FEATURES SECTION

Evidence-based orthodontics

J. E. Harrison
Liverpool University Dental Hospital, UK

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***In vivo* inhibition of demineralization around orthodontic brackets**
Gorton J, Featherstone JDB.

Objectives: To determine whether bonding with fluoride releasing glass ionomer cement (GIC) reduces enamel decalcification around brackets during orthodontic treatment.

Design: A double-blind, randomized controlled trial.

Setting: San Francisco, USA.

Participants: Twenty-four patients who required two or more premolar extractions.

Interventions: Two caries free, first premolars had brackets bonded with either fluoride releasing resin-modified GIC (Fuji Ortho LC, GC America Inc., Chicago, Illinois, USA) or non-fluoride releasing composite resin (Transbond XT, 3M Unitek, Monrovia, California, USA). Teeth were extracted after 4 weeks and randomly numbered for assessment.

Outcome measures: Relative mineral loss from enamel at four weeks and saliva fluoride content at days 1, 2, 3, 7, 14, 21, and 28.

Results: Twenty-one patients completed the trial. There was statistically significantly more decalcification in the non-fluoride releasing composite resin group than the fluoride releasing resin-modified GIC group ($P = 0.0048$). There was no statistically significant difference between the groups in the whole saliva fluoride level ($P = 0.06$).

Conclusions: This short-term trial found that the fluoride releasing resin-modified GIC inhibited caries around orthodontic brackets after 4 weeks, but did not affect salivary fluoride levels. This suggests that the effect of the fluoride releasing resin-modified GIC was local and insufficient to affect the whole mouth.

Implications: The inhibition of decalcification by the fluoride releasing resin-modified glass ionomer cement around orthodontic brackets could have significant benefits for our patients. However, a longer clinical trial would provide information of more clinical relevance, but the practicalities of this would be difficult if the same design and outcome were used.

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Efficacy of training dental students in the Index of Orthodontic Treatment Need
Bentele MJ, Vig KWL, Shanker S, Beck FM.

Objectives: To investigate the efficacy of using the Index of Orthodontic Treatment Need (IOTN) to improve dental students' ability to assess orthodontic treatment need.

Design: A stratified, randomized controlled trial.

Setting: Columbus, Ohio, USA.

Participants: Fourth year dental students without prior knowledge of occlusal indices.

Interventions: *All groups*: assessment of 30 sets of study models (SM) at baseline (T_1) and again at T_2. *Control*—no education; *sham control*—participated in an exercise on cephalometrics prior to T_2 SM assessment; *experimental group*—viewed a computer presentation, received instruction and were provided with manuals on IOTN prior to T_2 SM assessment.

Outcome measures: Assessment of inter-examiner agreement using Cohen's Kappa statistic.

Results: Sixty of the 98 students (61 per cent) who were eligible for the trial completed it. There were no statistically significant differences in the SM assessments at T_1. At T_2 the experimental group's ability to assess orthodontic treatment need was significantly improved compared with the sham and control groups ($P = 0.001$).

Conclusions: Teaching dental students, using a variety of mediums, about the use of IOTN significantly improved the agreement of their evaluation of orthodontic treatment need.

Implications: This study suggests that it is feasible to teach dental students about IOTN in order to improve their diagnostic skills and ability to refer patients appropriately for orthodontic treatment based on their needs. In countries where the provision of orthodontic treatment is limited, it would seem worthwhile training dental students in the use of IOTN in order to maximize the use of limited orthodontic resources.

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Analysis of efficacy of functional appliances on mandibular growth

Chen JY, Will LA, Niederman R.

Objectives: To examine the hypothesis that functional appliances (FAs) enhance mandibular growth.

Design: A systematic review.

Data Sources: All articles identified from a Medline search from 1966–1999 that assessed the effects of FAs on mandibular growth and length.

Study selection: Studies, reported in English, that were randomized controlled trials (RCTs) or meta-analyses that met four of seven validity standards and included measurable mandibular cephalometric values.

Data extraction: Data on the horizontal and vertical dimension of the mandible were extracted and converted to an annualized change.

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

Results: Seventeen eligible studies were identified, of which six met the inclusion and validity criteria and were included. The age group ranged from 7 to 13 years, treatment duration from 6 to 24 months, and appliance wear was greater than 14 hours per day. Only changes in Ar–Pg ($P = 0.003$) and Ar–Gn ($P = 0.028$) showed a significant difference between the functional appliance group and control. Appliance type did not affect the outcome.

Conclusion: The data from the RCTs examined suggest that FAs enhance mandibular length, as measured by Ar–Pg and Ar–Gn, to a limited, but statistically significant extent. However, this did not translate to an overall change in the horizontal or vertical position of the mandible.

Implications: From these meta-analyses it appears that FAs do increase mandibular length by 2–3 mm per year of treatment. Whether these changes are clinically significant or economically (in time and money) justifiable is debatable.

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Alkaline phosphatase activity in gingival crevicular fluid during human orthodontic tooth movement

Perinetti G, Paolantonio M, D'Attilio M, D'Archivo D, Tripodi D, Femminella B, Festa F, Spoto G.

Objectives: To investigate alkaline phosphatase (ALP) activity in gingival crevicular fluid (GCF) to assess whether it can serve a diagnostic aid in orthodontics.

Design: A controlled clinical trial.

Setting: Chieti, Italy.

Participants: Sixteen orthodontic patients who needed distal retraction of one maxillary first molar.

Interventions: Distalized molar (DM): bonded and attached to 0.018 inch nickel-titanium (NiTi) wire with a 250 g NiTi open spring placed between the second premolar tooth and the DM. *Contra-lateral molar (CM):* bonded and attached to 0.018 inch NiTi wire. *Antagonistic molar (AM):* no appliance. GCF collected from mesial and distal of test teeth to measure the volume and ALP activity at 1 hour, and at 1, 2, 3, and 4 weeks after appliance placement.

Outcome measures: Distal movement of DM, volume of GCF, and ALP activity.

Results: DMs underwent a mean distal movement of 1.7 ± 0.3 mm. There was no clinically detectable movement in the CMs and AMs. The GCF volume was significantly raised in the DMs and CMs compared with the AMs at 1, 2, 3, and 4 weeks ($P < 0.01$), but no significant difference between the levels from the DMs and CMs ($P > 0.1$). The ALP activity was significantly raised in the DMs compared with the CMs and AMs ($P < 0.01$), and at the mesial (tension) side of the DMs compared with the distal side 1, 2, 3, and 4 weeks ($P < 0.01$).

Conclusions: The volume of GCF produced increases during orthodontic treatment and the ALP activity reflects the biological activity in the periodontium during tooth movement.

Implications: This study suggests that it may be possible to use the ALP activity in the GCF as a diagnostic tool to monitor tooth movement.

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Temporomandibular joint (TMJ) morphology changes with mandibular advancement surgery and rigid internal fixation (RIF): a systematic review

Kersey ML, Nebbe B, Major PW.

Objectives: To assess the effects of bilateral saggital split osteotomy (BSSO) with RIF on TMJ osseous morphology, disc position and condylar position in all planes of space.

Design : A systematic review.

Data Sources: All articles identified from a Medline search from 1966 to October 2001 that assessed the effects of BSSO with RIF on adult patients.

Study Selection: Studies that used radiographs, computerized tomography or magnetic resonance imaging to view the TMJ with the minimum of an internal control. Case reports were excluded. Two researchers read all eligible reports. Agreement of inclusion was reached by discussion.

Data Extraction: Data on the surgical procedure, analysis tool, and time frame were extracted.

Data Synthesis: No formal data synthesis was possible. Results were presented in a descriptive form.

Results: Eight articles were eligible. One was excluded due to unclear methodology. Two reports were about the same sample. One of these was excluded. There was inadequate information to assess changes in the TMJ osseous morphology. One article assessed disc position but the results were not conclusive. The size and direction of changes in condylar position were variable.

Conclusion: Data from the studies examined were very limited. The nature of condylar remodelling or changes in disc position could not be established. There was large individual variability in changes in condylar position and the clinical significance of these changes is unknown.

Implications: The existing literature is inadequate to answer questions about the effect of BSSO with RIF on the TMJ. Further studies with appropriate controls and blinding are required.

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Optimum force magnitude for orthodontic tooth movement: a systematic literature review

Ren Y, Maltha JC, Kuijpers-Jagtman AM.

Objectives: To determine the optimal force or range of forces for orthodontic tooth movement.

Design: A systematic review.

Data Sources: All articles, assessing the effects different forces on orthodontic tooth movement, identified from a Medline search from 1966 to December 2001; hand searching dental and orthodontic journals, and reference lists.

Study Selection: Controlled studies on animals or humans that quantified the orthodontic force applied, and rate or amount of tooth movement. Two independent researchers manually evaluated all potential articles.

Data Extraction: Data extracted included the experimental conditions, initial force applied, its direction and duration, and type of tooth movement.

Data Synthesis: A meta-analysis was not performed due to the clinical and methodological heterogeneity of the studies. Results were presented in descriptive and tabular forms.

Results: Seventeen of 161 papers on animal studies and 12 of 305 on humans were included. The animal studies included experiments on a wide range of species. A wide range of initial forces and experimental conditions were used in the animal and human experiments.

Conclusion: The number of human studies dealing with the relationship between force magnitude and tooth movement was limited. No evidence-based recommendations on the optimal force for orthodontic tooth movement can be made from the available data.

Implications: From the existing studies it appears that orthodontic tooth movement occurs following the application of a wide range of forces. However, is not possible to answer questions about the optimal force for orthodontic tooth movement from the existing literature. Further studies with appropriate methodology are required.

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The level of cathepsinB (CAB) in gingival crevicular fluid (GCF) during orthodontic tooth movement

Sugiyama Y, Yamaguchi M, Kanekawa M, Yoshii M, Nozoe T, Nogimura A, Kasi K.

Objectives: To investigate the levels of CAB in GCF during orthodontic tooth movement.

Design: A controlled clinical trial.

Setting: Chiba, Japan.

Participants: Ten adult orthodontic patients who needed first premolar extraction and distal canine movement as part of their orthodontic treatment.

Interventions: Experimental tooth (ET): canine undergoing distal movement. *Control teeth (CT):* contralateral and antagonist canines. All maxillary teeth were bonded with 0.018 × 0.025 inch brackets. ET were retracted with elastomeric chain on a 0.017 × 0.025 inch wire with an initial force of 250 g. GFC was collected from the distal aspect of the ET and CT before activation and at 1, 24, and 168 hours (7 days) after initiation of tooth movement.

Outcome measures: Distal movement of ET; GCF volume, level of CAB in GCF.

Results: The mean distal movement of ET was 1.2 ± 0.2 mm after 168 hours. No movement was detected in the CT. There was no significant difference in the GCF volume from the ET and CT. The mean CAB concentration in the GCF was significantly higher in the ET compared with the CT ($P = 0.004$) at 24 hours.

Conclusions: The amount of CAB in GCF was increased by orthodontic tooth movement. The increase in CAB may be involved in matrix degradation or bone resorption as a response to mechanical stress.

Implications: This study suggests that it may be possible to use the CAB levels in the GCF to monitor orthodontic tooth movement.