

FEATURES SECTION

Evidence-based orthodontics

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Orthodontics and Craniofacial Research

Effects of low-level laser therapy on the rate of orthodontic tooth movement. *Orthod Craniofacial Res* 2006; 9: 38–43

Limpanichkul W, Godfrey K, Srisuk N, Rattanayatikul C

Objectives: To evaluate the effect of low-level laser therapy (LLLT) on the rate of orthodontic tooth movement.

Design: A split-mouth, double blind, randomized control trial.

Setting: Khon Kaen University, Thailand.

Participants: 12 patients, (4 male, 8 female) mean age 20.11 ± 3.4 years, having had maxillary first premolar extractions and needing fixed appliance therapy combined with maxillary first premolar extractions.

Interventions: Patients had pre-adjusted edgewise brackets bonded on all teeth except the maxillary canines which were bonded with self-ligating brackets. Immediately prior to beginning canine retraction with NiTi closing springs, either a placebo or LLLT was applied to the mucosa surrounding the maxillary canines. This was repeated for three days and again for three days each month for the following three months.

Outcome measures: Canine retraction was measured by superimposing serial dental cast taken at the start and then monthly for three months, using a reflex metrograph.

Results: The mean difference in canine retraction after three months was 0.01 mm ($SD \pm 0.17$, 95% CI -0.35 , 0.37 ; $P=0.97$) suggesting that there was no statistically significant difference in the amount of distal movement of the canine.

Conclusion: Low-level laser therapy, at an energy density of 25 J/cm, had no effect on the rate of orthodontic tooth movement.

Implications: It appears that low-level laser therapy conveys no advantage or disadvantage in terms of the rate of orthodontic tooth movement.

American Journal of Orthodontics and Dentofacial Orthopedics

Comparison of bond strength between orthodontic brackets bonded with halogen and plasma arc curing lights: an *in vitro* and *in vivo* study. *Am J Orthod Dentofacial Orthop* 2006; 129: 277–82

Signorelli MD, Kao E, Ngan PW, Gladwin MA

Objectives: To compare the *in vitro* shear bond strength and the *in vivo* survival rate of orthodontic brackets cured with a conventional halogen or plasma arc light.

Design: *In vitro:* randomized controlled trial. *In vivo:* a split-mouth controlled clinical trial.

Setting: West Virginia University, WV, USA.

Participants: *In vitro:* 90 extracted human teeth. *In vivo:* 25 patients undergoing fixed appliance therapy (445 teeth).

Interventions: *In vitro:* adhesive precoated brackets (APC) were cured to teeth using either a halogen (Ortholux XT, 3M Unitek, Monrovia, CA, USA) or plasma arc (OrthoLite, 3M Unitek) light for 2, 6, 10 or 20 seconds. Brackets were debonded after 30 minutes or after 24 hours thermocycling. *In vivo:* APC brackets were bonded in all quadrants and were cured with either a halogen light for 20 seconds or plasma arc light for 6 seconds.

Outcome measures: *In vitro:* bond strength and modified adhesive remnant index (ARI) score. *In vivo:* Quadrant and date of bracket failure and ARI score.

Results: *In vitro:* significant differences in the bond strength were found between the 6 test groups ($P<0.0001$). No statistically significant differences were found between the two curing techniques for the ARI scores of brackets debonded at 30 seconds or 24 hours. *In vivo:* 445 teeth, in 25 patients, were bonded. There were 11 bracket failures in each group. There were no statistically significant differences in the bracket failure rate (4.9%) or the ARI scores between the two groups.

Conclusion: Curing APC brackets with a plasma arc light for 6 seconds produces equivalent bond strengths, bond failure rates and adhesive remnant at debond when compared to curing with a conventional halogen light for 20 seconds.

Implications: It appears that curing APC brackets for 6 seconds with a plasma arc light is a viable and time saving alternative to curing for 20 seconds with the conventional halogen light.

In vivo comparison of force decay between injection molded and die-cut stamped elastomers. *Am J Orthod Dentofacial Orthop* 2006; 129: 384–89

Bousquet JA Jr, Tuesta O, Flores-Mir C

Objectives: To assess the effects of two different fabrication techniques on elastomeric chain force decay level.

Design: Split-mouth, randomized control trial.

Setting: Graduate Orthodontic Clinic, Lima, Peru.

Participants: Twenty-four patients, undergoing fixed appliance treatment, who required extraction of a premolar in each quadrant.

Interventions: Die-cut stamped or injection moulded elastomeric chain (American Orthodontics, Sheboygan, WI, USA) was placed in diagonally opposite quadrants, at a measured force of 200 g, from the hook on the first molar to the distal wings of the canine bracket to retract the canine. Dietary pH was regulated by using a controlled diet for all participants.

Outcome measures: Force levels were measured initially and after the elastomeric chain had been *in situ* for intervals of 1, 24, or 48 hours, 7, 14 or 21 days.

Results: No statistically significant difference ($P > 0.05$) was reported between the force decay of the two types of elastomeric chains at any of the time intervals. However, the greatest amount of force decay occurred within the first hour with the die-cut chain losing 31 g ($SD \pm 3.5$ g) and the injection moulded chain 39.4 g ($SD \pm 6.7$ g) of force ($P < 0.001$).

Conclusion: This study suggests that there is no difference in force decay levels of elastomeric chain produced by either die-cut stamped or injection moulded techniques.

Implications: It appears that elastomeric chain made using both techniques loses force, especially over the first hour, but that this is similar. It would be interesting

to see how this is translated into the rate of tooth movement produced by the two types of chain.

A prospective study of the treatment effects of a removable appliance with palatal crib combined with high-pull chin-cup therapy in anterior open-bite patients. *Am J Orthod Dentofacial Orthop* 2006; 129: 418–23

Pedrin F, Almeida MR, Almeida RR, Almeida-Pedrin RR, Torres F

Objectives: To evaluate radiographically the skeletal and dentoalveolar effects of high-pull chin-cup therapy when combined with a removable appliance.

Design: Randomized clinical trial.

Setting: Bauru Dental School, São Paulo, Brazil.

Participants: Sixty patients, aged 7–10 years, with a Class I incisor relationship and anterior open bite (AOB) > 1 mm. Patients had no posterior cross-bites, crowding or missing teeth.

Interventions: Participants were randomly allocated to either observation only or treatment with removable appliance and high-pull chin-cup at 450–550 g for 14–16 hours per day for 12 months.

Outcome measures: Dental and skeletal variables were measured from lateral cephalometric radiographs.

Results: There were no statistically significant differences in the sagittal or vertical skeletal relationships between both groups. There were statistically significant differences in the mean overbite change with the overbite increasing in the treatment group by 5 mm ($SD \pm 1.7$) and 1.4 mm ($SD \pm 1.5$) in the control group ($P < 0.001$). These changes corrected the AOB in 80% of the treatment group and 13% of the control (chi square 26.1; $df = 1$; $P < 0.001$).

Conclusion: This study found no skeletal effects associated with the combined removable appliance and high-pull chin-cup treatment in the mixed dentition. Reduction of the anterior open bite occurred by dentoalveolar change.

Implications: It appears that the palatal crib, in association with the chin-cup, was effective at reducing the AOB in these children. It will be interesting to read whether these changes are maintained in the long term.

Physical properties of root cementum: part 7. Extent of root resorption under areas of compression and tension. *Am J Orthod Dentofacial Orthop* 2006; 129: 504–10

Chan E, Darendeliler MA

Objectives: To quantify the extent of root resorption caused by heavy and light tipping forces.

Design: Split-mouth randomized controlled trial.

Setting: Sydney Dental Hospital, Australia.

Participants: Sixteen patients (36 teeth) with a mean age of 13.9 years requiring bilateral first premolar extractions prior to orthodontic treatment.

Interventions: Participants were randomly allocated to receive either a heavy (225 g) or a light (25 g) buccally tipping force via a cantilever spring to one first premolar for 28 days. The contra lateral premolar served as a control receiving no active force. The first premolars were subsequently extracted to allow scanning electronic microscope (SEM) imaging of the root.

Outcome measures: The root surfaces were imaged to allow volumetric analysis of any resorption craters.

Results: Over eight times more resorption occurred in the bucco-cervical region of the root when heavy rather than light buccally tipping force was applied ($P < 0.01$). There was more root resorption in the high-compression regions than in the other regions ($P < 0.01$). Regions under compression had more root resorption than regions under tension.

Conclusion: High force levels and compressive forces appear to produce more root resorption than light forces and areas under tension.

Implications: It would be interesting to see the effects of a longer period of force application and whether there was any capacity for healing of the roots when forces were reduced. This study suggests that as orthodontists we should aim to keep the forces we apply to teeth low in order to minimize the iatrogenic damage to the roots that can occur when heavier forces are applied.

Comparison and measurement of the amount of anchorage loss of the molars with and without the use of implant anchorage during canine retraction. *Am J Orthod Dentofacial Orthop* 2006; 129: 551–54

Thiruvengkatachari B, Pavithranand A, Rajasigamani K, Kyung HM

Objectives: To compare molar anchorage loss during canine retraction with and without the use of micro-implants.

Design: Split-mouth clinical trial.

Setting: Rajah Muthiah Dental Hospital, Tamil Nadu, India.

Participants: Ten patients (3 male and 7 female) aged between 18 and 25 years undergoing fixed appliance therapy. All cases were considered to be anchorage demanding having undergone first premolar extractions.

Interventions: Micro-implants (1.2 mm diameter and 9 mm length) were placed between the molar and premolar on the selected side whilst no anchorage reinforcement was used on the contralateral molar. Implants were placed either in both arches or the maxillary arch alone. Canine retraction started 15 days after implant placement using 100 g NiTi coil springs from the canine to the implant or the molar, until a Class I canine relationship was achieved.

Outcome measures: Dental and skeletal variables were measured from lateral cephalometric radiographs taken before and after canine retraction.

Results: All canines were retracted to Class I within six months. No molar anchorage loss occurred on the implant side. There was a mean of 1.6 mm and 1.7 mm anchorage loss in the maxillary and mandibular arches respectively on the contralateral side.

Conclusion: Micro-implants appear to be effective at preventing molar anchorage loss when used for canine retraction.

Implications: It appears that micro-implants are a viable option for reinforcing anchorage when retracting canines which would be useful in anchorage demanding cases.

Mandibular changes produced by functional appliances in Class II malocclusion: a systematic review. *Am J Orthod Dentofacial Orthop* 2006; 129: 599.e1–12

Cozza P, Baccetti T, Franchi L, De Toffol L, McNamara JA Jr

Objectives: To assess the effectiveness and the efficiency of functional appliances in enhancing mandibular growth.

Design: A systematic review.

Data sources: Medline and the Cochrane Clinical Trials Register (www.cochrane.org/reviews) were searched to identify articles published between January 1966 and January 2005 that assessed the effects of functional appliances on mandibular growth and length.

Study selection: Studies, reported in English, that were RCTs, meta-analyses, CCTs and prospective or

retrospective longitudinal and included measurable mandibular cephalometric values with respect to untreated Class II controls.

Data extraction: Data on the horizontal and vertical dimension of the mandible were extracted and converted to an annualized change. An assessment of methodological quality of the studies was undertaken.

Data synthesis: Data on annualized change in the cephalometric measurements were pooled from the included articles.

Results: The search strategy identified 704 articles, of which 22 studies (4 RCTs, 2 prospective and 16 retrospective CCTs) met the inclusion/exclusion criteria for analysis. The methodological quality was low in 3 studies, medium in 13 studies and medium/high in 6 studies. The patients were aged between 8 and 13.5 years. The average duration of treatment was 17 months. Two-thirds of the samples in the 22 studies reported a clinically significant (>2 mm) supplemental mandibular growth with functional appliance treatment. The average coefficient of efficiency was 0.16 mm per month. The Herbst and the twin-block appliances were the most efficient with co-efficient of effectiveness of 0.28 mm and 0.23 mm per month respectively. The amount of supplemental growth appeared to be larger if the functional treatment was performed at the pubertal peak. None of the RCTs reported a clinically significant change in mandibular length.

Conclusion: Functional appliances do increase mandibular length by 2–3 mm per year of treatment with the Herbst and twin-block being the most efficient.

Implications: This systematic review suggests that some clinically significant supplemental growth can be achieved when using functional appliances especially if used around the peak growth spurt. However, this meta-analysis should be viewed with caution as it included data from studies of diverse quality. It would have been interesting to see the results of a sensitivity analysis with the lower quality studies excluded from the meta-analysis.

European Journal of Orthodontics

A prospective, randomized clinical study on the effects of an amine fluoride/stannous fluoride toothpaste/mouthrinse on plaque, gingivitis and initial caries lesion development in orthodontic patients. *Eur J Orthod* 2006; 28: 8–12
Øgaard B, Alm AA, Larsson E, Adolfsson U

Objectives: To examine the effects of the combined use of amine fluoride/stannous fluoride (AmF/SnF₂; Meridol,

GABA international, Switzerland) toothpaste and mouthwash on demineralization, plaque, and gingivitis.

Design: Double-blind randomized control trial.

Setting: Orthodontic clinics in Falköping and Lidköping, Sweden.

Participants: 115 orthodontic patients (42 male, 73 female) mean age 14.4 years undergoing fixed orthodontic therapy.

Interventions: Participants were randomly allocated to use a daily toothpaste and mouthwash combination containing either amine fluoride/stannous fluoride (experimental group) or sodium fluoride (control group) for the duration of their orthodontic treatment.

Outcome measures: Pre- and post-treatment photographs and clinical examinations of the six maxillary anterior teeth were used to record the white spot lesion index (WSL), visible plaque index (VPI) and gingival bleeding index (GBI).

Results: Ninety-seven of the original 115 patients completed treatment. Statistically significant differences were found between the pre- and post-treatment scores for the sodium fluoride group for WSL, VPI and GBI ($P < 0.01$). No statistically significant differences were found for any of the outcomes in the amine/stannous fluoride group. The percentage of new lesions was higher in the sodium fluoride group (7.2%) compared to amine/stannous fluoride (4.7%) but this difference was not statistically significantly different (OR 1.67; 95% CI 0.81, 3.42).

Conclusion: The combined use of an AmF/SnF₂ toothpaste and mouthwash regime appears to reduce the adverse effects of orthodontic treatment on gingival health and demineralization.

Implications: The AmF/SnF₂ toothpaste and mouthwash regime may be of clinical benefit for patients undergoing orthodontic treatment in order to minimize decalcification and the development of WSL. It would be worthwhile assessing the effectiveness of this regime in a population whose baseline oral hygiene is lower than in this group.

Soft tissue facial profile changes following functional appliance therapy. *Eur J Orthod* 2006; 28: 35–41
Quintão C, Helena I, Brunharo VP, Menezes RC, Almeida MA

Objectives: To assess the changes in soft tissue profile associated with early twin-block treatment.

Design: Controlled clinical trial.

Setting: Department of Orthodontics, University of Rio de Janeiro, Brazil.

Participants: Thirty-eight children (24 male, 16 female) aged 8–11 years with Class II skeletal pattern and overjet ≥ 6 mm. All patients were assessed as just starting their pubertal growth spurt.

Interventions: Participants were recruited from those patients waiting for treatment at the graduate clinic. They were allocated to be treated with a twin-block appliance or observed for 12 months. The method of allocation is unclear.

Outcome measures: Changes in soft tissue variables as measured from lateral cephalometric radiographs taken at the start of treatment and 12 months later.

Results: All patients completed treatment. Facial harmony was improved in the twin-block group primarily due to retraction of the upper lip and anterior movement of soft tissue pogonion ($P < 0.05$).

Conclusion: Early treatment with the twin-block appliance appears to improve the facial profile in the short term however, the duration of these effects is unknown.

Implications: The twin-block appliance appears to improve patients' facial profile in the short term but this is largely due to changes in the position of the teeth, in particular the upper incisors, rather than skeletal change. The early benefits of this treatment need to be assessed in the longer term to assess the true benefits of this treatment.

Relationship between substance P and interleukin-1 β in gingival crevicular fluid during orthodontic tooth movement in adults *Eur J Orthod* 2006; 28: 241–46

Yamaguchi M, Yoshii M, Kasai K

Objectives: To measure substance P (SP) and interleukin-1 β (IL) levels in gingival crevicular fluid (GCF) during tooth movement and to investigate the interdependence between SP and IL.

Design: Split-mouth controlled clinical trial.

Setting: Nihon University School of Dentistry, Chiba, Japan.

Participants: Nine patients (3 male, 6 female) aged 19–26 years, undergoing fixed orthodontic treatment involving first premolar extraction.

Interventions: Participants had fixed appliances inserted after the premolar extractions. The clinician selected the

experimental canine which was retracted on a round 0.018-inch stainless steel wire using elastomeric chain at an initial force of 250 g. The contralateral canine served as the control and was under no active force.

Outcome measures: GCF was sampled at the distal aspect of both canines for volumetric measurement and immunoassaying, using ELISA kits, at 0, 1, 4, 8, 24, 72, 120, and 168 hours after the start of canine retraction. Overall canine movement was measured using dental casts and a digital calliper. SP and IL levels in the GCF were determined using enzyme-linked immunosorbent assay.

Results: There was no significant difference in mean volume of GCF at all time points for both groups. GCF levels of SP and IL for the experimental teeth were significantly higher ($P < 0.001$) than the control teeth from 8 to 72 hours. Total tooth movement was 1.5 ± 0.4 mm and 0 mm for the experimental and control teeth respectively.

Conclusion: The concentration of SP and IL in GCF both appear to increase with orthodontic tooth movement, and they may be involved in inflammation in response to mechanical stress.

Angle Orthodontist

Self-etching primers: is prophylactic pumicing necessary? A randomized clinical trial. *Angle Orthod* 2006; 76(1): 114–18

Burgess AM, Sherriff M, Ireland AJ

Objectives: To determine the effects of pumicing prior to bonding with a self-etching primer (SEP) on bracket failure rates.

Design: Split-mouth randomized control trial.

Setting: Hospital orthodontic clinics in Bath and Bristol, England.

Participants: Fourteen patients undergoing upper and lower fixed therapy.

Interventions: Each participant had diagonally opposite quadrants randomly assigned to be either pumiced or not, prior to the application of First Step SEP (Reliance Orthodontic Products Inc., Itasca, IL, USA). All brackets were subsequently bonded with Transbond XT (3M Unitek, Monrovia, CA, USA).

Outcome measures: Bond failures and adhesive remnant index (ARI) scores, were recorded at 6 and 12 months into treatment.

Results: An interim analysis was performed as bond failure rate was unacceptably high at 33% pumice group and 56% no pumice group at 6 months, reducing to 11% and 17% at 12 months respectively. The odds ratio at 6 months was 0.38 with confidence interval of 0.22–0.65 ($P < 0.001$) indicating the significant effect of pumicing relative to not pumicing. All ARI scores were 0.

Conclusion: Prophylactic pumicing is necessary when using a SEP as it significantly reduces bond failure rate.

Implications: This trial suggests that by not pumicing the teeth prior to bonding them, this increases the risk of debond by 2.6 times and by pumicing the risk of a bond failure is reduced by 40%.

Failure rate of self-ligating and edgewise brackets bonded with conventional acid etching and a self-etching primer: a prospective *in vivo* study. *Angle Orthod* 2006; 76(1): 119–22

Pandis N, Polychronopoulou A, Eliades T

Objectives: To compare bond failure rate of self-ligating and edgewise brackets bonded with either a self-etching primer (SEP) or conventional acid etch technique.

Design: Split-mouth clinical trial.

Setting: Private practice, Corfu, Greece.

Participants: Sixty-two patients, aged 13–16 years, undergoing fixed orthodontic treatment on a non-extraction basis.

Interventions: Participants were selected by the clinician to receive either edgewise brackets (Microarch, GAC, Bohemia, NY, USA) for 19 patients or self-ligating brackets (Damon2, Ormco, Glendora, CA, USA) for the remaining 43 patients. Brackets were bonded in diagonally opposite quadrants alternating between the combination of SEP and Transbond XP (3M Unitek, Monrovia, CA, USA) or conventional acid etch technique and Enlight paste (Ormco). Fixed appliance treatment continued and was observed for the following 12 months.

Outcome measures: First-time bracket failure.

Results: 371 edgewise and 849 self-ligating brackets were bonded, which were divided equally between the two bonding techniques (610 brackets each). Nineteen self-ligating and 11 edgewise brackets failed, 16 of which were bonded with SEP and 14 with acid etch. No statistically significant difference was found between the two bracket types or two bonding techniques ($P > 0.05$).

Conclusion: Bonding of self-ligating brackets with either SEP or conventional acid etching produces equivalent bond failure rates to either technique with edgewise brackets.

Implications: It appears that self-ligating brackets have similar failure rates to conventional edgewise brackets irrespective of whether they are bonded with SEP or conventional acid etching. This should give clinicians confidence in using self-ligating brackets in routine practice.