Abstracts

Indirect bonding – do custom bases need a plastic conditioner? A randomised clinical trial
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Aim: To compare the clinical failure rates over six months of indirectly bonded brackets with and without methyl methacrylate monomer (MMM) conditioned custom bases.

Methods: Thirty-six consecutive patients satisfying the selection criteria were randomly assigned to two groups in a split-mouth study design. In Group 1, the maxillary right and mandibular left quadrants were indirectly bonded after the custom bases had been conditioned with MMM. The brackets bonded to the teeth in the contralateral quadrants were not conditioned. In Group 2, the custom bases on the brackets indirectly bonded to the teeth in the maxillary left and mandibular right quadrants were conditioned and the brackets in the contralateral quadrants were not conditioned. Over the 6-month observation period all loose brackets were recorded, and the data were compared with a Wilcoxon signed ranks test.

Results: Of the 828 brackets placed, six with the MMM conditioning came loose (1.4 per cent failed) compared with five in the Control group (1.2 per cent failed). The difference was not statistically significant (p = 0.74).

Conclusion: These results indicate that conditioning custom bases with methyl methacrylate monomer is an unnecessary step when indirectly bonding brackets.

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The effect of morphine on orthodontic tooth movement in rats
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Objectives: To investigate the effect of morphine as an exogenous opioid on orthodontic tooth movement. Naltrexone will be used as an opioid antagonist to confirm the results.

Methods: Forty rats were randomly divided into four equal groups. The first group received no injection; the second group received daily injections of morphine; the third group received daily naltrexone-morphine injections and the fourth group daily injections of naltrexone-normal saline. The left first maxillary molar in each rat was tipped mesially with a NiTi closed coil spring. The rats were sacrificed after 14 days and the maxillae fixed, sectioned serially and examined histologically.

Results: The greatest amount of tooth movement occurred in the Control group and the least amount of tooth movement in the Morphine group. Tooth movement in the Morphine group was significantly different from the other three groups (p < 0.05). The differences in tooth movement in the Control, Morphine-naltrexone and Naltrexone-saline groups were not statistically significant (p > 0.05). No statistically significant histological differences were found.

Conclusions: Morphine reduced orthodontic tooth movement in rats. This effect was reversed by the opioid antagonist, naltrexone, which had no effect on tooth movement.

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Initial and fatigue bond strengths of chromatic and light-cured adhesives
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Aim: To compare the initial and fatigue shear bond strengths of a chromatic adhesive with a light-cured adhesive in an ex vivo laboratory study.

Methods: Hydroxyapatite discs were used as the bonding substrate. They were produced by cold uni-axial compression at 20 tons, sintered at 1300 °C and embedded in epoxy resin before grinding and polishing. One hundred and fifty upper left central incisor brackets were bonded to the discs with Transbond PLUS Color Change (3M Unitek, Monrovia, CA, USA) while another 150 similar brackets were bonded with Transbond XT (3M Unitek, Monrovia, CA, USA). Seventy-five brackets from each group were subjected to cyclic loading (5000 cycles at 2 Hz) at 50 per cent of the mean bond strength in a Dartec Series HC10 Testing Machine. Initial (unfatigued) and fatigued bond strengths were determined by applying a shear force at the bracket-substrate interface using a custom-made metal jig in an Instron Universal Testing Machine. One-way ANOVA with Bonferroni post-hoc correction and two-way ANOVA were used to analyse the differences between the initial and fatigue mean shear bond strengths of the adhesives. The survival and bond reliability of both adhesives were evaluated with the Kaplan- Meier and Cox regression analyses.

Results: The initial mean shear bond strength for Transbond PLUS Color Change (16.72 MPa) was higher than Transbond XT (15.11 MPa), but this was not statistically significant (p = 0.109). The fatigue mean shear bond strength for Transbond XT (15.87 MPa) was similar to that of Transbond PLUS Color Change (15.33 MPa), and the difference was not statistically significant (p > 0.999). There were no significant differences when the effects of the material (p = 0.264) or fatiguing (p = 0.512) were considered separately, but in combination, the effect on bond strength was statistically significant (p = 0.026). The survival analysis showed that both adhesives demonstrated similar survival patterns in the unfatigued and fatigued states. Analysis of the material type and fatiguing showed no effect on the survival pattern for both adhesives (p = 0.098).

Conclusions: There were no statistically significant differences between the mean initial (unfatigued) and fatigue bond strengths of Transbond XT and Transbond PLUS Color Change under laboratory conditions. A survival analysis for both resins with and without fatigue loading exhibited similar behaviour with respect to their survival patterns. Although this may imply that under clinical conditions the two adhesives could behave similarly, the clinical extrapolation of these results should be interpreted with caution.

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A comparative assessment of the forces and moments generated at the maxillary incisors between conventional and self-ligating brackets using a reverse curve of Spee NiTi archwire

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Objectives: To compare the intrusive forces and labio-palatal moments generated at the maxillary incisors by a 0.017 x 0.025 inch reverse curve NiTi wire using self-ligating and conventional brackets.

Methods: Ten 0.017 x 0.025 inch reverse curve NiTi archwires were used with each of the following 0.022 inch bracket systems: Titanium Ortho (Ormco/Sybron, CA, USA), In-Ovation R (GAC International, NY, USA) and Damon System 3MX (Ormco/Sybron, CA, USA). The wires were inserted on bracketed maxillary Frasaco models, with segmented maxillary incisors. Simulated intrusion from 0.0-1.0 mm was performed on the Orthodontic Measurement and Simulation System, which recorded the intrusive forces and the labio-palatal moments at 0.05 mm increments. The data were analysed with the ANOVA and Scheffe tests.

Results: The intrusive forces were significantly different between all bracket types. The highest force was recorded with the conventional Titanium Orthos brackets (8.2 N), followed by the Damon 3MX brackets (6.3 N) and the In-Ovation R brackets (5.5 N). The moments were found to be significantly different between the conventional and the self-ligating brackets, but not between the two types of self-ligating brackets. The highest moments were recorded with the self-ligating brackets (16.6-16.9 N/mm), followed by the conventional brackets (10.8 N/mm).

Conclusions: The intrusive forces exerted on the maxillary incisors by a 0.017 x 0.025 inch reverse curve NiTi archwire during the final 1 mm of levelling are very high and beyond the necessary intrusive force level for these teeth. Lower intrusive forces, but higher labio-palatal moments, were recorded with the self-ligating brackets.

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Bond strengths and debonding characteristics of two types of polycrystalline ceramic brackets
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Objectives: To compare the shear bond strengths and modes of failure of three orthodontic brackets: a polycrystalline ceramic bracket, a collapsible polycrystalline ceramic bracket and a metal bracket.

Methods: Ninety extracted human premolar teeth were selected and examined at x3 magnification for any enamel defects. Three types of brackets and one orthodontic adhesive were used. One half of the sample was tested in a universal testing machine to determine the shear bond strength. The other half was debonded with the appropriate pliers and the tooth surface examined at x5 magnification. The site of failure was scored with the modified Adhesive Remnant Index (ARI). Teeth with an ARI grade of zero were examined in a SEM to determine any enamel fracture.

Results: No statistically significant differences in bond strength among the samples were found (p > 0.159). The modes of failure after debonding with pliers were predominantly at the bracket-adhesive interface. The mean shear bond strength of the Clarity bracket was 10.78 ± 2.74 MPa, the InVu bracket was 12.43 ± 2.40 MPa and the metal bracket was 11.89 ± 1.83 MPa. There were significant differences in the mean rank of the ARI grade between the three groups (p = 0.006). The Clarity and InVu (p = 0.011) and the Clarity and metal brackets (p = 0.005) were significantly different, but there was no difference between the InVu and metal brackets (p = 0.187).

Conclusions: All three samples had similar bond strengths. The risk of ceramic fracture on debonding was greatest for the InVu ceramic bracket.

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**Skeletal and dental changes after rapid maxillary expansion: a computed tomography study**

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**Objectives:** To investigate the skeletal and dental changes induced by rapid maxillary expansion, using computed tomography (CT) scans and three-dimensional (3-D) reconstructed images.

**Methods:** Twenty patients (Mean age: 12.3 ± 1.9 years) who required rapid maxillary expansion as a part of their comprehensive orthodontic treatment underwent pretreatment (T1) and post-treatment (T2) CT scans. The T2 – T1 differences between selected skeletal and dental measurements on the coronal CT and 3-D volumetric images were compared using the Wilcoxon signed ranks test.

**Results:** At T2 the Maxillary alveolar width (4.5 ± 3.5 mm) was greater than the Maxillary base width (1.7 ± 0.9 mm). The greatest transverse dental change was in the Intermolar width (6.3 ± 2.1 mm and 2.7 ± 1.9 mm at the crown and the apex, respectively). On the 3-D volume, significant increases occurred in the Bicondylar width (1.2 ± 1.3 mm), Bimaxillo-mandibular width (2.1 ± 2.3 mm) and the Maxillary width (2.5 ± 1.6 mm). The greatest change in the dental measurements was in the Maxillary first molar width (6.4 ± 0.1 mm). The Maxillary central incisor angle decreased significantly (-7.9 ± 8.4 mm), indicating an increase in the distance between the apices of the central incisors.

**Conclusion:** Volumetric 3-D CT scanning provides a useful method for assessing skeletal and dental changes after rapid maxillary expansion. Although significant increases occurred in most skeletal and dental measures, it appears that dental tipping explains most of the expansion.

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Strength of attachment between band and glass ionomer cement

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Aim: To determine the strength of attachment between plain stainless steel band material and glass ionomer cement.

Methods: Seventy-five extracted upper premolars, free of visible structural defects, were used. The teeth were divided randomly into three groups and embedded in acrylic resin blocks. A short length of plain, stainless steel band material with a welded stainless steel standard edgewise 0.022 inch bracket was adapted to the buccal surface of each tooth. The bracket-stainless steel pads were then cemented to the teeth with either Bandtite (Group 1), Granitec (Group 2) or Ariadent (Group 3) glass ionomer cement and stored in an incubator at 37 °C for 30 days. The shear bond strengths of the specimens were measured and compared.

Results: The mean shear bond strengths (SBS) were significantly different: Bandtite 0.7331 ± 0.056 Mpa; Granitec 0.3869 ± 0.047 Mpa; Ariadent 0.2931 ± 0.033 Mpa (ANOVA, p < 0.001). Tukey HSD post-hoc tests also showed significant differences between Bandtite and Granitec, Bandtite and Ariadent, and Granitec and Ariadent (p < 0.001). All specimens failed at the band-cement interface.

Conclusion: The highest and lowest SBS were related to Bandtite and Ariadent cements, respectively. All cements had bond strengths less than the range of bond strengths considered to be clinically acceptable for bonded orthodontic attachments. Mechanical factors are important for band retention.

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Lip - tooth relationships during smiling and speech: an evaluation of different malocclusion types
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**Background:** Few studies have focused on the impact of malocclusion on lip – tooth relationships during smiling and speech.

**Aim:** To evaluate the impact of different malocclusions on lip – tooth relationships during smiling and speech, using video images.

**Methods:** One hundred and three subjects with Class I (N = 31), Class II division 1 (N = 26), Class II division 2 (N = 16) and Class III malocclusions (N = 30) were asked to repeat the same sentence and then smile in front of a video camera. Nine frames were extracted from each subject’s video clip: at rest, posed smile, unposed smile and during the pronunciation of the sounds: ‘che’, ‘fa’, ‘se’, ‘chee’, ‘tee’ and ‘mee’. On each frame, up to 10 parameters describing the lip – tooth relationships were measured.

**Results:** In all frames, there were no statistically significant differences in the upper central incisor display ratios among the malocclusion groups (p > 0.05). The buccal corridor ratio in the posed and unposed smiles did not differ significantly among the malocclusions (p > 0.05). The most frequently visible last maxillary tooth was the first premolar in the posed smile, and the second premolar in the unposed smile. In each malocclusion group, the upper central incisor display ratio varied significantly among the nine frames and the buccal corridor ratio during the unposed smile was less than the ratio during the posed smile; although this was only significant in the Class II division 2 subjects. The smile arc was similar in all malocclusions.

**Conclusions:** In each malocclusion the upper central incisor display ratio varied significantly among the nine frames. In each group, the buccal corridor ratio during the unposed smile was less than that during the posed smile, but only the Class II division 2 group was significantly different. The smile arc did not differ among the malocclusions.

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Effects of orthodontic treatment and premolar extractions on the mandibular third molars
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Background: The space available for an unerupted mandibular third may depend on the choice of premolar extracted.

Aims: To investigate the effects of orthodontic treatment and premolar extractions on the inclinations of the mandibular third molars and the space available for their eruption, and to compare these changes with a nonextraction group.

Methods: The pre- and post-treatment panoramic radiographs of 54 subjects (20 males, 34 females) were used. Eighteen of these subjects had the four first premolars extracted, 16 subjects had four second premolars extracted and 20 subjects were treated nonextraction. Changes in the inclinations and spaces available for the unerupted third molars were compared.

Results: In the nonextraction group the third molars uprighted approximately 1 degree and in the second premolar extraction group the third molars uprighted 10 degrees. The spaces available for the third molars increased significantly in the first and second premolar extraction groups as compared with the space available in the nonextraction group.

Conclusions: Orthodontic treatment and extraction of the second premolars improved the inclinations of unerupted third molars and the space available for their eruption into the arch. The changes in inclination and eruption space were less marked following first premolar extractions.

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Cephalometric analysis of Malay children with and without unilateral cleft lip and palate
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Objective: To investigate the craniofacial morphology of Malay children with repaired UCLP and compare the data with non-cleft Malay children.

Methods: Twenty Malay children with repaired UCLP (12 boys, 8 girls; Mean age: 10.5 years) and 20 normal Malay children (8 boys, 12 girls; Mean age: 9.72 years) were recruited from the Combined Cleft Lip and Palate Clinic and the Department of Children’s Dentistry and Orthodontics, Faculty of Dentistry, University of Malaya, Malaysia. Lateral cephalometric radiographs were taken with the head orientated parallel to the floor. Thirty-one linear and angular variables were measured on the lateral cephalometric radiographs with Dolphin Imaging Software Version 10.0 (Dolphin Imaging, Chatsworth, CA, USA). The data were analysed with the Mann-Whitney U test and the level of significance was set at p < 0.05.

Results: In the UCLP group, the girls had deeper overbites than the boys (p = 0.011), and in the Control group the girls had a significantly more acute cranial base angle (NSBa, p = 0.017) and a less protractive lower lip (LL-E line, p = 0.21). The data for the boys and girls were combined. Subjects in the UCLP group had a more acute cranial base angle, shorter and more retracted maxillae and were more skeletal III than the subjects in the Control group. In the UCLP group, the upper and lower incisors were less proclined than in the Control group, the interincisal angle was more obtuse and the overjet reduced by 6 mm. There were no significant facial height differences. The nasolabial angle (Col-Sn-UL) was significantly more obtuse and the upper lip relative to the E line more retrusive in the UCLP group. There was no significant difference between the groups in facial heights or the maxillo-mandibular planes angle.

Conclusion: Malay children with repaired UCLP have small, retracted maxillae. The mandible in this group of children was of normal size and position, relative to the cranial base. Pressure from the repaired upper lip may be responsible for the retracted maxillae, retroclined incisors and obtuse nasolabial angle.

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Factors contributing to stability of protraction facemask treatment of Class III malocclusion
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Aim: To identify the craniofacial characteristics that contribute to long-term stability of protraction facemask treatment of Class III malocclusion.

Methods: Fifty subjects who met the following criteria were recruited: subjects with an anterior crossbite and 'Wits' appraisal < -3.5 mm; subjects who had been successfully treated with a protraction facemask (at the end of active orthopaedic treatment the overjet was overcorrected by more than 4 mm); the facemask treatment was started at either CS1 or CS2 and the subjects were followed until CS4; no subject had a congenital craniofacial deformity. Based on the occlusal status at CS4, three groups were identified: Stable group (SG), Unstable group (USG) and a Failed group (FG). One-way analysis of variance and Scheffe's post-hoc multiple comparisons were used to analyse the differences between the groups. Stepwise discriminant analysis was used to identify the craniofacial characteristics able to predict the stability of protraction facemask treatment.

Results: There were no statistically significant differences between USG and FG. The N-S-Ar was significantly larger and Co-Gn, Wits and LAFH significantly smaller in the SG group as compared with the USG and FG groups. The critical score between SG and USG was 0.368 and between USG and FG it was -0.981. Individuals with scores higher than 0.368 showed relatively stable occlusions at CS4, whereas anterior crossbites returned in individuals with scores less than -0.981 at CS4. The overall percentage of correctly classified cases was 74 per cent, with 90.0 per cent in SG and 73.3 per cent in FG.

Conclusions: A severe maxillo-mandibular discrepancy, an increased vertical dimension and a prognathic mandible were unfavourable factors for long-term stability following early treatment of severe Class III subjects with protraction facemasks.

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Effects of rapid-slow maxillary expansion on the dentofacial structures
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Background: To date, no study has determined if rapid followed by slow maxillary expansion (also termed 'semi-rapid' expansion) has the same effects on the dentofacial skeleton as rapid maxillary expansion.

Objective: To determine the vertical and sagittal changes in the facial skeleton during and following rapid then slow maxillary expansion (R-SME).

Methods: Bonded maxillary expansion appliances were used to separate the maxillae over six days by activating the midline screws twice a day. The screws were then activated three times a week until sufficient expansion was obtained (Mean: 3.4 months) and used as retainers for six months. Cephalometric measurements at the start of expansion (T1), end of expansion (T2) and end of retention (T3) were compared with paired t-tests. Pearson correlation coefficients were used to determine the associations between the expansion (dental and skeletal) and the cephalometric changes.

Results: The maxillae moved forward a small, but statistically significant, extent during expansion. The upper molars were extruded and the mandible 'rotated' downward and backward. Although the vertical height of the facial skeleton (SN/GoMe, S-Go, N-Me, ANS-Me) increased significantly during expansion, the changes were small and highly variable. Some dimensions (SN/GoMe) relapsed during retention, while others (S-Go, N-Me) increased.

Conclusions: Rapid then slow maxillary expansion caused a small, but statistically significant, forward movement of the upper facial skeleton, a small downward and backward rotation of the mandible and a small increase in face height. The changes were similar to those found during rapid maxillary expansion.

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Shear bond strengths of buccal tubes
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Aims: To investigate the shear bond strengths of buccal tubes and to determine the sites of failure.

Method: Four orthodontic buccal tubes were selected: A, American Orthodontics; B, 3M Unitek - small base; C, 3M Unitek - large base; D, Hangzhou Dentop. Twenty buccal tubes from each group were bonded to the buccal surfaces of lower right first molars with the same light-cured composite resin. The buccal tubes were debonded with a universal testing machine and the data analysed. The amount of adhesive remaining on the teeth after debonding was classified with the modified adhesive remnant index (ARI).

Results: The groups ranked from the highest to lowest bond strength (MPa) were: B, A, D and C. The bond strengths of the buccal tubes, except Groups A and B, were significantly different (p < 0.05). The majority of the buccal tubes (63 per cent) had modified ARI scores of 1 and 2 and 25 per cent of the tubes had scores of 4 and 5. After debonding, no adhesive remained on 40 per cent of the teeth in Groups B and D.

Conclusions: The shear bond strengths of the buccal tubes fell below the value considered to be clinically acceptable. There were no differences between the shear bond strengths of the buccal tubes with photoetched and microetched bases. The buccal tubes with the largest base failed prematurely, possibly because the unsupported bonding pad flexed during debonding.

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The effect of a Clark twin block on mandibular motion: a case report
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Aims: To investigate mandibular motion in six degrees of freedom before, during and after twin block treatment in one individual.

Methods: The appliance was worn for eight months, and motion recordings, using a 12-camera opto-electric system, were captured prior to placement of a twin block appliance and 2, 4, 14 and 52 weeks after insertion.

Results: The wide variations in mandibular motion that accompany twin block wear disappeared post-treatment, except for an increase in anteroposterior movement of the mandible.

Conclusion: Twin block therapy appears to affect mandibular motion temporarily.

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Orthodontic treatment of a transmigrated mandibular canine: a case report

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Background: Intraosseous migration of a lower canine across the midline is a rare dental anomaly. The treatment options include: forced eruption of the unerupted tooth using orthodontic traction, autotransplantation, extraction followed by prosthetic replacement.

Aim: To report the management of a transmigrated lower right canine.

Method: The treatment involved surgical, orthodontic and cosmetic dental treatment. No permanent teeth were extracted.

Results: The transmigrated canine was placed between the left central and lateral incisors and the crown recontoured to simulate a lateral incisor. An acceptable aesthetic and functional outcome was gained.

Conclusion: Transmigration is a rare dental condition that can be treated successfully with a collaborative effort from several dental disciplines.

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Non-surgical treatment of mandibular deviation: a case report
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Background: Mandibular deviation due to premature contact of teeth in crossbite may be associated with facial asymmetry.

Aim: To describe the non-surgical treatment of mandibular deviation associated with a marked facial asymmetry.

Methods: A 13.5 year-old girl presented with a unilateral posterior crossbite, noticeable facial asymmetry, anterior crossbite and displacement of the mandible on closure. She had no history of head injury or significant medical problems and her parents rejected surgical correction. A removable appliance was used to correct the crossbite followed by fixed appliances to complete treatment.

Results: Treatment resulted in a marked improvement in facial symmetry and elimination of the mandibular displacement.

Conclusions: Early correction of a functional deviation associated with a unilateral facial asymmetry may avoid the need for surgery.

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