The effect of enamel pre-treatment on the bonding of orthodontic attachments to hypomineralised enamel  
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**Objective:** To determine the force to debond of stainless steel brackets bonded to hypomineralised enamel following pre-treatment with Duraphat and casein phosphopeptide-amorphous calcium phosphate fluoride (CPP-ACPF).

**Design and methods:** 120 enamel specimens were collected from the buccal surfaces of first permanent molars. 90 were from teeth exhibiting hypomineralisation (MIH) and 30 were unaffected controls. Prior to bonding, the MIH samples were treated with Duraphat (5000ppm NaF) for 2 minutes followed by (CPP-ACPF) for 5 minutes. Stainless steel orthodontic brackets were then bonded to the MIH specimens either with Fuji Ortho (n=30), Fuji Ortho following etching with poly(acrylic acid) (n=30), or Transbond XT following etching with 37% orthophosphoric acid (n=30). The controls were bonded with Transbond XT following etching with 37% orthophosphoric acid (n=30). Shear bond testing to failure was performed and force to debond (N) and locus of bond failure (ARI) recorded.

**Results:** There was no significant difference in the force to debond between the MIH specimens, but there was a statistically significant difference between the control and MIH specimens. Force to debond was significantly higher in the case of the unaffected controls (p=0.001). There was no statistically significant difference in the ARI scores between the four groups.

**Conclusion:** Force to debond of MIH affected enamel, pretreated with Duraphat and CPP-ACPF is significantly lower than observed with unaffected controls. The locus of bond failure was similar in all groups.
Objective: To evaluate the performance of four coated nickel-titanium aligning archwires over 8 weeks of clinical use.

Design and Setting: A multi-centre randomised clinical trial. Three hospital orthodontic departments: Addenbrooke’s Hospital (Cambridge), The Royal Alexandra Children’s Hospital (Brighton), and Guy’s Hospital (London).

Materials and Methods: 120 participants requiring fixed appliance orthodontic treatment had each dental arch randomly allocated to one of four interventions: (1) Forestadent® BioCosmetic® 0.017-inch (2) Forestadent® Titanol® Cosmetic 0.016-inch (3) TP Orthodontics Aesthetic 0.014-inch (4) Ortho Organizers® Tooth Tone® 0.016-inch. The archwires were ligated and remained in-situ for an eight week period. Retrieved archwires were measured for colour change (ΔE) and coating loss. Colour assessments were made using digital photography and Adobe® Photoshop®, with ΔE values computed using the CIE L*a*b* system. Coating loss was measured by analysing digitally scanned images and using Autodesk® AutoCAD®.

Results: All four archwires showed significant mean colour change and coating loss after clinical use. One-way ANOVA showed a statistically significant difference between the archwires for ΔE (p=0.001). There was no statistically significant difference between the archwires for coating loss.

Conclusions: There is appreciable colour change and coating loss after clinical use of coated aligning archwires. The aesthetic properties of these coated archwires are not ideal.
Use of QLF-D to assess demineralisation and plaque during orthodontics
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**Objective:** To assess the use of Quantitative Light-induced Fluorescence-Digital (QLF-D) to detect demineralisation and plaque coverage during fixed orthodontic treatment.

**Design and Setting:** A prospective RCT was conducted at Liverpool University Dental Hospital.

**Materials and Methods:** 33 patients undergoing fixed orthodontic treatment were randomly allocated to receiving oral hygiene reinforcement (OHR) at four consecutive appointments using white light (WL) or QLF-D images as visual aids. For both groups, change in demineralisation, measured by the degree of fluorescence loss, ΔF, and plaque coverage, ΔR30, were assessed on QLF-D images from the baseline to the final appointment. A questionnaire was used to ascertain the patients’ perspectives of the images being used as oral hygiene aids.

**Results:** There were no significant differences in demineralisation (P=0.56) or plaque accumulation (P=0.82) between the WL and QLF-D groups. There was no significant change in demineralisation over the four visits in either group. However, there was a trend for a reduction in plaque coverage in both groups (P=0.034). 100% of the QLF-D group and 81% of the WL group expressed it would be useful to be given such OHR for the full duration of orthodontic treatment.

**Conclusions:** OHR using WL or QLF-D images as visual aids was effective in reducing plaque coverage. There was no difference in the level of demineralisation or plaque coverage between the QLF-D and WL groups. Patients reported that the QLF-D images were more informative than WL images.
Objective To investigate the occurrence, clinical phenotype and genetic basis of autosomal recessively inherited forms of severe hypodontia in a high-risk consanguineous population

Design and Setting A cohort study investigating a high-risk population undertaken at Birmingham Dental Hospital in July 2013

Materials and Methods Ten unrelated individuals with hypodontia and consanguineous parents were ascertained after a systematic search of patient databases. After informed consent, a detailed family history, dental examination, an assessment of the presence/absence of syndromic features and a blood sample for DNA extraction was obtained from each subject. Molecular genetic analysis was undertaken to determine the likely genetic basis.

Results Dental examination revealed severe hypodontia in all cases. Dental anomalies such as microdontia, taurodont molars, hypoplasia of the enamel, infraocclusion, shortened dental roots and ectopic teeth were recorded, as well as the typical skeletal/facial traits expected in a hypodontia population. The pattern of dental agenesis demonstrated heterogeneity and appeared to be more varied than that described previously, with the involvement of atypical teeth. No syndromic features were detected.

Conclusion Four out of the ten families had affected members of the family that was consistent with a genetic basis for the severe hypodontia. However, mutation analysis of autosomal recessive hypodontia genes was negative. These observations provide a basis for further molecular genetic studies to define the exact genetic cause of the disorder.
Objectives: To quantify the effect of chewing gum on orthodontic outcome

Design: Multi-centred RCT with two parallel groups, allocated to chew gum as a primary analgesic following fixed appliance placement and adjustment, or asked not to chew gum and use ibuprofen (Control).

Setting and sample: 603 adolescent patients (222 male, 381 female) aged 12 to 16 years within 9 Hospital Orthodontic Departments across the South West, who had completed treatment and for whom PAR scores were available

Methods: Ethical approval was obtained. Data from written records for every visit from initial bond-up to debond was collated and analysed using parametric tests and generalised linear modelling. The measures of orthodontic outcome investigated were: duration of treatment, number of visits, reduction in PAR score and number, location and timing of attachment failure

Results: The use of chewing gum for pain relief had no significant effect on any of the measures of outcome (α = 0.05). Average treatment time was 18.3 months (range 6.4 ~ 46.3 months) The mode total number of visits was 9 (range 4 ~ 36 visits) The mean PAR score reduction was 83.5%. There was no significant effect of chewing gum upon breakages in either the upper (χ² = 14.17, p=0.29) or lower arch (χ² = 11.27, p=0.66)

Conclusion: Advising adolescent patients to chew gum had no clinically significant effect upon the outcome of fixed appliance therapy
Objective: To assess the effect of post-brushing mouthwashes on salivary fluoride retention.

Design: A double blind three phase cross over study

Methods: 30 participants were recruited. Each participant completed all 3 phases of the study with a minimum of 48 hours washout period between phases. Salivary Fluoride levels were measured before brushing (Time 0) and after brushing with a 1450ppm Fluoride toothpaste for 40 seconds, rinsing with water and then with one of either 0, 225 or 500ppm F mouthwash. Salivary Fluoride levels were measured at time points 1, 3, 5, 10, 20, 45, and 60 minutes after brushing using an ion specific electrode. Values in ppm were then calculated using bespoke excel based software.

Results: Significant differences in mean fluoride retention over the 60 minute period were found for all three pair wise groups using paired t tests (p<0.001). A 2660% increase in salivary fluoride retention was found between 500ppm F when compared with the 0ppm F group and a 120% increase compared to the 225ppm F group. An increase of 1160% was found between 225ppm and 0ppm F groups.

Conclusion: The use of a fluoride mouthwash containing 225ppm or 500ppm produced a significant increase in salivary fluoride retention following brushing with 1450ppm F toothpaste and rinsing with water. The use of the 500ppm F mouthwash may be of particular benefit to those at high caries risk including orthodontic patients.

Supporting agency: Colgate-Palmolive
Removable versus fixed orthodontic retention: A prospective randomised controlled trial
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Objective: Evaluate the effectiveness of bonded retainers (BR) versus vacuum-formed retainers (VFR) regarding stability (arch alignment, dimensions, occlusal relationships) and retainer survival rates, over 6 months.

Design: Randomised controlled trial

Setting: Three hospital departments

Participants: Consecutive orthodontic fixed appliance patients recruited using defined inclusion & exclusion criteria.

Ethical Approval: Leeds (East) Research Ethics Committee

Subjects and Methods: 60 patients having completed upper and lower fixed appliance therapy were invited to participate. Patients were randomly allocated to either upper & lower labial segment BR (n=30) or upper & lower VFR (n=30) using standardised clinical procedures, and materials.

Main outcome measures: Relapse (arch alignment, dimensions, occlusal relationships) & retainer survival rate.

Results: At the time of analysis 34 patients had completed their 6 month review, with no drop-outs. There was increased relapse in the maxillary labial segment alignment with BR compared to VFR (p=0.047). There was no difference in the retainers’ retentive capacity in the mandible (p=0.607), or any other measurements of stability. Failure of the BR was high (n=7, 43.8%) and in excess of the VFR (n=4, 22.2%), however the difference was statistically insignificant. Failed retainers were associated with greater relapse.

Conclusions: VFR retained the maxillary labial segment more effectively than BR over 6 months. There was no difference in relapse in the mandible.
Clinical investigation assessing treatment adherence, in obstructive sleep apnoea patients P. JAUHAR *, K. MCLAUGHLIN and A. JOHAL (Institute of Dentistry, Bart’s & The London School of Medicine and Dentistry, Queen Mary College)

**Objective:** Determine adherence to Mandibular Advancement Appliance (MAA) use and their level of acceptance.

**Design and Setting:** A hospital-based prospective cohort observational study.

**Materials and Methods:** Sample size determination revealed 43 patients, with a confirmed diagnosis of obstructive sleep apnoea & prescribed MAA therapy, were required. Adherence was assessed both objectively and subjectively. This entailed a removable thermo micro-sensor being fitted to the patient’s existing MAA for two weeks, during which they completed a daily diary, to permit comparison between the two methods of recording wear. Adherence is based on the assumption that when the thermometer inside the micro-sensor reaches 35°C the appliance was worn, the minimal accepted wear time a night was set at 4 hours and 7 nights a week, based on previous studies, (Weaver et al. 2010).

**Results:** A novel method was developed for attaching the removable thermo micro-sensor to the MAA. No adverse effects were reported from using the monitor. Interim results show all 20 patients (100%), recruited to date, had a mean wear time during the study of greater than 4 hours/night and showed a strong correlation between self-reported and objective data.

**Conclusions:** The interim results illustrate the safety and feasibility of objective measurement of OSAHS compliance. The objective measurement of OSAHS compliance appears to be very valuable and will translate into clinical practice.
Fabrication and characterisation of anisotropic ceramic/polymer composite for orthodontic brackets.
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Objective: To develop and then test a novel hybrid ceramic/polymer material for use as an aesthetic orthodontic bracket.

Design: A laboratory investigation into the production of a hybrid ceramic/polymer material using the technique of freeze casting, followed by characterisation using mechanical testing methods.

Setting: Dental biomaterials laboratory, School of Oral and Dental Science, Bristol

Materials and Methods: The technique of freeze casting was used to create porous ceramic frameworks, which were then infiltrated with polymer. In this way bespoke graduated hybrid materials, ranging from 10% to 40% ceramic at one surface and near 100% polymer at the other were created. Samples were characterised using compressive strength and abrasion test methods and compared with samples of pure ceramic and pure polymer.

Results: There was no significant difference in compressive strength between pure ceramic and the 40% by volume ceramic samples. Compressive strength was significantly lower for samples with 10%, 20%, 30% ceramic and for samples of 100% polymer. Following abrasion testing the mean difference in surface roughness over 2 years of simulated tooth brushing was less than 1.5 microns for any of the specimens.

Conclusions: Novel hybrid ceramic/polymer materials can be created using freeze casting, with 40% ceramic by volume showing the greatest promise as a potential aesthetic orthodontic bracket. It behaves like a ceramic bracket at the oral surface and should perform like a polymeric bracket at the enamel surface.
The relationship between maxillary central incisor proportions and facial proportions
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Objectives: To determine the relationship between height and width of the maxillary central incisor (MCI) and height and width of the face in adults and to assess the inter-gender difference. To assess measurement differences between right and left MCI.

Design and Setting: A prospective study undertaken at Guy’s and King’s College Hospitals.

Materials & Methods: 149 Caucasian dental students (F:76;M:73) aged 18-30 were included. MCI width and height measurements were taken. Horizontal (Ft-Ft’, Zy-Zy’, Go’-Go’) and vertical facial measurements (Tr-Me’, G-Me’, N-Me’) were recorded directly with digital calipers by one operator. Intra-examiner reliability was tested by re-measuring 25 volunteers.

Results: Mean MCI height was 10.28mm (Right and Left) and mean tooth width was 8.65mm (R) and 8.66mm (L). A mean ratio of 15.56 was found between bi-zygomatic width and tooth width (M=15.75,F=15.37), and a mean ratio of 17.93 between total face height and MCI height (M=17.97,F=17.89). Correlation coefficients were low for all tooth:face measurements. Intra-examiner reliability was clinically acceptable.

Conclusions: Males have larger teeth and faces but similar width:height ratios. There is no significant size difference between right and left MCI. There is little individual relationship between tooth and face proportions, with little influence of gender. The Biometric ratio of 1:16 for MCI width to bi-zygomatic width was not confirmed but a ratio of 1:18 and 1:12 is proposed for MCI height to total face height (Tr-Me’) and face height (N-Me’) respectively.
Effect of Fluoride on Orthodontically-Induced Root Resorption *In Vitro*

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**Objective:** Fluoride has been suggested to play a role in the prevention of orthodontically-induced root resorption. This study aimed to investigate the effect of fluoride on the differentiation and survival of the osteoclast cell, which is responsible for root resorption.

**Design and Setting:** An *in vitro* laboratory based study carried out at Cardiff university.

**Materials and Methods:** Slices were prepared from mandibles dissected from 28 day old male Wistar rats. A 50g force was applied, prior to culture of the slices at increasing concentrations of sodium fluoride (0,3,6,9,12,and 24 mM) for 7 or 14 days. Osteoclast numbers within the periodontal ligament (PDL) were then quantified by histomorphometric analysis. Additionally pre-osteoclast cells were cultured on glass slides at concentrations up to 30µM NaF. The effect of fluoride exposure on fusion of these cells to form osteoclasts was investigated after 7 days.

**Results:** Osteoclast numbers within the mandible slice PDL were not significantly affected by increasing fluoride exposure, with viable cells observed up to fluoride concentrations of 24mM. However culture of the pre-osteoclast cells showed a significant decrease (p<0.01) in formation of multinucleated osteoclasts at levels above 0.94µM NaF.

**Conclusions:** The findings indicate fluoride exposure does not cause apoptosis of existing osteoclasts within the PDL but, at concentrations above 0.94µM, fusion of precursors to form new osteoclasts is inhibited. This may have clinical applicability, as normal plasma levels of fluoride are reported as 0.7 - 2.4µM/L.