Literature
reviews

The following reviews were prepared by the postgraduate students from the University of Western Australia.

Referral patterns of pediatric dentists and general practitioners to orthodontists based on case complexity

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Background: The assessment of a patient's orthodontic treatment needs depends on the provider's experience and level of training. There are reported discrepancies in the number of orthodontic cases treated by non-orthodontists as well as the comprehensiveness of undergraduate orthodontic training. This study therefore investigated general and pediatric dentists' subjective judgements of orthodontic case complexity and aimed to determine how their perceptions influenced the decision to refer to an orthodontist.

Materials and methods: The authors conducted a survey-based study involving 41 panel members consisting of 20 pediatric dentists and 21 general dentists. Pretreatment orthodontic records of 20 patients with a variety of malocclusions and a range of American Board of Orthodontics Discrepancy Index (DI) scores were presented. All patients were aged between 11 and 17 years with a variety of malocclusions, excluding patients with craniofacial anomalies, severe facial asymmetries or who had previous orthodontic treatment. Participants were asked to identify the subjective complexity of the case with the use of a 100-point visual analog scale (VAS), and asked whether they would refer to an orthodontist.

Results: General dentists appeared to provide more overall orthodontic treatment than pediatric dentists. Many general dentists provided limited orthodontic treatment and clear aligner therapy. The perceived complexity score was not significantly different between general dentists and pediatric dentists. The association between DI and perceived complexity was similar in both groups. Pediatric dentists had higher referral rates for cases with DI scores both below and above 20.

Conclusion: General dentists provided more orthodontic care than pediatric dentists. Both groups identified case complexity similarly, with only minor differences, but pediatric dentists had higher referral rates to orthodontic specialists regardless of the initial case complexity.

Critique: Overall, this investigation was essentially a confirmational study of what many involved in the dental industry would suspect prima facie. That is, general dentists are providing more orthodontic care than pediatric dentists by the adoption of clear aligner therapy. The referral rate of pediatric dentists was higher than that of general dentists because general dentists were more likely to treat cases themselves.

For a study based entirely on a subjective assessment, it was noteworthy that there was no mention of any specific limitations other than the general statement "perception assessment could be an arduous and difficult task". The following issues are worth considering in the interpretation of the quality of the study and its findings.

Firstly, there was no mention of how the panel members were selected. One factor that was considered was experience in dentistry. *Experience* was sub-divided into two categories: 1) 20 or more years in practice, or 2) less than 20 years in practice. In this cohort, over two-thirds of general dentists had more than 20 years' experience whereas less than half of the pediatric dentists had more than 20 years. In terms of dental experiences, there were a greater number of experienced dentists compared with experienced specialists. Another factor considered was *annual orthodontic CE hours* (CPD). The sub-category for CPD does not appear to be sufficient to fully appreciate the type of clinician considered and whether they had a special interest and/or had limited their scope towards orthodontics. In this study, CPD was considered as 1) 0–5 hours or 2) >10 hours. The latter category could denote participation at one weekend course or subscription to an increasing number of orthodontic residency programs for general dentists. Including the approximate number of orthodontic cases treated would be beneficial as there is a large variation in the scope and activity between general dentists and their predisposition to orthodontic options. Furthermore, static pretreatment records may not justify case complexity as it is difficult to assess muscles, joints or the presence of functional shifts.

Secondly, it can be argued that the scope of this study precludes a full depiction of case complexity encountered in orthodontic practice. By limiting pretreatment records to individuals of 11–17 years and excluding craniofacial abnormalities, severe asymmetries and previous history of orthodontic treatment, it can be argued that complicated cases, other than obvious dental irregularities, may not have generated a significant difference in judging case complexity. As training for specialist clinicians, it is expected that pediatric programs involve formal education in embryology, genetics and growth and development. These formal experiences may improve the diagnostic acumen of specialists in recognising features, which may be subtle, such as those encountered in mild craniofacial microsomia. Furthermore, the age restriction in this study precludes many of the complex issues that dominate the orthodontic literature, such as early Class II and III management, growth prediction and the increasing demand in adult orthodontics.

Despite this, as the emphasis of this study was to compare pediatric dentists to general dentists, it was understandable that records were restricted to the age spectrum seen by pediatric dentists. These limitations aside, the authors made mention that despite similar assessment of case complexity between groups they "*were not necessarily a thorough one*".

In conclusion, this was an interesting study that highlights issues of increasing importance as orthodontic treatment is provided by a greater number of non-orthodontists. Future studies with outcome-based results correlated with initial assessment of complexity would be of great insight.

Ray Lam

A comparison of patient experience, chair-side time, accuracy of dental arch measurements and costs of acquisition of dental models

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Background and aim: Study models are integral for a sound orthodontic diagnostic assessment. They allow for careful examination of the status of the dentition and type of malocclusion without the patient being physically present. A thorough diagnostic record including study models provides the clinician the ability to conscientiously treatment plan. Historically, these models were taken with alginate and poured in plaster. However, many clinicians would attest to the unpleasant experience patients have and their reaction to alginate impressions. The problem is further compounded when working with children and young adolescents with small mouths, hypersensitive gag reflexes and dental anxieties. The initial impression may shape the remaining outlook on orthodontic treatment, including compliance. The often-touted solution for this issue is intraoral scanning to construct digital models. The benefits of the digital workflow are presented as decreased chair time, increased accuracy, cost and reliability. Unfortunately, there are only limited studies that have assessed these individual factors, comparing digital workflow with conventional alginate impressions. The aim of this study was to compare the patient experience, the chair-side time, dental arch distances, and costs of printed digital models for pre-orthodontic children and young adolescents with severe malocclusion.

Materials and method: The authors conducted a prospective study whereby they recruited 59 pre-orthodontic patients aged 9–15 years, 28 girls and 31 boys; the mean was 12.83 years and 12.56 years respectively. Each child had an alginate impression at the first appointment and an intraoral scan at the second appointment. Immediately after each appointment the patients answered a questionnaire including a visual analog scale (VAS) from a smiling face to a sad face; their comfort was assessed for time perception, comfort, gag reflex, breathing, smell/sound, taste/vibration, and temperature. Anxiety was assessed using six qualifying statements: feeling uneasy, feeling insecure, feeling upset, feeling afraid, feeling nervous, and feeling happy. The total chair-side time was measured to the nearest minute for each procedure. Dental arch relationships were assessed by measuring distances intraorally on an intraoral digital caliper, on the plaster dental casts, and on the digital model using the 3Shape software. The landmarks measured were intercanine distance, intermolar distance, the right molar to right canine distance, and left molar to left canine distance. Intra and inter-operatory reliability for dental casts and scan measurements were performed and reliability ranged from 0.99 to 1. A cost calculation was based on the assumption of 310 dental models per year; this included initial equipment costs for both digital workflow and maintenance, as well as initial out-lay for alginate impression materials and an alginate mixer. In terms of statistical analyses, the differences in patient experience and the effect with age and gender were assessed by General Linear models, while differences in dental arch distances and total chair-side time was assessed by paired *t*-tests. Cost differentials were demonstrated graphically.

Results and discussion: The comparison of patient experiences demonstrated that the intraoral scan was superior in all variables to a statistically significant degree. The exception was the patient's time perception and temperature, in which there was no difference found. Some of these findings are in concordance with recent studies performed on adults. With regards to total chair-side time, there was no statistically significant difference between intraoral scans and alginate impressions. No statistically significant difference was noted in dental arch measurements comparing digital scans to plaster models. There were statistically significant variations comparing the intraoral measurements to the digital scans and the plaster models; the variables effected for both methods were the inter-canine width and the first molar to canine width on the right side. In terms of cost differentials, initially the digital procedure was 10.7 times more costly than the conventional alginate impressions. However, by 3.6 years there was no difference in cost between the two methods.

Critical evaluation: Biases were limited in this study as the same operator performed the alginate impression and the intraoral scan for the same patient. As there were two operators in this study both were given the same level of training and proficiency in intraoral scanning and so the presumption is that they were equally calibrated. One could argue that, although there was no difference in time between the alginate impression and the intraoral scan, this was not explored at different intervals as more scans were performed; ostensibly the clinicians could become faster and more proficient with the digital workflow as they obtained greater experience. Another mentioned limitation was potentially priming the patient's perceptions negatively towards all appointments by starting with the alginate impressions. Furthermore, the background of the patients was not explored thoroughly enough to determine if a significant number had already had particularly negative or positive general dental experiences that may skew the results. The environmental toll between digital and conventional orthodontic workflow has had little representation and was not explored here but would be of future interest.

Conclusions: Overall this was a well-planned appraisal of digital model workflow versus conventional alginate impressions and is particularly relevant for those considering which to implement in their clinical practice. While increased accuracy is not demonstrable an intraoral scan is considerably more comfortable for younger orthodontic patients than alginate impressions and this may prove advantageous for future compliance.

Sadaf Sassani

Facial attractiveness of cleft patients: a direct comparison between artificial-intelligence-based scoring and conventional rater groups

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Background: Artificial intelligence (AI) is the simulation of human intelligence processes such as learning and problem solving by computer systems. Convolutional neural networks (CNNs) are one type of biologically inspired model that has been used for pattern recognition tasks. Advantageous uses of CNNs in medical fields have been recently reported; however, one area that has not been explored is the evaluation of facial attractiveness. To date, no valid objective model exists to study facial aesthetics and attractiveness. Historically, studies frequently use single raters to assess facial attractiveness; this can introduce heavy bias based on an individual rater's background and subjectivity.

Worldwide prevalence of cleft lip and palate is one in 600 live births. Current treatment involves an interdisciplinary team approach for a prolonged period. Regardless of thorough management, the treatment does not often result in average facial appearance due to scarring at the surgical sites and the presence of asymmetry around critical facial structures. Compromised facial aesthetics in cleft patients has been reported to affect their psychosocial wellbeing; therefore, it is critical to objectively assess facial attractiveness and determine the degree of treatment success.

The main aim of this study was to verify the feasibility and practical potential of AI-based ratings in dentistry by evaluating facial attractiveness of treated cleft patients and controls by AI and to compare these results with human raters.

Materials and methods: The subjects consisted of 20 treated cleft patients and 10 controls. Sixty photographs of post-treatment frontal and left side profile views were used in the study. The AI assessed facial attractiveness by a computational algorithm consisting of a face detector and CNNs trained to extract facial features. More than 13,000 facial images consisting predominantly of Caucasians were used to train CNN models with more than 17 million ratings for attractiveness. The expected attractiveness score was subsequently computed and normalised from a scale of 0 to 10. Human assessment involved 10 maxillofacial surgeons, 14 orthodontists and 15 laypeople, using a visual analogue scale (VAS) of 0 to 10. This allowed direct comparison between AI and Human assessments of facial attractiveness. Parametric *t*-tests or non-parametric Wilcoxon signed-rank tests were performed in SPSS software program.

Results and discussion: The evaluation of facial attractiveness for cleft patients was comparable between AI and human ratings and there was no statistical significance found ($Ps \geq 0.19$). However, the facial attractiveness of the control group was rated significantly higher by humans than AI ($Ps \leq 0.02$). Variance was considerably large in all human rating groups, and this was especially accentuated in the assessment of cleft patients. This demonstrated the absence of uniform opinion in all human rater groups. Alternatively, the AI rated the cleft and control subjects similarly and AI failed to detect facial features that rendered the cleft patients less attractive through human eyes.

Critical appraisal: This was a well-written pilot study that was a first attempt to introduce CNNs-based deep learning and compare it to human capabilities in dental fields. The authors clearly recognised the limitations and potential biases of the study. The nature of the study was cross-sectional with associated inherent limitations. Small and unequal sample sizes of human rater groups, including gender imbalance, add further limitations. The result could have been affected by overrepresentation of male raters. Also, age difference between raters (average age of 53.5 years) and subjects (average age of 21.3 years) could introduce bias to the study as the facial features that define attractiveness may vary in different generations. In addition, the data base from which the AI was trained was not an accurate representation of the population. As a result, there may be a selection bias introduced in the AI assessment, even though the study stated that the AI might be more robust to account for human biases.

Conclusions: The present study proposed a novel method to rate facial attractiveness using AI with a face detector and a dedicated CNN. The shortcoming of human assessment related to variance and inconsistency could potentially be overcome by this method. Nevertheless, the present AI assessment requires further refinement to differentiate cleft features of the face that negatively influence the human perception of attractiveness.

Ho Jin Yoo

Maxillary protraction with rapid maxillary expansion and facemask versus skeletal anchorage with mini-implants in Class III patients: a non-randomized clinical trial

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Background: Skeletal anchorage for protraction of the maxilla is a current topic in the literature and provides an alternative to facemask therapy in an attempt to increase compliance and reduce dental and vertical side effects. While the success rates of mini-plates for maxillary protraction are high, placement and removal is a disadvantage of the protocol, as both require an invasive procedure. The use of mini-implants as an alternative to mini-plates has the advantage of skeletal anchorage without the need for an invasive procedure for insertion and removal.

The aim of this study was to investigate whether mini-implants with intermaxillary elastics could provide anchorage for maxillary protraction, and to compare this to conventional facemask therapy.

Materials and methods: The authors conducted a prospective non-randomised clinical trial involving 24 patients between the ages of 7 and 12 years of age. The subjects were divided into two groups; 12 subjects (mean age of 8 years) had conventional facemask therapy (FM) while 12 subjects (mean age 10 years) had mini-implants (MI) placed for maxillary protraction. Allocation was made according to whether participants had sufficient space around the developing teeth for implants and each group was treated by a single operator. All patients were pre-pubertal and had a Class III malocclusion as determined by negative overjet or incisor end-to-end relationship, straight or concave profile, a Wits relationship of less than 2 mm and ANB of less than 1°.

Participants in the FM group had a rapid maxillary expansion, which was carried out prior to maxillary protraction. Four mini-implants were inserted into the (MI) group under local anaesthetic and elastics worn between the maxilla and mandible 24 hours a day. Protraction was carried out until the overjet was 2 mm. Cephalometric analysis was performed on both initial and final teleradiographs.

Results and discussion: The results showed a significant increase in the projection of the maxilla and improvement in the occlusal relationships, however there were no statistically significant differences in any cephalometric measurements between the FM group and the MI group. The treatment time for the MI group was, however, significantly shorter than the FM group.

Critical appraisal: The aim of the study was well founded, as the authors investigated a less invasive alternative for skeletal maxillary protraction. There were limitations that were acknowledged by the authors such as the non-randomisation of the groups and non-standardisation of the facial pattern, which may have led to selection bias. The authors did not make clear from where the sample was derived and why the protocols were different between the two groups, with one having expansion and the other not. Although the literature suggests expansion makes no difference to maxillary protraction, maintaining protocols' similarity apart from the experimental variable will only serve to strengthen the outcomes. Questions should also be asked about the authors' choice of carpal radiographs to determine pre-pubertal status instead of CVM.

Ultimately, the study highlights the advantages of the use of mini-implants in maxillary protraction; however, the results do not altogether reflect the conclusions. Nevertheless, the premise of the study was sound, and further research is required to look at less invasive methods of providing skeletal anchorage for maxillary protraction.

Jane Harding