as a predictor for SDB in children. Special attention should be paid to pharyngeal measurements. Systematic orthodontic evaluation of SDB children is needed because of the effects of obstructed sleep on the developing craniofacial skeleton.

308 INFLUENCE OF MAXILLARY INCISOR INCLINATION ON THE POSITION OF THE LIPS

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AIM: Facial aesthetics are known to be determined by the position of the lips. The aim of this study was to determine the influence of maxillary incisor inclination on the position of the upper and lower lips.
MATERIALS AND METHOD: Lateral cephalograms of 16 patients aged 14-16 years with a Class II malocclusion obtained in the natural head position. Standard cephalometric landmarks were used to construct the reference lines. The following values were measured: 1) U1/PP angle; 2) U1/FH angle; 3) U1-NA distance; 4) U1/NA angle; 5) position of the upper and lower lip relative to Ricketts (UL-E, LL-E) and Burstone (UL-B, LL-B) planes; 6) Sassouni analysis. The patients were divided into two groups according to lip position: retrusion or protrusion of the lips with regard to the aesthetic planes, E and B.
RESULTS: The mean values of UL-E, LL-E and UL-B, LL-B were significantly different when compared with the standard data. Correlations between maxillary incisor inclination and lip position relative to the aesthetic planes in the patients with lip retrusion were not significant.
CONCLUSIONS: The position of the maxillary incisor edge determines upper lip position, but it is not influenced by incisor inclination. Thus it is necessary to keep the incisor edge stable while carrying out maxillary incisor retrusion.

309 TENSILE STRESS ON THE EXPRESSION OF SOX 9 AND SUBSEQUENT RELEASE OF TYPE II COLLAGEN IN A SYNCHONDROSIS

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AIM: To evaluate the expression of SOX 9 and the associated release of type II collagen, at the molecular level, in the spheno-occipital synchondroses upon application of tensile stress across the mouse cranial base *in vitro*.
MATERIALS AND METHOD: Fifty newborn male BALB/c mice were sacrificed and the spheno-occipital synchondroses were aseptically excised and randomly assigned to five control and experimental groups. Each group was divided into five time points. In the experimental groups, mechanical force was applied across the synchondroses, using helical springs. For the control groups, the springs were not activated. Both groups were incubated in 24 well plates and cultured for 6, 24, 48, 72 and 168 hours. *In situ* hybridisation was undertaken for quantitative analysis of SOX 9 and type II collagen expression.
RESULTS: Quantitative analysis revealed that SOX9 and type II collagen expressions reached a peak at 24 and 72 hours, respectively. Compared with the control groups, the experimental groups of both SOX9 and type II collagen were consistently higher at all time points. Application of tensile stress across the spheno-occipital synchondroses increased the expression of SOX 9 and subsequently up regulated the expression of type II collagen, which is a major component of the extracellular matrix.
CONCLUSIONS: Application of mechanical force could enhance growth of the spheno-occipital synchondroses and points to the effect of growth of epigenetic structures such as the brain on the growth of the spheno-occipital synchondrosis.

310 THE DYNAMICS OF FACIAL MOVEMENT USING THREE-DIMENSIONAL MOTION ANALYSIS

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AIMS: To objectively quantify facial movement in response to the spoken word, and to investigate the reproducibility of using the spoken word as a measure of facial movement.
SUBJECTS AND METHOD: Twenty-two 'normal' subjects in whom facial movement was assessed in response to the isolated word /puppy/. The subjects were then separately asked to say the word /puppy/ in a normal, relaxed manner twice within a 10 second time interval. The sequence was recorded using a non-invasive, three-dimensional (3D) motion analysis image capture system (3DMDface™ dynamic system) at 48 frames per second. To quantify facial movement, sequential frames of a sequence were aligned to the baseline/reference frame three-dimensionally using best fit on non-moveable points in the upper half of the face. To measure reproducibility, corresponding frames between the two utterances were also aligned three-dimensionally. Reproducibility was measured as the percentage point deviation between ± 0.5 mm between two corresponding frames.
RESULTS: Quantifiable changes to the lower half of the face were seen during the isolated utterance /puppy/. Mean intra-session reproducibility (SD) for the group was recorded at 86.2 per cent (5.8). The reproducibility ranged from a minimum of 66.8 per cent to a maximum of 97.5 per cent. When the utterance was split into its two separate viseme segments (/P //u /P and /P //y/), the second part of the utterance was seen to be more reproducible than the first. The male group was more reproducible than the female group.
CONCLUSIONS: The 3dMDface™ dynamic system allows objective, 3D, non-invasive assessment of facial movement. Intra-session reproducibility of the utterance /puppy/ showed high intra- and inter-subject variability in this group of normal subjects.

311 CRANIAL BASE DEVELOPMENT IN ANGLE CLASS II AND CLASS III SUBJECTS

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AIM: Skeletal development and the relationship of the upper and lower jaws is the result not only of intrinsic growth, but also of the growth pattern of the cranium and facial bones. Of these, the cranium base, due to the sphenoid-occipital synchondrosis, has a decisive role in the formation of the lower part of the face. A decreased sphenoid angle will favour anterior positioning of the mandible (skeletal Class III anomalies) and an increased sphenoid angle a posterior positioning of the mandible (skeletal Class II anomaly). The aim of this comparative study was to determine cranial base development using the value of the NSBa angle and the mandibular dimensional characteristics in skeletal Class II and Class III subjects.
SUBJECTS AND METHOD: Three groups of subjects aged 11-15 years: group A, 30 patients, skeletal Class II; group B, 30 patients, skeletal Class III and group C (control) 15 patients, dental and skeletal Class I. Lateral cephalograms taken at the start of treatment were used to investigate the following parameters: BSBa angle, mandibular angle, SNB, SNA, ANB, Cf-Go, Go-Ar, Go-Me, Co-Go.
RESULTS: There was a wide variation in the values of the sphenoid angle both within and between the three groups. In group A, 60 per cent of the subjects displayed normal sphenoid angle values, 26.7 per cent decreased values, and 13.3 per cent increased values. In group B, 70 per cent displayed a normal angle while 30 per cent had increased values.
CONCLUSIONS: A statistically significant correlation was observed between the sphenoid angle and the type of skeletal anomaly, demonstrating that upper and lower jaw growth is related to growth of the cranium bones. The observation of eventual changes at the cranium base level is of importance when choosing the therapeutic approach, and for orthodontic retention.

312 EVOLUTION OF UPPER THIRD MOLAR SPACE FOLLOWING ORTHOPAEDIC TREATMENT OF CLASS III ANOMALIES

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AIM: Difficulties regarding the space required for third molar eruption, especially in the lower jaw, but also in the upper are recognized. The aim of the present study was to analyze the dimensional evolution of this space following orthopaedic treatment to increase sagittal and transverse growth of the maxilla in Class III subjects during pre-pubertal growth.
SUBJECTS AND METHOD: Fourteen patients aged between 6-9 years at the start of treatment, diagnosed with a skeletal Class III malocclusion, with retruded maxilla, who received orthopaedic treatment using a Delaire facemask and removable Hawley plate for a minimum period of 1.5 years. The control group comprised nine subjects aged 7-9 years with a skeletal Class I or II malocclusion, untreated during the period of the study. The space available for the upper third molars was measured between the distal margin of the upper first molar and a line tangent to the posterior face of the pterygoid process. The following parameters were also measured: SNA, SNB, ANB, FMA angles, Olp-M1s and NSA-OLp distances as described by Pancherz. The measurements were performed before and after orthopaedic treatment, and for the control group at two different growth stages. For each variable, the mean and median values and standard deviations were calculated for the two groups and variations in parameters were compared between the two groups (with/without treatment).
RESULTS: For the Class III group there was a statistically significant difference for M1-fossa distance, demonstrating the therapeutic effect of posterior growth of the maxilla. Parameter changes in the control group were less than in the study group.
CONCLUSIONS: Orthopaedic treatment of Class III anomalies during growth generates significant growth through traction on the maxilla, with significant posterior growth, beneficial for the upper third molars. It aids mandibular repositioning (SNB angle reduction).

313 CORRELATIONS BETWEEN ROOT FORM AND APICAL RESORPTION IN ANTERIOR TEETH DURING ORTHODONTIC TREATMENT

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AIM: To determine correlations between apical root form and apical root resorption (ARR) during orthodontic treatment.
SUBJECTS AND METHOD: Twenty patients (13 females, 7 males, 10 with removable and 10 with fixed appliances) aged 12-17 years. For each patient two panoramic radiographs were analysed, one obtained before treatment and one at least 12

month after bracket placement (12 to 22 months; average 17.5 months). On each radiograph the apical root morphology of the maxillary anterior teeth were evaluated (normal, blunt, eroded, narrow and angulated) and root resorption (evaluation index of Shape *et al*.). Forty radiographs were analysed (480 teeth).
RESULTS: In patients with removable appliances there were no cases of ARR. In the patients treated with fixed appliances 90 per cent showed ARR. Teeth with root resorption were considered to be grade 1, 55.26 per cent, grade 2, 42.1 per cent and grade 3, 2.63 per cent. The frequency of moderate and severe resorption for each anterior tooth was: 66.67 per cent of maxillary lateral incisors, 60 per cent of mandibular canines, 50 per cent of maxillary canines, 37.5 per cent of maxillary central incisors, 3.33 per cent of mandibular central incisor and 28.57 per cent of mandibular lateral incisors. Analysis of tooth form showed that 34.22 per cent had a normal and 65.78 per cent a modified root form: 31.58 per cent angulated (and usually narrow), 15.79 per cent blunt, 10.52 per cent eroded and 7.89 per cent narrow. In teeth with a normal root form, grade 1 resorption was found in 61.53 per cent and grade 2 in 38.47 per cent. With a modified root form, 47.82 per cent were grade 1, 47.83 per cent grade 2 and 4.35 per cent grade 3.
CONCLUSIONS: ARR is frequent in patients with fixed appliances but rare when removable appliances are used. The tooth most frequently affected by root resorption is the maxillary lateral incisor. ARR is more frequent in teeth with a modified root form. ARR is more frequent in teeth with angulated roots.

314 WETTABILITY OF THREE TYPES OF MATERIALS USED IN ORTHODONTICS

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AIM: To evaluate, *in vitro,* the wettability of three types of dental materials (cements, composite resins, polyacrylic materials) used in orthodontics.
MATERIALS AND METHOD: Wettability was evaluated using the dynamic contact angle analysis technique (the sessile drop method) by water-contact angle measurements with a CAM 101 (KSV, Finland). The materials tested were: zinc phosphate cement (Adhesor, Spofa), self cure glass ionomer cement (Kavitan CEM, Spofa), light cure glass ionomer (Fuji Ortho LC, GC America Inc.), self cure composite resin (Ortho Loc, GAC International Inc), light cure composite resin (Con Tec LC Set, Dentaurum) and acrylic biopolymers: self cured (Duracryl, Spofa), heat cured (Superacryl, Spofa), transparent heat cured (Ptorakc) and by pressure cured (Prothyl hot, Zhermack S.P.A.). Forty-five samples were tested (five for each material). The liquid used was distilled water.
RESULTS: For all materials, the contact angle had a value below 90 degrees, the lowest for Adhesor (53.82°) and the highest for Superacryl (89°). The contact angle for composite resins (79.16 and 79.20°) was larger than that for GIC (62.30 and 70.7°), and for zinc phosphate cement (53.82°). The light cured materials presented larger contact angle values than self cured materials. The largest contact angle from the acrylic polymers was found for Superacryl (89°).
CONCLUSION: Measurement of the contact angle and its interpretation for different dental biomaterials can explain their behaviour in the oral cavity.

315 PSYCHOLOGICAL PROFILE AND SELF-ADMINISTERED RELAXATION IN PATIENTS WITH CRANIOFACIAL PAIN. AN IN-OFFICE STUDY

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AIMS: To evaluate the psychological profile of craniofacial pain sufferers and the impact of patient subtype classification on the short-time effectiveness of self-administered relaxation training.
SUBJECTS AND METHOD: One hundred in-office patients (67% females) suffering from chronic facial pain and/or headache with the presumptive diagnose of temporomandibular disorder completed a battery of questionnaires comprising craniofacial pain perception, somatic complaints, irrational beliefs, and pain behaviour and were classified into subtypes using cluster analysis. They underwent self-administered progressive relaxation training and were re-evaluated for pain perception after 3 months.
RESULTS: Pain was mild to moderate in the majority of patients. Symptom domains comprised parafunctional activities, temporomandibular pain and dysfunction, frontotemporal headache, head/neck and neck/back pain. Three patient subtypes were identified regarding symptom/dysfunction level: (i) low burden (mild/moderate), (ii) psychosocial dysfunction (moderate/high), (iii) adaptive coping (moderate/mild). Self-rated adherence to the recommended relaxation training was moderate throughout the sample, but self-rated relief was significantly different between clusters. At follow-up, pain intensity was significantly decreased in all patients, whereas pain-related interference was improved only in dysfunctional and adaptive patients. Improvement of symptom domains varied between clusters and was most comprehensive in adaptive patients.

CONCLUSIONS: Craniofacial pain sufferers can be divided into meaningful subtypes based on their pain perception, irrational beliefs, and pain behaviour. Self-administered relaxation training generally yielded positive effects on pain perception, however the benefit may be greater in patients with more marked symptom impacts (both dysfunctional and adaptive).

316 ASSOCIATION OF DENTOSKELETAL MORPHOLOGY WITH INCISOR INCLINATION IN ANGLE CLASS II PATIENTS. A CEPHALOMETRIC STUDY

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AIM: To identify possible dentoskeletal parameters systematically associated with variations of anterior tooth inclination in Angle Class II subdivision subjects.
MATERIALS AND METHOD: Pre-treatment lateral radiographs of 147 Class II patients aged 7 to 17 years were classified for upper incisor inclination into three groups (proclined; normally inclined; retroclined), homogeneous for gender and skeletal jaw relationship. The effect of age on the 22 cephalometric variables measured was controlled by covariance analysis.
RESULTS: Multivariate analysis of the cephalometric parameters evaluated at the mean age of 11.5 years indicated significant inter-group differences. Systematic associations with incisor inclination were revealed using rank correlation: lower incisor proclination, the Wits appraisal and the gonial angle significantly decreased, while interincisal angle, mandibular total and corpus length and the nasolabial angle increased with decreasing incisor proclination.
CONCLUSIONS: Clear-cut classification criteria and control of confounding effects may clarify previous conflicting findings on dentoskeletal differences between Class II subdivisions in the late mixed dentition. Only minor dentoskeletal differences appear to be associated with incisor inclination. The increased interincisal and nasolabial angle in Class II division 2 are due to retroclination of both upper and lower incisors. Jaw position and chin prominence are not significantly different between subdivisions. However, the Wits appraisal is decreased in Class II division 2. The increased mandibular length observed in Class II division 2 requires further scrutiny. Class II division 2 subjects with a deep bite show a tendency to a low angle, while a normal incisor inclination safeguards against anterior rotation of the mandible.

317 INFLUENCE OF ENVIRONMENTAL CONDITIONS ON BONDING OF ORTHODONTIC BRACKETS: A PILOT STUDY

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AIM: To investigate the influence of temperature and relative humidity (RH) on the shear bond strength (SBS) of orthodontic brackets.
MATERIALS AND METHOD: Twenty-four precoated upper central incisor brackets (APC™ II Adhesive Coated Appliance, 3M Unitek, Monrovia, California, USA) were bonded to either the mesio-buccal or disto-buccal enamel surface of 12 bovine incisors. The procedure was carried out in a temperature/humidity chamber under two environmental conditions: 23°C and 50 per cent RH for bonding one tooth half versus 37°C and 90 per cent RH for bonding the other. Previously the teeth were randomly assigned to a conventional etch group (CE; 35% phosphoric acid + Transbond™ XT Light Cure Adhesive Primer, both 3M Unitek) and a self-etching primer group (Transbond™ Plus SEP, 3M Unitek). SBS testing was performed at a crosshead speed of 1.0 mm/minute after a storage time of 24 hours in 37°C water.
RESULTS: The simulated oral conditions adversely affected the bond strength in both groups (CE median: 20.3 versus 7.5 MPa; SEP median: 20.9 versus 12.0 MPa). However, the SEP group seemed to be less sensitive to the unfavourable setting.
CONCLUSIONS: Bond strength testing under simulated oral conditions may produce significantly different findings than customary laboratory experiments.

318 DIFFERENCES BETWEEN EASTERN AND WESTERN FINNISH MALES IN CORRELATIONS OF TOOTH SIZES WITH UPPER FACE AND CRANIAL BASE

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AIM: Methods of modern genetics have revealed gene differences between eastern and western Finnish populations. The aim of this study was to compare the morphology of eastern and western groups of adults by selecting some anatomical regions that are preferable to determine genetic relationships.
MATERIALS AND METHOD: Dental study material of males with a distinct eastern or western ancestry collected in the 1980s. Measurements of tooth size, cephalometric angles and linear dimensions were selected for comparison between the

two population groups. Correlation analysis was undertaken between tooth sizes [mesio-distal (MD), bucco-lingual (BL) and crown height], the angle between the nasion-sella line and nasal line (nsnl), cranial base angle (nsba) and the length of the cranial base (n-ba).
RESULTS: Some significant size differences existed: western males had larger tooth crowns of d11, d12 and d43. The eastern group had a wider lower jaw. Correlations were different between eastern and western males. The western group had a high positive correlation between n-ba and nsnl-angle (0.774**). The size of the anterior teeth correlated positively with both measurements. The highest correlations were between MD13 and n-ba (0.753*) and between mesio-md13 and nsnl-angle (0.621 $P = 0.056$). Eastern males had positive correlations between cranial base length and cranial base angle (0.479**). There was no correlation between cranial base and nsnl angles. The MD dimensions of d13 and d43 correlated negatively with nsnl, –0.602** and –0.539**, respectively. Tooth crown heights had a tendency to negative correlations with cranial base angle in western males. There was no correlation for eastern males between tooth crown heights and cranial base angle.
CONCLUSION: There seem to be differences between population groups in coordination of tooth size to jaw size. This difference may be genetic.

319 NON-EXTRACTION THERAPY IN CLASS II DIVISION 1 MALOCCLUSION, WITH SELF-LIGATING BRACKETS AND ORTHODONTIC MINI-IMPLANTS

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AIM: Self-ligating bracket systems appear to be a promising solution, reducing frictional resistance and shortening treatment and chairside time. Orthodontic mini-implants provide absolute anchorage – their ability to distalize the teeth without adverse reciprocal movement is especially important in non-extraction treatment of Class II malocclusions. Such therapy requires posterior movement of the upper teeth, anterior movement of the lower teeth, or a combination of both.
SUBJECT AND METHOD: The patient was a 15-year-old adolescent boy who presented with a Class II division 1 malocclusion. Analysis of photographs, diagnostic models and cephalometric measurements indicated extraction of two upper premolars, subsequently negated by the parents. Non-extraction treatment was then applied, utilizing Quick self-ligating brackets and four miniscrews; the latter upper were loaded with NiTi coil springs, expanded between miniscrew-implants and a posted 0.016×0.022 stainless steel basic archwire. Indirect anchorage in the mandible was achieved due to the stiff connection, via 0.016×0.016 stainless steel, of miniscrew implants and bands on the lower first molars serving as the attachments for Class II elastics. After 10 months of treatment a Class I relationship of the molars and canines was achieved. The miniscrews were maintained firmly throughout the therapy.
CONCLUSIONS: Non-extraction therapy of Class II division 1 malocclusions using self-ligating brackets and orthodontic miniscrews seems to be a promising, effective, and well-tolerated modern treatment modality.

320 PHOTOGRAPHIC PROFILE QUANTIFICATION OF THE EFFECT OF LE FORT I OSTEOTOMY ON FACIAL PROFILE IN PATIENTS WITH CLEFT LIP AND PALATE

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AIM: One of the purposes of the Le Fort l osteotomy (LF) in cleft patients is to improve the facial aesthetics and hide the cleft stigma of face. For patients with cleft scars, there exists no standard cephalometric prediction concerning operative facial changes. Moreover, the change in soft tissue profile individually is more valued by the eye. The aim of this study was to investigate the effect of a LF on the soft tissue profile in patients with cleft lip and palate by evaluating pre- and post-operative facial photographs.
MATERIALS AND METHOD: The profile photographs of 30 males and 24 females (mean age 20 years) with clefts (2 cleft lip, 10 cleft palate, 12 bi- and 30 unilateral cleft lip and palate) were taken using a Nikon D2-camera (objective Nikkor Macro 60 mm) with the patients sitting in the natural head position. The photographs obtained pre-operatively and 6 to 12 months after LF and photographic prints were analyzed using soft tissue landmarks and parameters. Only angles and proportions of profile dimensions were used. A paired *t*-test was used to determine changes in pre- and post-operative facial aesthetics. The reliability of the method was analyzed using Dahlberg's formula.
RESULTS: The post-operative LF photographs showed significant proportional changes between upper and lower face heights compared with total face height. Improved harmony in face height proportions was obtained. LF increased the height of the red vermillion and the fullness of the upper lip. Both the nasolabial and the nasal tip angle increased significantly, turning the downward tipped nose more upwards and slightly forward.
CONCLUSION: Although photographic analysis cannot provide reliable information about the actual dimensions and lengths, angular and proportional analysis of clinical photographs can provide important knowledge. Photographic

profile quantification can be used pre-operatively to explain the surgical benefits to the cleft patient and to measure the success of surgery.

321 INTEGRATION OF DIGITAL DENTAL CASTS IN THREE-DIMENSIONAL FACIAL PHOTOGRAPHS

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AIM: Numerous attempts have been made to make a model of the complete face, with the dentition in an anatomically correct position. With the introduction of three-dimensional (3D) imaging techniques researchers have regained interest in this topic. The aim of this study was to evaluate the reliability of a method to position digital dental casts in 3D stereophotographs of the face without the use of radiographs.
SUBJECTS AND METHOD: Twenty patients scheduled for surgical-orthodontic treatment. For each patient a digital dental cast, a stereophotogrammetric image of the face and a cone beam computed tomographic (CBCT) scan were available. Radio-opaque skin markers were placed on the face of the patient to perform an exact match between the stereophotograph and the CBCT. Using Maxilim® software, the digital dental cast was placed inside the stereophotograph without using the CBCT data. Positioning the dental cast in the stereophotograph was done by surface matching on the anterior teeth. This new dataset was then compared with the CBCT of the same patient to evaluate the anatomical position of the dentition in the stereophotograph.
RESULTS: It was technically possible to position the digital dental cast inside the 3D stereophotograph. With the current software this is a labour intensive and time consuming procedure. Nevertheless, the reliability study showed that the position of the dentition in the 3D photograph was in good relation to the correct anatomical position of the dentition in the skull.
CONCLUSION: A digital dental cast can be integrated in a stereophotogrammetic image of the face in the correct anatomical position. Since the matching procedure is difficult and time consuming, enhanced software needs to be developed to make this method useful for daily practice.

322 FACTORS INFLUENCING THE STABILITY OF MAXILLARY INCISORS AFTER ORTHODONTIC TREATMENT

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AIM: To examine factors that influence relapse of the upper incisors, and how relapse of the lower incisors influences the stability of the upper anterior teeth.
SUBJECTS AND METHOD: Sixty-two patients with an Angle Class II division 1 malocclusion treated with a standardised Begg technique involving extraction of teeth. Records were available in the form of plaster models and lateral cephalograms from before treatment (T1), after treatment (T2), and more than 3 years after the end of retention (T3). Standardised measurements were carried out on the plaster models at T1, T2 and T3. Overjet and overbite were measured manually using digital callipers, while contact point displacement of the upper and lower incisors, intercanine width in both the upper and lower arch, and the length of the dental arch in the maxilla were measured using the computer program, Facad. All statistical analyses were undertaken using the Statistical Package for Social Sciences. Method error was calculated with Dahlberg's formula.
RESULTS: Both the presence of contact point displacement of the lower incisors at T1 and changes in the maxillary intercanine width from T1 to T2 were found to be risk factors for contact point displacement of the upper anterior teeth at T3. The combination of irregularity of the lower anteriors at T1 and changes in the maxillary intercanine width from T1 to T2 (≥ -0.02), was associated with an increased risk of irregularity of the anterior teeth at T3 when compared with cases where only one of these factors was present (47.8 versus 18.2%; $P = 0.052$).
CONCLUSION: Contact point displacement of the lower incisors at T1 and changes in the maxillary intercanine width from T1 to T2 are risk factors for relapse of the upper anterior teeth at T3. The findings further suggest that relapse of the lower anterior teeth at T3 is not significantly associated with relapse of the upper anterior teeth at T3.

323 SHEAR BOND STRENGTHS OF ONE- AND TWO-STEP SELF-ETCHING ADHESIVE SYSTEMS FOR BONDING CERAMIC BRACKETS

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AIM: To determine the shear bond strengths (SBS), on debonding, among a total-etching system, a two-step self-etching system and a one-step self-etching system, when bonding ceramic brackets.

MATERIALS AND METHOD: Ceramic brackets were bonded with three bonding systems to extracted human maxillary premolars. The samples were randomized and categorized into three groups: 1) Total-etching system; 2) Two-step self-etching system and 3) One-step self-etching system. Composite resin (Transbond XT™) was applied to the bracket base and the adhesive was cured with a light-curing lamp at the midbracket for 5 seconds. After bonding, all samples were mounted in acrylic resin and incubated in distilled water at 37°C for 24 hours. The samples were then thermocycled between 5° and 55°C for 1000 cycles. SBS was measured with a universal testing machine at a crosshead speed 0.5 mm/minute.
RESULTS: The mean SBS of the one- (11.34 ± 2.87 MPa) and two- (10.39 ± 4.8 MPa) step self-etching system were greater than that of the total-etching system (4.4 ± 0.89 MPa). ANOVA indicated that there was no statistically significant difference in the SBSs among the three groups.
CONCLUSIONS: The SBS of a one-step self-etching system, a two-step self-etching system and a total-etching system are not statistically significantly different when bonding ceramic brackets.

324 COMPARISON OF SHEAR BOND STRENGTHS BETWEEN TEETH AND ORTHODONTIC BRACKETS, USING A HIGH-POWER LIGHT EMITTING DIODE

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AIM: To compare the shear bond strengths (SBS) of adhesives cured by a high-power light emitting diode (LED) curing unit at various curing times.
MATERIALS AND METHOD: Adhesive, pre-coated, stainless steel brackets were bonded to human upper first premolar teeth, using a high-power LED curing unit at 1,250 mW/cm² for 2, 4, 6, 8, 10 or 12 seconds. A conventional halogen lamp with a light intensity of 300 mW/cm² was used for 40 seconds to bond a control group of brackets. All teeth were mounted in hard resin and stored in distilled water at 37°C for 24 hours and thermocycled at 5 and 55°C for 1,000 cycles. SBS was measured on debonding with a universal testing machine. The Kruskal-Wallis test was applied.
RESULTS: No statistically significant differences in SBS were found among the control group (8.4 ± 4.1 MPa) and the 2-, 4-, 6-, 8-, 10- and 12-second LED groups (4.6 ± 1.9 MPa, 6.2 ± 2.6 MPa, 8.6 ± 3.4 MPa, 7.8 ± 3.6 MPa, 7.1 ± 2.7 MPa and 7.3 ± 2.5 MPa, respectively).
CONCLUSIONS: Bonding of stainless steel brackets using a high-power LED curing unit at various reduced curing times was found to provide SBS comparable with those of brackets bonded with a conventional halogen lamp. However, a curing time of 2 seconds with an LED curing unit provided the lowest SBS values.

325 VARIATIONS IN INCLINATION OF THE CONDYLAR PATH IN CHILDREN AND ADULTS

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AIM: To test the null hypothesis that there are no differences between children and adults in condylar path inclination angle (CPIA) on the right and left sides.
SUBJECTS AND METHOD: Eighty children aged 6 to 10 years (subgroups 1–5, according to chronological age) were compared with an adult group with regard to CPIA on the right and left sides. CPIA was measured using the ultrasonic JMA® system.
RESULTS: The CPIA increased with age in the child subgroups. A significant difference was found in CPIA between the adult and child groups. In the group of oldest children (average age: 10.3 years), the CPIA had reached 81.87 per cent on the right side and 78.85 per cent on the left side compared with the adult group at a 5 mm protrusive path. In the group of pooled children, the CPIA was 73.08 per cent on the right and 72.13 per cent on the left side in comparison with the adult values. No significant difference was found between the right and left CPIA in any group.
CONCLUSIONS: The hypothesis is rejected. The CPIA on the right and left sides increased with age in the child group and was significantly smaller in the child group when compared with the adult group.

326 GROWTH RELATED DIFFERENCES IN MAXIMUM LATEROTRUSION AND RETRUSION BETWEEN CHILDREN AND ADULTS

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AIM: To test the null hypothesis that there are no differences between children and adults in maximum laterotrusion and maximum retrusion on the right and left sides.
SUBJECTS AND METHOD: The population-based study included 81 randomly selected children aged 6-10 years and 67 adults. Kinematic variables were measured using the ultrasonic JMA® system.

RESULTS: The mean maximum laterotrusion of the child group (10.6 ± 1.5 mm on the left, and 11.0 ± 1.7 mm on the right) was significantly smaller than that of the adult group (11.7 ± 2.0 mm on the left and 12.2 ± 1.7 mm on the right). Maximum laterotrusion in the child group corresponded to about 90 per cent on the left and right side to that of the adult group. The mean maximum retrusion in the child group was significantly greater than that of the adult group. The adult values corresponded to 66.7 per cent on the left and 50 per cent on the right side to the children's values. There was no significant difference in maximum laterotrusion and retrusion of the right and left sides and also no significant difference according to gender related measurements in either group.
CONCLUSIONS: The hypothesis is rejected. In the development of the temporomandibular joint, maximum laterotrusion on the right and the left sides increases significantly with age, while maximum retrusion decreases significantly with age.

327 TEN YEARS (1995-2004) OF ORAL CLEFTS: AN EPIDEMIOLOGICAL AND GENETIC STUDY

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AIMS: To characterize the clinical characteristics, demographic data, and associated congenital anomalies of patients with syndromic or non-syndromic cleft lip, with or without a cleft palate.
MATERIALS AND METHOD: A retrospective study was carried out of the data at the Registry of Congenital Malformations of Alsace (department of Bas-Rhin) in France between 1995 and 2004.
RESULTS: Two hundred and sixty six children were seen during this period, giving an overall incidence of 2.008 per 1000 live births. A cleft lip palate (CL/P), cleft lip alone (CL) and cleft palate alone (CP) accounted for 13.52 and 35 per cent, respectively. CL/P gender ratio was 1.94 whereas CP gender ratio was 0.86. Considering all anatomical types of oral clefts, 141 oral clefts were isolated (53%) and 125 (47%) were associated with other birth defects. Thirty-six per cent of CL/P were associated, contrasting with 67 per cent of associated CP. There was a predominance of deformities to the left side. Isolated and associated Pierre Robin sequences were estimated. Among associated oral clefts, chromosomal anomalies, monogenic syndromes and other multiple congenital anomalies were described. Forty seven per cent of children had associated anomalies, especially with a palatal cleft: chromosomal and genetic syndrome, depending on clinical form, from 20 to 34 and 10 to 21 per cent. Syndromal forms with polymalformities were over-expressed with 56 to 70 per cent.
CONCLUSIONS: The prevalence of a syndromic cleft was found to be increased compared with published rates (10-30%). The results suggest that CP plays an important role in these values by increasing syndromic forms of cleft lip. Clinical and epidemiological analyses support the hypothesis of different pathogenic origins of CL/P and CP.

328 MONITORING OF GENE EXPRESSION IN CARTILAGINOUS GROWTH CENTRES OF THE SKULL

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AIM: Several cartilaginous growth centres affect post-natal growth of the skull. The growth occurs by proliferating dividing chondrocytes that secrete mainly type II collagen or aggrecan. The secretion of type X collagen signals the presence of hypertrophic chondrocytes and the onset of ossification. The aim of this study was to observe the gene expression of both collagens to determine the time course of endochondral ossification.
MATERIALS AND METHOD: Twelve rats of different ages were killed and dissected for isolation of the lamina perpendicularis, the condylar cartilage and the spheno-occipital synchondrosis. Total RNA was isolated from these samples and reverse transcribed into cDNA. The gene expression of type II and type X collagen was examined by quantitative polymerase chain reaction (qPCR).
RESULTS: Type II collagen was significantly up regulated at the later lactation phase (10 until 21 days) while its gene expression decreased significantly on reaching adolescence (52 days). The gene expression pattern of type X collagen was partially different to that of type II collagen. The gene expression of type X collagen was approximately 10 fold less compared with type II collagen. Moreover, the highest gene expression was reached at the same time as of that of type II collagen.
CONCLUSION: qPRC is a good method of choice to examine gene expression of cartilage specific genes. Proliferating activity of growth centres at maximum at the lactation phase was identified. These results are in agreement with the recent findings of a morphometric study where the maternal nutrition state during lactation strongly affected the craniofacial development of rat pups.

329 ROLE OF THE CPG-ISLAND IN THE P2-PROMOTER OF RUNX2

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AIM: Runx2 is the master gene in bone metabolism and point mutations in Runx2 can evoke cleidocranial dysplasia. However, the same mutation shows a variable expressivity of the disease between individuals. The P2-promoter of Runx2 contains a CpG-Island that is known to affect gene transcription. The focus of this investigation was to determine the methylation status of this CpG-Island and its impact on the gene transcription under different nutritional conditions.
MATERIALS AND METHOD: Two groups of rats were randomly divided into a control group and a test group, which were fed with an excess of folate or methionine and with 4-chloro-6-(2,3-xylidino)-pyrimidynylthioaceticacid. After decapitation, craniofacial growth centres were dissected and processed for the isolation of DNA and RNA for analysis. Genomic DNA from several growth centres was treated with sodium bisulphate to convert unmethylated cytosine to uracil, whereby methylated cytosine was not converted to uracil. The methylation status of the CpG Island was evaluated by sequencing and by MethyLight-qualitative polyermerase chain reaction (qPCR). The gene expression pattern of Runx2 was determined using reverse transcription qPCR.
RESULTS: Preliminary studies indicate that prolonged administration of 4-chloro-6-(2,3-xylidino)-pyrimidynylthioaceticacid leads to hypomethylation of the CpG Island, which potentially affects the gene expression pattern of the different Runx2 isoforms. Therefore, the gene dose of Runx2 is probably influenced by several factors, i.e. nutrition, availability of folate or methionine, dysfunction of DNA-methyltransferases and environmental poisons.
CONCLUSION: Preliminary observations indicate that the low gene dose of Runx2 in patients with cleidocranial dysplasia is influenced by extrinsic and epigenetic factors. Consequently, the treatment of cleidocranial dysplasia should also consider extrinsic and epigenetic factors, which influence the expressivity of this bone disease.

330 SHEAR BOND STRENGTH AND ENAMEL LOSS AFTER MULTIPLE BONDING OF BRACKETS

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AIM: When rebonding of brackets is necessary, a repeated acid etch technique with the risk of irreversible enamel damage is usually performed. The aim of this study was to determine whether or not complete removal of adhesive remnants and repeated etching is mandatory with respect to adequate shear bond strength (SBS).
MATERIALS AND METHOD: One hundred and twenty human premolars were bonded and rebonded with orthodontic brackets three times (Transbond™ XT, 3M Unitek). Rebonding in group 1 (G1) was performed after complete removal of adhesive remnants and re-etching, while in group 2 (G2) all adhesive remnants were removed but repeated etching was not undertaken. In group 3 (G3) composite was left on the enamel surface and the remnants were only levelled, so that the bracket could be rebonded in a correct position. Rebonding was performed without repeated etching. SBS and Adhesive Remnant Index (ARI) scores were assessed following each debonding sequence. Enamel tag damage and tear outs exceeding 50 µm were recorded.
RESULTS: SBSs in the first debonding sequence were 11.69 MPa (G1), 12.57 MPa (G2) and 11.93 MPa (G3). After the first rebonding the values increased in G1 to 14.30 MPa and in G3 to 12.06 MPa. In G2 the values decreased to 4.95 MPa. After the second rebonding the values reached 12.19 MPa in G1, 9.7 MPa in G3 and were reduced to 3.6 MPa in G2. ARI scores after the second debonding were significantly lower in G2 and G3 than in G1. Seven specimens in G1, two in G3 and one in G2 showed enamel tear-outs.
CONCLUSION: Re-etching is essential for a SBS of approximately 8 MPa if the greater part of adhesive remains on the tooth and if an accurate placement of the bracket is possible after levelling of the composite remnants. However, if most of the composite remains on the bracket base after tear-off, repeated acid etching is mandatory, thus increasing the risk of enamel tear-outs. The use of remnants for rebonding is recommended for new bracket positioning.

331 SENSITIVITY OF DIAGNOSTIC IMAGING IN ROOT RESORPTION

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AIM: To determine the most appropriate type of radiographic examination to describe root resorption.
MATERIALS AND METHOD: Nineteen extracted teeth. A comparison was made between a traditional endoral, a digital endoral and a panoramic radiograph. The teeth were fixed on a support with orthodontic wax and an endoral radiograph of the teeth was taken using 70 KV and 7 mA, at a distance of 20 cm from the X-ray tube and with a 0.12 second exposure for the traditional and 0.10 seconds for the digital technique. The teeth were then fixed on an acrylic resin support to simulate the dental arches and the panoramic radiograph was taken using 60 KV and 9 mA, with a 15 second exposure both for the traditional and digital techniques. The 'real' length of the teeth was measured between the occlusal surface and the radicular apex, and the radiographic tooth length by a calliper. Root resorption was caused by bathing the ending radicular portion in a 10 per cent nitric acid solution for 24 hours, following which the radiographic examinations and calliper measurements were repeated. The measurements obtained were statistically compared.

RESULTS: Endoral imaging was more reliable (sensitivity 90%) than extra-oral imaging (sensitivity 70%) because the anatomic elements in the panoramic images are enlarged and less detailed.
CONCLUSIONS: Among the radiological devices the endoral technique produces a better quantitative and qualitative diagnosis of root resorption than the extra-oral technique.

332 ONE OR TWO PHASE THERAPY? – SELECTION CRITERIA FOR THE CLINICAL CHOICE
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AIM: To evaluate the efficacy of early versus late therapy and the selection criteria for each therapy.
SUBJECTS AND METHOD: Three hundred and ninety one subjects (189 males, 202 females), with different types of malocclusion (Angle Class I, II, III). Their age range was from 6 to 14 years. The sample was divided into three groups on the basis of age: pre-puberal (7-9 years), puberal peak (10-12 years) and post-puberal (13-14 years). The rotational type and the auxologic category was calculated for every patient according to the analysis of Petrovic, Lavergne and Gasson (1983) and the following cephalometric variables were measured: SNA, SNB, ANB, FMA and Co-Pg distance, evaluated in the pre- and post-treatment phases.
RESULTS: In the Angle Class I puberal peak group, A1N and R1N types had the greatest changes versus the P1N type according with the higher growth potential of the first ones. The same variation was observed in the A1N (Angle Class II) and A3M and P1M (Angle Class III) according with the higher growth potential of these rotational types. In the post-puberal phase, P1M and A1N types revealed a significant increase of SNB and Co-Pg distance after treatment, whereas the P1N showed no significant difference. The results indciated that patients with a higher growth potential could also have residual mandibular growth.
CONCLUSIONS: During orthodontic treatment planning, knowledge of the mechanisms which control craniofacial growth and prognosis of individual growth potential are necessary. The findings of this study indicate that patient age and rotational type according to Petrovic, Lavergne and Gasson are a determinant guide to orthodontic treatment selection.

333 IS THERE A RELATIONSHIP BETWEEN THE CENTRE OF CRANIUM-NASION LENGTH AND MAXILLARY LENGTH?
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AIM: It has been well demonstrated that the anterior cranial base (S-N) is the counterpart of the maxilla and its growth is directly proportional to that of the maxilla. The aim of this research was to determine whether there is a relationship between anterior cranial length (centre of the cranium = CC) and Nasion (N).
MATERIALS AND METHOD: One hundred and nineteen lateral cephalogram taken in the natural head position with same source-object film distance. Since CC is dependent on the position of gnathion, subjects who had unusual growth patterns and prognathic or retrognathic mandibles were excluded. Therefore, 70 radiographs of 41 females and 29 males were selected. The patients were between 20 and 25 years of age. Forty six had a Class 1 malocclusion, 14 a Class II malocclusion with maxillary excess (facial angle and SNB were normal) and 10 a Class III malocclusion with a retrognathic maxilla and normal mandible. Jarabak's index was between 62-66 per cent. For calculating maxillary length, the distance from A-perpendicular to the palatal plane to PNS was measured. All data were analyzed with SPSS 15.0. The relationship between anterior cranial length and maxillary length was analyzed with a paired *t*-test.
RESULT: Anterior cranial base (S-N) has direct effect on maxillary growth. The proportion of anterior cranial length to maxillary length was on average 1.23 (standard deviation 0.038). The relationship between anterior cranial length and maxillary length was significantly proportionate ($P = 0.000$).

334 FREQUENCY OF ROTATIONAL TYPES IN ORTHODONTIC PATIENTS
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AIM: To determine the rotational types that are most frequently represented in clinical practice and which age, gender and skeletal malocclusion most frequently require orthodontic treatment.
SUBJECTS AND METHOD: Seven hundred and thirty two untreated subjects (426 females, 306 males) without systemic pathologies or deformities and no previous orthodontic treatment. Their age range was from 6 to 17 years and the skeletal malocclusions were Angle Class I, II and III. In order to determine the skeletal Class, ANB angle was calculated. Analysis of the rotational type and the auxologic category was based on the studies of Petrovic, Lavergne and Gasson (1983). On the basis of the results, a correlation was sought between the different skeletal Classes and rotational types.
RESULTS: The most frequent rotational types were R1N and R2D. The most represented Angle Class was Class II, and in that group the most frequent rotational type was R2D. Among the Class I patients, the most frequent rotational type was

R1N, while among the Class III patients the most frequent was P1M. Females were more likely to require orthodontic treatment than males.
CONCLUSIONS: The findings confirm the determinant role of rotational types and auxologic categories for prognostic considerations to guide the treatment choice.

335 EVALUATION OF INDICATIONS FOR CONE-BEAM IMAGING AND ITS CONSECUTIVE APPLICATION
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AIM: Radiographic imaging plays an essential role in orthodontic diagnosis and treatment planning. Two-dimensional imaging has limitations and the development of three-dimensional (3D) imaging offers new prospects in orthodontics. The aim of this study was to evaluate whether the acquisition of cone-beam images and subsequent cone-beam imaging is justified.
MATERIALS AND METHOD: Three hundred randomly selected images acquired with the Galileos® device (volume of 15 × 15 × 15 cm, resolution up to 0.150 mm). The images were evaluated to determine whether they fulfilled one of eight justifications for 3D imaging in orthodontics as recommended by the German Association of Orthodontists. These indications are: dental anomalies, root dysplasias and resorptions, eruption disturbances and ectopic teeth. Pathologic bony structures, craniofacial malformations and cleft lip and palate (CLP) are also considered as indications. Subsequent images were obtained of one-third of the patients and superimposed with a new software tool.
RESULTS: One-third of the images were obtained because of ectopic teeth and another third had a CLP. Craniofacial malformations were an indication in 12 per cent, and the same percentage had pathologic bony findings such as cysts or condylar fractures. The remaining images were acquired because of dental anomalies or root resorption. Approximately 3 per cent of the images did not fulfil any of the criteria. In the case of skeletal asymmetries, the images required application of software tools in order analyse the information. It was found that the superimposed images contributed information to the orthodontic diagnosis and treatment progress.
CONCLUSIONS: Cone-beam imaging is ideally suited for dentomaxillofacial scanning and can offer useful information to accurately diagnose particular orthodontic findings and to pursue the effects of orthodontic treatment. When combined with application-specific software tools, orthodontists can perform more specific diagnostic and therapeutic tasks.

336 SKELETAL AND DENTOALVEOLAR EFFECTS OF A FATIGUE-RESISTANT APPLIANCE IN GROWING CLASS II DIVISION I INDIVIDUALS
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AIM: To evaluate skeletal and dentoalveolar cephalometric changes in Class II division 1 patients treated with a fixed functional treatment appliance, the Forsus™ fatigue-resistant device.
SUBJECTS AND METHOD: Eighteen patients with Class II division 1 malocclusions and a normal to low angle growth pattern. All were in the permanent dentition and in the pre-peak or early stages of the peak growth period. Treatment started with levelling and alignment with a 0.018 inch slot preadjusted appliance. The Forsus appliance was applied following insertion of a 0.017 × 0.025 inch stainless steel wire and removed after achievement of a super Class I molar and canine relationship. Lateral cephalometric films taken just before placement and removal of the Forsus were traced and evaluated.
RESULTS: All patients were treated to a super Class I molar and canine relationship which took an average of 126 days (maximum: 83 days, minimum: 75 days). Wits and overjet decreased significantly 6.11 ± 4.05 and 6.23 ± 2.31 mm, respectively. SNB angle increased, whilst ANB angle decreased significantly (0.76 ± 1.23, 1.61 ± 1.55°, respectively, $P < 0.05$). Total mandibular length (Co-Pog) and ramus length increased significantly 1.46 ± 2.33 and 1.84 ± 2.02 mm, respectively, but the change in corpus length was not significant. The upper molars were distalized 1.66 ± 1.55 mm and the upper incisors moved palatally 1.92 ± 1.89 mm. The lower molars and incisors moved mesially 3.96 ± 2.34 and 4.19 ± 2.43 mm, respectively ($P < 0.001$).
CONCLUSIONS: The Forsus™ is effective in treating Class II malocclusions in growing individuals. The treatment result was a combination of skeletal and dental effects through growth.

337 MISINTERPRETATION OF GROWTH BY SUPERIMPOSING LATERAL CEPHALOGRAMS ON THE S-N LINE
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AIMS: The most reliable way of following growth is by superimposition of lateral cephalograms using anatomical structures (Björk). It is not possible to superimpose digital cephalograms in this way so the S-N line is typically used for this purpose. The aim of this study was to investigate whether superimposition is equal to the anatomical method.

MATERIALS AND METHOD: Seventy pairs of lateral cephalograms with a mean difference of recording time of 1.2 years were superimposed according to the method of Björk. The angle between both S-N-lines of time A and B was measured and the change of angles SNA, SNB, NL-NSL and ML-NSL resulting from this superimposition was determined. The values of these angles were then compared with superimposition on the S-N line.
RESULTS: Seventy-two per cent of the patients had an angle for the S-N lines larger than 1 degree. In these patients point N grew downward by 73 per cent. The largest angle was –4.12 degrees. The other angles also showed a large difference between both methods of superimposition, which means that there is a high risk of misinterpretation of growth using the S-N line for superimposing and calculating the changes of angles. In addition, visual interpretation of both superimposition methods resulted in large differences.

338 A COMPARISON BETWEEN TWO TYPES OF SELF-CURED ACRYLIC CONCERNING THE RELEASE OF METHYL METHACRYLATE

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AIM: Plymethyl methacrylate (PMMA) denture base material is cured from methyl methacrylate (MMA) by an additional polymerization reaction. The incomplete conversion of MMA to PMMA leaves some unreacted MMA, called residual monomer. It is known that high levels of residual monomer have a deleterious effect on the properties of denture base polymers and may cause irritation or hypersensitivity of the oral tissue. According to previous studies, there is more residual monomer in self-cured compared with other types of resins. However, resins having higher residual monomer may not necessarily release higher amounts of MMA. In this study the amount of MMA released into saliva from two self-cured acrylic resins was compared.
MATERIALS AND METHOD: Ten specimens of each material were used. Moulds were made in dental flasks using a metal model (35 ×8 ×3 mm). According to the manufacturer's instructions, the specimens were prepared in the moulds. Each specimen was placed in a separate test tube containing 3 ml of the supernatant part of the unstimulated whole saliva from one subject. Tubes were incubated at 37°C. After 24 hours, 2 ml of saliva was drawn off and added to 2 ml MEK and 2 µl of P-xylene. The solutions were centrifuged and then frozen at –75°C. The upper part of the solution of each tube was analyzed using gas chromatography (GC). Each acrylic specimen was placed into a new tube with 3 ml of saliva. The same procedure was performed for the second 24 hours.
RESULTS: The most release occurred in the first 24 hours for both materials, but there was more reduction in the second 24 hours with Orthoresin. *t*-tests showed that there was no significant difference ($P > 0.05$) in the MMA concentrations released from the two materials in the first and second 24 hours after processing.
CONCLUSIONS: Concentrations of MMA released from Acropars and Orthoresin did not vary considerably.

339 THREE-DIMENSIONAL FINITE ELEMENT ANALYSIS OF THE EFFECTS OF COMMONLY USED LOOPS IN THE EDGEWISE SYSTEM FOR ANTERIOR RETRACTION

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AIM: The popularity of retraction loops is attributed to the features they possess such as their failsafe action, statically determinate force system, and frictionless mechanics. The objectives of the present study were to evaluate the forces and moments generated by changing different parameters of the vertical loop and then to study their effects on the periodontium.
MATERIALS AND METHOD: Different models of the vertical loops and an archwire having vertical loops for retraction, together with labial teeth and their periodontium were generated. The dimension of the wire for both the loops and the archwire was 0.018×0.025 inches. Different vertical loops were modelled simulating them to be placed between the molar and canine for canine retraction, and as a part of the archwire with loops between the lateral incisor and canine region for incisor retraction. A total of 64 models of the loops were created, representing parametric changes related to the amount of activation, degree of gable bends and wire materials. All wires were subjected to non-linear analysis, and the tooth models were studied by linear analysis. Certain combinations of forces and moments (for specific M/F ratios) were applied on the teeth. The resultant displacement/deformation, and maximum and minimum principal stresses were assessed.
CONCLUSIONS: 1) Forces, moments and M/F ratios can be altered by incorporating additional wire, by changing the degree of gable bends, and by varying the activation. 2) The initial tooth movement for any M/F ratio is uncontrolled tipping. 3) As the M/F ratio increases, the stresses become more evenly distributed over larger areas of the periodontium. 4) Even when the force applied was as low as 80 g, the stresses generated at initial loading were higher than the accepted ideal values, which could lead to pathologic changes. The finite element method is a useful tool in predicting the stress and strain pattern in the periodontium.

340 MORPHOLOGICAL ALTERATIONS IN THE ALVEOLAR BONE PATTERN FOLLOWING ORTHODONTIC TREATMENT – A DENTAL PANTOMOGRAPHIC STUDY

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AIMS: Changes within the body are analysed with the available laws of science. Orthodontics plays an important role in altering the morphological pattern of the alveolar bone during tooth movement. Orthodontic treatment is about manipulating the bone structure to achieve the desired results. This study evaluated both quantitative and qualitative changes of the alveolar bone. The objectives were to assess the general skeletal radiographic changes following orthodontic treatment, to compare the trabecular pattern between pre- and post-treatment dental pantomograms (DPTs), to determine the changes if any between extraction, non-extraction and surgical orthodontic treatment procedures, and to assess clinical significance of these changes.

MATERIALS AND METHOD: Pre- and post-treatment DPTs of 48 patients were studied from the crest of the alveolar bone to the periapical region – first manually by counting the number of striae and measuring them with a digital calliper then later importing the images into Photoshop Adobe and AutoCAD software for quantitative and qualitative analysis.

RESULTS: There was a structural change in the alveolar trabecular bone pattern of 20 to 25 per cent in non-extraction and 50 to 60 per cent in extraction cases between the pre- and post-treatment DPTs. The other changes observed were a significant decrease in the number of interdental striae, a reduction in the length and a marked increase in the orientation angle between these striae. Average alveolar crestal bone loss of 2 mm and root resorption of 1.8 mm was observed in extraction cases.

CONCLUSION: Long-term evaluation of radiographic findings should be undertaken together with clinical examinations to qualify and quantify the detrimental effects of orthodontic treatment. These changes in the alveolar bone occur not only following orthodontic treatment but also with physiologic loads and stresses.

341 EFFECTS OF SURFACE CONDITIONING METHODS ON SHEAR BOND STRENGTH OF BRACKETS BONDED TO DIFFERENT ALL-CERAMIC MATERIALS

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AIM: To investigate the effects of two surface conditioning methods on the shear bond strengths (SBS) of metal brackets bonded to three different all-ceramic materials.

MATERIALS AND METHOD: Twenty feldspathic (Vitadur Alpha; Vita Zahnfabrik, Bad Säckingen, Germany), 20 apatite layering (Empress 2; Ivoclar Vivadent, Schaan, Liechtenstein) and 20 leucite reinforced (Empress Aesthetic; Ivoclar Vivadent) ceramic specimens. Two different surface conditioning methods were used for each all-ceramic material: air-particle abrasion (APA) with 25 μm aluminium trioxide (Al_2O_3) and silica coating with 30 μm Al_2O_3 particles modified by silica (CoJet Sand; 3M Espe, Seefeld, Germany). After silane application, the metal brackets were bonded with Transbond XT adhesive (3M Unitek, Monrovia, California, USA). After SBS testing the amount of composite resin according to the Adhesive Remnant Index was determined.

RESULTS: No significant differences for ceramic type, surface conditioning method and their interaction were observed with two-way analysis of variance ($P > 0.05$). SBS for feldspathic, apatite and leucite reinforced ceramics after APA were 22.50, 23.22 and 25.31 MPa, respectively. SBS for feldspathic, apatite and leucite reinforced ceramics after silica coating were 23.66, 23.39 and 29.38 MPa, respectively. Adhesive failures between the ceramic and composite resin were noted in all groups. Damage to the porcelain surfaces was not observed.

CONCLUSIONS: SBS values obtained with two surface conditioning methods for the three all-ceramic materials did not show any significant difference. No porcelain fracture was observed despite the high SBS values.

342 SKELETAL AND DENTOALVEOLAR EFFECTS OF A FUNCTIONAL APPLIANCE

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AIM: To evaluate the effectiveness of the Biobloc Stage 3 appliance from both a skeletal and dentoalveolar perspective. Functional appliances improve Class II malocclusions among adolescent patients through their skeletal and dentoalveolar effects. The Biobloc Stage 3 appliance was devised in order to induce skeletal effects as much as possible, whilst restricting dentoalveolar effects. The appliance is also considered capable of inducing mandibular forward and upward growth and does not raise bite height; this in turn prevents an increase in face height. The appliance is thus considered to be adaptable to high angle cases.

SUBJECTS AND METHOD: Thirteen adolescent patients (2 males, 11 females; average age 9 years 5 months; average appliance wear 24 months) treated with a Biobloc Stage 3 appliance at two orthodontic clinics. All patients had Angle Class II division 1 malocclusions with maxillary protrusion. The appliance was used for approximately 7 hours daily during the daytime. Lateral cephalograms taken at the beginning and end of treatment were analysed in order to determine skeletal and dentoalveolar effects.

RESULTS: The overjet was reduced by an average of 2.0 mm and the molar relationships were corrected on average by 3.0 mm. The reduction in overjet and improvement in the molar relationship was as a result of forward mandibular growth. Skeletal effects were greater than dentoalveolar effects in the correction of both overjet and molar relationships. Moreover, the SN-Mandibular plane angles were reduced.
CONCLUSIONS: The Biobloc stage 3 appliance induces upward and forward mandibular growth and does not open the bite; hence the appliance is suitable for high angle cases.

343 STABILITY CHANGE OF CHEMICALLY MODIFIED SAND BLASTED/ACID ETCHED TITANIUM PALATAL IMPLANTS

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AIM: To examine, in a randomized controlled clinical study, changes in the stability of palatal implants with chemically modified sandblasted/acid-etched (modSLA) titanium surfaces compared with standard SLA surfaces, during early stages of bone healing.
SUBJECTS AND METHOD: Forty adult volunteers were recruited and randomly assigned to either the test (modSLA-surface) or control (SLA-surface) group. The test and control implants had the same microscopic and macroscopic topography, but differed in surface chemistry. To document implant stability changes, resonance frequency analysis (RFA) was assessed at implant insertion and at 1, 2, 3, 4, 5, 6, 7, 8, 10 and 12 weeks thereafter. RFA values were expressed as an implant stability quotient (ISQ).
RESULTS: Immediately after implant placement the ISQ values for both groups were not significantly different and yielded mean values of 73.8 ± 5 for the control and 72.7 ± 3.9 for the test surface. In the first 2 weeks after placement, both groups showed only small changes and thereafter a decreasing trend in mean ISQ levels. In the test group, after 28 days there was a transition to increasing ISQ values and 42 days after surgery the ISQ values corresponded with those after implant insertion. For the SLA-control group the trend changed after 35 days and reached ISQ values corresponding to baseline after 63 days. At the 12 week observation, the test surface reached significantly higher stability values of 77.8 ± 1.9 compared with the control implants of 74.5 ± 3 9, respectively.
CONCLUSIONS: The results support the potential for chemical modification of the SLA surface to alter the biological process of osseointegration and to decrease healing time.

344 LOWER BONDED RETAINERS: SURVIVAL RATE, FAILURE TYPES AND INFLUENCING FACTORS

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AIMS: To analyse the frequency and types of failure of lower bonded retainers (LBR) as well a possible factors influencing the survival rate.
SUBJECTS AND METHOD: All orthodontic patients finishing their active fixed appliance treatment between 1995 and 2006 were analyzed retrospectively. One thousand and sixty two patients (461 males, 601 females) had been retained with a LBR. The mean age at the time of retainer bonding was 15.7 years. Failure types (loss, detachment, fracture), their sites, and time points during the entire retention period were retrieved from the patients' records.
RESULTS: Almost all patients (99%) received bonded canine-to-canine retainers. Most of these retainers were only bonded to the canines (78%), while the remaining 22 per cent had six bonding sites. Forty-three per cent of the patients exhibited single or multiple retainer defects. Of the retainers, 22.6 per cent were completely lost during the retention phase. The loss rate varied insignificantly (17.4-24.0%) between the retainer types. Detachments of single bonding sites were observed in 18.3 per cent of the patients, while multiple detachments were only seen in 4.5 per cent. On average, detachments occurred in 14.2 per cent of the bonding sites, without any difference between the retainer types. Less than 1 per cent of the LBR fractured. Kaplan-Meier analysis revealed a survival rate of 75 per cent for all LBR after 1 year. Neither malocclusion type, co-operation, nor oral hygiene significantly influenced the survival rate. However, the LBR 1-year survival rate was found to be significantly ($P < 0.001$) higher in patients treated by a certified orthodontist (84%) than in those treated by postgraduate students (70%). A clear learning curve was detectable.
CONCLUSIONS: LBR defects occurred in 43 per cent of the patients; the most frequent defects were total loss and single bonding site detachment. More retainer defects must be expected when treatment is performed by less experienced practitioners.

345 PREVALENCE OF SUPERNUMERARY TEETH

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AIM: To study the prevalence of supernumerary teeth in the current Swiss population.
MATERIALS AND METHOD: Two thousand four hundred dental pantomograms (DPTs) obtained in connection with dental examinations of 3rd grade schoolchildren (mean age 9.5 years, 1114 girls, 1286 boys) in the city of Winterthur, Switzerland, during 1995-2005. The DPTs were studied by two researchers and the number of supernumerary teeth was recorded.
RESULTS: There were 34 supernumerary teeth in the 2400 studied individuals, giving a prevalence rate of 1.4 per cent. The prevalence of supernumerary teeth in boys was higher than in girls, 1.04 and 0.38 per cent, respectively, i.e. 25 boys had extra teeth compared with nine girls. Most of the supernumerary teeth were located in the upper anterior area (25 out of total 34, 74%), were considerably smaller than the permanent incisors and thus were considered as mesiodens. Only three individuals had a 'normal' looking extra tooth in the lower anterior area.
CONCLUSIONS: The prevalence of supernumerary teeth is quite low (1.4%) and is comparable with that found in previous studies from the 1970's. Since most of the supernumerary teeth were located in the upper anterior area, orthodontists should bear in mind the possibility of an extra tooth in case of eruption failure or delayed eruption of permanent upper incisors.

346 DIRECT INTRAORAL PHOTOGRAPHY VERSUS INDIRECT PHOTOGRAPHY AS A RELIABLE TOOL FOR DOCUMENTATION OF SAGITTAL DISCREPANCY

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AIM: Intraoral photography is an essential tool for documentation of diagnostic findings and treatment progress in orthodontics. The buccal view is used for evaluation and documentation of occlusal relationships. Buccal views should be taken with the camera angle as perpendicular to the molar-premolar area as possible, to allow for a true representation of a buccal segment sagittal discrepancy. The aim of this study was therefore to determine if direct photography without the use of mirrors is a reliable technique.
SUBJECTS AND METHOD: The maximum perioral soft tissue stretching and the transverse dental arch width was recorded in 50 subjects and a template to determine the orthogonal projection was custom built on the dental cast. Photographs in a buccal view were taken using both the direct and indirect technique of every subject. Individual angular misalignment from the orthogonal projection was recorded and the corresponding projection error was calculated using trigonometric functions.
RESULTS: Direct photography (median 19.83°) resulted in statistically significant ($P < 0.001$) larger angle deviations to the desired orthogonal projection than indirect photography with the use of mirrors (median 0°). Soft tissue stretching showed large interindividual differences and a negative correlation with angle differences to the desired orthogonal projection for the indirect technique. Depending on the transverse distance between the mesiobuccal cusp of the first upper and lower molar and the recorded angle difference from the orthogonal projection, a parallax error of one-eighth to one-quarter premolar width was found.
CONCLUSION: Indirect mirror dependent intraoral photography is superior to direct intraoral photography concerning validity of diagnostic documentation. With dental arch width differences, poor buccal view photographs can lead to misjudgement of sagittal discrepancy.

347 LIP MORPHOLOGICAL CHANGES AFTER SKELETAL CLASS III TREATMENT

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AIM: To assess morphological changes in the lips after orthodontic treatment in skeletal Class III subjects with maxillary retrusion.
SUBJECTS AND METHOD: Thirty growing orthodontic patients. The treatment group included 15 subjects with a skeletal Class III malocclusion (ANB <0°) with maxillary retrusion (mean age 11.8 ± 1.6 years) and a Class I control group of 15 subjects with minimum crowding (mean age 13.1 ± 1.7 years). In the Class III group, maxillary protraction was achieved with a removable upper appliance and a facemask, via heavy elastics. The facemask was worn at least 18 hours/day. The Class I control group received only fixed orthodontic treatment. Frontal photographs were obtained of all subjects at the beginning and end treatment in a normal seated posture, at a standard distance between the camera and the subject. Landmarks were placed on each tracing of the photographs. Linear measurements were undertaken using the Poridos software. Analysis of variance (ANOVA) and Duncan tests were used to compare pre- and post-treatment lip morphology.
RESULTS: The treatment differences were statistically significant between the two groups regarding upper lip height/lower face height ratio ($P < 0.05$). Right and left upper lip height increased significantly in the Class III group (4.4 to 5.8 mm, 4.3 to 4.9 mm, respectively) ($P < 0.05$) while it was statistically insignificant in the control group. Lip width was not statistically different between the pre- and post-treatment measurements in either group.

CONCLUSION: This study demonstrates the improvement in the lip morphology particularly in the vertical dimensions in growing subjects after facemask therapy for the correction of skeletal Class III malocclusion with maxillary retrusion.

348 LONG-TERM SENSORY CHANGES OF ORO-FACIAL TISSUES FOLLOWING ORTHODONTIC TREATMENT

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AIM: To assess inflammation-induced sensory changes in the permanent maxillary incisors and surrounding skin of the upper lip during orthodontic tooth movement.
SUBJECTS AND METHOD: This prospective, longitudinal, cohort study was carried out at the Dental School, Sheffield, and Queen's Medical Centre, Nottingham, UK. Thirty patients attending for fixed appliance treatment (19 females, 11 males, aged 11–27 years) underwent sensory testing at baseline, three and six months into active treatment, and at debond. The upper permanent incisors were assessed for mechanical thresholds using von Frey hairs. The skin of the upper lip was subject to light touch, and patient responses were recorded using a visual analogue scale.
RESULTS: Preliminary data are presented for 17 patients, who completed fixed appliance therapy and were subject to sensory testing at debond. The mean pressure threshold of the upper incisor teeth decreased significantly during initial treatment but subsequently showed recovery at debond ($P < 0.001$, ANOVA). The quality of sensation towards light touch on the skin of the upper lip, using a single stoke, remained fairly constant throughout treatment. However, the quality of sensation reported in response to light touch continuous stroking was found to increase significantly during initial treatment ($P < 0.001$). This patient-reported response then decreased at debond and tended to return to pre-treatment values.
CONCLUSIONS: A primary hyperalgesic response was shown by the upper incisors and a secondary hyperalgesic response was demonstrated in the skin of the upper lip during the initial phase of fixed orthodontic treatment. These sensory changes showed some recovery at debond, but did not return completely to baseline levels. Further assessment, following debond, is therefore indicated to determine whether there are any permanent changes in sensory responses that could be attributed to inflammatory changes associated with orthodontic interventions.

349 PHOTOGRAPHIC NORMS OF PROFILE AND FRONTAL VIEWS IN 16-18 YEARS OLD IRANIAN FEMALES

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AIM: To obtain objective average measurements of the soft tissue and frontal facial profile to use them as a guide for aesthetic treatment goals. Analysis of the soft tissue facial and frontal profile from photographic records provides information on the underlying dentoskeletal tissue.
SUBJECTS AND METHOD: One hundred female high school students aged 16-18 years, mean age 17 years 2 months. None of them had any facial deformities, and all of the subjects and their parents were born in Tehran. For each subject two standard photographs were taken in the profile and frontal view in the natural head position. The measurements were digitally analysed using CCTA-SH2. The average, standard deviation and range for a total of 43 indices were calculated. Twelve judges (6 males, 6 females) scored each subject's photographs. At the end, 21 subjects who received a high score from at least 90 per cent of judges were chosen at the 'supernormal' group and compared with the whole group.
RESULT: Fifteen angular and seven linear measurements of the profile had significant differences when compared with those of the Hispanics, and also showed a significant difference for seven indices in comparison with those of Canadians. Statistical analysis (*t*-test) showed ethnic differences in most parameters of the labial, nasal and chin areas. In general Iranians had more prominent lips with a less prominent chin in comparison with Hispanics.

350 CORRELATION COEFFICIENTS BETWEEN SURGICAL TREATMENT AND PREDICTED OUTCOMES IN CLASS III PATIENTS

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AIM: To retrospectively analyse the accuracy and reliability of predictions generated in Class III patients with horizontal growth patterns treated with orthognathic surgery by comparing CCTA-SH2 software predictions with post-surgical lateral cephalographs.
MATERIALS AND METHOD: Pre- and post-surgical lateral cephalographs of 18 adult patients were scanned into the computer and 14 landmarks were identified and digitized. Computer-simulated surgical movement of the mandible was accomplished by moving the mandible parallel to the occlusal plane such that the mandibular incisors were positioned in an acceptable overjet and overbite relationship with the maxillary incisors. The computer then calculated the hard and soft

tissue changes. Nine measurements of the predicted and actual post-surgical hard and soft tissue landmark were compared using a Student's paired *t*-test.
RESULTS: There was good correlation between seven of the nine measurements. The E line to Ls ($P = 0.556$) and Z angle ($P = 0.063$) demonstrated very poor correlation. Eight of the nine measurements showed no statistically significant difference. Only *Y* axis ($P = 0.017$) showed a statistically significant difference between the predicted and actual measurements.
CONCLUSIONS: CCTA-SH2 can accurately predict six of the nine measurements. This software cannot predict the upper lip well. The magnitude of the differences in the *Y* axis and *Z* angle were within clinically acceptable limits.

351 INFLUENCE OF GENDER ON STAFF MANAGEMENT PRACTICES IN ORTHODONTICS
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AIM: Previous studies have focused on the impact of gender on working patterns by documenting differences in hours worked, time taken off, days worked in a year, practice ownership status, and possible differences in income. Little research has been done to investigate the impact of gender on staff management. The goal of this project was to investigate possible gender-specific managing styles.
MATERIALS AND METHOD: Surveys were mailed to 427 orthodontists in Virginia and Maryland. The survey consisted of 35 questions and covered basic demographic questions, general information about their current staff, questions about benefits offered to the staff, the hiring and training practices, and termination policies. Descriptive statistics were used to summarize the results obtained for both female and male groups. The nominal responses were compared with either Fisher's exact or a chi square test. Continuous measures were compared using Wilcoxon's rank sum test.
RESULTS: One hundred and sixty eight orthodontists (39%) responded, of which 48 were female (29%). On average, males were more typically graduates of two-year programmes and females were more likely to have graduated from longer programmes. Of all females, 42 per cent were practicing in Virginia and 58 per cent in Maryland. Of the males, 95 per cent owned their own practices compared with 83 per cent of the females. However, for those who were owners or associates, there was no difference between males and females. Females implemented staff performance reviews more consistently than males.
CONCLUSIONS: Gender has an impact on the length of the programme attended, and on the implementation of a systematic performance review of staff. The size and make up of staff were not affected by the gender of the practitioner.

352 COMPARATIVE ASSESSMENT OF THE FORCES AND MOMENTS GENERATED WITH VARIOUS INCISOR INTRUSION SYSTEMS
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AIM: To comparatively evaluate the intrusive forces and torquing moments in the saggital plane generated during anterior intrusion using different incisor intrusion mechanics in both jaws.
MATERIALS AND METHOD: Five wire specimens were used for each of the following intrusive arches: non-heat-treated Blue Elgiloy utility arch 0.016 × 0.016, TMA utility arch 0.017 × 0.025 and 0.017 × 0.025 TMA Burstone intrusion arch. The wires were constructed according to the specifications given and were inserted on bracketed dental arches on maxillary Frasaco models, segmented mesially to the maxillary canines. Simulated intrusion from 0.0-1.5 mm was performed on the Orthodontic Measurement and Simulation System, and forces and moments were recorded at 0.1 mm vertical displacement increments. All measurements were repeated five times for each specimen, and maximum values recorded at 1.5 mm for all wires were used for all statistical evaluations. The data were analyzed with two-way analysis of variance with forces and moments serving as the dependent variables, separately, and wire type and jaw as the independent variable. *Post hoc* multiple comparisons were performed using the Tukey test (0.05 error rate).
RESULTS: Comparison of the two major intrusion techniques for the maxillary anterior teeth, segmented and bioprogressive, revealed that the 0.017 × 0.025 TMA Burstone intrusion arch exerted the lowest intrusive forces, followed by the 0.017 × 0.025 TMA utility and the 0.016 × 0.016 Blue Elgiloy utility arch. The lowest anterior moment in the sagittal plane in this experiment was generated from the 0.017 × 0.025 TMA Burstone intrusion arch, followed by the 0.016 × 0.016 Blue Elgiloy utility and the 0.017 × 0.025 inch TMA utility arch. The intrusive forces, as well as the generated moments, were always higher in the mandible.
CONCLUSION: A 45-degree molar tip-back in the mandibular intrusion arches tested produces forces that may exceed the biological threshold.

353 MONITORING OF CO-OPERATION AND FORCE MAGNITUDE DURING EXTRAORAL TRACTION USE***
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AIMS: To test the clinical applicability of a newly developed device to monitor co-operation and force during the use of extraoral traction.
MATERIALS AND METHOD: A digital recorder was developed to be placed between the force module and the facebow of the extraoral traction. The device records the mean delivered force for each 15 minutes over a period of up to six months. The mean time of use and mean force magnitude can be displayed on the built-in LCD screen. When connected to a computer, detailed data can be exported to a calculation programme. In the pilot study the device was used on 20 patients for 30 days. In addition, in some cases, overnight video monitoring was used.
RESULTS: The device does not seem to increase discomfort when using extraoral traction. The force level that was intended to be delivered was, on average, maintained but also fluctuated during the night. In some patients the force from the headgear decreased to almost zero for several hours despite not falling off. Video monitoring revealed that the headcap had shifted to the forehead and therefore the force was reduced. The recordings also accurately showed the duration, i.e. co-operation of headgear use. In some patients the recording revealed a discrepancy between the patient's own report and the actual use.
CONCLUSIONS: The device seems to be a promising tool for research and clinics to reveal reliable data of the use and force of extraoral traction. For the first time, duration and force magnitude can be recorded and included in studies to examine the effectiveness of extraoral traction use. It is also expected that the device will improve co-operation and thus excellence of treatment.

354 SOFT TISSUE PROFILE CHANGES AND PATIENT SATISFACTION WITH APPEARANCE AFTER SURGICAL-ORTHODONTIC TREATMENT

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AIM: To investigate the impact of soft tissue profile changes on satisfaction with appearance following surgical-orthodontic treatment.
SUBJECTS AND METHOD: Twenty-two patients (18 females, 4 males, mean age 34.4, range 19-59 years) with severe skeletal malocclusions. The patients underwent orthodontic treatment in combination with orthodontic surgery involving a sagittal ramus osteotomy and/or Le Fort I. Lateral cephalograms were taken before treatment (T0), within one week of surgery (T1) and one year after treatment (T2). The patients were asked to fill in a questionnaire concerning general and facial appearance using a 100 mm visual analogue scale (VAS) in the time points T0-T2. Angular and linear soft tissue measurements were undertaken on the cephalograms.
RESULTS: There was a significant difference in improvement of satisfaction with general appearance at T1 ($P = 0.021$) and with general and facial appearance at T2 ($P = 0.020$, $P = 0.003$, respectively). The greatest improvement in satisfaction was found for facial appearance between T0-T2, mean improvement being 27 mm on the VAS scale (SD 37.0). However, no significant difference was found for the correlation between soft tissue profile changes and satisfaction with appearance.
CONCLUSION: Improvement of satisfaction with appearance is explained by factors other than individual changes in soft tissue profile. Nonetheless, it is important that the majority of patients experienced the change in appearance as positive.

355 ORTHODONTIC RETENTION PATTERNS IN THE UNITED KINGDOM

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AIM: To determine whether retention patterns in the United Kingdom are influenced by operator gender, age or sphere of practice.
MATERIALS AND METHOD: A questionnaire was mailed to 301 orthodontists in private, national health service (NHS), hospital and community practices. Two hundred and forty orthodontists returned the questionnaires (80% response). The respondents were asked to report on their retention regimens for a hypothetical crowded Class II division 1 case in the one, or more, practice settings they worked in.
RESULTS: Most respondents (61%) worked in more than one practice setting. Vacuum retainers were the most commonly used type in NHS and hospital practice, while Hawley retainers were frequently used in community practice. Vacuum retainers were also most popular in private practice although often used in conjunction with bonded retainers in both arches, particularly the mandible.
RESULTS: Regression analysis revealed that there were no statistically significant associations between retainer preference and gender or age. However, trends were identified that suggested females were less likely to use bonded retainers in the maxilla than males, and older clinicians were more likely to use bonded retainers in the mandible than younger colleagues. Practice setting differences were found to be statistically significant ($P < 0.005$) with bonded retainers being more frequently used in private practice.

CONCLUSIONS: Vacuum retainers are popular in NHS, hospital and private practice. Bonded retainers are more commonly used in private practice than in other settings.

356 PAIN EXPERIENCE AFTER SEPARATION OF UPPER FIRST MOLARS IS GENDER DEPENDENT

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AIM: To determine the subjective pain level and the consumption of analgesics in young patients during a period of 12 hours after separation of the upper first molars.
SUBJECTS AND METHOD: One hundred Caucasian patients [50 females, 12-18 years, and 50 males 12-18 years ($P = 0.97$ Mann-Whitney test)] seeking orthodontic treatment. Elastic separators were placed mesially and distally for the upper first molars by one operator. The patients were asked to complete numerical rating scales (ranging from 0 to 10) 5 minutes pre-operatively, immediately after placement of the separators, and every hour for the next 12 hours. The patients were also asked to report the number and type of analgesics used during this observation period.
RESULTS: Both genders reported pain immediately after placement of the separators. The mean [standard deviation (SD)] pain for females just after placement of separators was 1.8 (1.4) and for males 1.6 (1.3). This numerical difference in reported pain experience was not statistically significant ($P = 0.50$ Mann-Whitney test) but remained throughout the study period. The maximum reported pain for females was 2.2 (2.0) at 9 hours, and for males 1.4 (1.5) at 9 hours after separation. The mean sum pain intensity (SD) for the whole observation period was 24.3 (20.4) for females and 16.5 (11.7) for males showing a statistically significant gender difference ($P = 0.02$ *t*-test). Six patients (2 females/4 males) used analgesics during the study period. These patients reported using analgesics only once. The drugs used were paracetamol 500 mg tablets (1 female/2 males) or ibuprofen 200 mg tablets (1 female/2 males).
CONCLUSIONS: An apparently limited subjective pain was reported by young patients after separator treatment. Only 6 per cent of the patients used analgesics for their pain experience.

357 FRONTAL CEPHALOMETRIC ANALYSIS IN PATIENTS WITH TRANSVERSE MALOCCLUSIONS

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AIM: Assessment of skeletal, alveolar and dental components for rapid palatal expansion on the supramaxilla in the transverse plane.
SUBJECTS AND METHOD: Twenty-four patients (9 males, 38.71%, 15 females, 61.29%), with a symmetric supramaxilla with narrowing in the mixed and permanent dentition, divided into groups with respect to age: below 13 years of age; 13 to 20 years of age, 21 to 30 years and 31-40 years. Measurement and assessment of several parameters were carried out on a frontal cephalogram. This was undertaken by comparison of supramaxilla breadth quantity parameters (JR-JL), correlation between the supramaxilla and nasal cavity dilatation, molar breadth (B6-B6), and first upper molar angulation measurement. During the initial period, the apparatus was activated two-quarter turns a day (0.25 mm = 1 revolution), until complete opening of the screw (8 mm). The appliance was then left *in situ* as a passive retainer for 2 to 3 months. For these assessments, the Onix Ceph system was used.
RESULTS: Skeletal: supramaxilla breadth (norm = 61.9 mm, SD: 2 mm), correlation between supramaxilla and nasal cavity dilatation (norm = 25 mm, SD: 2 mm). Dentoalveolar: there were changes in the location of the molars; molar breadth (norm = 58 mm, SD: 2 mm) and upper first molar angulation.
CONCLUSION: Frontal cephalometry is indispensable in the diagnosis and treatment planning phase.

358 ELECTROMYOGRAPHIC EVALUATION OF MUSCLE ACTIVITY IN PATIENTS WITH CLASS II MALOCCLUSIONS

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AIM: To evaluate the bilateral electromyographic (EMG) muscle activity of anterior temporal, masseter and anterior digastric muscles of patients with a Class II malocclusion wearing an activator appliance, at rest, and during maximal clenching and swallowing.
SUBJECTS AND METHOD: Twenty-six subjects with a Class II malocclusion treated with an activator appliance. An EMG device was used with bipolar surface electrodes to determine the activity values of the right and left muscles. The measurements were performed both with and without the appliance *in situ*. EMG records were obtained at the start of treatment (T1) and at 1 week (T2) and 1 (T3), 3 (T4) and 6 (T5) months after activator insertion.
RESULTS: There was a significant decrease in the activity values of the anterior, temporal and masseter muscles during maximal clenching at T2 and T3 without the appliance. The activity values of the same muscles then showed a significant

increase during maximal clenching at T4 and T5 without the appliance. The increased EMG activity can be attributed to neuromuscular adaptation. No significant difference was observed between the activity values of the muscles with or without the appliance during maximal clenching at T5, as a result of the skeletal response to the activator appliance. The activity values of the anterior digastric muscle at T1 showed a progressive and significant decrease at T5. The decreased EMG activity can be attributed to the reduction in overjet as a result of the activator treatment.
CONCLUSIONS: The findings reaffirm the importance of full-time wear of functional appliances to exert their maximum therapeutic effect by way of neuromuscular adaptation. The main force of treatment appears to be provided through increased active tension in the stretched muscles.

359 BILATERAL ELECTROMYOGRAPHIC ACTIVITY OF ANTERIOR TEMPORAL, MASSETER AND ANTERIOR DIGASTRIC MUSCLES
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AIM: To investigate bilateral electromyographic (EMG) activity of the anterior temporal, masseter and anterior digastric muscles of patients with a Class II malocclusion and individuals with a 'normal' occlusion, at rest and during maximal clenching and swallowing.
SUBJECTS AND METHOD: Twenty-six subjects with a Class II malocclusion treated with an activator appliance and 21 subjects with a normal occlusion. An EMG device was used with bipolar surface electrodes to determine the activity values of the right and left muscles. EMG records were obtained at the start of treatment (T1) and after 1 week (T2) and 1 (T3), 3 (T4) and 6 (T5) months of activator insertion in the subjects with Class II malocclusion, and once in those with a normal occlusion.
RESULTS: The anterior temporal muscle showed asymmetric activity at all time periods ($P < 0.01$), the masseter muscle showed asymmetric activity only at T3, and the anterior digastric muscle only at T2 ($P < 0.05$), at rest. No significant difference was observed between the activity values of the right and left muscles of the normal occlusion subjects at rest. The anterior temporal muscle showed asymmetric activity at T3, T4 and T5 ($P < 0,05$), and the masseter muscle asymmetric activity only at T5 ($P < 0.05$) during maximal clenching. In subjects with a normal occlusion, the anterior temporal muscle showed asymmetric activity ($P < 0.001$) during maximal clenching. The anterior digastric muscle showed asymmetric activity at T3 and T4 ($P < 0.05$) during swallowing, while the anterior temporal muscle showed bilateral asymmetric activity ($P < 0.01$) during swallowing in the normal occlusion subjects.
CONCLUSIONS: Significant asymmetric muscle activity is present in Class II malocclusion subjects and in individuals with a normal occlusion.

360 PROSPECTIVE STUDY OF ORAL HEALTH-RELATED QUALITY OF LIFE OF ORTHOGNATHIC SURGICALLY TREATED PATIENTS
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AIM: To assess quality of life issues
SUBJECTS AND METHOD: All patients in the age range of 18 to 50 years treated orthodontically and orthognathic surgically in the years 2005 to 2008. The sample included 48 females and 26 males. Within the framework of the quality of life questionnaire, the subjects first answered the OHIP-G14 (Oral Health Impact Profile - German version), an internationally acknowledged questionnaire for gathering oral health-related quality of life, in addition to a self-developed questionnaire particularly for patients with skeletal facial dysgnathia. In parallel, the sensitivities were tested according to Zerssen. The patients were investigated at the beginning of the combined treatment, before orthognathic surgery, and at the end of the treatment.
RESULTS: Normal sensitivities were found in 78.5 per cent of subject during the entire treatment period. No statistically significant correlation was found between the OHIP-G14 and the self-developed questionnaire. The OHIP-G14 does not represent a suitable instrument for gathering oral health-related quality of life of orthognathic surgically treated patients.
DISCUSSION: The quality of life improved in all but a few patients.

361 UPPER BONDED RETAINERS: SURVIVAL RATE, FAILURE TYPES AND INFLUENCING FACTORS
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AIMS: To analyse the frequency and type of failures of upper bonded retainers (UBR), as well possible factors influencing the survival rate.
SUBJECTS AND METHOD: All orthodontic patients finishing their active fixed appliance treatment between 1995 and 2006 were analyzed retrospectively. Four hundred and sixty six patients (286 males, 180 females) had been retained with an UBR. The mean age at the time of retainer bonding was 17.5 years. The failure types (loss, detachment, fracture), their sites, and time points occurring during the entire retention period were retrieved from the patients' records.

RESULTS: The majority of the patients (69%) received bonded canine-to-canine retainers (3-3), while the remaining patients had other retainer types (2-2, 1-1). Of the retainers, 14.4 per cent were completely lost during the retention phase; the highest loss rate (37.1%) was found for 1-1 retainers. Detachments of single bonded sites were found in 37.9 per cent of the patients. On average, detachments occurred in 18.9 per cent of the bonding sites. The lowest detachment rate was found for 1-1 retainers, while the other retainer types showed detachment rates close to the mean. Twelve per cent of the UBR fractured at different sites, the highest fracture rate was found for 3-3 retainers. Kaplan-Meier analysis revealed a survival rate of 70 per cent for all UBR after 1 year. Neither different morphological characteristics of the malocclusions nor co-operation or oral hygiene seemed to significantly influence the survival rate. However, the UBR 1 year survival rate was found to be significantly ($P < 0.001$) higher in patients treated by a certified orthodontist (83%) than in those treated by postgraduate students (62%). A clear learning curve was detectable.
CONCLUSIONS: The most frequent defect of UBR is single bonding site detachment occurring in almost 38 per cent of the patients. More retainer defects must be expected when treatments is performed by less experienced practitioners.

362 PATIENTS' SATISFACTION AFTER ORTHOGNATHIC CLASS II SURGERY

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AIM: Quality of life is a multidimensional concept of which oral health is an integral part. Accordingly, the subjective oral health perception of patients is gaining increasing importance. In the present study adult Class II patients' satisfaction after combined orthodontic-orthognathic surgical treatment was evaluated.
MATERIALS AND METHOD: A 93-item questionnaire was sent to 30 consecutive Class II patients (6 males, 24 females), operated on at least one year previously by one single surgeon using either surgical mandibular advancement or bimaxillary surgery. The age of the patients was between 19 and 52 years. The questionnaire comprised five topics: (1) orthognathic surgery satisfaction, (2) orthodontic satisfaction, (3) perception of occlusion and function, (4) facial image, and (5) general problems. Each topic was divided into several subscales. The patient had to mark his/her level of satisfaction on a scale from 1 to 6 (1 = dissatisfied, 3. 5 = neutral, 6 = satisfied).
RESULTS: The questionnaire was derived from the English language (forward-backward process). The German version proved to be reliable (mean Cronbach's alpha: 0.89) to be used as a measure of patient perceptions after orthognathic surgery. The questionnaire return rate was 63 per cent. The patients tended to be satisfied with their post-operative improvement in interpersonal relations (mean score 4.2). They also perceived their occlusal function as being better compared with the pre-treatment situation (mean score 4.5). With respect to the function of the temporomandibular joint, the patients reported neither positive nor negative changes after combined orthodontic-orthognathic surgery treatment.
CONCLUSIONS: On average, combined orthodontic-orthognathic surgery treatment results in a perceived improvement of interpersonal relations and occlusal function.

363 ENDOTHELINS INCREASE BONE RESORPTION AND FORMATION VIA ETA RECEPTOR IN EXPERIMENTAL TOOTH MOVEMENT IN RATS

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AIM: Orthodontic tooth movement (OTM) comprises three phases – initial, lag and late. During the late phase intense bone resorption on the pressure side and bone formation on the tension side are present. The aim of this investigation was to study the involvement of endothelins via ETA receptor in the bone modelling processes.
MATERIALS AND METHOD: Male Wistar rats (n = 80) divided into three groups: control group (n = 8) without an appliance, and two appliance groups, in which a superelastic closed coil spring was positioned between the left first maxillary molar and the incisors. The rats were treated daily with either TBC3214 (n = 36; TBC3214 group) or with saline (n = 36; appliance only group). TBC3214 is a highly selective antagonist on ETA receptors. The distance between the teeth was measured on days 0 and 42. On days 0, 14, 28 and 42 seven animals in the TBC3214 and the appliance only group were sacrificed and tissue samples were taken. Gene expression levels of cathepsin K, a marker for bone resorption, and osteocalcin, a marker for bone formation, were assessed by means of relative real-time polymerase chain reaction. Eight animals of each group were sacrificed on day 42 and tissue samples were prepared for histological analysis. Osteoblast and osteoclast volume were determined histomorphometrically.
RESULTS: The gene expression level of cathepsin K and osteocalcin were significantly down-regulated on day 42 in the TBC3214 group compared with the appliance only group ($P < 0.05$ and $P < 0.001$, respectively). Osteoclast volume was significantly lower in the TBC3214 group compared with the appliance only group on day 42 of force application ($P < 0.05$).

CONCLUSION: These data suggest that endothelins increase bone resorption and formation via ETA in the late stage of OTM.

364 ET-1, ET-2 AND ET-3 EXPRESSION LEVELS VARY DURING ORTHODONTIC TOOTH MOVEMENT IN RATS

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AIM: Endothelin-1, -2 and -3 (ET-1, ET-2, ET-3) are one group of cytokines released during orthodontic tooth movement (OTM). Therefore their gene expression levels in all three phases of OTM were determined.
MATERIALS AND METHOD: Male Wistar rats (n = 32) divided into four groups (n = 8): a control and a 14, 28 and 42 day group. A closed coil spring was inserted between the upper left first molar and the upper incisors in the last three groups. The distance between the teeth was measured on days 0, 2, 7, 14, 21, 28, 35 and 42 and the rate of tooth movement was calculated. The animals were sacrificed on days 14, 28 and 42 and the gene expression levels of ET-1, ET-2 and ET-3 were determined using real-time polymerase chain reaction.
RESULTS: The distance between the teeth decreased in all appliance groups ($P < 0.001$). The rate of tooth movement was 0.20 ± 0.02, 0.03 ± 0.01 and 0.06 ± 0.02 mm/day between days 0-2, 3-21 and 22-42, respectively. On day 14 gene expression levels for ET-1 ($P < 0.05$) and ET-3 ($P < 0.001$) increased compared with day 0. On day 28 a down-regulation of ET-3 was observed when compared with day 0 ($P < 0.001$). On day 42 ET-1 ($P < 0.001$) and ET-3 ($P < 0.01$) gene expression levels were strongly upregulated, while the ET-2 gene expression level was downregulated ($P < 0.01$) when compared with day 0.
CONCLUSION: The pattern of gene expression of ET-1, ET-2 and ET-3 during all three phases of OTM suggests that ET-1 and ET-3 are the predominant endothelin isopeptides in the late phase of OTM.

365 ANALYSIS OF TONGUE POSITION IN DIFFERENT TYPES OF MALOCCLUSION

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AIM: Modern radiographic techniques make intraoral soft tissue evaluation possible. As the tongue is considered a stimulating factor in lower jaw growth, the aim of this study was to test if there are differences in tongue position in different types of malocclusion.
MATERIALS AND METHOD: Tongue position was measured on lateral cephalograms of 104 Class I, 158 Class II, and 60 Class III subjects prior to therapy. Cephalometric measurements were obtained of hard (mandible, maxilla, hyoid bone) and soft tissue (pharynx, velum, tongue) structures. The posterior position of the tongue was defined by measuring three different distances from velum to tongue base. The inclination of the velum was measured relative to the maxillary base line. Seventeen parameters for topographical determination of tongue position were analysed. Mann-Whitney tests were used for statistical analysis.
RESULTS: The distance between the tongue base and velum was statistically significantly different between the various types of malocclusion. Class II patients showed the closest contacts between the tongue and velum. Class III patients had the most anterior tongue position and the velum was more inclined. The hyoid bone was placed more posteriorly in Class II patients. No correlations were found for the distance between the base of the tongue and the velum and different types of growth pattern. Only hyoid bone position was found to be statistically significantly different in subjects with different growth patterns.
CONCLUSIONS: An objective assessment of tongue position from lateral cephalograms is only possible in the posterior region of the tongue. Differences in the antero-posterior position of the tongue in different malocclusion types might explain the reduced sagittal development of the lower jaw in Class II subjects and the stimulated sagittal growth of the lower jaw in Class III patients. Therefore orthodontic influence on the soft tissue structures is best undertaken during the early stages of dental development.

366 IMPACT OF MANDIBULAR ASYMMETRY ON DENTAL ASYMMETRY

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AIMS: To assess the impact of mandibular asymmetry on dental asymmetry in a group of young adult males with a Class III malocclusion. The hypothesis was (1) that mandibular asymmetry is more severe in subjects with a pronounced skeletal Class III relationship and (2) that dental asymmetry increases with increasing mandibular asymmetry.

MATERIALS AND METHOD: The records of 54 subjects presenting a Class III or signs of a Class III malocclusion. Variables describing skeletal Class III (ANB, Wits, ArPog, GoPog, ANS-PNS) were measured on lateral cephalograms. Mandibular asymmetry was evaluated on dental pantomograms by calculating the right-left difference of condylar and ramus heights. Sagittal and transverse dental asymmetry was assessed on dental casts by measuring the right-left difference of the canine and molar relationship, anterior crossbite, posterior crossbite and midline deviation.
RESULTS: No correlation was found between the severity of a skeletal Class III malocclusion and mandibular asymmetry. Condylar asymmetry due to lengthening of the condyle on one side was related to an asymmetric aggravation of Class III on the ipsilateral side ($r = –0.53$ and $r = –0.61$, $P < 0.001$ for canine and molar relationship). In contrast, the presence of ramus asymmetry was related to contralateral aggravation of the Class III ($r = 0.27$ and $r = 0.29$, $P < 0.05$). No significant correlation was found between asymmetry in total height of the condyle and ramus and asymmetry in canine and molar relationship, but a correlation existed with asymmetry in anterior and posterior crossbite ($r = 0.34$ and $r = 0.30$, $P < 0.05$).
CONCLUSION: Mandibular asymmetry induces dental asymmetry, especially in the sagittal plane. Condylar asymmetry was the most important factor, explaining 28 and 37 per cent of variance in canine and molar asymmetry, respectively. Ramus asymmetry seems to compensate for the impact of condylar asymmetry on the occlusion.

367 THE USE OF FACIAL ANALYSIS IN ORTHOGNATHIC SURGERY AESTHETIC OUTCOME EVALUATION

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AIM: One of the main reasons for combined orthodontic-surgical treatment is to overcome psychosocial difficulties relating to facial and dental appearance. Unfortunately, aesthetics is not measurable and beauty is in the eye of the beholder. However, distorted and asymmetric facial features are major contributors to facial disharmony and therefore facial aesthetics is usually related to golden proportions apparent in the ideal human face. The aim of this study was to evaluate the effect of combined orthodontic-surgical treatment on facial aesthetics by analyzing frontal and lateral photographs.
SUBJECTS AND METHOD: Fifteen patients (11 females, 4 males) with vertical and sagittal jaw discrepancies. Frontal and lateral pre- and post-operative photographs were analyzed using standard methods for photographic and soft tissue analysis. Eight parameters were measured on the frontal (total face height, upper, mid and lower face height, stomion position in the lower face, N-Gn, upper and lower lip vermilion) and seven on the lateral (nasolabial angle, soft tissue facial angle, total face height, upper, mid and lower face height, St position in the lower face) photographs. The pre- and post-operative measurements were compared, and each group was compared with standard values.
RESULTS: Statistically significant differences were found between the pre-operative and standard values for nasolabial angle, but there was no statistically significant difference between post-operative and standard values. For the lower face, measured on both frontal and lateral views, statistically significant differences were found between pre- and post-operative St position, as well as between pre-operative and standard values, whereas no statistically significant difference was found between post-operative and standard values.
CONCLUSION: The facial appearance improved.

368 WHICH DENTAL STUDENTS CHOOSE TO SPECIALIZE IN ORTHODONTICS?

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AIM: To determine dental students' interests in pursuing orthodontic specialty training and to evaluate if previous experience of having undergone orthodontic treatment plays a role in the decision making process.
MATERIALS AND METHOD: During the 2007–2008 academic year, an online questionnaire was sent to dental students attending the University of Manitoba. The survey was sent electronically to all full time dental students' emails, with reminders automatically sent every 7 days for 1 month. The survey comprised a total of 33 questions. Answers were based on a 5-point Likert scale using the QuestionPro program. To ensure confidentiality, no names or emails were traceable.
RESULTS: Of the total 115 surveys sent, 88 students responded, giving a response rate of 77 per cent. Approximately 19 per cent of dental students had at some point during their dental school experience hoped to gain admittance into an orthodontic specialty programme. Of this group of students, the vast majority (78%) had received orthodontic treatment prior to dental school. Furthermore, 50 per cent of these students had a parent, relative, or close family friend who was an orthodontist. Respondents felt overwhelmingly that their orthodontist's environment was a positive one (1.812 Likert scale; 1-very much so 5-not at all) and 64 per cent stated that the orthodontic office environment where they were treated played a key role in their decision to pursue orthodontics. An average Likert scale value of 2.000 was recorded for respondents being pleased with the outcome of their orthodontic treatment.

CONCLUSIONS: Large numbers of dental students wish to specialize in orthodontics making orthodontics one of the most popular specialty areas. Positive personal experiences in having previously been an orthodontic patient, as well as exposure to the orthodontic specialty through family members and friends with close ties to the specialty, are strong career choice motivational factors.

369 DIRECTION OF FACIAL GROWTH IN PATIENTS WITH A CLASS III MALOCCLUSION

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AIM: To identify the direction of facial growth in patients with a Class III malocclusion by analysis of profile cephalograms.
MATERIALS AND METHOD: Fifty profile cephalograms of patients with a Class III malocclusion (18 males, 32 females) aged 15–25 years. Linear and angular parameters were analyzed using the methods of Björk and Jarabak.
RESULTS: A harmonious direction of facial growth was present in both genders, but distribution of individual values indicated that posterior face growth was present in the same percentage in both genders (56%). An anterior direction of face growth was present in 44 per cent of males and 33 per cent of females. An interesting finding was that 11 per cent of males had a harmonious direction of facial growth. Gonial angle was significantly larger in both genders, while other angles of Björk's polygon did not show significant differences, except for the cranial base angle, which was significantly smaller in females. Anterior face height was significantly larger in males, while posterior face height did not differ significantly between genders.
CONCLUSIONS: The direction of facial growth is of importance in diagnosis and therapy planning for patients with a Class III malocclusion.

370 USE OF MINI-IMPLANT SUPPORTED ABUTMENTS FOR ORTHODONTIC ANCHORAGE: 1-YEAR CLINICAL OUTCOMES

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AIMS: To retrospectively evaluate the potential factors related to clinical failure of an orthodontic mini-implant system using detachable abutments during orthodontic treatment.
MATERIALS AND METHOD: One hundred and eighteen mini-implants (Benefit, Mondeal, Tuttlingen, Germany) were inserted in the mandible and maxilla of 65 patients (male = 24; female = 41) without flap reflection. The average age of patients was 20.6 ± 10.4 years (minimum = 8; maximum = 58 years). After one week the patients were recalled to receive their implant-borne orthodontic appliances, and from then on every other 4 weeks when the status of the mini-implants was evaluated. The implants were regarded as failed when they were unable to resist the orthodontic forces. Logistic regression analysis was used to investigate the potential factors that influenced the clinical failure rates of the orthodontic mini-implants.
RESULTS: The overall failure rate was 14 per cent (n = 17) during the 1-year of orthodontic treatment. There were no significant differences in failure rates among the mini-implants for the following variables: age, use of pre-drill procedure, direct /indirect anchorage, number of supporting implants (1 versus 2), and peri-implant soft tissue inflammation ($P > 0.05$). The mini-implants with a thread diameter of 2 mm and a thread length of 11 mm showed lower failure rates than those with a 1.5 mm diameter and 7 mm length ($P < 0.05$). A significantly lower failure rate was noted when the mini-implants were placed in the anterior mid-palatal region and/or loaded with continuous orthodontic forces ($P < 0.05$).
CONCLUSIONS: Single mini-implant supported anchorage provides sufficient resistance to orthodontic loading. The use of fixed-detachable abutments helps to control the status of peri-implant soft tissue inflammation.

371 AESTHETICALLY ACCEPTABLE OCCLUSION – ADEQUACY OF THE CRITERION

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AIMS: The Occlusal Morphology and Function Index has been developed for clinical assessment of occlusal acceptability in the permanent dentition. It includes six morphological and four functional criteria. Recently, it has been complemented with a criterion for acceptable dental appearance. The aim of this study was to test the adequacy of the suggested cut off value, grade 3 in the Aesthetic Component (AC) of the Index of Orthodontic Treatment Need (IOTN).
SUBJECTS AND METHOD: The sample comprised 1,109, 14–18-year-old adolescents (mean age 16.3 years). Two calibrated specialist orthodontists assessed the acceptability of dental appearance with the AC of the IOTN. Each participant also filled in a semi-structured questionnaire and scored his/her dental appearance on a visual analogue type 10-grade scale

(VAS). Associations between the AC grades/self-assessment grades and satisfaction with own dental appearance were analyzed using logistic regression. Receiver operating characteristic (ROC) curves were used to determine the cut off values closest to the top left corner on the AC scale/VAS for acceptable dental appearance.
RESULTS: On the applied AC and the VAS type 10-grade scale, grades 1 and 2 fulfilled the criterion for acceptable dental aesthetics. On both scales, the cut off value was found to be grade 3. The areas under the ROC curve were 0.712 (AC scale) and 0.789 (VAS).
CONCLUSIONS: The cut-off set for acceptable dental appearance (the AC grade 3) was identical to the cut-off values found in this study.

372 ASSESSMENT OF SMILE AESTHETICS AS AN ELEMENT OF ORTHODONTIC TREATMENT PLANNING
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AIMS: To define features of an aesthetic smile and to assess the influence of particular smile parameters on patients' subjective feelings.
SUBJECTS AND METHOD: Thirty-five patients with full permanent dentitions aged from 20 to 28 years. Colour, frontal photographs were taken from a distance of 30 cm with a digital camera (Nikon D100 with Nikkor 60/2, 8 lens) during spontaneous smiling. The smile parameters were chosen on the basis the studies of Kokich, and the following were judged: the coincidence of the upper dental arch midline to the facial midline, the angulation of the maxillary incisors, the incisal plane, the gummy smile and the extent to which the upper lip covered the upper incisors. Based on the existence of one of the studied parameters, six patients were classified for further research. In order to determine the threshold of perception of the studied features, surveys were carried out among 40 dentists, 33 students from the Academy of Fine Arts and 29 laypeople. Respondents used a 5-grade scale to assess the photographs with each smile parameter modified by a computer program. Below grade 3 was considered as unaesthetic
RESULTS: Among the respondents, dentists were the most sensitive to aesthetics. This group noticed a midline deviation of 3 mm and above. All groups noted incorrect angulation of the upper incisors of over 1 mm; however only dentists paid attention to an oblique incisal plane of over 2 mm. A gummy smile of more than 2 mm was considered unaesthetic by all respondents. The covering of the upper incisors of over 2 mm was observed by dentists and art students, and of over 4 mm by laypeople.
CONCLUSIONS: Orthodontic treatment may be undertaken for aesthetic reasons. The parameters analysed in this study can be employed while planning orthodontic treatment.

373 NUMERICAL ANALYSIS OF MECHANICAL STRESS IN ROOT APICES INDUCED BY ORTHODONTIC FORCES
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AIM: Finite element (FE) methods have been widely used in orthodontics in order to evaluate biomechanical behaviour during orthodontic treatment. The aim of this study was to evaluate the stress distribution in root apices after the application of orthodontic forces.
MATERIAL AND METHOD: A three-dimensional model of an upper central incisor and surrounding tissues was generated based on standard anatomical data. The material characteristics were taken from previous studies. The numerical model consisted from 2487 nodes and 3468 solid isoparametric elements. FE analysis was performed using COSMOSM 2.5 software. Horizontal and vertical forces were applied on different points from the labial side of the tooth. Biomechanical parameters (stress and strain values) were evaluated at the apex of the root.
RESULTS: The highest stress concentrations were found after application of intrusive forces. Apical stress was higher after application of vertical loads and lower after the use of forces.

374 EFFECT OF BRACKET POSITIONING ON BIOMECHANICAL PARAMETERS DURING ORTHODONTIC TREATMENT
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AIM: Numerical investigations can predict the response of the dentoalveolar tissues to orthodontic loads in a number of situations. The objective of this study was to evaluate the effect of varying the bracket position on the biomechanical parameters of orthodontic movement.

MATERIALS AND METHOD: The numerical model of an upper central incisor together with the surrounding tissues was constructed using the finite element method. Orthodontic forces of different intensities were applied on the labial surface of the crown. The application points were central and also 1.3 mm mesial and distal to the axis of the tooth in the transverse direction. The height of the application point also varied from the incisal to the cervical area. Initial stress values and distribution were recorded and the results were statistically analyzed.
RESULTS: The distribution and quantity of stress showed important variations after changing the height of the point of application. The more it approached the incisal area, the higher the stress values. The variation of application point in a mesial and distal direction showed fewer effects on initial stress distribution.
CONCLUSIONS: A very small error in bracket positioning can result in unwanted movements and stress concentrations. Therefore, the accurate positioning of orthodontic brackets is important in achieving the desired treatment result.

375 FACIAL AESTHETICS FOLLOWING COMBINED SURGICAL-ORTHODONTIC TREATMENT

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AIM: The aesthetics of the face may be assessed in macro-, micro- and mini-aesthetic aspects. Upper incisor exposure with the lips relaxed and during smiling (mini-aesthetic) is important. The aim of this study was to analyse the mini-aesthetics of patients with a skeletal Class III malocclusion before and after combined surgical-orthodontic treatment.
SUBJECTS AND METHOD: Thirty patients (19 females, 11 males, average age 23 years) treated according to a surgical-orthodontic treatment protocol (pre-surgical orthodontic treatment; surgery; retention of orthodontic treatment). Before treatment (T1) and 12 months after surgery (T2) incisor exposure with the lips relaxed (the same lip position as during the pronunciation of the word 'Emma') and the aesthetics of the smile (the line of age of the upper incisors to the lower lip line, exposure of the last upper premolars, symmetry and 'dark corner' of the smile) were analysed. Clinical examination and photographic documentation (using a Nikon digital camera – Coolpix 8700) was undertaken. The results were statistically analysed using a chi square test.
RESULTS: There was a statistical increase in the number of patients with upper incisor exposure between 3–4 mm with the lips relaxed at T2 (T1: 4 patients, T2: 22 patients; $P = 0.000$). At T2 the line of age of the upper incisor and the lower lip line during smiling were parallel to each other (T1: 2 patients, T2: 30 patients, $P = 0.000$); a symmetrical smile was observed (T1: 12 patients, T2: 28 patients, $P = 0.000$); the upper premolars were more exposed ((T1: 5 patients, T2: 27 patients, $P = 0.000$); the dark corner was observed to a lesser extent (T1: 29 patients, T2: 5 patients, $P = 0.000$).
CONCLUSIONS: Combined surgical-orthodontic treatment is effective in improving aesthetics. Mini-aesthetics is the key measurement when planning surgical changes.

376 RELATIONSHIP BETWEEN BUCCOLINGUAL POSITION AND MOLAR ANGLE AND INTRAORAL PRESSURE IN SUBJECTS WITH FACIAL ASYMMETRY

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AIM: Previous studies have suggested that an imbalance in buccolingual pressure may play a role in dental compensation of the molars and asymmetry in the dental arch of the mandible in subjects with facial asymmetry. However, it is still unclear whether buccolingual pressure is associated with this phenomenon. Thus, the purpose of this study was to test the hypothesis that cheek pressure on the shifted side (SS) was greater than that on the non-shifted side (nSS), while tongue pressure on the SS was less than that on the nSS in FA subjects.
SUBJECTS AND METHOD: Twelve adult facial asymmetry subjects with a unilateral posterior crossbite. The resting buccolingual pressure on the bilateral mandibular first molars was simultaneously measured using four miniature pressure sensors embedded in a thin plastic plate. In addition, a posteroanterior cephalometric radiograph was taken in the intercuspal position to determine the buccolingual positions (Kecik *et al*., 2007; L6-FP and L6-M) and the inclination of the mandibular first molars (L6inc). Wilcoxon's *t*-, Kruskal-Wallis H and Mann-Whitney U-tests together with Spearman's correlation by rank were used for statistical evaluation ($P < 0.05$).
RESULTS: Cheek pressure (Cpres) on the SS was significantly greater than that on the nSS, while tongue pressure (Tpres) on the SS was significantly less than that on the nSS. On the other hand, the Tpres/Cpres ratio on the SS was significantly smaller than that on the nSS. Regardless of the side, there were significant negative correlations between L6-FP and Cpres, and significant positive correlations between L6-FP and the Tpres/Cpres ratio. Moreover, there were significant negative correlations between the Tpres/Cpres ratio and L6inc on both the SS and nSS.
CONCLUSIONS: The findings support the hypothesis. The imbalance in buccolingual pressure in facial asymmetry subjects appears to be related to dental compensation of the molars and asymmetry in the mandibular arch.

377 eNOS AND iNOS EXPRESSION IN RAT OSTEOCYTES INDUCED BY ORTHODONTIC FORCE APPLICATION

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AIM: Osteocytes are mechanosensitive cells, which are posited to play a key role in bone remodelling after mechanical loading during orthodontic tooth movement. Nitric oxide (NO) is an important regulator of bone remodelling, and is rapidly increased in response to mechanical stress by bone cells. NO is produced by osteocytes through the activity of constitutive endothelial nitric oxide synthase (eNOS) or inducible nitric oxide synthase (iNOS). It was hypothesized that these enzymes mediate the tissue response to orthodontic force, and therefore eNOS and iNOS expression in osteocytes during orthodontic force application was investigated.
MATERIALS AND METHOD: Forty 6-week-old male Wistar rats randomly assigned to eight groups. In each rat, the upper three molars at one side were moved mesially by NiTi coil springs with a force of 10 cN, and the contralateral side served as control. The force was applied for 6, 12, 24, 36, 48, 72, 96, or 120 hours. Serial parasagittal 5 µm paraffin sections were prepared and selected sections were immunohistochemically stained for eNOS or iNOS. Positive osteocytes in predefined mesial (compression) and distal (tension) areas of the alveolar bone were counted. The data were statistically analyzed by one-way ANOVA and subsequent Tukey's multiple comparisons tests.
RESULTS: Immunohistochemical staining revealed that in the tension area, the number of eNOS-positive osteocytes increased from 24 hours on, while the number of iNOS-positive osteocytes remained largely constant throughout the experimental period. In the compression area, iNOS positive osteocytes had already increased after 6 hours, while eNOS positive osteocytes increased after 24 and 48 hours, and returned to baseline levels thereafter.
CONCLUSION: eNOS mediates bone formation in the tension area, while iNOS mediates inflammation-induced bone resorption in the compression area. Both eNOS and iNOS seem to regulate bone remodelling during orthodontic force application.

378 A RADIOGRAPHIC STUDY OF THE STAGES OF THIRD MOLAR DEVELOPMENT ACCORDING TO DEMIRJIAN'S CLASSIFICATION

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AIM: To determine the presence of third molars on panoramic radiographs and the stages of development according to the classification of Demirjian.
MATERIAL AND METHOD: One hundred and twenty four panoramic radiographs of 69 female and 55 male Brazilian patients aged 8 to 11 years 11 months.
RESULTS: At 8 years of age, 83 per cent of patients had not reached the stage of calcification, while 17 per cent were classified as stage D or 4 (a crown without fully calcified formation of the root). For children aged 9, 10 and 11 years of age, 39.5, 32 and 27.5 per cent, respectively, did not present or had not reached the stage of classification, while 60.5, 68 and 72.5 per cent, respectively, were classified in stages 4 or D.
CONCLUSION: According to Demirjian's classification of stages of development and calcification, the ideal age for observation of third molars on panoramic radiographs is 9 years, as calcification of the crown was visible in more than half of the subjects analysed in this study.

379 DENTAL MATURATION ASSESSMENT USING NOLLA'S TECHNIQUE ON A GROUP OF EGYPTIAN CHILDREN

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AIM: To assess the maturation of the permanent dentition using Nolla's technique.
MATERIALS AND METHOD: Panoramic radiographs of 384 male and female Egyptian children aged 6 to 15 years. The data was used to plot dental maturation curves for Egyptian boys and girls
RESULTS: There was significant sexual dimorphism in dental development of Egyptian children from the youngest age group (6 years) up to the oldest age group (13–15 years). The lower teeth were found to be advanced with respect to the upper teeth in all age groups. The results for maxillary and mandibular teeth, including or excluding the third molars gave similar results.
CONCLUSIONS: The norms of dental maturation for Egyptian children derived from this study facilitate the way that clinicians assess growing children during diagnosis and treatment planning.

380 CEPHALOMETRIC ASSESSMENT OF SAGITTAL RELATIONSHIPS BETWEEN THE MAXILLA AND MANDIBLE AMONG EGYPTIAN CHILDREN

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AIMS: To provide a reliable parameter for assessment of sagittal jaw relationship.
MATERIALS AND METHOD: One hundred and fifty five lateral cephalometric radiographs of Egyptian children (99 boys, 56 girls), with a mean age of 10.5 ± 1.39 years. Six linear and nine angular measurements were derived from 19 reference landmarks.
RESULTS: No gender or age differences were detected for any parameters except a larger S-N distance in boys (6.77 versus 6.55 mm). The most homogenous parameters were A-B distance followed by AS-BS, ANB, AF-BF, AP-BP (CV = 15.80; 46.81; 54.83; 57.20 and 72.40, respectively). The least homogenous parameter was AO-BO distance (CV = 84.74). Significant positive correlations were found between the linear parameters (sagittal and vertical), between sagittal parameters and the angles formed by the inclination of A-B plane with the studied sagittal planes, and between the sagittal parameters and the facial divergence angles. Significant negative correlations between the sagittal parameters and the facial contour angle ($P < 0.05$ and $P < 0.001$, respectively) were also found.
CONCLUSIONS: Sagittal parameters (AS-BS, AF-BF, AP-BP, and AO-BO) could be used instead of ANB angle, particularly when identification of nasion is difficult. No single parameter or one approach can be used to provide an accurate picture of the jaw relationship.

381 SHEAR BOND STRENGTHS OF DIFFERENT ADHESIVE SYSTEMS FOR BONDING ORTHODONTIC BRACKETS TO PORCELAIN SURFACES

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AIM: To evaluate the effects of five different adhesive systems on the shear bond strengths (SBS) of orthodontic brackets bonded to porcelain surfaces.
MATERIALS AND METHOD: Fifty porcelain cylindrical disks were prepared and randomly divided into five equal groups. The orthodontic brackets were bonded to the porcelain using five different adhesive systems: (I) etching with 9.6 per cent hydrofluoric acid, (II) etching with 37 per cent phosphoric acid followed by silane, (III) etching with 9.6 per cent hydrofluoric acid followed by silane, (IV) etching with 37 per cent phosphoric acid followed by silane and (V) etching with 9.6 per cent hydrofluoric acid followed by silane. Specimens in groups I, II, III were bonded with System1+™ and those in groups IV and V with Superbond C&B. All specimens were stored in distilled water at 37°C for 24 hours and then subjected to thermocycling between 5 ± 2° and 55 ± 2°C for 1000 cycles. The SBS were then tested using an Instron testing machine at a crosshead speed of 0.5 mm/minute. All data were analyzed using an analysis of variance.
RESULTS: The highest mean SBS were in group IV and were significantly different ($P < 0.05$) from those in group I. There was no significant difference between the bond strengths in group IV and groups II, III and V. Group IV had the highest SBS when bonding orthodontic brackets to porcelain surfaces.

382 PATIENT-CENTRED EVALUATION OF ORTHODONTIC TREATMENT IN NORWAY

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AIMS: To examine the provision of orthodontic services in a patient-centred perspective. The objectives were to analyze the initiative to have treatment, the reason for treatment, waiting lists and waiting time, treatment time and cost, satisfaction with information and service, satisfaction with orthodontic treatment and outcome.
MATERIALS AND METHOD: The information was collected using a self-report questionnaire, which was divided into two main parts. The first part concerning malocclusion and treatment was answered by the orthodontist, and second part about experience and satisfaction by the patient/parents. The survey was anonymous. One hundred and sixty six Norwegian orthodontists received five sets of questionnaires which they distributed consecutively to their patients after having filled in the first part.
RESULTS: Responses were obtained from a total of 238 (29%) individual patients (41% male, 59% female). Most patients were between 9 and 16 years of age at the start of treatment. Ninety-six per cent of individuals were assessed to have a great or obvious need of treatment. Improvement in appearance was the most important motivation for treatment for 71 per cent of the respondents. The most frequently reported reason for entering into treatment was that the orthodontist thought it necessary. Seventy per cent had been on a waiting list for less than six months before the start of treatment. The percentage of subjects who were totally satisfied with the results was 84.5 per cent, and 81 per cent would choose to have treatment today if they had to make the decision again. The cost of treatment was considered to be high by most respondents.

CONCLUSIONS: Improvement in aesthetics is the main motive to have orthodontic treatment. Dental professionals' advice had the greatest influence on the patient's decision to enter treatment. Most patients were satisfied with the information they had received and the provision of care. In general, a high degree of satisfaction with the care provided was reported and most of the patients would choose treatment again.

383 THREE-DIMENSIONAL DIGITAL CAST ANALYSIS OF UNILATERAL CLEFT LIP AND PALATE SUBJECTS

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AIM: In order to fully appreciate the three-dimensional (3D) growth pattern of cleft lip and palate (CLP) the traditional two-dimensional analysis is often inadequate. The aim of this study was to develop a computer generated 3D cast analysis.
MATERIALS AND METHOD: Thirty-nine cast series of the upper jaws (taken in the first post natal week and in the 3rd, 6th and 12th month of life) of infants with complete (n = 22) or partial (n = 17) unilateral CLP were digitized with a high-resolution 3D scanner and visualised with 3D imaging software (Digimodel®, OrthoProof, Nieuwegein, Netherlands). Various pre-defined landmarks on the surface were then identified and the distances between these points and angular measurements calculated. In addition, the 3D computer generated model surfaces, taken at different ages, were superimposed. Morphological differences were evaluated.
RESULTS: The user-friendly software interface allowed reproducible identification of all pre-defined landmarks and simultaneous 3D measurement of all defined parameters. The measurement values showed statistically significant morphometric differences between the two patient groups. The reduction in cleft palate width was significantly greater in patients with complete CLP in the first year. Alveolar ridge length increased significantly in both groups. In the first year sagittal growth was considerably higher in patients with complete CLP by approximately 50 per cent when compared with those with a partial unilateral CLP.
CONCLUSIONS: The newly developed 3D analysis demonstrated that patients with complete unilateral CLP had significantly higher sagittal growth when compared with their peers with partial CLP. Analysis of the computer generated 3D surfaces allowed detailed evaluation of the different growth patterns in infants with complete and partial unilateral CLP.

384 ELEMENTS OF PRE-NATAL DEVELOPMENT OF THE CEPHALIC EXTREMITY

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AIM: To investigate the facial growth phenomenon that starts from month IV of intra-uterline life.
SUBJECTS AND METHOD: Twenty embryos from months II and III and 40 foetuses. Thirteen were sectioned medio-sagitally for radiographic cephalometric investigation. Two embryos (month III) and 10 foetuses (months IV–IX) were selected. Month II embryos showed no ossification points, thus being inconclusive for radiographic analysis. Ten linear sagittal and vertical parameters of the cranium base and of the facial parameters (S-N, S-Ba, NSa-NSp, Go-Gn, N-Nsa, NSa-Gn, N-NSa-Gn, S-NSp, NSp-Go, Kdl-Go) and six angular parameters (N-S-Ba, S-N-NSa, N-S-NSp, N-NSa-Gn, S-NSp-Go, Kdl) were measured from which the average values for each age group were calculated. The superimposed radiographs were centred on the N-S plane at point S to show the initiation of the growth pattern.
RESULTS: Progressive growth of the length of the anterior segment of the cranium base exists compared with the posterior cranium for all investigated periods until the last month of foetal life. The height of the inferior face had a uniform growth rate from the month III to birth. The highest embryo-foetal growth rate was until months IV–V, which was greater than in any other period of life. The sphenoid angle significantly decreased until birth and subsequently continued to do so.

385 CRANIOFACIAL GROWTH DISTURBANCES IN TURNER SYNDROME SUBJECTS

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INTRODUCTION: Turner syndrome is part of the gonadic dysgenesis group; it predominantly affects females, but also males with a reduced frequency. The syndrome is due to the lack of one of the sexual chromosomes (44A +XO) or to a morphologically modified X chromosome. Males with Turner syndrome frequently have a normal chromosomal formula (44A + XY), rarely having additional or pathological chromosomes or mosaicism. For both genders the clinical aspect has the same general or craniofacial morphological signs.
MATERIALS AND METHOD: Cephalometric radiographs of 37 patients with Turner syndrome (32 females and 5 males) with an age range of 9 to 30 years. The analysis included 42 craniofacial linear and angular parameters.

RESULTS: Both genders showed delayed development of the facial parameters and of the neurocranium involving the sutures, the spheno-occipital syncondrosis and the condylar cartilage. The increased sphenoid angle resulted in a worsening of bimaxillary quantitative retrognathism, especially in the mandible. Bimaxillary retroclination was also present.

386 ASSESSMENT OF GENETIC INFLUENCE ON CRANIOFACIAL CHARACTERISTICS

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AIM: Whilst growth is strongly influenced by genetic factors, it can also be significantly affected by environmental factors. Improved understanding of the influence of genetic or non-genetic factors might enhance our knowledge concerning growth and development of the craniofacial complex. The aim of this investigation was to analyse the role of genetic and non-genetic factors in the development of the craniofacial complex.
SUBJECTS AND METHOD: Fifty-two pairs of twins (20 identical, 32 fraternal). Three types of measurements of the linear cephalometric variables were undertaken on lateral cephalograms: 1) Length of the cranial base (S-N); (2) Length of the maxilla (Sna-Snp) and (3) Length of the mandible (Go-Me). Intra- and interpair comparisons were carried out and the results were statistically analysed with a *t*-test.
RESULTS: The differences between the identical and fraternal twin groups for S-N, Sna-Snp and Go-Me were statistically significant ($P = 0.03$, $P = 0.02$ and $P = 0.03$, respectively).
CONCLUSIONS: Linear craniofacial characteristics (such as the lengths of the cranial base, maxilla and mandible show a strong genetic influence. Investigations of identical and fraternal twins are a good model for estimation the role of genetic or environmental factors in craniofacial growth.

387 THERAPEUTIC EFFICACY OF A STIMULATING PLATE IN CHILDREN WITH SEVERE PROBLEMS OF SPEECH ARTICULATION AND ORAL MOTOR SKILLS

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AIM: To investigate the effects of an oral stimulating plate in children with severe speech articulation and oral motor skill problems.
SUBJECTS AND METHOD: Twelve girls and 45 boys with severe problems in speech articulation or in oral motor skills. The mean age of the subjects was 6.8 years (SD 2.4 year). The main diagnoses of the children were verbal dyspraxia (33%), functional misarticulations (23%) and mild mental retardation (19%). A speech therapist observed the articulatory speech disorders and problems in oral motor movements. Altogether 90 per cent of the subjects had problems with speech articulation and 37 per cent with tongue movements. Sixteen per cent had drooling and 14 per cent lip incompetence. The decision as to whether the child might benefit from stimulating plate treatment was made by the professionals in the oral-motor treatment team, including a phoniatrician, a speech therapist and an orthodontist. They also planned the shape of the stimulating component of the appliance. The effects of the plates were observed by the same speech therapist who examined the children at the beginning of plate therapy. The plates were to be used twice a day about 20 minutes per time and during speech therapy. The mean treatment time was 5.7 months (SD 3.0).
RESULTS: Speech sound articulation improved in 79 per cent in the children with verbal dyspraxia and in 77 per cent in those with functional misarticulations. Furthermore, there was an improvement in tongue movement in 44 per cent and in its rest position in 12 per cent of the subjects. Drooling decreased in 11 per cent and lip seal improved in 7 per cent during plate therapy.
CONCLUSION: The stimulating plate was successful, especially in the children with articulatory speech disorders of a dyspractic and functional origin.

388 EVALUATION OF TWO DIFFERENT DIGITAL CEPHALOMETRIC IMAGING METHODS AND CONVENTIONAL TRACING

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AIM: Recent advances in computer science have led to its wide application in orthodontics. Computer aided digital tracing programs have many benefits. It is known that digital cephalometric tracing does not introduce more measurement error as long as landmarks are identified manually. The aim of this study was to explore the differences between two different digital tracing software programs and the conventional manual tracing method.
MATERIALS AND METHOD: Thirty lateral cephalograms were selected from the archive of the Department of Orthodontics, University of Ondokuz Mayıs. Equal numbers of cephalograms representing each malocclusion (Class I, Class II and Class

III) were used. These radiographs were scanned into digital format at 300 dpi using an Epson Z700 Pro scanner. All scanned images of the radiographs were then processed by the same operator (ET) using two different digital tracing software programs (Dolphin Imaging Software 9.0, California, USA, and Dental Studio NX Version 6.0, Nemotec S.L.). The same radiographs were then traced by hand and measured manually using a protractor. Ten angular and four linear measurements were assessed on each lateral cephalogram. All measurement values were analysed with one-way analysis of variance (ANOVA) and further investigation was undertaken using Tukey HSD *post hoc* test with a 95 per cent confidence level ($P < 0.05$).
RESULTS: Statistically significant differences between the three methods were noted only for two of the 14 cephalometric items. The angles, occlusal plane to SN and upper incisor axis to palatal plane, were unreliable between the methods.
CONCLUSIONS: The validity of the measurements with the two digital software programs and the conventional method are highly correlated. When the advantages of digital imaging such as archiving, transmission, and enhancement are taken into consideration, digitized methods may be preferred in daily orthodontic use.

389 FIXED MANDIBULAR REPOSITIONING APPLIANCES IN THE TREATMENT OF TEMPOROMANDIBULAR JOINT DISORDERS***
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AIM: To investigate if fixed mandibular appliances are capable of improving or treating temporomandibular joint disorders (TMD).
SUBJECTS AND METHOD: One hundred and fifty one randomly selected patients with TMD were studied to see if a mandibular anterior repositioning appliance with simultaneous full mouth orthodontics could reduce or even eliminate TMD [muscle pain, temporomandibular joint (TMJ) sounds, dizziness and tinnitus]. The following records were obtained pre- and post-treatment: full orthodontic records, magnetic resonance images of the TMJs, and a manual functional orthopaedic analysis of the TMJ. The patients' ages were from 16 to 51 years. Treatment consisted of condylar antero-inferior repositioning with a fixed repositioning appliance and bite raising with fixed pivot build-ups on the second molars. The patients had concurrent physiotherapy during most of the treatment. A prerequisite was to have at least 28 teeth present, including implants. The majority of the patients were retained with fixed ramps from the upper to the lower second molars to prevent distal movement of the mandible and dorsal bruxism.
RESULTS: The symptoms in 27 per cent of the patients were totally eliminated, 31 per cent were considerably reduced, 18 per cent were reduced slightly, 21 per cent showed no change and 3 per cent became worse. The patients were followed for 2.5 to 10 years after treatment (average 4.5 years). Sixteen patients in the 'no change and worse group' were given Botulinum injections; 10 of the 16 patients then improved.
CONCLUSIONS: It appears that antero-inferior condylar repositioning can help TMD, especially if the mandible is held anteriorly with ramps after treatment. Long-term studies with more patients should be conducted in order to determine the permanency of this treatment. In addition it appears the use of Botulinum at the beginning of treatment could help in the success of TMD treatment.

390 NON-CONVENTIONAL ASYMMETRIC ANCHORAGE FOR LOWER MOLAR MESIALIZATION
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AIM: To illustrate the use of miniscrews for skeletal anchorage in subjects undergoing asymmetric molar mesialization following the loss of the lower first molars.
SUBJECTS AND METHOD: Ten adult patients who had missing mandibular first molars and atrophic bone in the area, making implant placement difficult. The efficiency of spider screws (HDC Verona, Italy) in the provision of asymmetric anchorage was tested. Panoramic and lateral radiographs were obtained before and at the end of treatment. The insertion area was represented by the inter-radicular space between the lower premolars; a drill free technique was preferred after cortical access. The force needed for space closure was applied by means of a NiTi coil spring (150 g) exerted from the power arm bonded on the second molar and tied to the miniscrew. The patients were all fully banded and the molar translation was performed on a 0.018 inch Australian wire. All patients were included in a periodontal programme during orthodontic movement.
RESULTS: Treatment was successful in all patients; the asymmetric spaces were closed without anchorage loss and with good contact between the adjacent teeth. The periodontal tissues were healthy at the end of treatment.
CONCLUSIONS: This skeletal anchorage system is an effective treatment alternative for asymmetric space closure without anchorage loss and with a minimal increase in treatment time. Miniscrews for immediate loading can be a valid treatment choice in patients requiring lower molar mesialization.

391 COMPETENCIES AND ASSESSMENT FOR THE SPECIALIST ORTHODONTIST

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AIMS: To identify, by consensus, a list of competencies and their assessment for a specialist orthodontic training programme.
MATERIALS AND METHOD: A modified Delphi technique was used as it was considered to be a reliable method to obtain a consensus of opinion of a group of 'experts', by a series of intensive questionnaires interspersed with controlled feedback. The panel of experts consisted of nine members of the teaching staff working on the Taught Postgraduate Degree Course in Orthodontics at Cardiff Dental School. Following analysis of existing information on the concepts of competence, competency continuum, outcome and assessment in postgraduate programmes in orthodontics, two lists were created: outcomes to be achieved by postgraduate students undergoing specialist orthodontic training. Each outcome was associated with one level of the competency continuum (novice, beginner, competent, proficient, and expert). Assessment methods associated with each level of the competency continuum. These two lists formed the basis of a questionnaire that was sent twice (two rounds) to all the panellists.
RESULTS: From a starting point of 126 items, consensus was achieved for 110 (87.3%) after round 1 and for 124 (98.4%) after round 2. Two lists were compiled: learning outcomes of specialist orthodontic training at Cardiff Dental School and assessment methods to evaluate these learning outcomes.
CONCLUSIONS: The considerable consensus achieved in obtaining a list of outcomes and their assessment in specialist orthodontic training can be considered as a starting point towards European convergence of standards. This convergence is essential for free movement of specialists and the well-being of the specialty within Europe.

392 ORAL HABITS IN 80 CONSECUTIVELY TREATED ORTHODONTIC PATIENTS: INCIDENCE AND TREATMENT OUTCOME

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AIMS: To investigate the prevalence and correlation of lip incompetence, digit sucking, atypical tongue activity and lip biting in a group of orthodontic patients, and to evaluate orthodontic treatment time and outcome.
SUBJECTS AND METHOD: Eighty consecutive patients (30 boys, 50 girls, mean age 12.2 ±1.7 years) treated at one author's practice (LL). The presence of an oral habit was evaluated from standardized pre- and post-treatment video recordings. Digit sucking (beyond 6 years of age) was noted during a routine interview. Pre- and post-treatment cephalograms were traced to assess sagittal and vertical jaw and incisor relationships. Correlations and differences were tested for statistical significance using the *t*-test, Mann-Whitney and odds ratio.
RESULTS: One or more habits were present in 56.3 per cent before treatment; lip incompetence was registered in 48.9 per cent, an atypical tongue activity in 37.8 per cent, digit sucking in 35.6 per cent and a lip habit in 17.8 per cent. The total prevalence fell to 23.7 per cent after treatment and was statistically significant for all of the habits, except atypical tongue activity. A clear correlation was found between digit sucking and atypical tongue activity. Pre-treatment cephalograms showed that patients with a habit had a larger overjet, smaller overbite, more proclined and protruded incisors, a greater ANB angle and a greater intermaxillary angle (ML/NL) than those without a habit. Cephalometric differences between the groups after orthodontic treatment were less pronounced. Those with an oral habit also showed a tendency for increased treatment time/number of visits, but this was not statistically significant.
CONCLUSIONS: The findings of oral habit prevalence are in agreement with other reports. Their overall reduction at the end of orthodontic treatment coincided with a normalization of the sagittal skeletal and dental variables. Patients with oral habits are expected to have a longer orthodontic treatment.

393 REPAIR OF ORTHODONTICALLY INDUCED ROOT RESORPTION IN RATS: A SCANNING ELECTRON MICROSCOPY STUDY

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AIM: To study, in detail, the repair of orthodontically induced root resorption during the initial phase of tooth movement using scanning electron microscopy (SEM).
MATERIALS AND METHOD: Thirty 40–50 day-old male Wistar rats equally divided in to five experimental tooth movement groups and one control group. The maxillary right first molars of the experimental animals were moved mesially using a fixed appliance for 1, 2, 4, 7 and 10 days. No appliance was used in the control animals. At the end of the experimental period, the specimens were prepared for SEM. The mesial aspects of the mesiobuccal root of the first molars were used for evaluation.

RESULTS: Resorption lacunae containing mosaic-like cementum were often seen on the root surfaces of the control animals. After 1 and 2 days of tooth movement, the area of shallow resorption bays was larger than in the controls. The cementum in such resorption bays had a smooth appearance without a mineralized projection. Large resorption lacunae extending into the dentine were obvious by day 4. Initial repair with mineral deposition, in the form of calcospherulites and flake-like structures, were visible after 7 days of force application. After 10 days, as repair was progressing, a new layer of mineralized cementum covering the resorption lacunae was clearly visible. It is tempting to speculate that these resorption lacunae might have been filled with cementoblasts that may have been dissolved during specimen preparation.
CONCLUSIONS: The transition from resorption to repair occurred rather early in this material. The reparative cementum started with the formation of characteristic mineral structures, calcospherulites that aggregate during time, forming the mineralized part of newly formed cementum.

394 MAXILLARY BONE REMODELLING DUE TO HEAVY ORTHODONTIC FORCES IN RATS
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AIM: To investigate modelling and remodelling patterns in cortical maxillary bone after application of heavy orthodontic forces in rats.
MATERIALS AND METHOD: Two groups of 8-month-old female rats, each group consisting of 12 animals. The experimental group comprised osteoporotic rats and a control group of normal rats in which orthodontic forces were exerted. An open coil spring exerting a heavy mesial traction force of 60 g was placed on the maxillary right first molar of all animals on the 60th experimental day and for 14 days. Histologic examination of the maxillary bone of both groups was performed.
RESULTS: Regional acceleratory and distraction like phenomena were observed in the maxillary bone at the retraction side in both groups. The cortical bone ahead of the affected teeth showed distortion of the bone structure, being less distinctive in the control group. Hypertrophy and subperiosteal callus formation were also noticed at the retraction site extending to the distal and remote cortical maxillary region.
CONCLUSION: Heavy orthodontic forces applied to the dentoalveolar complex of female rats affect the morphology and structure of the cortical maxillary bone. Orthopaedic forces applied to the dentoalveolar complex cause hypertrophy and fatigue failure of the cortical maxillary bone both mesial and distal to the applied force areas.

395 AIRWAY DIMENSIONS AND DENTOFACIAL CHARACTERISTICS OF OBSTRUCTIVE SLEEP APNOEA PATIENTS
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AIM: To evaluate airway dimensions and dentofacial characteristics of obstructive sleep apnoea (OSA) patients.
MATERIALS AND METHOD: Standardized lateral cephalograms of 16 OSA patients and 16 healthy volunteers were obtained. Airway dimensions and dentofacial measurements were performed with a cephalometric analysis program (Dolphin Imaging Cephalometric and Tracing Software, Chatsworth, California, USA). Statistical analysis was undertaken with the Statistical Package for Social Sciences, version 16.0 (SPSS Inc., Chicago, Illinois, USA). The differences between groups were evaluated by independent samples *t*-test.
RESULTS: Statistically significant differences were found in the following measurements: middle airway space dimension ($P < 0.01$), ANB angle ($P < 0.01$), upper lip to E plane length ($P < 0.01$), U1-NA angle ($P < 0.05$), U1-SN angle ($P < 0.01$), midface length (Co-A) ($P < 0.01$) and hyoid-MP perpendicular length ($P < 0.05$).
CONCLUSIONS: OSA patients had more protrusive upper incisors, reduced midface lengths, narrower middle airway space and more inferiorly positioned hyoid bones than healthy controls.

396 EVALUATION OF SHEAR BOND STRENGTHS OF COLOUR CHANGE ADHESIVES
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AIM: To compare bond strengths of three commercially available colour change adhesives.
MATERIALS AND METHOD: Forty-eight human permanent premolar teeth, freshly extracted for orthodontic reasons and without any caries or visible defects. The 48 teeth were divided into four equal groups and the brackets were bonded on all teeth as follows: group I: Light Bond primer and adhesive (Reliance Orthodontic Products, Inc, Itasca, Illinois, USA); group II: Ortho Solo Primer and Grengloo adhesive (Ormco, Glendora, California, USA); group III: Ortho Solo Primer and Blugloo adhesive (Ormco); group IV: Transbond XT Primer and Transbond Plus Colur Change adhesive (3M Unitek, St Paul, Minnesota, USA). All brackets were cured with a Heliolux DLX light (Vivadent ETS, Schaan, Liechtenstein) for 40 seconds. Each specimen was loaded

into a universal testing machine (Lloyd, Fareham, Hants, England) using Nexjen (Charlotte, North Carolina, USA) software for testing. Bond strengths were determined in shear mode at a crosshead speed of 0.5 mm/minute until fracture occurred.
RESULTS: Analysis of variance (ANOVA) indicated a significant difference between groups I and IV ($P < 0.001$). No significant difference was found between groups II, III and IV ($P > 0.05$).
CONCLUSIONS: No significant difference exists between the bond strengths of the three tested colour change adhesives. Brackets bonded with Grengloo and Blugloo yielded comparable bond strengths to conventional light cure adhesives. Only Transbond Plus produced lower bond strengths than the conventional light cure adhesives.

397 DIAGNOSIS OF DENTAL ABNORMALITIES IN CHILDREN USING MAGNETIC RESONANCE IMAGING

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AIM: Radiographs are routinely used for diagnosis of dental abnormalities as well as for orthodontic treatment and surgery planning. However, radiographic images provide only limited information especially in the case of superimposition of dental structures. The purpose of this study was to assess the feasibility of magnetic resonance imaging (MRI) for diagnosis of dental abnormalities in children.
SUBJECTS AND METHOD: Thirty-eight orthodontic patients (mean age 12 years, range 8–18 years) with abnormalities in the size, shape, position and number of teeth. Three-dimensional (3D) images were acquired using a MRI scanner in combination with a 4-channel multifunctional coil array. To provide full information necessary for treatment and surgery planning, the data were semi-automatically segmented using region growing algorithms and the surface of the structures of interest was rendered into 3D images.
RESULTS: Measurement times of 4 to 5 minutes were well-tolerated by all children. Diagnosis of dental abnormalities was not possible in one patient because of a strong image artefact caused by a metallic orthodontic appliance. In all other patients, MRI yielded a clear view of the tooth substance and surrounding tissues; the position and shape of malformed teeth could be assessed in all three spatial dimensions. Supernumerary teeth were diagnosed in 26 per cent of patients, gemination in 3 per cent, dilacerations in 3 per cent and transpositions in 3 per cent.
CONCLUSIONS: Dental MRI is a safe, well-tolerated method that can be used for diagnosis of dental abnormalities in children as well as for orthodontic treatment and surgery planning. Compared with conventional radiographs, dental MRI has the advantage of allowing a full volumetric examination without ionizing radiation, which is particularly relevant for repeated examinations of children.

398 EFFICACY AND SAFETY OF MAGNETIC RESONANCE IMAGING GUIDED STEROID INJECTIONS FOR TEMPOROMANDIBULAR JOINT ARTHRITIS

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AIMS: The temporomandibular joints (TMJs) are frequently affected in patients with juvenile idiopathic arthritis (JIA). Most patients have no complaints requiring magnetic resonance imaging (MRI) for early detection of TMJ arthritis. Systemic treatment seems to be unsatisfactory with continuing joint destruction. Therefore the long-term efficacy and safety of MRI guided intra-articular steroid injections (IAS) for TMJ arthritis was evaluated as a treatment option.
SUBJECTS AND METHOD: Ten children with a mean age of 10.9 years (3–17) at diagnosis of TMJ arthritis and mean disease duration of 3.9 years (1–8) underwent IAS. Diagnostic criteria for active TMJ arthritis were synovial enhancement, synovial hypertrophy and bone marrow oedema/osteitis. Arthritis was graded as minimal, moderate or severe by a radiologist. Indications for IAS was moderate or severe arthritis. Each joint was injected with 20–40 mg triamcinolone acetonide under MRI guidance under general anaesthesia. Follow-up included clinical and MRI examinations every three to six months over a period of up to three years.
RESULTS: A total of 20 IAS [mean 2 (1–5) per patient] were performed. Prior to IAS the following clinical signs/symptoms were present: one patient with pain, six with asymmetrical mouth opening and six with decreased maximal incisor opening (MIO). At the last presentation the findings were: two patients with pain, three with asymmetrical mouth opening but none with decreased MIO. On the MRI at the last presentation two patients still had minimal synovitis, two had synovial hypertrophy without synovitis but no patient showed bone marrow oedema/osteitis. Subcutaneous atrophy in one patient was the only adverse event that occurred.

CONCLUSIONS: Patients with JIA and TMJ arthritis may require multiple IAS for the treatment of active arthritis. MRI-guided IAS is a safe and the superior modality for correct steroid placement to prevent injection related damage and complications. Regular MRI follow-ups are required.

399 TREATMENT EFFICIENCY OF A MANDIBULAR ADVANCEMENT APPLIANCE ON SIMPLE SNORING AND MILD OBSTRUCTIVE SLEEP APNOEA

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AIM: To determine the effective vertical opening amount for mandibular advancement devices that are used in the treatment of simple snoring and mild obstructive sleep apnoea (OSA).
SUBJECTS AND METHOD: Fifteen simple snoring and/or mild OSA patients, with a baseline total apnoea/hypopnea index (AHI) of 0-20 events. The patients were treated with a modified monobloc mandibular advancement device made of silicon and constructed to position the mandible at 75 per cent of maximal mandibular advancement and with a 6 mm vertical opening. The patients were controlled 1 and 2 weeks later. At the end of 6-8 weeks, the patients underwent polysomnographic analysis. The sample comprised the lateral cephalograms, polysomnography reports and questionnaire forms obtained before and after oral appliance therapy. Linear, angular and area measurements were undertaken on the lateral cephalograms. The results were analyzed using paired comparison *t*- and non-parametric Wilcoxon test.
RESULTS: A significant reduction was found in the total AHI, total hypopnoea index, awakening number and awakening plus arousal number ($P < 0.05$). A significant increase was found in oropharyngeal airway dimension ($P < 0.05$), hypopharyngeal airway dimension ($P < 0.05$), the narrowest sagittal distance of the pharyngeal airway ($P < 0.01$), tongue area ($P < 0.01$), oral area ($P < 0.01$), oropharyngeal area ($P < 0.01$) and total airway area ($P < 0.01$). Epworth sleepiness scores and snoring also showed significant reduction ($P < 0.01$).
CONCLUSION: A modified monobloc mandibular advancement device with a vertical opening of 6 mm was found to be an effective treatment alternative for snoring and/or mild OSA.

400 ORTHODONTIC ANOMALIES IN THE HABSBURG FAMILY

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AIMS: Occurrence of hereditary mandibular prognathism in the Royal House of Habsburg is generally accepted as a fact. The aim of this study was to verify this statement by analyzing the profile portraits of family members on historical coins.
MATERIALS AND METHOD: Research was carried out on coins portraying the right profile of the Habsburg monarchs reigning in Europe from 1478 to 1790. To determine the authenticity of the numismatic material, available cephalometric radiographs of Ferdinand I, Maximilian II and Rudolf II were compared with the profile portraits. Coins were chosen according to the date and place of coinage. Digital photographs of the selected coins were taken in a standardized manner and profile analysis was undertaken using the PC Doctor software program. The angle of facial convexity (Gl´-Sn´-Pg´) and N´-Sn´-Pg´ angle were measured to assess the diagnosis of mandibular prognathism. The measured values were then compared within the Habsburg family tree.
RESULTS: Values of the Gl´-Sn´-Pg´ angle corresponded with a skeletal Class III malocclusion in 63 per cent of the examined profiles and N´-Sn´-Pg´ angle in 56 per cent, both reaching extreme values in Philip IV. Not all Austrian Habsburgs displayed the anomaly, while the Spanish line was more severely affected.
CONCLUSIONS: Orthodontic profile measurements on historical coins confirm the incidence of mandibular prognathism in more than half of the European Habsburg monarchs. The 'Habsburg jaw' is apparent in Charles VI, however the progenic tendency disappears numismatically in his daughter Maria Theresa and her offspring. Despite the aesthetic and logopaedic handicap often associated with mandibular prognathism, the Royal House of Habsburg dominated the European political scene from the 15th to the 17th centuries.
Acknowledgement: This study was supported by ROD a.s.

401 EVALUATION OF MECHANISM AND EFFECTIVENESS OF LEVELLING AND ALIGNMENT WITH SELF-LIGATING BRACKETS USING DIGITAL MODELS

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AIM: Self-ligating brackets are ligatureless bracket systems that reduce resistance to sliding, allow faster archwire removal and ligation, a decrease in treatment duration and an increase in patient comfort. The aim of this study was to evaluate the

mechanism and effectiveness of levelling and alignment with self-ligating brackets in comparison with conventional brackets.
SUBJECTS AND METHOD: Twenty skeletal and dental Class I patients with moderate crowding (6-8 mm). Quick brackets (0.018 inch slot) were used in 12 patients and conventional straightwire brackets in the eight patients in the control group. During levelling, 0.012 inch Biostarter wire was used as recommended. Models were obtained before treatment and at the end of initial alignment, just before changing to rectangular wire. All models were scanned with 3 Shape D250 (3Shape A/S) and digitized. Model analyses were performed with 3 Shape Orthoanalyzer, version 1.0, software (3Shape A/S).
RESULTS: Intercanine distance, interpremolar distance and arch perimeter increased and Hays-Nance value decreased significantly during levelling in both groups ($P < 0.05$). Intermolar distance did not change significantly. Correction of crowding was achieved by arch expansion in both groups. There was no significant difference between the study and control groups in Hays-Nance value and upper and lower arch perimeter ($P > 0.05$). The only difference between the study and control group was related to duration of archwire ligation and total number of appointments, which were less in the self-ligating group.
CONCLUSIONS: The mechanism of levelling and alignment was similar with self-ligating and conventional brackets, but the number of appointments was less and ligating time was shorter with the self-ligating system.

402 THE TOPOGRAPHIC, AETIOLOGIC, EPIDEMIOLOGIC AND SOCIAL PROFILE OF CLEFT LIP AND PALATE PATIENTS

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AIM: Orofacial clefts are congenital malformations characterized by malunion of structures separating the nasal and oral cavities. Among the aetiologic factors, genetics, exposure to radiation, medicament use, diabetic mother, malnutrition and consanguinity can be attributed. This study was undertaken to assess the epidemiologic and topographic data, to search for possible associations of clefting with demographic variables of the cleft patients.
SUBJECTS AND METHOD: Three hundred and nine patients. An anamnesis form was prepared that included 35 parameters. The data was verified twice by the same researcher and the findings were handled by classification of these data.
RESULTS: When the pool of patients was grouped according to cleft type, the percentages were 72.2, 22 5.2 and 0.6 for cleft lip and palate (CLP), isolated cleft palate (CP), cleft with associated syndrome and cleft lip groups, respectively. The proportion of unilateral and bilateral cases was 1.6/1 in the CLP group. In the unilateral CLP group, clefts on the left side were 1.9 times more frequent than on the right side. The number of cleft patients born prematurely was 22, which accounted for 7.1 per cent of the patients. Eighty-six unilateral and 39 bilateral CLP patients had NAM treatment protocol. One hundred families were from the Karadeniz region of Turkey. Education was at the preliminary level for 61.4 per cent of fathers and 70.2 per cent of mothers. Two hundred and fifty nine of the mothers were housewives, 126 of the fathers were workers, while 22 out of 309 patients had no social insurance. Sixty-five families had consanguinity between parents. Fifty-four families (17.5%) reported a family history. The mean parental ages were highest in the CP only group, followed by the cleft with syndrome group. Only one mother had epilepsy. Sixty-nine mothers and 179 fathers smoked. Seven families had two children with clefts, 15 families contained twins and one family had triplets. A cleft was not diagnosed in the twins.

403 EVALUATION OF MICROLEAKAGE UNDER PRECOATED AND UNCOATED BRACKETS BONDED WITH SELF ETCHING PRIMER

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AIM: To test the null hypotheses that there is no significant difference in the amount of microleakage (1) between occlusal and gingival sides of precoated and uncoated brackets bonded using self-etching primer (SEP) and the conventional etching method (CEM) or (2) between precoated and uncoated brackets bonded using SEP and CEM in the enamel-adhesive-bracket complex
MATERIALS AND METHOD: Sixty freshly extracted human maxillary premolar teeth. The teeth were separated into four equal groups: CEM+uncoated brackets, SEP+uncoated brackets, CEM+precoated brackets, SEP+precoated brackets. The dye penetration method was used for microleakage evaluation. Microleakage from both the occlusal and gingival margins was determined using a stereomicroscope for the enamel-adhesive and bracket-adhesive interfaces. Statistical analysis was performed using Kruskal-Wallis test and Mann-Whitney U-test with a Bonferroni correction.
RESULTS: When the gingival and occlusal sides were compared, gingival scores were found to be statistically significantly higher for the CEM+ and SEP+uncoated groups at the enamel-adhesive interface and for the SEP+uncoated group at the adhesive-bracket interface. According to the multiple comparison of groups, at the occlusal side no difference was found between the groups at either interface. At the gingival side at the enamel adhesive interface, CEM+ and SEP+uncoated

groups had statistically more microleakage than both the precoated groups. At the adhesive-bracket interface the SEP+uncoated group showed statistically significantly more microleakage than the SEP+precoated group.
CONCLUSIONS: The hypotheses are rejected. Uncoated brackets result in more microleakage between the enamel-adhesive-bracket interfaces at the gingival side when compared with the occlusal side. No difference was found between the CEM and SEP technique.

404 EVALUATION OF CHIN CHANGES IN CLASS II DIVISION 1 PATIENTS AFTER TREATMENT
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AIM: A Class II malocclusion is one of the most common malocclusions. Growth modification treatments result in significant changes in the soft tissue profile. In this study changes in the chin soft tissue after functional therapy were evaluated.
SUBJECTS AND METHOD: A quasi-experimental study was conducted on 13 Class II division 1 patients (mean age: 10.6 years). All were in the mixed dentition without a history of previous orthodontic treatment. All used a twin block appliance for 7-18 month. Lateral cephalograms obtained before and after treatment were analyzed by two orthodontists. Differences between the mentocervical, mentolabial and nasolabial angles were analyzed by paired *t*-test.
RESULTS: The mean difference in mentocervical angle before and after treatment was 1.9 ± 7 degrees, but this difference was insignificant ($P > 0.05$). Mentolabial and nasomental angles increased after treatment. The mean difference for mentolabial angle was 8.7 ± 14.9 degrees and for nasomental angle 2.4 ± 3.5 degrees. The mean differences for mentolabial and nasomental angle before and after treatment were significant ($P < 0.05$).
CONCLUSION: Functional therapy results in forward and downward movement of the chin and an increase in lower face height. Convexity of the profile and the depth of the mentolabial fold decrease.

405 CHEWING EFFICIENCY AND LIP STRENGTH IN PATIENTS WITH MARFAN SYNDROME
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AIM: Marfan syndrome (MFS) represents a connective tissue disorder with dominant autosomal inheritance that affects *inter alia* the musculoskeletal apparatus, however only scant attention has been paid to orofacial function. Therefore, the aim of the present study was to evaluate chewing efficiency and lip strength in patients with MFS.
SUBJECTS AND METHOD: Twenty-seven adult patients (10 males, 17 females) with MFS aged between 18 and 58 years. Twenty-five healthy adults (4 males, 21 females) aged between 25 and 53 years served as the control group. Lip strength was measured with the digital piezoresistive relative-pressure sensor, Myo-Bar-Meter® (Akkuphon, Unna, Germany) three times for each patient. Masticatory performance was measured according to the method suggested by Yurkstas and Manly by chewing a defined portion of carrots and peanuts that were strained through a standard mesh sieve after a specified number of strokes. Possible intergroup differences were determined using the independent *t*-test.
RESULTS: Differences in masticatory performance were not statistically significant. Patients with MFS did not show a reduced chewing efficiency in comparison with the controls. Lip strength showed highly statistically significant differences between the two groups. Lip strength in the MFS group was significantly reduced (MFS group 19.28 mbar, control group 32.47 mbar).
CONCLUSIONS: Connective tissue disorders in patients with MFS did not affect chewing efficiency, but lip strength was statistically significantly reduced. Lowered lip strength may be a co-factor in the increased clockwise rotation of the mandible resulting in a skeletal and dental Class II malocclusion, which has been described as a common diagnostic feature in patients with MFS.

406 ADULT ORTHODONTICS – INTERACTION BETWEEN GENERAL PRACTITIONERS AND ORTHODONTISTS IN NORWAY
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AIMS: To assess the interaction between general practitioners and orthodontist in the treatment of adult patients in Norway, and to identify factors that may limit interaction.
MATERIALS AND METHOD: Questionnaires were sent electronically to random samples of general practitioners (500) and orthodontists (263) recorded with e-mail addresses by the national dental association. The response rates were 35 per cent for general practitioners, and 44 per cent for orthodontists.
RESULTS: The general practitioners referred, on average, 2.4 (SD = 3.2) adult patients to orthodontists per year (range 0-20). The orthodontists reported receiving an average of 15.2 (SD = 18.0) adult patients per year (range 0–100). The

most frequent reason reported for referrals was untreated malocclusions both by orthodontists (58 %) and dentists (50%). Treatment indication was reported to be aesthetic needs by 59 per cent of the orthodontists and by 53 per cent of the general practitioners. The most frequent reasons given by general practitioners for not referring more adults were not having patients with a need for orthodontic care (47%) and that patients were not willing to wear orthodontic appliances (25%). The reasons given by orthodontists for not treating more adults were no demand for care (60%) and that patients were not willing to wear appliances (23%). Most general practitioners, 77 per cent, reported not having received information from orthodontists that they would welcome referrals and 65 per cent of the orthodontists reported that they had not provided such information. Among the orthodontists, 64 per cent wanted more cooperation in the treatment of adult patients. Seventeen per cent of the general practitioners stated that they did not know if the orthodontists wanted to cooperate.
CONCLUSION: Interaction between orthodontists and general practitioners is limited. Information about possibilities for referral may increase the cooperation between orthodontists and general dentists.

407 RELIABILITY OF DENTAL ARCH AND APICAL BASE MEASUREMENTS ON DIGITAL MODELS
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AIM: To assess intra- and interexaminer reliability of dental arch and apical base measurements of the upper arch on digital models.
MATERIALS AND METHOD: Upper plaster casts of 20 patients were obtained from the material of a growth study carried out in the 1960's of children of Dutch origin. The inclusion criteria were: high quality study casts with full buccal fault corresponding to the following stages of dental development: full primary dentition (presence of first permanent molars allowed), early mixed dentition and permanent dentition (presence of all permanent teeth mesial of the first permanent molar). The plaster casts were scanned and measured using Digimodel® software. The outline of the apical base was defined as the line running through the most concave point of the buccal fault in the region of the apices. The outline of the dental arch was defined as the line running through the tip of the buccal cusp or the incisal edge of every tooth. For both outlines the following measurements were investigated: 1) molar width, 2) canine width, 3) circumference of the outline running from the first molar to the contralateral molar and, 4) surface of this area enclosed by the molar width line. Two examiners measured each model twice with a wash out period of at least two weeks.
RESULTS: The ICCs (intra) ranged from 0.903 to 0.988 for the apical base measurements and from 0.920 to 0.994 for the dental arch measurements. The ICCs (inter) ranged from 0.881 to 0.986 for the apical base measurements and 0.901 to 0.988 for the dental arch measurements.
CONCLUSIONS: ICCs for the dental arch measurements are slightly higher than those for apical base measurements. They are, however, still very reliable and suitable for research purposes.

408 LONGITUDINAL CHANGES IN GINGIVAL CREVICULAR FLUID, FLOW AND COMPOSITION AFTER PLACEMENT OF FIXED ORTHODONTIC APPLIANCES
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AIMS: To monitor microbiological and periodontal changes after placement of orthodontic attachments, and to link these changes to alterations in cytokine concentrations in the gingival crevicular fluid (GCF).
SUBJECTS AND METHOD: This split-mouth trial included 24 patients. Microbiology (sub- and supragingival), probing depth, bleeding on probing (BOP) and GCF flow and composition were assessed at baseline (Tb) and after a one year period (T52). A comparison was made over time and between the banded and bonded sites. Prognostic factors for the clinical reaction at T52 in the GCF at Tb were determined.
RESULTS: The pathogenicity of the plaque and all periodontal parameters significantly increased between Tb and T52, but inter-site differences were not seen except for BOP (greater increase for banded sites, $P < 0.05$). Cytokine concentrations in the GCF did not differ significantly between the sites nor between Tb and T52. Interleukin (IL)-6 concentration in the GCF at Tb appeared to be a significant predictive value for the GCF flow at T52 ($P < 0.05$), and the IL-8 concentration at Tb was predictive for the increase in probing depth at T52 ($P < 0.05$).
CONCLUSIONS: IL-6 and IL-8 concentrations before orthodontic treatment are significant predictive factors for some inflammatory parameters during orthodontic treatment.

409 ROOT RESORPTION DURING ORTHODONTIC TREATMENT OF TRAUMATIZED TEETH: A SYSTEMATIC REVIEW
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AIM: To investigate whether previously traumatized teeth have an increased risk of root resorption during orthodontic treatment compared with non-traumatized teeth.
MATERIALS AND METHOD: Several electronic databases (Medline, Embase, PubMed, Web of Science and Cochrane) were searched by two independent investigators for the years 1960 until May 2008 using the Mesh terms 'Tooth injuries' and 'Orthodontics'. The search was limited to the English language literature and human clinical trials. Papers dealing with surgery cases, craniofacial syndromes, case reports and animal experimental studies were excluded. From the selected abstracts, all articles were retrieved and evaluated by two independent investigators according to the inclusion and exclusion criteria. In the case of disagreement, a mutual decision was made or a third independent senior investigator was consulted. All the reference lists from the included articles were hand searched to identify more studies that might have been missed by the electronic database search. Quality criteria were used to finally select only those trials that used a matched control group, measured possible root resorption on standardized peri-apical radiographs, and checked for the error of the method.
RESULTS: Medline identified 181 articles, Embase 13, PubMed 553, Web of Science and Cochrane both 0. After selection on the inclusion criteria and a quality check, a total of four eligible articles remained. Due to severe heterogeneity, the results were summarized without pooling. Teeth with slight or moderate trauma do not resorb more compared with uninjured teeth, but only if there is a waiting period of 4 to 5 months. Traumatized endodontically treated teeth seem to show less root resorption compared with vital control teeth.
CONCLUSIONS: More randomized controlled trials are needed to elucidate the risk for root resorption during orthodontic treatment performed on previously traumatized teeth.

410 THE RELIABILITY OF ASSESSMENTS OF ABNORMAL ROOT SHAPE ON PANORAMIC RADIOGRAPHS

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AIM: Several studies suggest a relationship between dental anomalies and root resorption during orthodontic treatment. However, the reliability of the assessments of dental anomalies has not been investigated. The aim of this study was to determine the reliability of the assessments of dilacerated, short, blunt, pipette-shaped, pointed roots and agenesis on panoramic radiographs.
MATERIALS AND METHOD: Pre-treatment panoramic radiographs of 40 patients selected from a pilot study of the effects of orthodontic treatment on root resorption (14 males, 26 females; 20 with an assumed anomaly, 20 without an assumed anomaly). The inclusion criteria were a minimum of 15 years of age, no maxillary surgery, no previous fixed appliance treatment in the maxilla, and a minimum fixed appliance treatment duration of 18 months. Two observers assessed the radiographs independently, and one observer assessed them twice with a washout period of 1 week. An angle between the long axis of the root and the long axis of the crown of 45 degrees or more defined a dilacerated root. A dilaceration towards the buccal or lingual was determined by a round opaque area with a dark shadow in its centre. A short root was defined as a root length/crown length ratio ≤ 1. Blunt, pipette-shaped and pointed roots were defined as drawn by Levander and Malmgren (1988). Agenesis of a tooth was assessed on the panoramic radiograph and from the dental history. Intra- and inter-reliability was evaluated by calculating Cohen's kappa.
RESULTS: Kappa values for intra-reliability of the anomalies were: 0.471, –0.002, 0.631, 0.799, 0.643 and 0.965 and for inter-reliability: 0.199, 0.000, 0.201, 0.304, 0.371 and 0.923, respectively.
CONCLUSIONS: According to this study, assessments of dental anomalies on panoramic radiographs, except for agenesis, are not reliable.
Levander E, Malmgren O 1988 Evaluation of the risk of root resorption during orthodontic treatment: a study of upper incisors. European Journal of Orthodontics 10: 30-38

411 PREVALENCE AND SEVERITY OF VESTIBULAR GINGIVAL RECESSION IN MANDIBULAR INCISORS AFTER ORTHODONTIC TREATMENT

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AIMS: To assess the prevalence and severity of vestibular gingival recession of mandibular incisors after orthodontic treatment, and to evaluate possible contributing factors.
MATERIALS AND METHOD: Five hundred and eighty eight good pre- and post-treatment records from the archives of the Department of Orthodontics, University of Oslo. Fifty-seven patients (35 girls, 22 boys) were found to have vestibular gingival recessions of the mandibular incisors after orthodontic treatment. A control group without gingival recessions was randomly selected from the same files. Intraoral photographs were used for evaluation of gingival recessions (based on Millers classification), presence of visible plaque and gingival inflammation. Cephalometric radiographs were used to assess

ANB, mandibular and intermaxillary angles, and the position of the lower incisors to APg (Ili/APg) and the mandibular plane (Ili/ML). All statistical analyses were performed by SPSS®. Correlations and differences between the measured variables were tested for statistical significance.
RESULTS: The prevalence of gingival recessions after orthodontic treatment was 10.3 per cent. The majority (8.6%) were classified as Millers 1 and 1.7 per cent as Millers 2. Pre-treatment gingival inflammation in the control group and post-treatment gingival inflammation in the recession group were significantly higher ($P \leq 0.05$) in intragroup analysis. No significant intergroup differences were found for any of the cephalometric variables. However, in the presence of gingival recession, if the post-treatment value of ANB was ≤1.5 degrees and/or inclination of the lower incisors to the mandibular plane was ≤92.5 degrees, the chance for the development of more severe gingival recession increased 4 fold.
CONCLUSIONS: Prevalence and severity of gingival recession after orthodontic treatment correspond with the findings in the literature. When gingival recession is present, decreased values of ANB and Ili/ML might increase the chance of its development to a more severe recession.

412 EVALUATION OF DENTAL ARCH FORM AND APPROXIMATION OF DENTAL ARCH CURVATURE BY MATHEMATICAL FUNCTIONS

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AIM: To consider the possibility of using three-dimensional (3D) models for evaluation of dental arch form and approximation of dental arch curvature by mathematical functions for orthodontic treatment outcome planning.
MATERIALS AND METHOD: The dental casts of 15 patients before and after orthodontic treatment (in total 60 casts) were digitized using a 3D dental scanner (VAS-38, Elintos prietaisai, Kaunas, Lithuania). The system operation is based on the laser triangulation method. All processing of raw scan data and dental cast shape reconstruction routines are performed on the scanner computer module with a multicore processor. System software developed n Borland C++ uses acquired data for automatic measurement of dental arches, to store dental cast models in 3D database. 3D model information was imported to a reverse modelling software package, Rapidform™ 2006, for additional analysis. The occlusal plane was determined using the principal component analysis method. Curve fitting for the lower arch on plane points was carried out by utilizing the 4th order polynomial equation, and β function was calculated using the distobuccal cusp tips of the first permanent molars and the central incisors.
RESULTS: The 3D scanning system is designed to achieve a total measuring depth of 60 mm, and depth and lateral resolution of 50 μm. The average correlation coefficient between mathematical arch shape expressed by β function and the arch shape after treatment expressed by 4th order polynomial was 0.9363. The mean square difference between arch shape expressed by β function and arch shape before treatment expressed by the 4th order polynomial was 0.034 mm.
CONCLUSIONS: The 4th order polynomial equation can be used to predict an individualized ideal arch for each patient when spatial coordinates of all teeth are known. β function has been shown to be an accurate representation of the human dental arches. 3D database from digital models is a useful tool for diagnosis and treatment planning.

413 CLINICAL PHENOTYPE AND GENETIC AND GENOMIC BASIS OF CLEFT LIP AND/OR PALATE IN THE LITHUANIAN POPULATION

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AIM: To apply contemporary knowledge in genomics, modern techniques for experimental testing and data analysis in the investigation of genetic and genomic basis of cleft lip and/or palate (CL/P) of the population of Lithuania according to clinical, syndromic and genetic data.
MATERIALS AND METHOD: The records of patients with congenital CL/P from the database of the Lithuanian CLP Biobank. Protocols for the investigation of clinical phenotype were established, and subjects qualifying the criteria were selected for clinical investigation. The medical records of 49 families were studied. The type of cleft was classified according ICD-10 and LAHSHAL classifications. Additionally, assessment of syndromic clefts was performed.
RESULTS: Three CL/P cases were classified as familial according to genealogic data. Out of 49 probands 13 had multiple congenital anomalies (MCA); after performing syndromic analysis of these patients, they were divided into a group of identified cases and a group of unknown origin cases. Two Pierre-Robin sequences, one foetal alcohol syndrome and one Cornelia de Lange case were identified. In the MCA group of unknown origin, 34 congenital anomalies were identified (average 3.7 anomalies/proband), most often skeletal.

CONCLUSIONS: An interdisciplinary approach by collaboration of specialists from different fields (geneticists, orthodontists, bioinformatics specialists, mathematicians) is necessary for developing new and elaborating existing methods for biostatistical analysis of testing results to estimate their relation to the CLP phenotype.

414 CHEWING PATTERN BEFORE AND AFTER THE FIRST PERMANENT MOLAR ERUPTION – IS THERE A CHANGE?

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AIM: To evaluate the relationship between chewing pattern and the developmental stage of the dentition.
SUBJECTS AND METHOD: Chewing pattern was assessed in 31 children (17 boys, 14 girls; = 5.42 years; SD = 0.50) with the use of a Sirognatograph electrognathographic device (Siemens, Germany) in the primary dentition period (T1) and after the eruption of the first permanent molars (= 6.92 years; SD = 0.50) (T2). The chewing pattern morphology in the frontal and sagittal planes was analysed in terms of shape (15 parameters) and duration of chewing cycles (4 parameters). Data analysis was performed using the COSIG II software program. A Student's *t*-test was used for statistical analysis.
RESULTS: Chewing pattern morphology was found to be significantly different between T1 and T2 for 10 chewing parameters ($P < 0.05$). In the frontal plane, a lateral deviation of chewing cycles from the midline was enlarged from 3.06 mm (T1) to 4.55 mm (T2), while the axial inclination angle of the chewing cycles and mouth closing angle were reduced. In the sagittal plane, an enlarged inclination angle of chewing cycles (from 92.92 to 114.90°) was measured. The mouth opening angle (from 87.90 to 113.81°) and the mouth closing angle (from 86.95 to 106.91°) were increased. The surface of the chewing cycles was enlarged (from 3.08 to 9.53 mm^2). The average opening time in an individual chewing cycle was extended (from 0.21 to 0.28 seconds), resulting in a prolonged duration of the whole chewing cycle (from 0.6 to 0.7 seconds).
CONCLUSIONS: Eruption of the first permanent molars had a significant influence on the shape and duration of the chewing cycle. The measured parameters indicated a shift of mastication to the working side and a characteristic surface enlargement of chewing cycles. In addition, the duration of the whole chewing cycle was prolonged, mainly due to the increase in mouth opening time.

415 CONVERGENT SIGNALLING THROUGH FIBROBLAST GROWTH FACTOR RECEPTOR 2 REGULATES DIVERGENT CRANIOFACIAL MORPHOGENESIS

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AIMS: To investigate the role of Fgfr2IIIb/Fgf10 signalling in controlling epithelial-mesenchymal interactions during craniofacial morphogenesis, and to find further evidence that Fgfr2IIIb/Fgf10 signalling can function solely within the mesenchyme during calvarial morphogenesis.
MATERIALS AND METHOD: In *Fgfr2IIIb*$^{-/-}$ and *Fgf10*$^{-/-}$ mice the tooth phenotype was confirmed by haematoxylin and eosin staining, and proliferation was studied by pulsed-BrdU incorporation during early tooth development. mRNA expression of *Fgfr2IIIb* and *Fgfr2IIIc* as well as their ligands, *Fgf3, -7* and *–10,* was studied by *in situ* hybridisation in the developing murine tooth, palate and calvaria.
RESULTS: Molar tooth development in *Fgfr2IIIb*$^{-/-}$ mice is arrested early in development and the molar teeth of *Fgf10*$^{-/-}$ mice develop through all the normal stages of morphogenesis. Molar tooth agenesis of *Fgfr2IIIb*$^{-/-}$ mice is, in part, due to reduced cell proliferation in both epithelial and mesenchymal compartments. The developing molar teeth of *Fgf10*$^{-/-}$ mice exhibited reduced cell proliferation. This reduction, however, was not sufficient to arrest molar development. Recent evidence indicates that Fgfr2IIIb/Fgf10 signalling is active in the calvaria in some pathological situations such as heterozygous deletion of *Fgfr2* exon *IIIc* in mice leads to ectopic expression of *Fgfr2IIIb* in the calvarial bones and causes craniosynostosis. In this study it was found that *Fgf7* is expressed in the calvarial mesenchyme adjacent to the developing frontal bone and *Fgf10* is expressed by osteoprogenitors in the developing frontal bone condensation.
CONCLUSIONS: Taken together, the overlapping roles of Fgfr2IIIb/Fgf10 signalling in controlling epithelial-mesenchymal interactions during normal palate and tooth morphogenesis, and how elevated signalling through Fgfr2IIIb/Fgf10 solely within the mesenchyme can result in abnormal calvarial morphogenesis are highlighted.

416 MAXILLARY GROWTH DURING PUBERTY DETERMINED BY THE IMPLANT METHOD COMPARED WITH CEPHALOMETRY

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AIM: To compare maxillary growth estimates during puberty as determined by the 'scientific method' compared with three common cephalometric methods.

SUBJECTS AND METHOD: Nineteen subjects (7 girls, 12 boys), from the maxillary implant study of Björk and Skieller (1972). The records were obtained three years before puberty (T1), and three years after puberty (T3). Tracings between T1 and T3 were assessed and changes during puberty were calculated. The scientific method involved measuring the displacement of the most anterior implant inserted in the maxilla to determine the direction and amount of actual maxillary growth. Horizontal and vertical displacement of point A was assessed according to three cephalometric methods (Bergin *et al*., Hack *et al*. and Pancherz). The values obtained from absolute, horizontal and vertical displacement of point A with the scientific method with those from the three methods were compared.
RESULTS: There were significant differences between the assessments using the scientific method and the three other methods ($P < 0.05$). All three methods overestimated changes in maxillary positioning compared with the scientific method. There were significant differences between the absolute displacement with the scientific method and the other three methods ($P < 0.001$). There was also a significant difference between the horizontal and vertical displacement assessments of the scientific method and the other three methods ($P < 0.05$).
CONCLUSION: Estimation of growth changes in maxillary positioning using the scientific method and common cephalometric methods were different. All the three cephalometric methods overestimated the growth changes in the maxilla.

417 AGEING EFFECTS OF STRAIN-STRESS AND THERMOCYCLING ON THE LOAD DEFLECTION OF NICKEL TITANIUM

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AIM: Nickel-titanium (NiTi) coil springs have been shown to perform better than stainless springs and elastomeric chains in terms of load deflection response to strain/stress. However, little data has been reported on the ageing effects of thermocycling on load deflection of such devices. The aim of this *in vitro* comparative study was to compare the load deflection generated by NiTi closed coil springs after the combined ageing effects of stress strain and thermocycling, which should more closely resemble oral environment conditions.
MATERIALS AND METHOD: Ninety 150 g NiTi closed coil springs, 30 from each of the following manufacturers: 1) 3M Unitek, Monrovia, California, USA, 2) Ormco Corporation, Glendora, California, USA, and 3) Novaxa Ortodonzia, Milan, Italy. Within each sample group, two equal subgroups of 15 springs were extended to either 20 or 30 mm, immersed in artificial saliva and kept at 37°C for a total of 45 days. All springs also underwent 1000 one minute long thermocycles from 5 to 55°C at 22 and 45 days. Force deflections were measured using a universal testing machine prior to strain/stress (baseline), and at 22 and 45 days, immediately after thermocycling.
RESULTS: At baseline, the load values ranged from 102.8 to 194.2 g and from 131.6 to 248.1 g under the 20 and 30 mm strain/stresses, respectively. Differences were seen at each time point, both at 20 and 30 mm stress/strain, generally with the greatest and lowest values recorded in the Ormco and 3M Unitek groups (all $P < 0.001$). Among the time points, the load deflections showed increases for the Ormco group, both at 20 and 30 mm stress strain, and a decrease for the Novaxa group at 20 mm stress strain (all $P < 0.001$).
CONCLUSIONS: The combined effects of strain/stress and thermocycling may produce noteworthy changes in load deflections of NiTi coil springs that must be taken into account in clinical practice.

418 IS NON-SYNDROMIC UNILATERAL HYPODONTIA OF A SECOND PREMOLAR ACTUALLY A BILATERAL ANOMALY?

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AIM: To test the hypothesis that dental maturity of the antimere in non-syndromic unilateral hypodontia of a second premolar is delayed compared with a control group without hypodontia.
MATERIALS AND METHOD: Panoramic radiographs of 20 Danish boys and 20 Danish girls (mean age 12 years for both groups) with non-syndromic unilateral hypodontia of a second premolar were evaluated with regard to dental maturity of the antimere and the second permanent molars according to the method of Haavikko. The results were compared with normative Danish data (Svanholt, 2008). In order to test for general delay in dental maturity, the sum of the delay of the four permanent second molars was subtracted from the delay in dental maturity of the antimere, to give a more precise estimate of the delay in maturity. Intra-observer reliability was tested.
RESULTS: For the group as a whole, the antimere showed a significant mean delay of 1.8 years for boys and 2.6 years for girls compared with Danish standards. The second permanent molars showed a significant mean delay of 1.1 years for boys and 2.3 years for girls compared with Danish standards. When using the second permanent molars as a reference for dental

maturity of the individual subjects, it was found that the mean delay was 0.6 and 0.3 years for boys and girls, respectively, which was still significant ($P < 0.001$). Initially, dental maturity of both the antimere and the second permanent molars was similar to the normative data, but became more delayed for each year the patient aged from 10 years. The degree of delay was similar for boys and girls.
CONCLUSIONS: The hypothesis was not refuted. Rather, the findings indicate that the process of development of other teeth, the antimere and the second permanent molars, is significantly slower in subjects with unilateral hypodontia of a second premolar, than in subjects without hypodontia.

419 JUVENILE CHRONIC ARTHRITIS – A SYSTEMATIC REVIEW: DENTOFACIAL MORPHOLOGY
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AIM: To systematically search for literature published on the impact of juvenile chronic arthritis (JCA) on dentofacial morphology.
MATERIALS AND METHOD: Several electronic databases (PubMed, Medpilot, Web of Science, DIMDI) were systematically searched for studies published until April 2008. Additionally, a hand search of the orthodontic and rheumatology literature and of the reference lists of the selected articles was performed. The retrieved articles were rated by two independent reviewers and included after three selection steps (title; abstract; full text).
RESULTS: The selection process resulted in the inclusion of 10 publications. The studies were characterized by great heterogeneity of the subject material comprising different types of JCA with or without temporomandibular joint (TMJ) affection. Explicit information on the dentofacial morphology in the different types of JCA (pauci-, polyarticular or systemic) was rare (n = 4) and none of these studies differentiated between subjects with or without condylar affection. Two studies evaluated pauci- and polyarticular JCA children with TMJ affection. Three authors analyzed the dentofacial differences in relation to condylar condition pooling all types of JCA and one study pooled both all types of JCA and TMJ conditions.
RESULTS: The average ANB and mandibular plane angles of the JCA patients was between 4.5–6.7 and 31–40 degrees, respectively, and was always larger than in healthy controls. Accordingly they exhibited increased lower anterior face heights while the upper face heights did not differ significantly from healthy controls. Subjects with a polyarticular onset type generally had higher ML/NSL angles than those with a pauci-articular onset.
CONCLUSIONS: Due to the heterogeneity of the subject material the comparability of the results is compromised. Nevertheless, it appears that JCA patients have smaller sagittal and increased vertical mandibular dimensions. Patients with a polyarticular onset seem to be at high risk for abnormal mandibular growth.

420 INFLUENCE OF FOOD CONSISTENCY ON FIBRE CHARACTERISTICS OF THE TEMPORALIS AND MASSETER MUSCLES
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AIMS: Muscle fibres can change their myosin heavy chain (MyHC) isoform and cross-sectional area (CSA) to adapt to different functional demands. Reduced muscle activity leads to faster fibres (MyHC IIX>IIA>cardiac α>I) with smaller CSAs. The aims of this study were to determine the MyHC composition and CSAs of temporalis and masseter muscles fibres and to assess how these parameters change in response to reduced masticatory demands.
MATERIALS AND METHOD: The MyHC composition and corresponding CSAs of fibres were determined in the temporalis and masseter muscles of male rabbits aged 20 weeks. Between 8 and 20 weeks of age the experimental animals (n = 8) had been fed pellets requiring a significantly lower force to break the pellet (10 N) in comparison with the standard pellets (120 N) fed to the controls (n = 8).
RESULTS: In the temporalis muscle an average of 0.1, 0.4, 70.8 and 20.6 per cent of the fibres of the experimental animals contained only MyHC I, cardiac α, IIA or IIX, respectively. These fibres had mean CSAs of 110, 363, 1519 and 3146 μm^2. The remaining fibres expressed more than one MyHC isoform (hybrid fibres). Proportions and CSAs of pure and hybrid fibres did not differ significantly from those of the controls ($P > 0.05$). In the masseter muscle an average of 0.1, 9.7, 59.2 and 0.6 per cent of the pure fibres of the experimental animals expressed MyHC I, cardiac α, IIA and IIX, respectively. These fibres had mean CSAs of 824, 1759, 4721 and 6116 μm^2. These values did not differ significantly from those of the controls ($P > 0.05$). The mean proportions and CSAs of hybrid fibres co-expressing MyHC cardiac α and MyHC I, however, were significantly lower ($P < 0.05$) in the experimental group (10.3%, 1085 μm^2) than in the control group (17.6%, 1258 μm^2).
CONCLUSION: A reduction in masticatory demands during development leads to an underdevelopment of slow fibres in the jaw-closing muscles that are mainly associated with force generation during chewing.
Supported by a European Orthodontic Society Research Grant

421 A COMPARISON OF LATEX AND NON-LATEX ORTHODONTIC ELASTICS IN THE ORAL ENVIRONMENT

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AIMS: To compare, *in vivo*, the force extension characteristics of natural rubber latex (NRL) and non-latex orthodontic elastics and to determine if they produce equivalent forces, after stretching in a standard oral environment.
MATERIALS AND METHOD: Four groups (n = 30) American Orthodontics™ (Sheboygan, Wisconsin, USA) quarter inch (6.4 mm) 4.5 oz NRL and non-latex elastics were tested. NRL and non-latex elastics were stretched in intra-oral and laboratory conditions for 24 hours. Force extension characteristics were determined by stretching the elastics from 0 mm to breaking point on a universal testing machine. Independent *t*-tests and equivalence ranges were used to determine significant differences in mean force production. The predetermined equivalence range at 19 mm extension was a mean difference [95% confidence interval (CI)] = 0 N (–0.15 N, 0.15 N).
RESULTS: NRL and non-latex elastics demonstrated equivalent force extension characteristics after stretching in laboratory conditions, mean difference (95% CI) in forces at 19 mm extension 0.07N (–0.135, –0.006). However, intra-oral conditions produced a significant difference ($P < 0.001$) between the groups of NRL and non-latex elastics, the mean difference (95% CI) = 0.4 3N (0.332 N, 0.525 N). This was found to be clinically significant.
CONCLUSIONS: Due to the reduction in force-extension characteristics over a 24 hour period in intra-oral conditions, American Orthodontic™ non-latex elastics cannot be recommended as a simple substitute for their NRL elastics. Alterations to their method of use would be needed to provide the same clinical outcome.

422 PATIENT PERCEPTIONS AND SATISFACTION WITH ALIGNER TREATMENT: A MULTI-CENTRE STUDY

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AIM: Invisalign® has recently gained increasing popularity among orthodontic patients. However, little scientifically based research data exists on why Invisalign® is increasing in popularity. The aim of this study was to investigate the gender and centre differences of patient perceptions and satisfaction with Invisalign® treatment.
SUBJECTS AND METHOD: One hundred and twenty six patients from three large orthodontic practices in three separate metropolitan areas across Canada were surveyed. Centre comparisons were made with the Kruskal-Wallis test. Multiple comparisons were made with the Mann-Whitney U test. Wilcoxon signed rank test was used to compare the genders.
RESULTS: Significant differences were found between the three centres regarding satisfaction with the progression of treatment, fashionability of the appliance and whether it would be recommended to others ($P < 0.05$). Mutiple comparisons analysis showed that patients from one of the centers were less satisfied with Invisalign® treatment. Invisalign® marketing to the public equally influenced both genders. However, females were more likely to be influenced by the endorsement from their orthodontist and their friends ($P < 0.05$). Additionally, females were more likely to be satisfied with the progression of their treatment ($P < 0.05$).
CONCLUSIONS: Patients' perceptions of Invisalign® differ significantly between different metropolitan areas. Male patients were less satisfied with the progression of treatment than females. However, the individual orthodontist may play a significant role in the perceived excellence and satisfaction of treatment with Invisalign®.

423 THE RELATIONSHIP BETWEEN BONE COLLAGEN PARAMETERS AND BONE STIFFNESS IN THE DEVELOPING MANDIBULAR CONDYLE

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AIM: Although the degree of mineralisation of bone is highly related to its stiffness, it only partially explains the variance in bone stiffness. It is likely that collagen, as the most abundant bone matrix component, is also related to bone stiffness. The aim of this study was to examine the extent to which collagen and bone stiffness are related.
MATERIALS AND METHOD: A total of 20 cancellous and cortical bone samples were derived from the right mandibular condyles of five young and five adult female pigs. The degree of mineralisation of bone was assessed using micro-computed tomography. The total collagen content and the number of hydroxylysylpyridinoline (HP), lysylpyridinoline (LP), and pentosidine (Pen) cross-links per triple helix of collagen were quantified using high performance liquid chromatography. Bone stiffness was assessed by nanoindentation. The relationship between collagen and bone stiffness was calculated using multiple linear regressions, separately for cancellous and cortical bone with the degree of mineralisation of bone as first predictor.
RESULTS: The collagen content and the number of HP cross-links did not differ between the two age groups. The number of Pen cross-links was lower in the adult group in both types of bone. Only in cancellous bone was the number of LP cross-links

lower in the adult group. The stiffness of cancellous bone did not differ between the two age groups, whereas cortical bone stiffness was higher in the adult group. The degree of mineralisation of bone explained almost 40 per cent of the variance in bone stiffness. Adding the total collagen content as a predictive factor increased the explained variance by 7 and 5 per cent for cancellous and cortical bone, respectively. The explained variance increased by an extra 9 per cent by taking the number of cross-links into account.
CONCLUSIONS: Although the degree of mineralisation of bone is the major factor, the collagen content and the number of HP, LP, and Pen cross-links are substantial determinants of bone stiffness.

424 EFFECT OF INSERTION TORQUE AND SITE ON FAILURE RATES OF ORTHODONTIC MINI-IMPLANTS: A PROSPECTIVE CLINICAL STUDY***
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AIMS: To clinically investigate the effect of insertion torque on failure rates of orthodontic mini-implants. In addition, the influence of different insertion sites was investigated.
MATERIALS AND METHOD: Two hundred and thirty four orthodontic mini-implants placed in 126 patients (46 males, 80 females; age, 20.6 ± 10.3 years). The diameter of the mini-implants ranged from 1.5 to 2.0 mm and the length from 7 to 13 mm. The relationship between insertion torques, insertion sites and failure of the mini-implants was analysed.
RESULTS: Mini-implant insertion torques ranged from 3 to 28 Ncm. The overall failure rate was 14.5 per cent (n = 34). There was a significant difference in mean insertion torques between the failed (8.0 ± 4.8 Ncm) and successful group (11.4 ± 5.7 Ncm) ($P = 0.0013$). Below an insertion torque of 7 Ncm the risk of implant failure significantly increased. The region with the lowest failure rate (5.6%) was the anterior palate.
CONCLUSIONS: Failure rates of mini-implants depend on the insertion torque. Below a value of less then 7 Ncm the risk of failure increases. The anterior palate compares very favourably with the alveolar ridges of the maxilla and the mandible in terms of failure rates.

425 EFFECT OF BLEACHING AGENTS ON AESTHETIC BRACKETS PREVIOUSLY STAINED BY FOOD – AN *IN VITRO* STUDY
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AIM: To investigate the effect of bleaching agents on the colour changes of aesthetic brackets previously discoloured by food.
MATERIALS AND METHOD: Seven specimens of six different tooth-coloured brackets (3 made of ceramic and 3 of various plastic materials), which had been stained by red wine, tea, coffee and curry, or used as controls in a former study (Wriedt *et al*., 2007) were bleached on six consecutive days for 55 minutes per day using 35 per cent carbamid-peroxide gel. The Easyshade® spectrophotometer was used to determine CIELCh coordinates, and the Euclidean distance ΔE was calculated to express colour changes in relation to the start of testing. Before and after the bleaching procedure the bracket slots were measured twice using a ×10 power microscope. ANOVA, corrected according to Tukey-Kramer, and the Mann-Whitney U-test were performed. $P < 0.001$ was considered statistically significant.
RESULTS: After the first bleaching process, all brackets, especially those stained with tea, were bleached strongly ($P < 0.001$). During testing the wine stained brackets showed remarkable colour changes ($P < 0.001$). The extremely discoloured curry stained bracket made of polyoxymethylene changed colour most during the first process, but did not reach the range of normal tooth colour at the end of the whole procedure ($P < 0.001$). At the end of testing some brackets showed a more yellowish colour, independent of the type of bracket or staining. Although use marks could be observed on the brackets after testing, there were no measurable changes in slot dimension.
CONCLUSIONS: During treatment with fixed appliances the use of bleaching agents can reduce staining by food. However, it should be taken into account that there might be unfavourable reactions to the enamel surface and/or the bracket material caused by the bleaching process.
Wriedt S, Schepke U, Wehrbein H 2007 The discoloring effects of food on the color stability of esthetic brackets – an *in-vitro* study. Journal of Orofacial Orthopedics 68: 308-320

426 ADOLESCENT EXPERIENCES, CONSENT AND COMPLIANCE IN ORTHODONTIC TREATMENT
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AIM: To assess the influence of two different methods of information delivery on adolescent orthodontic experiences and compliance.

SUBJECTS AND METHOD: Seventy-six adolescents (12–16 years) due to start fixed appliance therapy. This was a prospective, randomised, questionnaire based study. The participants were randomised into either control/intervention groups. Both groups received the same verbal information about fixed appliances: in addition the intervention group received a leaflet. Adolescents' experiences were assessed using a 16-point questionnaire that measured anxiety, motivation and apprehension. The questionnaire was completed at three time points in the treatment pathway; prior to meeting the orthodontic clinician (T1), following consent to treatment (T2) and after 12 weeks (T3). Appointment attendance, breakages and level of oral hygiene were used to determine patient compliance. Non-parametric tests were used to analyse the data. A *P*-value of 0.05 was considered significant throughout.
RESULTS: Sixty participants completed the study (control group n = 31; intervention group n = 29). At T2, there was no change in anxiety scores for either group ($P = 0.412$). There was a statistically significant difference with regard to motivation; the intervention group was more motivated than the control group ($P = 0.049$). At T3 both groups demonstrated non-statistically significant reductions in anxiety ($P = 0.311$), treatment motivation ($P = 0.756$) and apprehension ($P = 0.790$). The intervention group displayed better oral hygiene ($P = 0.065$), appointment attendance ($P = 0.732$) and fewer breakages ($P = 0.525$) than the control group – these were not statistically significant.
CONCLUSIONS: When obtaining consent from adolescent patients to undertake fixed appliance therapy, supplementation of verbal information with written information was found to have several positive effects. Therefore, it is recommended that both verbal and written information is routinely provided as part of the consent process.

427 MICROLEAKAGE UNDER ORTHODONTIC BRACKETS BONDED WITH INDIRECT BONDING TECHNIQUES

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AIM: To compare, *in vitro,* microleakage between the enamel/composite and composite/bracket interface at the occlusal and gingival margins of brackets bonded using indirect bonding systems compared with a conventional direct bonding method.
MATERIALS AND METHOD: Forty freshly extracted human maxillary premolar teeth were randomly divided into two equal groups: group 1 were bonded directly according to the manufacturer's recommendation and group 2 indirectly with Transbond XT, as the adhesive, and Sondhi Rapid Set A/B Primer (3M Unitek, Monrovia, California, USA), a filled resin primer. After bonding, the specimens were further sealed with nail varnish, stained with 0.5 per cent basic fuchsine for 24 hours, sectioned, examined under a stereomicroscope, and scored for microleakage at the enamel-adhesive and bracket-adhesive interfaces from both the occlusal and gingival margins. Statistical analyses were performed using Kruskal-Wallis and Mann-Whitney U tests.
RESULTS: The gingival sides of group 1 displayed a high median microleakage score than the occlusal side at the enamel/composite interface, but this was not statistically significant ($P > 0.05$). All occlusal margins in both groups showed no microleakage under orthodontic brackets at the enamel/composite or composite bracket interfaces. Statistical comparisons of the microleakage scores between the two groups at the enamel/composite and composite/bracket interfaces indicated that the type of bonding method did not significantly affect the amount of microleakage at the gingival or occlusal margins. The type of bonding method (direct versus indirect) did not significantly affect the amount of microleakage at the enamel-adhesive-bracket complex.

428 EFFECTS OF THE LOWER LIP LEVEL ON UPPER INCISOR INCLINATION IN CLASS II DIVISION 2 MALOCCLUSIONS

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AIM: Class II division 2 malocclusions are characterized by retroclination of the upper incisors, a Class II molar relationship and a deep overbite. Retroclination of the upper incisors and post-treatment relapse seen in Class II division 2 malocclusions is caused by non-physiological lip pressure against these teeth. The causes of increased resting lip pressure may include a high lip line relative to the upper incisors and/or hyperactivity of the perioral musculature. The aim of this study was to investigate the relationship between the lower lip level and retroclination of the upper incisors and overbite.
MATERIALS AND METHOD: Pre-treatment lateral cephalometric radiographs of two groups, Class I and Class II division 2 malocclusions. The Class II division 2 group consisted of 15 subjects (5 males, 10 females; mean age 14 years 9 months). Upper incisor inclination was less than 104 degrees and overbite was more than 3 mm for all subjects in this group. The Class I malocclusion group included 15 subjects (5 males, 10 females; mean age 15 years 4 months). Upper incisor inclination, overbite, ventral lip line level (VLLL), dorsal lip line level (DLLL) and lower lip level (LLL) measurements were compared between the groups. An independent sample *t*-test was used for cephalometric evaluation with a level of 95 per cent confidence ($P < 0.05$).

RESULTS: Differences between the groups for upper incisor inclination, overbite, VLLL, DLLL and LLL values were statistically significant ($P < 0.05$). The mean values of VLLL, DLLL, LLL and overbite were higher in the Class II division 2 malocclusion group than in the Class I group.
CONCLUSIONS: A high lower lip level and lower lip shape are significant aetiological factors for upper incisor retroclination and increased overbite in Class II division 2 malocclusions.

429 EFFECTS OF LASER AIDED COLONY STIMULATING FACTOR AND LASER IRRADIATION ON ORTHODONTICALLY ROTATED TEETH IN BEAGLE DOGS

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AIM: To investigate the effectiveness and periodontal side-effects of laser colony stimulating factor (CSF) and low level laser irradiation on orthodontically rotated teeth in beagle dogs.
MATERIALS AND METHOD: Nine dogs divided into three groups: group A with orthodontic couple force only (control), group B with orthodontic couple force plus laser CSF and group C with orthodontic couple force plus low level laser irradiation. Both mandibular lateral incisors were rotated for 4 weeks and were observed without any retainers for 4 weeks. The amount of relapse, sulcus depth and gingival recession were measured at weeks 1, 4 and 8. The tissue specimens were examined at week 8 under light microscopy with haematoxylin and eosin and Masson's trichrome staining.
RESULTS: 1. Laser CSF significantly alleviated relapse following rotation. There was a mean 14.52 per cent relapse after laser CSF compared with a mean of 41.29 per cent in the controls. Four weeks after laser CSF, sulcus depth increased to 0.67 mm with no gingival recession. 2. Four weeks after laser CSF, the organizational pattern appeared to consist of healthy tissues in a state of repair without any histological alteration in bone and tooth. 3. Low level laser irradiation for 4 weeks promoted relapse tendency (mean value, 56.80%) compared with the control group. There was no significant difference in sulcus depth and gingival recession in the control group. 4. Four weeks after low level laser irradiation, supragingival fibres resembled the density and arrangement of the fibre pattern in the control group.
CONCLUSION: Laser CSF is an effective procedure to decrease relapse following rotation with no apparent damage to the supporting periodontal structures of the teeth. Low level laser irradiation on orthodontically rotated teeth without any retainers, increases relapse tendency.

430 EFFECTS OF ER:YAG LASER ETCHING ON ORTHODONTIC BOND STRENGTH, SURFACE CHARACTERISTICS AND MINERAL CONTENT OF ENAMEL

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AIM: To evaluate orthodontic bond strength, enamel surface characteristics and mineral content of teeth prepared for bonding with erbium-doped yttrium aluminium garnet (Er:YAG) laser etching, and to compare laser etching with phosphoric acid etching.
MATERIALS AND METHOD: For assessment of orthodontic bond strength, 40 premolars, extracted for orthodontic purposes, were randomly divided into two groups, and laser or phosphoric acid etching methods were used to prepare the tooth enamel in each group. After surface preparation, a light-cured adhesive was applied to the specimens for orthodontic bonding under standardized conditions. The brackets were debonded 24 hours later and shear bond strengths were measured with a universal testing machine. Additionally, the adhesive remnant index (ARI) scores of all specimens were recorded. For assessment of surface characteristics a new study group was designed. Fifty premolars were randomly divided into five groups: control group (no surface treatment), laser etching group (no orthodontic bonding), acid etching group (no orthodontic bonding), debonded laser etching group (ARI score 0) and debonded acid etching group (ARI score 0). Scanning electron microscopy and wavelength dispersive X-ray fluorescence spectrometry were used for analyzing the surface characteristics and mineral content of the enamel.
RESULTS: Er:YAG laser etching showed statistically similar orthodontic bond strength values to conventional acid etching for bonding brackets. The surface characteristics and mineral content of the enamel significantly changed with both etching modalities, before and after bonding.
CONCLUSIONS: Er:YAG laser etching can be an alternative to conventional acid etching, but effects of the preparation methods on the structural characteristics of the enamel must be taken into account.

431 OCCLUSAL EVALUATION OF MAXILLARY THIRD MOLARS AFTER MAXILLARY SECOND MOLAR EXTRACTION

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AIM: To evaluate the erupted state of maxillary third molars after maxillary second molar extraction.

MATERIALS AND METHOD: Diagnostic models of 80 treated patients. The occlusal status of the third molar was evaluated and divided into three groups of good, acceptable and poor according to the number of occlusal contact points and contact with the adjacent tooth, and discrepancy from the line of occlusion. Each group was evaluated according to six categories of size, rotation, contact, in-out distance, buccolingual angulation and mesiodistal angulation. The size of the third molar was compared in percentage to the first molar, rotation was evaluated by the angle between the line of occlusion and the buccal cusp of the third molar, in-out distance was determined by the position of the third molar from the line of occlusion, and buccolingual and mesiodistal angulation was measured with a torque angulation device.
RESULTS: 1. There was no statistically significant difference in size and mesiodistal angulation of the third molar between the three groups ($P > 0.05$). 2. The third molars in the good occlusion group had significantly higher scores for rotation, contact, in-out distance and buccolingual angulation followed by the acceptable and poor occlusion groups in descending order ($P < 0.05$). 3. For all three groups, scores for rotation and in-out distance were relatively low, indicating that regardless of the occlusion, the amount of rotation and in-out distance discrepancy from the line of occlusion is compromised in cases of third molar eruption followed by second molar extraction.
CONCLUSION: Most maxillary third molars erupt after second molar extraction, however there are variations in eruption features that may affect occlusion.

432 ANTIMICROBIAL ACTIVITIES OF FORTY TRADITIONAL CHINESE MEDICINES ON ORAL BACTERIA: AN EXPERIMENTAL STUDY

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Dental caries and periodontal disease are common human diseases that affect a large majority of subjects, in particular, orthodontic patients with fixed appliances which prove to be more susceptible to both of them (Geiger *et al*., 1992). Microorganisms in oral biofilm are the major aetiological agents of dental caries. The 'pioneer species' of oral biofilm are *Streptococcus oralis*, *S. mitis* and *S. sanguis*. There are also specific bacteria that are closely related to specific dental diseases, for example, *S. mutans* and *Porphyromonas gingivalis* are associated with dental caries and periodontal disease, respectively (Samaranayake, 2006). Traditional Chinese medicines (TCM) have been used in China to treat various infectious diseases for more than 4000 years. Different from western medicine, TCM works as a formula of herbs that is tailored to individual patients under their specific condition (Eisenberg, 1998). Recently the mechanism of one of these formulae has been investigated at the molecular, cellular and organism levels (Wang *et al*., 2008).
Certain TCM have been shown to have antibacterial properties (Seneviratne *et al*., 2008) but so far none has shown to have any known resistance. Currently, a number of TCM herbs are used in oral healthcare products such as toothpaste according to their effects. Yet few studies have been performed to screen these TCM and evaluate their effectiveness against oral bacteria forming oral biofilm. Forty TCM herbs were selected for investigation as they are used to treat infections and diseases in different parts of body. The aim of this study was to evaluate *in vitro* 40 TCM herbs that are currently used to treat infectious diseases for their antimicrobial activity against bacteria in oral biofilm that cause caries and periodontal disease. The null hypothesis is the TCMs investigated have no effect against the four common oral bacteria.

433 CANINE ERUPTION IN CLEFT LIP AND PALATE PATIENTS GRAFTED WITH BONE MORPHOGENIC PROTEIN-2

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AIM: To compare the eruption pattern of the cleft-side canine grafted with bone morphogenic protein-2 (BMP-2) with those grafted with iliac crest bone graft.
SUBJECTS AND METHOD: Twelve patients, aged 9–11 years, with non-syndromal unilateral alveolar clefts were selected and randomly allocated to two equal groups. The first group underwent grafting of the alveolar cleft defect with BMP-2 while the second group was grafted using a traditional iliac crest graft. A third control group was selected from the contralateral canines on the non-cleft side of the same patient. Standardized pre-treatment radiographs, including panoramic, occlusal, and periapical, in addition to computed tomograms, were taken before grafting and were compared with those obtained 6 months post-treatment. Canine eruption was evaluated clinically in both groups. The radiographs were reviewed by two clinicians with a 1 week period between assessments. Linear and angular measurements, including interalveolar septal height, were analyzed. A Student's *t*-test was used to compare the groups.
RESULTS: Canines that erupted through grafted alveolar defects with BMP-2 showed a higher percentage (85%) of intact levels of clinical attachment than those erupted through alveolar defects grafted traditionally. Canines in the BMP-2 group erupted without a significant change in angular measurement. All cases grafted with BMP-2 showed

canine eruption and there was no need for surgical intervention. Only one case in the second group showed failure of canine eruption. Continued evidence of root development and eruption of canines in the grafted alveolar clefts was achieved in the BMP-2 group.
CONCLUSIONS: Grafting with BMP-2 resulted in a satisfactory peridontium to support the canines as they erupted through the grafted defect. Improved bone healing and decreased post-operative pain was achieved with BMP-2 grafting.

434 THREE-DIMENSIONAL ASSESSMENT OF MUSCULOSKELETAL FEATURES IN CLASS II AND CLASS III PATIENTS

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AIM: To evaluate and compare three dimensional (3D) morphology of the masseter and medial pterygoid muscles and mandibular skeletal parameters between subjects with skeletal Class II and Class III malocclusions.
SUBJECTS AND METHOD: Thirteen patients with a skeletal Class II and 10 with a skeletal Class III malocclusion with no clinically evident asymmetry prior to the start of combined orthodontic treatment and orthognathic surgery. Magnetic resonance imaging was performed for the mandibular muscles and the following two- and 3D measurements were carried out: cross-sectional area (CSA), thickness, width, longitudinal dimension and volume. A 3D multi-slice computed tomography investigation was undertaken for assessment of the skeletal mandibular parameters and the following were measured bilaterally: height of the mandibular ramus, length of the mandibular corpus, overall mandibular length, intergonial width. Data were analyzed using descriptive statistics, *t*-tests, and correlation coefficients.
RESULTS: All mandibular and medial pterygoid measurements were significantly greater in the Class III subjects ($P < 0.05$). There was a tendency for all masseter variables to be greater in the Class III patients. Positive correlations were found between muscle volume and CSA in both groups, muscle volume and all mandibular parameters and muscle CSA and all mandibular variables, except for intergonial width in Class II patients. Overall symmetry was observed between the left and right sides for all muscular and mandibular measurements in both groups.
CONCLUSIONS: Significant differences were observed between the study groups for both skeletal and muscular measurements.

435 ANALYSES OF THE POSTURE OF THE HYOID BONE DURING ORTHODONTIC TREATMENT

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AIM: To study the movement of the hyoid bone and of the cervico-mental soft tissue in patients undergoing orthodontic or surgical-orthodontic treatment.
SUBJECTS AND METHOD: Fifty patients with a skeletal Class II or Class III malocclusion, 25 treated orthodontically and 25 by surgical-orthodontic treatment. The clinical and paraclinical documentation pre- and post-treatment showing the position of the hyoid bone in the hypo- and hyperdivergent subjects were analysed. The following parameters were analysed: occlusal relationship, dento-skeletal relationship, aesthetics and muscular tonicity. Soft tissue analysis: for each facial image an aesthetic score was attributed, which permitted analysis of the differences between the samples. The following measurements were undertaken on the radiographs: Rocabado triangle (5) Solow and Tallgren (6): seven dento-skeletal points, five soft tissue points, four angular measurements, 24 values and 28 parameters. Eleven parameters that identify and verify the correction of muscular dysfunctions were determined electromyographically.
RESULTS: On the 9th and 11th scans the following were observed: annealing of values with the increase of masseter muscle potential and improvement of the contraction force in habitual occlusion; annealing of functions of suprahyoid muscles implicated in physiological swallowing with symmetrical potential and normal values. Correlation between sagittal and vertical movements of the hyoid bone and those of the anterior mandibular skeletal points.
CONCLUSIONS: There is a strong correlation between the position of the hyoid bone and the cervical cutaneous profile. The hyoid bone seems to be more related to the mandible than to the tongue.

436 EFFECT OF A MOUTHRINSE CONTAINING ESSENTIAL OILS ON DIFFERENT MATERIALS PRESENT IN ORAL CABITY

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AIM: Mouthrinses containing essential oils are effective in plaque and periodontal disease control. However, no information is available in the literature about the effect on materials present in the oral cavity. The aim of this laboratory study was to investigate the possible effects of Listerine® mouthrinse on the surface composition of dental materials and devices (glass-ionomer, composite resin and bracket).

MATERIALS AND METHOD: The surfaces of two dental materials and of the bracket were compared by visible and scanning electron microscopy. Half of the specimens were immersed in distilled water for 30 seconds twice a day for 30 days and the other half in Listerine® using the same procedure. At the end of the experiment the surfaces of the specimens were observed and hardness testing was undertaken using Wallace hardness testing instruments.
RESULTS: The difference between the two groups was not significant, indicating that the routine use of Listerine® mouthrinse containing essential oils has no adverse effect on the surfaces of glass-ionomer, composite resins or bracket surface composition.

437 THE ROLE OF ORAL HYGIENE METHODS IN PATIENTS WITH FIXED ORTHODONTIC DEVICES

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AIM: Plaque adheres to the outer surfaces of appliances and arches, the spaces that surround them, and interdental spaces. This results in decreased possibilities for maintaining oral hygiene that may lead to soft tissue inflammation and caries. The aim of this study was to compare the role of oral hygiene in patients with fixed orthodontic devices with and without appropriate education.
SUBJECTS AND METHOD: Fifty subjects (27 females, 23 males) aged 16 to 25 years, divided into two groups. Group 1 comprised individuals with appropriate oral hygiene education, and group 2 subjects who were not specially educated.
RESULTS: In group 1 no soft tissue inflammation or caries were observed after placement of the fixed appliances. In group 2, 17.33 per cent of subjects had soft tissue inflammation and 4.6 per cent (5 patients) caries.