Association between malocclusion and the contextual factors of quality of life and socioeconomic status
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American Journal of Orthodontics and Dentofacial Orthopedics 2016; 150: 58-63

Background: The authors had previously published articles on the value of epidemiological factors and quality of life on orthodontic treatment needs, as well as trends and prevalence of dental caries and fluorosis in school children.

Malocclusion and the predominantly aesthetically driven motivation for treatment by patients has consequential psychological as well as physical impacts. This has been well established within the existing literature in both the deciduous and permanent dentition stage and in the short- and long-term.

The aim of the paper was to identify associations between the presence of malocclusion and a patient’s quality of life, as well as with socioeconomic status factors, specifically within the mixed dentition stage.

Materials and methods: The authors conducted an observational, cross-sectional, survey-based study that involved 1256 children aged between 7 and 10 years, from 11 public schools located in São Paulo, Brazil. The sample size was calculated based on previous studies of dental caries and occlusal problems, and took into account malocclusion prevalence, sample error, confidence interval, sample loss, design error, and test power. The exclusion criteria were those who had or were currently receiving orthodontic treatment, or if physical or psychological problems prevented the examinations from being performed.

In order to assess the impact on the oral health-related quality of life (OHRQoL), data were collected from a Brazilian version of the Child Perceptions Questionnaire, which included 25 items distributed over four subscales described by oral symptoms, functional limitations, emotional well-being, and social well-being, as well as assessing the frequency of these events over the previous four-week period. Clinical examinations involved an assessment of the anteroposterior canine relationships, overjet, overbite, and the presence or absence of an anterior or posterior crossbite. Those with at least one variation from the norms used within the study were identified as having a malocclusion. Socioeconomic status was determined using data from the Research and Planning Institute of São Paulo, and was identified as being either high or low.

Bivariate individual analyses were performed, as well as a multiple multilevel logistic regression model utilising the SAS software program. A novel approach was applied through the use of this multilevel model in the analysis of factors, both individual and contextual, as they related to malocclusion.

Results and discussion: The results showed a high prevalence of malocclusion in the sample of 82.1%. The variables of age and socioeconomic status were significantly associated with malocclusion. A low socioeconomic status was an individual factor associated with a low OHRQoL, and increased overjet, as a contextual factor, had the most negative impact on OHRQoL.

Critical appraisal: Overall this is a satisfactory study that addresses, via a novel analysis, an important aspect of orthodontics and its impact on quality of life. There are limitations, some of which were highlighted by the authors. The nature of this study was cross-sectional, with associated inherent limitations which provided associations as opposed to a causal relationship between the variables and outcomes. Secondly, there are the potential errors that may be introduced into the
study from the accessed government database. Thirdly, although the authors make mention of randomisation in selecting the subjects, there may be selection bias, as the exact nature and method was not discussed. Furthermore, given that the sample was derived from public schools, there may be inherent biases towards a lower socioeconomic status background. In addition, it was not clear as to whether the examinations were performed by the authors or by others. Additionally, no evidence of measurement error, related to verifying potential malocclusions, was noted. These final two aspects provide potential issues related to the consistency of the data. Finally, with regard to external validity, the survey was based on a location-specific sample. Therefore, the ideal societal norms, or what is considered desirable, and subsequent findings, may not be applicable to other populations, which reduces the applicability of these results to patients from other global locations.

Conclusion: The paper utilises a novel approach to analyse associations between malocclusion and quality of life, as well as contextual factors, such as socioeconomic status, specifically within the mixed dentition stage of treatment. These associations are valuable despite having been previously established in either the deciduous or permanent dentition. Although it is a well-executed study, it is nevertheless only confirmational in nature, which does not alter the existing understanding of the impact of malocclusion on a patient’s well-being, nor its treatment.

Christophe Duigou

Evaluation of long-term stability of skeletal anterior open bite correction in adults treated with maxillary posterior segment intrusion using zygomatic miniplates

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American Journal of Orthodontics and Dentofacial Orthopedics 2016; 150: 78-88

Background: The treatment and retention of anterior open bite malocclusions, particularly those with a skeletal contribution, are considered to be challenging. A skeletal anterior open bite is characterised by a steep mandibular plane angle, an obtuse gonial angle, an increased lower facial height and excessive dentoalveolar features related to posterior vertical growth in maxilla / mandible or both. Numerous approaches have been suggested to manage this condition and a multitude of biomechanical methods advocated, including high pull headgear, vertical holding palatal arches, TADS, MEAW and interarch elastics, as well as orthognathic surgery.

The morbidity of surgical management as well as the financial impost has made clinicians reconsider options, particularly when significant aesthetic changes to the jaw positions are not part of the treatment goals. TADS have been shown to be effective in the short to medium term at intruding posterior teeth with significantly less morbidity compared with orthognathic surgery. A meta-analysis demonstrated relatively similar outcomes for surgical and non-surgical approaches in the management of anterior open bite correction. Although many clinicians have demonstrated excellent clinical outcomes in the short to medium term, long-term stability is yet to be demonstrated.

The present study was conducted to assess the stability of posterior intrusion of the posterior segments in managing anterior open bite malocclusions.

Materials and methods: Twenty-eight patients from 19–28 years of age were selected, with an Angle Class 1 or Class II malocclusion in the permanent dentition with an anterior open bite of -3 to -8 mm (cephalometric measurement) due to maxillary posterior vertical excess (according to Burstone analysis) and acceptable incisor lip relationship.

All subjects were treated by the same orthodontist using the edgewise technique in conventional 0.022 × 0.028 inch slot brackets. The upper posterior teeth were banded and eventually placed into a 0.019 × 0.025 inch stainless steel archwire and a double transpalatal arch to stabilise the segments.

Miniplates were inserted after the posterior segments were aligned and levelled and the mandibular arch was banded and stabilised by a continuous 0.019 × 0.025 inch stainless steel archwire except for the lower incisors. After completion of the intrusion of the maxillary molars, they were ligated to miniplates and the patients referred for first premolar extractions. Retention was achieved with maxillary and mandibular Hawley retainers for four years.

Results and discussion: The results of the study indicated that molar intrusion with zygomatic miniplates appeared to be stable four years after treatment.

However, the methodology was unclear as the radiographic examples did not match the text as lower
appliances were not present. The panoramic and lateral cephalograms did not represent consistent morphology when the curve of Spee was demonstrated. Moreover, the extraction protocol would also contribute to uprighting of the upper and lower dentition and a proportion of the open bite correction, yet the average reduction in lower incisor angle was not evident in the results.

Overbite correction confounds the outcomes in these patients as the biomechanical strategies generally may produce extrusive side effects. The effects of the molar intrusion alone are then difficult to clearly identify.

Conclusion: This study demonstrated relative stability of overbite correction using a combination of bone plate-facilitated posterior intrusion and incisor retraction. However, the precise contribution of either effect was difficult to identify. Moreover, it is important to consider the option of lower posterior intrusion that may facilitate a greater degree of vertical control than lower fixed appliances alone.

Tharanga Nawagamuwa

Reliability of cervical vertebral maturation staging

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American Journal of Orthodontics and Dentofacial Orthopedics 2016; 150: 98-104

Background: It has been suggested that estimating peak growth velocity can contribute to enhanced treatment outcomes in certain types of malocclusions. Several methods of staging skeletal maturation have been proposed, including chronological and dental age, pubertal markers, physiological parameters such as height and weight, psychological age and radiographic evaluation of bone maturation. Radiographic analysis is widely used to determine skeletal maturation and to provide an estimate of growth status. Before the cervical vertebral maturation (CVM) method was introduced, hand-wrist radiographs were used to assess bone maturation; however, there is a disadvantage of extra radiation to the patient. After introduction of the CVM method, studies have evaluated its reproducibility, but the results have been equivocal. While some have reported the CVM method to be reproducible, other studies have shown poor agreement between observers and significant variation in determining the CVM stages between 3 and 4. The aim of this study was to assess the reliability of the CVM method for the assessment of mandibular growth.

Materials and methods: Twenty orthodontists (9 orthodontists and 11 orthodontic residents) were trained to evaluate the CVM staging method using lateral cephalometric radiographs. The training involved explanation and a written description of the morphologic features of each stage followed by a PowerPoint presentation outlining a learning guide. The assessed sample consisted of 72 consecutive lateral cephalograms taken from patients at the Liverpool University Dental Hospital during a four-month period, which satisfied the inclusion and exclusion criteria. All cephalograms presented with complete visualisation of cervical vertebrae C2, C3 and C4. Radiographs that were not completely clear were eliminated from the sample. Initially, 11 ‘standardised’ cropped images showing only the cervical vertebrae were presented to the orthodontists in a PowerPoint presentation, and hard copies of the reference material were provided as a form of memory aid. Immediately after the training session, 83 images including the ‘standardised’ images were presented to the orthodontists for 30 seconds each, with a five-minute interval break. Each assessor was required to score the images using the CVM staging guidelines. After an interval of three months, the orthodontists were retrained before grading the same cephalometric radiographs that were presented in a different order.

Results and discussion: The authors concluded that the CVM classification is reproducible and reliable and it was identified that the quality of the image influenced the reliability of assessment method. This contradicts a previous study that showed that there was an overestimation of the evaluation, especially when identifying CVM 3 and 4, and low reliability has been previously documented. In addition, there was variation between the outlines of the concavity of the cervical vertebrae between individuals, and it was suggested that the clinician should draw the CVM outline and compare to a template to objectively conduct the assessment. It is important to note that the clinicians in this study received training just prior to the evaluation of radiographs on two occasions. From a practical perspective, this article is assessing the influence of a training exercise more than the reliability itself, and it does not represent orthodontic practice.

Conclusion: In conclusion, if the clinician considers it
important to determine peak growth velocity, having a template during CVM assessment may be beneficial. However, there are circumstances in which the ideal skeletal time does not correspond with the ideal dental time and vice versa. It was considered that there are many factors that influence treatment timing, and a comprehensive individual evaluation is necessary before commencing orthodontic treatment.

**Fabiana Petrykowski**

**Malocclusion and its relationship to speech sound production: Redefining the effect of malocclusal traits on sound production**

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American Journal of Orthodontics and Dentofacial Orthopedics 2016; 150: 116-123

Scope and aim: Speech is the vocalisation of thoughts, ideas and feelings and a primary method of communication in humans. It is a complex process containing neurological and physiological components. The physiological components include the teeth, lips, tongue and muscles of the pharynx and larynx, which play an important role in articulation by the modulation of airflow. The treatment of malocclusions – that is, the correction of malalignment in the position of the teeth and underlying skeletal structures – is the primary focus of orthodontic therapy. The impact of malocclusion on speech is poorly understood. The contribution of malocclusion to an articulatory disorder and the impact of treatment of the malocclusion on the correction or improvement of a speech disorder remains a controversial topic. This observational, cross-sectional study aimed to identify variables of dental malocclusion with the greatest effect on sound production that can be easily identified during an orthodontic assessment.

Materials and methods: The study involved 115 patients (50 male and 65 female) aged from 8 years 2 months to 36 years who presented for consultation at the orthodontic department in a medical centre in New York. Applied exclusion criteria were the presence or history of previously diagnosed speech disorder and hearing deficits and previous speech or orthodontic therapy, as well as patients with physiologic or anatomic disabilities. The ethnicity of the subject pool was primarily Hispanic and the authors did not exclude subjects who spoke another language as the primary language in addition to English.

The principal investigator performed a chairside orthodontic examination to evaluate the following occlusal characteristics: angle classification, overjet, overbite, anterior crossbite, posterior crossbite, maxillary crowding, mandibular crowding, maxillary and mandibular spacing. Additional data on missing, rotated or displaced teeth and teeth in crossbite were recorded for the calculation of the Orthodontic Treatment Priority Index. This allowed for categorisation of severity and prioritisation for treatment of the malocclusion.

A video record of a speech sample was obtained, with the subject asked to repeat a standard sample of syllables, words and phrases without the investigator seen to eliminate any bias created by the visual cues. The consonants chosen as target sounds were /m/, /p/, /t/, /f/, /s/, /sh/, /ch/, /th/ and /l/ as they were similar in English and Spanish. The speech samples were analysed for sound production of the target sounds, any placement errors, severity of the sound error and the type of distortion – i.e., visual or articulatory or a combination of the two.

Results and discussion: Despite all subjects exhibiting a degree of malocclusion – 60 (52%) subjects had an Angle Class I, 47 (41%) Class II and 8 (%) had a Class III malocclusion – normal sound production was reported in 44 (38%) of the sample population. A sound production error was present in 71 (62%) individuals. Two individuals exhibited an auditory distortion, 12 exhibited a combined auditory and visual distortion and 56 exhibited a visual distortion of the sound. The authors concluded that components of malocclusion are associated with speech sound production errors and the greater the severity of the malocclusion the more likely a speech sound error will occur. The presence of a bilateral crossbite and an open bite had greater significance than the Angle classification in affecting sound production and, in particular, an open bite as small as 2 mm is associated with sound production errors. Combined auditory and visual distortions were present in 17% of the subjects with a sound production error. A visual distortion was present in 80% of the subjects with a sound production error but in itself may not be considered a true sound error.

Critical appraisal: The authors correctly acknowledged the bias associated with their sample population, being predominantly Hispanic from a similar social background and region in New York, which may not
be representative of Australian patient populations. Although there was a lack of clarity and consistency in the reporting of the results, the article highlights the complex nature of speech problems and the difficulties in evaluating the interaction between speech and malocclusion. Seventy-one patients were reported to have a sound production error, and 56 of these had a visual distortion in the production of the sound. The authors went on to state that by itself a visual distortion might not constitute a true sound error. If the error is purely visual and the acoustic properties of the sound are still correct, it might be argued that the visual distortion error is purely an adaptive capacity to maintain adequate speech.

**Conclusions:** The production of speech is complex, requiring both neurological and physiological processes. The development of these processes occurs early in childhood and is intimately related to hearing development. Speech or hearing difficulties that progress beyond the first few years of life may have an irreversible effect on speech and articulation and this is often well before the child first presents to the orthodontic office. The existing research suggests that while malocclusion may have an impact on speech production, the adaptive capacity often compensates to maintain adequate speech. Moreover, there is insufficient evidence to suggest that correction of the malocclusion by orthodontic treatment will influence the speech problem. Orthodontic treatment with appliances may in itself induce a temporary speech issue in some patients. As orthodontists we should be cognizant of speech problems in our patients and institute appropriate referrals to speech pathologists.

**Richard Lee**

**Comparison of cone-beam computed tomography with multislice computed tomography in detection of small osseous condylar defects**

**Jones EM, Papio M, Tee BC, Beck FM, Fields HW and Sun Z**

American Journal of Orthodontics and Dentofacial Orthopedics 2016; 150: 130-139

**Background:** Temporomandibular joint (TMJ) assessment is performed routinely by orthodontic practitioners prior to the commencement of treatment. The identification of TMJ pathology holds great importance in many clinical circumstances, including situations of suspected condylar breakdown in which early medical intervention can significantly improve prognosis and when orthognathic surgery or distraction osteogenesis is planned. Historically, two-dimensional imaging (panoramic images, tomograms, cranial projections) and, more recently, three-dimensional imaging (cone-beam computed tomography (CBCT) and multi-slice computed tomography (CT)) are used to complement clinical findings during TMJ evaluation. Significantly, while providing improved visualisation of bony pathologies relative to two-dimensional images, reports suggest that orthodontic grade CBCT is limited in displaying small condylar defects. The same limitation of multislice CT has not been reported. Therefore, the aim was to identify whether the limited capacity of CBCT to display small condylar defects was an inherent quality of CBCT, or whether this limitation is seen in other imaging modalities, specifically multislice CT. Further, assessment was undertaken as to whether image segmentation and colour mapping could overcome limitations in diagnosis of small condylar defects.

**Methods:** Eighteen condyles without existing defects from nine cadaver pigs’ heads were analysed. Small osseous defects (1.5 mm diameter) were created in each medial and lateral condyle surface. The condylar soft tissue was restored prior to imaging. Two images of each condyle were made using, firstly, orthodontic-grade CBCT (0.4 mm voxel size; i-CAT; Imaging Sciences International, Hatfield, PA, USA) and, secondly, medical-grade multislice CT (0.625 mm voxel size; LightSpeed; GE, Little Chalfont, Buckinghamshire, UK). The images were assessed by two orthodontic residents. Each image underwent segmentation and colour mapping (Dolphin 3D software) before a second assessment by each resident. Polyvinyl siloxane impressions of each condyle with the soft tissue removed, detailing the defects, were used for comparison.

**Results:** No significant differences existed between either the two imaging techniques (CBCT/multislice CT) or the two analytic methods (segmented/non segmented). However, classification function parameters revealed lower accuracy and lower sensitivity for CBCT diagnosis compared with multislice CT diagnosis. Further, logistic regression analysis revealed that using multislice CT significantly improved the probability of correct diagnosis. Interrater reliability (kappa) was ≥ 0.75 for all images.
and analysis methods except for segmented CBCT images.

Conclusion: For the diagnosis of small mandibular condylar defects, orthodontic grade CBCT images (0.4 mm voxel size) are inferior to medical grade multislice CT images. Image segmentation and colour mapping (Dolphin 3D software) does not overcome the identified limitations.

Critical evaluation: The presented study raises awareness that orthodontic grade CBCT images are not a reliable method for the diagnosis of small osseous defects. Therefore, the present study helpfully indicates an important limitation of CBCT imaging, which is becoming an ever-increasing part of routine orthodontics. However, the small sample size is a key limitation of the study; the lack of power preventing a statistical difference between the assessed groups in regard to undiagnosed defects or over-diagnosed defects to be measured. Additionally, the study would have had much greater relevance if the analysis was undertaken by experts in diagnosing condylar pathology rather than orthodontic residents with limited experience in the field. Finally, it must be appreciated that TMJ imaging should only be performed following a clinical examination that is suggestive of joint pathology; current evidence does not support routine TMJ imaging in the absence of symptoms. Further, without undertaking additional training in radiology, it may be prudent to have TMJ images reviewed by an oral and maxillofacial radiologist to ensure a correct diagnosis is made.

Stephen Naoum