

Abstracts

The effect of fluoride on orthodontic tooth movement in humans. A two- and threedimensional evaluation

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Aims: The aim of the present study was to determine whether high and low fluoride concentrations in drinking water affected the early stages of tooth movement when heavy and light orthodontic forces were applied for 4 weeks. A further aim was to compare and evaluate the resulting two-dimensional (2-D) and three-dimensional (3-D) orthodontic tooth movement.

Methods: The sample consisted of 96 maxillary upper first premolars from 48 patients who required premolar extractions as part of their orthodontic treatment. Patients were selected from two different cities in Turkey with low and high fluoride concentrations of 0.05 and 2 ppm, respectively. The patient sample was divided into four groups according to the magnitude of force applied to the first premolars and the concentration of fluoride in the public water supply; Group 1, High fluoride intake (≥ 2 ppm)-Heavy force (225 g); Group 2, Low fluoride intake (≤ 0.05 ppm)-Heavy force; Group 3, High fluoride intake-Light force (25 g); and Group 4, Low fluoride intake-Light force. A light or heavy buccal tipping orthodontic force was applied to the upper first premolars for 4 weeks. The first three palatal rugae were used for the superimposition of patient casts in a 2-D and 3-D evaluation of generated movements.

Results: It was found that heavy force application and fluoride intake increased the average rate of tooth movement. It was further shown that age was negatively correlated with tooth movement in the 2-D and 3-D measurements.

Conclusions: The average rate of tooth movement was found to be greater in the heavy force and high fluoride intake group (Group 1HH). Age was negatively correlated with orthodontic tooth movement. Two- and three-dimensional methods were accurate for the assessment of tooth movement after four weeks of buccal tipping force application when the palatal rugae were used for superimposition.

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The presence of TNF- α and TNFR1 in aseptic root resorption. A preliminary study

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Background: It is hypothesised that osteoprotegerin (OPG), as an osteoclast antagonist, may offer molecular control over the process of orthodontic root resorption. Previous work investigating OPG in a rat periodontal ligament (PDL) ankylosis model found no inhibitory effect on osteoclasts and odontoclasts when given at a recommended dosage of 2.5 mg/kg. It was considered that traumatically-induced PDL inflammation produces mediators and cytokines with the ability to stimulate clast cell differentiation and counter the effects of OPG.

Aims: The present study investigated the presence of Tumour Necrosis Factor Alpha (TNF- α) and its receptor Tumour Necrosis Factor Receptor 1 (TNFR1) in a PDL sterile inflammatory model.

Methods: Dry ice was applied for 15 minutes to the upper right first molar crown of eighteen, 8-week-old, male Sprague-Dawley rats of which 9 were injected with OPG at a dose of 2.5 mg/kg of body weight at the time of freezing. After 7 days, the rats were sacrificed and each maxilla processed for immunohistochemical identification of TNF- α and TNFR1.

Results: Results showed the presence of root resorption in varying amounts and locations in both experimental and control rats. Reparative processes appeared greater in the OPG-treated rats, often with the presence of an ankylotic union. Immunolabelling showed the presence of TNF- α and TNFR1 in the sterile inflammation located mainly in the interradicular PDL area. More definitive labelling appeared in OPG-treated rats.

Conclusion: The results indicated that TNF- α , and its receptor TNFR1, by their presence, may modify OPG effectiveness by offering an alternative pathway for osteoclast formation, which counters the anti-resorptive effects of OPG.

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Comparison of the effects of fixed and removable functional appliances on the skeletal and dentoalveolar structures

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Objective: To compare and analyse the effects of activator and Forsus FRD EZ appliances in the treatment of skeletal Class II division I malocclusion.

Methods: Lateral cephalograms and hand-wrist radiographs were collected from 24 Class II division I growing patients (14 females, 10 males). The patients were randomly divided into two equal groups and either treated with an activator appliance (Mean age 12.67 ± 1.24 years) or with a Forsus FRD EZ appliance (Mean age 12.31 ± 1.09 years). Pretreatment and posttreatment cephalometric radiographs were obtained, traced, superimposed and data analysed using paired t-tests and the Wilcoxon signed rank test.

Results: The results demonstrated that the Forsus FRD EZ effectively corrected the Class II malocclusion, but the changes were mainly dentoalveolar. The Forsus FRD EZ appliance induced a clockwise rotation of the occlusal plane without significant alteration in the vertical facial dimension. Skeletally, maxillary growth was restricted and pogonion moved forward which improved the profile.

Conclusion: The Forsus FRD EZ appliance may be an effective dentoalveolar treatment method to manage a skeletal imbalance and improve the profile in growing patients.

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New clinical classification of dental arch form using facial axis points derived from threedimensional models

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Introduction: The purpose of the present study was to use facial axis (FA) points to classify dental arch form generated from an analysis of 3-D virtual models of a sample of normal occlusions . A secondary aim was to introduce a new arch form template based on this classification for clinical application.

Methods: One hundred and twenty five plaster models of Class I occlusions were 3-D scanned (Orapix Co., Ltd, Seoul, Korea) and FA points digitized on the virtual models using Rapidform 2006 software (INUS Technology Inc., Seoul, Korea). Following intercanine and intermolar arch width and depth measurements, K-means cluster analysis was applied on 77 cases (Dataset 1) to classify the sample into arch form types. A curve of best fit of the mean arch form of each type was generated. The remaining 48 cases (Dataset 2) were mapped into the clusters and a multivariate test was performed to assess the differences among the clusters.

Results: Classification into five clusters demonstrated maximum inter-cluster distance in the arch parameters and produced the most homogeneous cluster size. The differences between the 5 cluster types were statistically but not clinically significant and so they were recombined to form three clusters representing 'narrow', 'moderate' and 'wide' arch forms.

Conclusions: A template with three arch form types based on anterior and posterior dimensions has been proposed through 3-D analysis of FA points for more accurate arch form identification and arch wire selection.

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Finite element method (FEM) analysis of the force systems produced by asymmetric inner headgear bows

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Background: Extra-oral traction appliances were introduced more than a century ago and continue to be used to produce orthopaedic and/or dental changes in the maxilla. While force systems produced by asymmetric outer bows have been studied extensively, the force systems produced by asymmetric inner bows have been overlooked.

Aim: To analyse the forces acting on the maxillary first molars: when the size of one bayonet bend is increased; when the point of application of the distalising force on the inner bow is moved to one side; when one molar is displaced palatally.

Methods: Four FEM models of cervical headgear attached to maxillary first molars were designed in SolidWorks 2010 and transferred to an ANSYS Workbench Ver. 12.1. Model 1, each molar was 23 mm from the midpalatal line and the inner bow was symmetrical; Model 2, the left molar was displaced 4 mm towards the midpalatal line and the inner bow was symmetrical; Model 3, the molars were equidistant (23 mm) from the midpalatal line, but the left molar was engaged by a 2 mm larger bayonet bend; Model 4, the molars were equidistant (23 mm) from the midpalatal line but the join between the inner and outer bows was displaced 2 mm towards the left molar. In all FEM models, a 2N force was applied to the inner bow at the join between inner and outer bows and the energy transmitted to the teeth and the von Mises stresses on the molar PDLs were assessed.

Results: There were marked differences in the strain energy on the teeth and the von Mises stresses on their PDLs. A 14 to 20 per cent increase in energy and force was produced on the tooth closer to the symmetric plane of the headgear. In addition, the increase in energy produced a 30 to 62 per cent increase in the von Mises stresses within the PDLs.

Conclusion: Small asymmetries in molar position, the size of a bayonet bend and the point of application of a force on an inner bow resulted in asymmetrical forces on the molars. These forces were higher on the molar closer to the symmetric plane of the headgear.

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The effects of lubrication on the static frictional resistance of orthodontic brackets

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Background: Difficulties are experienced with the collection and storage of freshly harvested human saliva to use as a lubricant for the laboratory testing of the frictional resistance of orthodontic brackets. In order to overcome these difficulties, researchers have suggested the use of saliva substitutes due to their ease of storage and consistency of properties throughout testing. Others have criticized the use of artificial saliva and prefer the dry state. The present study aimed to compare the effects of human saliva and an artificial saliva (Saliva Orthana®) with the dry state for the static frictional resistance testing of orthodontic brackets.

Methods: The static frictional resistance and the lubrication effect of human saliva, Saliva Orthana® and the dry state were investigated using upper central incisor stainless steel brackets and 0.019 x 0.025 inch stainless steel wires in an Instron® Universal Testing Machine. Static frictional resistance was measured 100 times for each lubrication state. The 'wettability' of each lubricant was determined by measuring the contact angle against a stainless steel surface using the CAM 200 Optical Contact Angle Meter. Distilled water acted as a control. The viscosity of each lubricant and their Newtonian or non-Newtonian fluid behaviour under stress was measured using a Brookfield Digital Rheometer Model DV-III+.

Results: The differences in static frictional resistance between the three lubricants when examined as a group did not reach statistical significance ($p = 0.059$). The difference between human saliva and Saliva Orthana® was considered to be of weak statistical significance and clinical relevance (Means: 0.917 N; 0.819 N; $p = 0.053$). Human saliva and the dry state revealed very similar mean frictional values (Means: 0.917 N; 0.875 N; $p = 0.932$). The contact angle tests indicated a statistically significant difference between the lubricants with Saliva Orthana® having the smallest angle and therefore the highest 'wettability'. Human saliva had the highest initial viscosity and behaved as a non-Newtonian fluid, contrasting with Saliva Orthana® and distilled water, both of which behaved as Newtonian fluids.

Conclusion: The current results indicate that artificial saliva is not an ideal alternative to human saliva for friction testing in the laboratory. The results therefore support the proposal that, when human saliva is not available, it may be preferable to test orthodontic frictional resistance in the dry state.

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Bond failure rates of two self-ligating brackets: a randomised clinical trial

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Aims: To evaluate the bond failure rates of two self-ligating appliance systems bonded with a self-etching primer.

Methods: Forty patients were randomly assigned to either Group SC (SmartClip, 3M Unitek, Monrovia, CA, USA) or Group IR (In-Ovation R, GAC International, Bohemia, NY, USA) appliance groups. Seven hundred and sixty six brackets were bonded with Transbond Plus Self-Etching Primer and Transbond Plus Color Change Adhesive according to the manufacturer's instructions. Over a 12- month period, the survival rates of the brackets were estimated with the Kaplan-Meier analysis. The survival distributions for the appliance systems, dental arch and position in the dental arch were compared with the log-rank test.

Results: The bond failure rate for SC was significantly lower than IR ($p = 0.022$). There were no differences in failure rates between either the maxillary and mandibular arches or between the anterior and posterior brackets.

Conclusion: SC provided a more reliable bond than IR over the 12-month observation period, however, both brackets had clinically acceptable bond failure rates.

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Orthodontic treatment provision and referral preferences among New Zealand general dental practitioners

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Background: General dental practitioners (GDPs) are key clinicians in the orthodontic referral chain as they complement (and may compete with) orthodontists in providing treatment for the public.

Objectives: To determine the nature and extent of GDPs' involvement in orthodontic treatment provision and to identify influences on GDPs' choice of orthodontist.

Methods: An email survey was conducted of actively-practising GDPs in May-June 2010. Two timelines of contact were followed, with non-responders to the first survey re-contacted three weeks later.

Results: Just under one-fifth (19.3 per cent) reported providing forms of orthodontic treatment. This proportion was higher among males, more experienced practitioners, and dentists in rural locations. The percentage involvement ranged from 22.3 per cent in Greater Auckland to 10.5 per cent in Greater Wellington and 11.9 per cent in Christchurch. In the remainder of New Zealand, percentages ranged from 11.5 per cent in urban areas to 37.1 per cent in rural areas. Of those providing treatment, almost half had 1-10 patients under management, and just over one-third had greater numbers. Sixty-one per cent of orthodontically-involved GDPs in Auckland had more than 10 orthodontic patients. The most commonly treated condition was a simple crossbite, while the least commonly treated condition was the severe Class III malocclusion.

Conclusions: The provision of orthodontic treatment by New Zealand GDPs has decreased in recent years to an average of about one in five, but this figure is considerably higher in rural areas and is a notable feature of the greater Auckland area. The findings suggest that the majority of the more complex cases are continuing to be referred to specialist orthodontists.

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Differences in dentofacial characteristics between southern versus northern Chinese adolescents

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Aim: To compare the dentofacial characteristics of southern and northern Chinese adolescents.

Methods: A southern Chinese sample comprised 70 males (Mean age 12.4 ± 0.60 years) and 60 females (Mean age 12.5 ± 0.4 years), and a northern Chinese sample consisted of 50 males (Mean age 12.8 ± 1.8 years) and 50 females (Mean age 12.4 ± 1.2 years). All subjects had a Class I molar relationship with no or minimal crowding, a well balanced cephalometric profile, and no history of orthodontic treatment. Patient cephalograms were traced and digitized and McNamara's analysis applied.

Results: A smaller midface and a shorter overall mandibular length were observed in southern Chinese, whereas significantly increased vertical dimension and a retrusive chin were noted in northern Chinese. Protrusive upper and lower incisors and a protrusive upper lip were found in southern Chinese.

Conclusions: There were significant differences in dentofacial morphology between southern and northern Chinese adolescents. It is suggested that separate cephalometric norms be used for patients originating from different parts of China.

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A comparative diagnostic assessment of anterior tooth and bone status using panoramic and periapical radiography

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Aims: The aim of the present study was to compare diagnostic assessments of anterior tooth and bone status in a randomised cohort of pre-orthodontic patients using panoramic and periapical radiographs.

Method: Four hundred and forty-four cases with matched periapical and panoramic radiographs were examined by three observers. Two were final-year postgraduate endodontic students and the other, a final-year Honours degree dental student. Multirater Kappa values were used to assess the reliability of the observers, with a value of 1 equating to complete agreement.

Results: With the exception of endodontic Class 1 and 2 palatal invaginations, reliability exceeded 0.95 for all three observers. An assessment of the graduate endodontic students revealed only a marginal increase in the kappa values. Statistical analysis ($p < 0.05$) determined that developmental anomalies or tooth/bone pathoses were more reliably detected by observers using periapical radiographs compared with panoramic films. This finding has relevance given the likelihood of anterior dental trauma among young children.

Conclusion: While there have been considerable improvements in the quality of dental panoramic radiography, the present study indicated that a reliable pre-orthodontic or post-trauma diagnostic assessment should include both panoramic and intra-oral radiographs.

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Changes in malocclusion over time in New Zealand adolescents

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Background: The Dental Aesthetic Index (DAI) has been used in many cross-sectional studies of population samples, but its use in assessing changes in malocclusion is less common. The aim of the present study was to describe the natural history of malocclusion and investigate the utility of the DAI as a measure for describing changes in malocclusion in a population-based sample of adolescents.

Method: A repeat examination was conducted of a sample of 430 children first assessed in 2003 at age 13 and re-examined at age 16 (255 or 59.3 per cent of the baseline sample) with their DAI and orthodontic history recorded at each age.

Results: Of the adolescents re-assessed, 28 were in active orthodontic treatment, 30 had completed treatment and 197 had not received any treatment. There were substantial changes in the DAI items from age 13 to 16, with the greatest improvement in maxillary anterior irregularity. Overall, almost one-quarter of participants showed an improvement in their DAI treatment need category which was considerably higher among those who had either received treatment or were in treatment.

Conclusion: The DAI is a valid and responsive tool for measuring change in malocclusion over time. Anterior mandibular irregularity shows the greatest change with age, and orthodontic treatment is effective in treating malocclusion, at least in the short term.

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Long term follow up of clinical outcome of orthodontic tooth movement following extraction of previously auto-transplanted maxillary canines and bone grafting: a case report

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Background: The present case is a 13-year follow up of a patient in which the treatment plan involved removal of unsatisfactory auto-transplanted maxillary canines together with a bone graft to re-establish normal dento-alveolar ridge morphology. Active tooth movement occurred in the graft site. At the time, this was a new approach and there was no information in the literature as to the outcome of this treatment modality. Long-term reports regarding the success of this treatment are lacking.

Aims: To assess the long-term outcome of active tooth movement into a site that required bone grafting.

Methods: The upper right canine was non-vital with poor periodontal support on its buccal aspect. Examination revealed a substantial bony defect with a loss of the buccal cortical plate following extraction. To augment the ridge defect bone was taken from the maxillary tuberosity and grafted in the upper right canine extraction site and fixed with a bone screw. Protraction of the first premolar and retraction of the lateral incisor into the graft site was slow and constant.

Results: Significant closure of the upper canine extraction space was achieved. There were no significant detrimental bone changes in the interproximal areas of 14 and 12.

Conclusion: By employing a bone graft to re-establish alveolar bone prior to tooth movement, excellent bone support, periodontal health and a long-term stable result were obtained.

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Management of severe Class II division 1 malocclusion: a case report

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Aims: To describe the two-phase treatment of a pre-adolescent boy with a severe skeletal Class II division 1 malocclusion with vertical maxillary excess and spaced upper incisors.

Methods: Treatment involved an orthopaedic phase using high-pull headgear and a maxillary intrusion splint followed by nonextraction orthodontic treatment with a pre-adjusted edgewise appliance. The case was assessed at the start of treatment (T1), at the end of orthopaedic treatment (T2), at the end of orthodontic treatment (T3) and 2 years after debanding (T4).

Results: At T2 the Class II molar occlusion was corrected to a Class I molar relationship and the overjet and overbite were considerably reduced. A lower lip trap was relieved and a normal mentolabial sulcus obtained. The cephalometric changes at T2 revealed a 4 degree reduction in the ANB angle but no change in the SNA angle. At T3, the inclination of the upper central incisors, the overjet and overbite were normal and the spaces between the upper anterior teeth were closed. At T4, the Class I molar and canine relationships, reduced overjet, reduced overbite and intercuspation were maintained. The curve of Spee deepened slightly.

Conclusion: A severe skeletal Class II division 1 malocclusion with vertical maxillary excess may be successfully treated in two phases with an initial orthopaedic appliance in the form of high-pull head gear and a maxillary intrusion splint followed by fixed appliances.

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