
Recent literature

These reviews have been prepared by the orthodontic postgraduate students from the University of Western Australia

Evaluation of incisor position and dental transverse dimensional changes using the Damon system

R. Vajaria, E. BeGole, B. Kusnoto, M.T. Galang and A. Obrez

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In 1998, Dwight Damon proposed that low friction and light forces used during orthodontic treatment produce more biologically stable results. This led to the development of the Damon system with its low friction self-ligating brackets and broad archwires. The Damon philosophy believes that the use of light forces allows the arch form to align and develop by taking the path of least resistance (that is, posterior expansion) rather than overpowering the musculature. This allows the perioral muscles to produce a 'lip bumper' effect, minimising proclination of the incisors and expansion of the intercanine width. However, previous studies comparing the Damon system to conventional bracket systems have reported the resolution of crowding to occur by a combination of arch expansion and incisor proclination, regardless of the bracket system used.

The aim of the present study was to evaluate the anteroposterior changes of the incisors (inclination and position) and transverse changes of the dental arches (intercanine, interpremolar and intermolar widths) in patients treated with either the Damon self-ligating system or conventionally-ligated edgewise appliances. Patients with bi-maxillary Class I crowding, or constricted dental arches, with no skeletal discrepancies in the permanent dentition were retrospectively selected. Twenty-seven patients were treated with a 0.022 inch-slot Damon D3 MX appliance and 16 patients with a 0.018 inch-slot standard edgewise bracket system. All patients were treated nonextraction and no other appliances were used. Pretreatment and post-treatment dental models

and lateral cephalometric radiographs were used to determine differences in the anteroposterior and transverse dimensions between the two groups during treatment.

Results revealed that both systems alleviated crowding and levelled the curve of Spee with similar, significant increases in incisor advancement, incisor proclination and transverse dental arch expansion. The only significant difference observed between the two groups was a greater change in the maxillary intermolar width of patients treated with the Damon system.

The study highlights that, when no additional auxiliary appliances are utilised, advancement of the incisors and expansion of the buccal segments occurs in crowded dental arches treated nonextraction in either the Damon or a traditional edgewise appliance system. The Damon philosophy that incisor advancement and proclination will be significantly reduced using the Damon system was not supported by this study.

The authors concluded that it was imperative for clinicians to be wary about exaggerated appliance claims. With the introduction of new technologies, materials and techniques, a thorough objective appraisal should be undertaken before deciding if these products will be of clinical patient benefit.

Effects of facemask treatment anchored with miniplates after alternate rapid maxillary expansions and constrictions: a pilot study

D. Kaya, I. Kocadereli, B. Kan and F. Tarar

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Facemasks have been successfully used for the correction of Class III malocclusions since the late 1960s. One of the main goals of early maxillary protraction is to reduce or simplify phase 2 treatment, and possibly

avoid later surgery. Rapid maxillary expansion has been recommended for use in conjunction with facemask therapy because the appliance disrupts the circummaxillary and intermaxillary sutures. It has also been reported that the circummaxillary sutures may be better managed by the use of alternate RME and constriction (Alt-RAMEC). In addition, tooth-borne appliances with a facemask achieve orthopaedic improvement and dental compensation seen as incisor proclination. However, a facemask anchored to osseointegrated implants has provided rigid anchorage and is a critical element in pure maxillary orthopaedic movement.

The objective of this pilot study was to describe the dentoskeletal and soft tissue effects of facemask treatment anchored with miniplates after alternate rapid maxillary expansions and constrictions (Alt-RAMEC) in maxillary retrusion patients.

The study group consisted of 15 Class III patients (nine females, six males) with a mean skeletal age of 11.6 ± 1.59 years. A bonded RME was attached to each patient and was alternately opened and closed for 2-week periods over the course of 8 weeks. Daily activation for the expansion/constriction course was 0.5 mm. After the final constriction, titanium miniplates were adapted to the lateral nasal wall of the maxilla. After soft tissue healing (10 days), a Delaire-type facemask was adjusted and 350-400 g of full-time force per side applied via elastics at 30 degrees forward and downward to the occlusal plane between the miniplates and facemask. Patients were reviewed every 3 weeks and when the desired forward movement of the maxilla was achieved for a good profile, the miniplates and bonded RME appliance were removed. The total treatment time, including 8 weeks of the Alt-RAMEC protocol, measured 9.9 ± 2.63 months.

Lateral cephalometric radiographs were taken before treatment and after maxillary protraction following a standardised protocol. The results were analysed by means of the dependent *t*-test and the Wilcoxon sign rank test. All but one of the miniplates withstood the orthopaedic force exerted during treatment. Cephalometric findings showed that there was significant forward movement of the maxilla (2 mm), with a slight counterclockwise rotation (0.8 mm) but without maxillary incisor proclination. There was significant clockwise rotation of the mandible (1.2 degrees) and slight uprighting of the mandibular incisors (2 degrees). The vertical dimension increased

significantly (1-1.3 degrees). An improvement in soft tissue profile was seen as evidenced by significant forward movement of the upper lip and backward movement of soft tissue pogonion.

It was concluded that this treatment approach can offer an advantage for correcting mild to moderate maxillary retrusion in Class III patients.

The present article shows the initial success of facemask treatment with skeletal anchorage but initial success is also seen with conventional facemask treatment. The authors contend that the ultimate success of facemask therapy should be evaluated at the end of growth. Conventional facemask treatment has long-term success in maintaining a positive overjet in approximately 75 per cent of patients. It remains uncertain whether facemask treatment with skeletal anchorage is superior to conventional treatment. There is less anterior dental proclination, but the necessity of the invasive surgical procedure is questionable. In addition, the Alt-RAMEC procedure has been shown to disarticulate the circummaxillary sutures, but whether the added affects on the teeth and alveolus and the increased risk of root resorption and dehiscence outweigh the benefits also remain unanswered questions.

The authors suggest a long-term study to determine the effectiveness of facemask treatment with skeletal anchorage and Alt-RAMEC and to further determine whether there is increased benefit compared with conventional facemask treatment.

Arch dimension changes from successful slow maxillary expansion of unilateral posterior crossbite

C.A. Wong, P.M. Sinclair, R.G. Keim and D.B. Kennedy

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A posterior crossbite in the primary or early mixed dentition is reported to occur in 8-22 per cent of cases, many of whom may have a functional mandibular shift. A unilateral posterior crossbite is believed to be maintained from the primary to the permanent dentition and may have long-term effects on the growth and development of the teeth and jaws. For this reason, early treatment of a unilateral posterior crossbite is indicated in order to prevent adverse effects on the temporomandibular joints and

masticatory system as well as to reduce the complexity of treatment in the permanent dentition.

Several studies have been carried out to assess the early treatment of posterior crossbites, however, a considerable variety of treatment approaches, study design, sample sizes and research approach has produced disparate outcomes. The present study aimed to conduct a retrospective clinical evaluation of the short and long-term effects of slow maxillary expansion on arch dimensions in early mixed dentition patients exhibiting a unilateral posterior crossbite.

One hundred and ten patients treated in a Private Orthodontic Practice with either a Haas-type appliance, hyrax or quadhelix appliance, were chosen. The inclusion criteria identified patients with a unilateral posterior crossbite involving at least two consecutive posterior teeth with a functional mandibular shift, patients no older than 10 years of age, with pretreatment (T1), post-treatment (T2), and early permanent dentition (T3) models available. All patients were treated using one appliance without other treatment complicating the slow maxillary expansion effects.

The treatment protocol involved one turn (0.25 mm) every 2 days for the Haas type and Hyrax appliances. The quadhelix appliance was activated once every 4-6 weeks. Measurements identifying arch circumference, intercanine and intermolar width, arch length and molar angulation were made on photocopied images of the models at stages T1, T2, T3.

Results indicated that all three expanders produced a similar change ($p < 0.001$) and were equally effective at correcting unilateral posterior crossbites in the early mixed dentition. The intercanine and intermolar widths increased during active expansion ($p < 0.001$). A high percentage of intercanine (90%) and intermolar (84%) expansion was maintained over a 4-year period without the use of retainers post-treatment. From T2 to T3, there was a significant decrease in arch perimeter compared with the control group. Molar angulation calculations revealed buccal crown tipping of approximately 4 degrees for both arches during the expansion phase (T1-T2).

The present study concluded that maxillary arch dimensions in the early mixed dentition in patients with a unilateral posterior crossbite showed good stability 4 years post-treatment in the permanent dentition. Although the type of appliance used was not significant, it was clear that there was selection

bias regarding appliance allocation. The definition of success was defined as the stability of crossbite correction at T2 and T3. However, the apparent high level of stability may be due to growth effects, since 1.5-2 mm of arch width increase is generally expected in the period between 9-13 years. Whilst the study reinforces previous academic findings, it remains debatable whether the results contribute substantially to the existing literature.

Molar height and dentoalveolar compensation in adult subjects with skeletal open bite

J. Kucera, I. Marek, H. Tycova and T. Baccetti

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Because of its complex nature, skeletal open bite is one of the most difficult problems to treat in orthodontics. As the name suggests, the main contributory factor related to the open bite is vertical skeletal dysplasia. It is recognised that the aetiology of open bite is closely linked with the interaction between form and function and its complex nature renders open bite a difficult malocclusion to manage. The present study therefore aimed to describe the morphological features of skeletal open bite among compensated and non-compensated subjects compared with a control group possessing normal Class I occlusions. It was considered that a comparison between compensated and non-compensated skeletal open bites might not be possible unless selection criteria established that the open bite was truly of a skeletal nature.

Sixty-nine subjects were selected based on inclusion criteria restricted to white females, 17 years and older. Contemporary cervical vertebrae maturation stages were used as developmental indicators to identify growth status with its associated limitations. Skeletal open bite patient selection was based on the vertical relationship of the maxilla and mandible in pretreatment cephalometric radiographs. The study comprised three groups, namely, skeletal open bite with and without dental compensation and a control group, upon whom cephalometric measurements were made.

The results indicated that, among adult skeletal open bite malocclusions, dental compensation occurred more commonly in the incisal region. The

compensated group revealed less proclination of the upper incisors. Molar height in both arches in the compensated and non-compensated groups was the same and greater than the control group. Narrowing of the lower anterior alveolar process was observed in all skeletal open bites.

While the present study ignored the sagittal relationship of the open bite subjects, it confirmed the findings of previous authors who used two-dimensional cephalometric variables. These potentially oversimplified the underlying character of the open bite which was reflected in the uncertainty and clinical difficulty in treatment.

The authors concluded that open bite was a complex malocclusion due to its multifactorial aetiology and complex form-function interaction. Further characterisation of open bite malocclusions would be of benefit in the understanding of their aetiology and management. It is suggested that the identification of phenotypic variability with the precision provided by three-dimensional imaging and genotyping may further unravel open bite malocclusions and thereby improve treatment success and stability.

Temporomandibular disorders: a position paper of the International College of Cranio-Mandibular Orthopedics (ICCMO)

B. Cooper

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The International College of Cranio-Mandibular Orthopedics considers that there are two principal schools of thought regarding the aetiology and optimal treatment of temporomandibular disorders. One school centres on physical/function aspects and the other focuses on the biopsychosocial. This position paper attempts to establish the scientific basis for the physical/function school. The stance taken by the International College indicates that temporomandibular disorders comprise a group of musculoskeletal disorders which produce alterations in the structure and/or function of the TM joints, masticatory muscles, dentition and supporting structures. An initial disorder diagnosis is based on history, clinical examination and imaging, if indicated. It is suggested that diagnosis is greatly enhanced with physiologic measuring devices which provide an

objective measurement of the functional status of the masticatory system.

The American Alliance of TMD organisations, which represents thousands of clinicians involved in the treatment of TMD, has produced ten basic tenets. One principle indicates that dental occlusion may have a significant causative, precipitating or perpetuating role in TMD. An overwhelming majority of dentists believe that dental occlusion plays a major role. While the International College believes that occlusal treatments most frequently resolve TMD, it is recognised that TMD can be multifactorial and may exist with co-morbid physical or emotional factors that require therapy. The College further believes that TMD has a primary physical/functional basis and that initial conservative and reversible treatment is most often successful. Treatment usually employs a therapeutic neuromuscular orthosis that incorporates relaxed, healthy masticatory muscle function and a stable occlusion. These objectives are achieved using measurement technologies and ultra-low frequency transcutaneous electrical neural stimulation (TENS). The International College of Cranio-Mandibular Orthopedics concludes that the scientific validity of the physical/functional basis of TMD is supported by substantive literature, as is the efficacy of measuring devices and TENS as an aid to diagnosis and the establishment of a therapeutic neuromuscular occlusion.

Head and cervical posture in patients with temporomandibular disorders

S. Armijo-Olivo, K. Rappoport, J. Fuentes, I.C. Godott, P.W. Major, S. Warren, N.M. Thic and D.J. Magee

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It has been postulated that an altered posture of the head and neck might cause or predispose to painful conditions by altering the biomechanics and muscular balance of the craniocervical region. Therefore, the authors aimed to determine whether patients with myogenous or mixed (myogenous plus arthrogenous) temporomandibular disorders had a different head and cervical posture measured through angles commonly used in clinical research settings when compared with healthy individuals. One hundred and fifty-four subjects participated in the study and

of these, 50 were healthy and were therefore the control group. Fifty-five subjects were diagnosed with myogenous TMD and 49 subjects had myogenous and arthrogenous TMD. A standardised lateral photograph was taken of all subjects with their heads held in a self-balanced position. Four angles were measured and involved: 1) the eye-tragus-horizontal, 2) the tragus-C7-horizontal, 3) pogonion-tragus-C67 angle and 4) the tragus-C7-shoulder angle. Specially designed software was used to measure all angles and measurements were performed by a trained rater who was an orthodontist blinded to the group status of each subject. A statistical one-way MANOVA test was used to analyse differences between the angles among the groups.

Results indicated that the only angle that reached statistical significance among the groups was the eye-tragus-horizontal angle. Pair-wise comparisons determined that a mean difference of 3.3 degrees (95% confidence level) existed when comparing subjects with myogenous TMD and healthy subjects. Postural angles were not significantly related to neck disability, jaw disability or pain intensity. Intra-rater and inter-rater reliability of measurements were excellent with intra-group correlation coefficient values ranging between 0.996 – 0.998.

The authors concluded that the significant difference between those patients with myogenous TMD and healthy subjects was a more extended position of the head. The difference was small and so the alteration in craniocervical posture was not considered to be of clinical significance.

Occlusal wear following orthodontic treatment assessed by 3-D CT scanning

P.G. Panos, T.M. Tarawneh and A.E. Athanasiou

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Tooth wear is generally regarded as multifactorial with an unclear definitive aetiology. It is often difficult to dissect out the contributing factors related to abrasion, erosion and attrition. Occlusal wear usually progresses slowly and so pronounced wear during the course of orthodontic care is considered unlikely. However, the authors aimed to evaluate occlusal wear after a course of comprehensive orthodontic treatment.

Consecutive pre- and post-treatment study casts of 30 patients who had received orthodontic treatment with fixed appliances were digitised using a 3-D CT scanner. The final sample consisted of 1256 teeth comprising 628 sets for pre- and post-treatment volumetric superimposition comparison.

Statistical analysis was performed using the Kolmogorov-Smirnov test for normality of distribution, the Levene test for homogeneity of dispersion and the Wilcoxon test for differences in mean values.

Almost all teeth decreased in volume after orthodontic treatment with the mean decrease identified as 1.03 mm³ per tooth. Increased treatment duration was associated with increased occlusal tooth loss. No significant differences were found between extraction and non-extraction cases, genders, or between different groups of teeth or malocclusions.

The authors concluded that there was a relationship between orthodontic treatment, its duration and the level of occlusal wear, although specific association and reasons were not provided. Additional investigation is required.

Assessment of the reliability of root angulations on panoramic radiographs

K.D. Dholakia and S.R. Bhat

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Can you be certain of tooth root angulations on panoramic films taken to assess root positions prior to orthodontic appliance removal? Because of distortion and focal problems associated with panoramic radiographs, the authors aimed to check the reliability of these films for the assessment of mesiodistal tooth angulations.

A clear anatomical typodont with removable teeth was used and 0.8 mm chromium steel balls were glued over the incisal/occlusal and apical/furcal regions of the teeth. These served as reference markers to identify the long axes of the teeth on radiographs and photographs and considered in relation to a horizontal reference plane provided by a rectangular, ovoid, stainless steel archwire inserted into tubes bonded to the first molars. The typodont was placed and aligned in an imaging unit so that the maxillary occlusal plane was 9 degrees to the beam and a 3 mm opening existed between the incisors.

By way of the metal ball images identified on the panoramic film, the tooth crown and root and therefore the radiographic angulation of the teeth was identified. Also identified were the mesial and distal occlusal extremities of each tooth by the measured imaging of wires attached to the occlusal surfaces.

In addition, photographs were taken of the teeth and used to assess the alignment and angulation of an additional occlusal wire centred between the buccolingual aspects of the teeth and marked midpoint at the buccal cervical face. This provided a mesio-distal tooth angulation and the degree of convergence/divergence between the long axes of the teeth was compared with the radiographic findings. All measurements were checked three times and statistically processed using SPSS17 and Cohen kappa coefficients calculated.

Previous research had shown that a 2.5 degree difference in the clinical and radiograph long axis assessment of teeth was clinically acceptable. However, the results of

the present study indicated that the readings between the true and radiographic angulations of teeth were beyond acceptable limits in the majority of cases. In particular, mandibular tooth angulation comparisons provided clinically unacceptable differences. The lower teeth commonly affected were the lateral incisors, canines, second premolars and first permanent molars. In the maxilla, the canines and premolars revealed the greatest discrepancy/differences.

The authors concluded that there were significant limitations in the use of panoramic radiography in the clinical assessment of root angulations. It was suggested that panoramic radiography be used only to check root parallelism as mesiodistal angular representations of the teeth was poor. The panoramic images should only be seen as a basic guide to root parallelism and if non-parallelism is observed, clinical judgement should be applied.