

Literature

reviews

The following reviews were compiled by the orthodontic postgraduate students from the University of Sydney.

Comparison of skeletal maxillary transverse deficiency treated by microimplant-assisted rapid palatal expansion and tooth-borne expansion during the post-pubertal growth spurt stage: A prospective cone beam computed tomography study

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Background: The ideal age for tooth-borne maxillary expansion to elicit skeletal changes is prior to 13–15 years because side effects such as bony dehiscence, buccal tipping of the posterior teeth and relapse are higher in older patients. Thus, expansion in patients during their post-pubertal growth phases are of concern. To increase the skeletal effects of expansion, bone-borne expanders have been developed and shown to be effective in patients treated before the post-pubertal growth phase.

Aim: To investigate the differences between bone-borne and tooth-borne expansion in maxillary deficient patients in their post-pubertal growth phase.

Materials and methods: This prospective randomised controlled clinical trial consisted of 60 consecutively recruited patients randomised to micro-implant-assisted rapid palatal expansion (MARPE) (N = 30) or Hyrax (N = 30) groups in a 1:1 ratio. Both groups were matched for gender, age (mean: 15.1 and 14.8 years respectively) and posterior occlusion; namely a skeletal maxillary transverse discrepancy and requiring > 5 mm of dental expansion. The MARPE group consisted of an expander fixed to four 12 mm miniscrews and the upper molars, whereas the Hyrax group consisted of four bands including the first premolars and first molars. Activation of the expanders was at a rate of 0.5 mm per day until the lingual cusps of the upper first molars contacted the buccal cusps of the lower first molars. Patients then all underwent orthodontic

treatment after three months of retention. CBCT data and study models were taken before expansion (T1) and one week after active expansion (T2). The primary outcome was the ratio of skeletal to dental expansion at the level of the maxillary first molar. Statistical analysis was performed using paired *t*-tests and independent *t*-tests.

Results: Successful expansion was defined as the presence of palatal suture opening on CBCT after expansion. 86.7% of the Hyrax group and 100% of the MARPE group exhibited opening of the mid-palatal suture ($P < 0.05$). There were significant increases for all variables involving maxillary width at the skeletal, alveolar and dental levels in both MARPE and Hyrax groups. The MARPE group showed greater skeletal maxillary width compared to the Hyrax group, with the ratio of skeletal to dental expansion almost two times greater in the MARPE group (61.4% vs 32.2%). Additionally, the study included a pair of twin sisters (aged 17.6 years) who received different expanders and also exhibited different types of suture openings despite the same amount of jackscrew expansion. The amount of buccal tipping of the first molars in the MARPE group was approximately half that in the Hyrax group. Alveolar bone height loss on the mesio-buccal roots of the first molars was less in the MARPE group when compared to the Hyrax group.

Conclusions: When considering MARPE against Hyrax expansion for patients during the post-pubertal growth phase with maxillary transverse discrepancies, MARPE could be a better alternative with more favourable skeletal expansion, buccal tipping and buccal alveolar height loss at the level of the first molars. Overall this was a well-designed study; however, limitations included a lack of blinding, although practically this was almost impossible due to the stark difference in expander design between the groups. Within the MARPE group, the expander design varied in connection type from the miniscrews

to the jackscrew. Furthermore, if no anterior diastema formed, the expansion rate was slowed to minimise tissue damage in four of the Hyrax group patients, potentially contributing to the decreased skeletal effects observed in this group.

Ihsan Savran

Quantitative evaluation of implemented interproximal enamel reduction during aligner therapy: A prospective observational study

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Background: Enamel interproximal reduction (IPR) is another way to increase the space available to relieve crowding and is sometimes considered as an alternative to extraction. IPR is also implemented when a Bolton's discrepancy exists and helps to reduce the black triangle in an adult patient who has aesthetic concerns or a history of periodontitis. In aligner therapy, accurate IPR plays a role in a successful treatment outcome as it provides adequate space for precise tooth movement as determined by virtual planning and good fitting of the aligners. The programmed IPR (p-IPR) should correspond to what is clinically implemented IPR (i-IPR) to achieve the desired alignment with accurate interproximal contacts. By using the digital checking tool in aligner software, p-IPR and i-IPR may be compared.

Aim: To investigate the correlation between p-IPR and i-IPR in a daily practice setting. The secondary objective was to determine the potential factors that might affect a difference between p-IPR and i-IPR and to produce guidelines to make IPR more efficient and the results of therapy more predictable.

Materials and methods: This was a prospective observational study. The sample was comprised of 50 patients (mean age 31.42 years, ranging from 16–63 years) treated using clear aligner therapy by six orthodontists. Digital or manual impressions were taken at the beginning of treatment and after the first set of aligners. IPR was achieved by interproximal reduction using manual strips, a contra angle mounted disc or burs. p-IPR and i-IPR measurements and technical comparison of IPR were obtained from 464 teeth. Statistical analyses included the Wilcoxon signed-rank test, Kruskal-Wallis, and multilevel mixed regression.

Results: Mean difference between p-IPR and i-IPR was 0.15 mm (SD: 0.14 mm, range: 0.43 mm to 0.15 mm), with the lower canines showing the highest discrepancy. IPR by burs and measuring gauges showed a smaller difference ($p = 0.029$, $p = 0.013$ respectively). IPR was performed more accurately on the mesial surface of teeth than on the distal surface. IPR after alignment resulted in a slightly more precise i-IPR compared to IPR before alignment ($p = 0.041$). There was no significant predictor effect for gender or age.

Conclusions: p-IPR was more than the i-IPR, especially for the distal surfaces of teeth and mandibular cuspids. Burs tended to provide more precise i-IPR than a contra angle disc and manual strips showed the least precision. Using a measuring gauge tended to increase the precision of i-IPR.

In the study, the subjects selected were Lite and Comprehensive treatment cases which indicated a variation in pretreatment crowding that could influence the results of the study. In addition, there were six operators with different levels of experience who used different IPR techniques and a mixture of digital and manual impressions were taken. Therefore, the methodology of this study was not standardised. Lastly, the ClinCheck digital tool was used to perform all measurements but the accuracy of this program was not documented.

Conroy Chow

Effect of clear aligner wear protocol on the efficacy of tooth movement: A randomized clinical trial

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Background: Although clear aligner therapy (CAT) is fast gaining popularity among orthodontists as an accepted mainstay of mechanotherapy, there are still unanswered questions regarding the efficacy and efficiency of these appliances. Based on current protocols from manufacturers, clear aligners are to be worn 20–22 hours per day and to be changed sequentially every seven days. Previously, however, the recommended wear schedule was 14 days. There is limited literature evidence to support either wear schedule. According to a company's internal data, an analysis comparing tooth movement predictability in

200 cases showed no difference in predictability or refinement rates between one- or two-week aligner changes. To date, no independent study has evaluated the efficacy of tooth movement with different aligner wear protocols (7-day, 10-day, 14-day). A better understanding of the optimal aligner wear protocol would help clinicians and patients improve efficiency.

Aims: To compare the efficacy of orthodontic tooth movement using three aligner wear protocols: 7 days, 10 days and 14 days.

Materials and methods: Eighty patients were randomly allocated into three groups: 7-day changes (group A), 10-day changes (group B), and 14-day changes (group C). Inclusion criteria were initial aligners of 17 to 25, patients in the permanent dentition and without extractions. Patients who needed the use of auxiliary appliances, oral surgery, dental restorations or who had previous orthodontic treatment, were excluded. The post-treatment scans were compared with the final virtual treatment simulations through digital superimposition. Six angular and six linear dimensions were computed and compared between the predicted and achieved treatment outcomes. The mean ages of the patients were 36.3, 34.3 and 35.4 for group A, B and C, respectively.

Results: All linear discrepancies in both jaws were deemed clinically insignificant (<0.5 mm), while nearly all angular discrepancies were considered clinically significant (>2.0 degree) except two variables in group C: mesial rotation in the maxillary posterior segment and buccal crown torque of the mandibular anterior segment. The 14-day change group showed significantly greater accuracy in the posterior segment for maxillary intrusion, distal crown tip and buccal crown torque and mandibular intrusion and extrusion when compared to the other groups. The mean treatment duration for group A, group B and group C were five, eight and nine months respectively.

Conclusion: The 14-day wear protocol showed statistically greater accuracy for some posterior movements but these differences were not clinically significant (>0.5 mm/>2.0 degree), suggesting that the 7-day protocol and 14-day protocol achieved a clinically similar accuracy. The 7-day protocol is acceptable given that the treatment duration is halved. If challenging posterior movements are desired, clinicians may consider slowing down to a 14-day protocol.

This prospective study was clinically relevant and well-designed with treatment provided by one highly experienced orthodontist. The patients were randomised and data collection was blinded. One of the limitations of the study was that the patients recruited may have a relatively mild malocclusion, as the selection criteria only included patients who could be treated with 17 to 25 aligners and treatment duration was relatively short. The findings of the study may not be applicable for moderate to severe malocclusions requiring difficult tooth movement. In addition, the cases included in each group comprised a mixture of malocclusions. Further studies with a more even number of cases of each malocclusion could give a better insight into the effect of different aligner wear protocols on each malocclusion. The method of superimposition by a best-fit 3D superimposition algorithm may lead to errors in measurement as teeth are moving in relation to each other and there is a lack of stable anatomic structures for the superimposition analysis. The alternate use of an occlusal index to measure the end of treatment outcome may mitigate the limitation of the ClinCheck plan, which may not be a true prediction of the final tooth position.

Hui Theng Chong

Orthopedic outcomes of hybrid and conventional Hyrax expanders: Secondary data analysis from a randomized clinical trial

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Background: Rapid maxillary expansion (RME) is a treatment modality adopted to correct maxillary transverse deficiency. Conventional Hyrax expanders are commonly used to achieve orthopaedic maxillary expansion in young patients. Recently, skeletal anchorage supported expanders have gained in popularity, introducing the question of whether there is an increase in the orthopaedic effect of a RME by the incorporation of skeletal anchorage (Hybrid-Hyrax). Previous studies discussing the outcomes of miniscrew-supported maxillary expanders are mostly in adult patients; however, there is a lack of evidence in young patients.

Aims: The aim of this study was to compare the orthopaedic outcomes of hybrid skeletal anchorage supported expanders and conventional expanders in growing patients.

Materials and methods: This study was a secondary data analysis from a previous single-centre randomised clinical trial. The sample consisted of 40 mixed gender individuals presenting with either a Class I or Class III malocclusion and a posterior crossbite. The age ranged between 9–13 years and therefore the patients were in the late mixed or early permanent dentition. The Hybrid-Hyrax (HH) group of 18 patients had a 9 mm expander with two para-sutural mini-screws (1.8 × 7 mm mini-screws and 4 mm transmucosal length) supported by bands on the maxillary first molars. The conventional Hyrax (CH) group of 14 patients similarly had bands on the maxillary first permanent molars and bonded C-shape clasps on the maxillary canines or premolars. The expansion screw was activated one-quarter turn twice a day for 14 days, thereby achieving 5.6 mm of expansion in both groups. The appliances were maintained in the mouth for 11 months whilst bone-anchored maxillary protraction therapy was performed for a previous clinical trial. Cone-beam computed tomography (CBCT) and digital dental models were obtained before (T1) and after expander removal (T2).

Results: The HH group exhibited significantly greater increases in nasal cavity and maxillary width and buccal alveolar crest widths. There were no intergroup differences in intermolar, inter-premolar or inter-canine distance, arch length or perimeter and arch size displayed similar increases in both groups after treatment. The HH expander demonstrated an orthopaedic effect of approximately 40% whilst the CH group effect was 20%. A relative intrusion of the maxillary first molars was observed in the HH group, which may have contributed to the increase in molar inter-crestal distance. There was a 97.36% stability rate for the palatal mini-screws.

Conclusions: The Hybrid-Hyrax expander produced greater increases in the nasal cavity and maxillary widths compared to the conventional Hyrax expander. Similar dental effects, as well as arch size and shape changes, were observed in both groups. There were, however, a number of limitations in this study. Firstly, the study design was retrospective, which used data from a previously designed investigation which introduces selection bias as some participants

may be excluded due to the previous trial inclusion criteria; e.g., Class II patients. Secondly, the literature stated that the subjects had bone-anchored maxillary protraction therapy but did not clearly show whether the T2 records were taken prior to or after the maxillary protraction therapy. This would greatly influence the outcome of the results. Thirdly, there were uneven group sizes which exhibited intergroup differences (3 out of 15 variables). In addition, subjects were between 9–13 years, who would have different degrees of skeletal maturity and would have responded to skeletal expansion differently. Finally, patients and investigators were not able to be completely blinded due to the nature of the intervention, contributing to performance bias.

Dr Priyanka Ponna

Does age influence self-perception of the soft tissue profile in children?

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Background: Soft tissue aesthetics is of major importance in orthodontic diagnosis and treatment planning. Once initial orthodontic records have been taken, an evaluation of the pretreatment soft tissue profile and changes that might occur during orthodontic treatment must be discussed in detail with the patients before commencing treatment. It is crucial for patients to be aware of the potential effects of proposed treatment options on their soft tissue profile in order to make an informed decision. However, it is often unclear how relevant the soft tissue profile is for patients, and interpretation of their profile may be age dependent. Orthodontists, together with patients, must align their perceptions of the patient's soft tissue profile to ensure there is appropriate communication during treatment planning.

Aim: The primary aim of this study was to investigate whether age affects self-perception of the soft tissue profile in children

Methods: This prospective cross-sectional observational study consisted of 180 participants (117 females and 63 males) without craniofacial abnormalities, aged between 9–20 years old. Participants were divided into three equal groups according to their age: <12 years, 12–15 years and >15 years. The right-sided facial profile of each participant was photographed

at rest to create a silhouette. Facial profile silhouettes templates were created from the pool of patients within a university clinic to represent the local population. Templates were created for each gender and age group, with each set of templates containing nine silhouettes. The silhouette of the individual participant was then inserted into the appropriate set of templates and they were requested to identify their soft tissue profile. Other variables investigated included gender, sexual maturation rating (using Tanner staging), reason for a paediatric consultation, and history of orthodontic treatment.

Results: Participants > 15 years of age were most likely to recognise their own facial profile (80%). This rate of recognition was significantly higher than the other two age groups ($P = 0.001$ and $P = 0.003$ respectively). Female participants were more likely to recognise their own facial profile in comparison to males (68% (F), 51% (M) $P = 0.028$). In addition, there was a correlation between sexual maturity and self-recognition of facial profile, with patients at Tanner stage V demonstrating a higher self-recognition ability in comparison to the other Tanner stages (I-IV) ($P < 0.001$). Following stepwise multiple linear regression analysis of all variables, sexual maturation rating was the only significant variable in predicting facial profile self-recognition ($R^2 = 0.251$; $P < 0.001$).

Conclusion: It is evident that facial profile self-recognition is more likely to occur in older and more sexually mature children. Furthermore, females are more likely to recognise their facial profile in comparison to males. However, one of the limitations of this study was that the authors used a convenient sample, with the investigator approaching patients in the waiting area, contributing to selection bias. In addition, the groups were not appropriately gender matched with 79% of females in Tanner stage V, leading to bias. Because orthodontic treatment planning takes soft tissue changes into account, it is important to understand the degree of self-perception of each individual and improve the delivery of treatment discussions to the patients and their parents so that an informed decision can be achieved.

Neha Sood

Traditional vs digital communication channels for improving compliance with fixed orthodontic treatment: A randomized controlled trial

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Background: Patient compliance in orthodontics is crucial for successful treatment outcomes. Compliance in orthodontics relates to keeping appointments, following oral hygiene instructions, elastic use and avoiding hard and sticky foods that might result in appliance breakage. Adolescents often make up the majority of orthodontic patients. Internet and communication technologies have had a considerable impact on the everyday life of young people, many of whom use it for education and a source of information. Previous studies attempting to predict the factors that might affect compliance during orthodontic treatment have rated communication as an important method for improving compliance.

Aims: The main aim of this randomised controlled trial was to study the effect of different methods of communication (traditional verbal and written, and digital communication strategies including weekly text messages or emails with audiovisual links) on the level of patient compliance. The second aim was to investigate the effect of baseline demographics, including age, gender, baseline oral hygiene habits, socioeconomic and parents' education, on compliance with fixed orthodontic treatment.

Materials and methods: One hundred and twenty patients (aged 12 to 18 years) were randomly allocated to three groups: Group 1 (G1) received traditional communication including verbal and written instructions, Group 2 (G2) received traditional communication and a weekly text message and Group 3 (G3) received traditional communication and weekly emails with audiolinks to remind them about the instructions. All patients were treated using the same fixed orthodontic appliance by the first author who remained blinded to group allocations. At the end of each month, clinical notes were used to record a number of compliance indicators including treatment duration, number of appointments the patients had failed to attend, number of appointments with reported appliance breakage and the total number of breakages. Before the start of the treatment, all participants were required to complete a questionnaire

that recorded data on a number of factors: age, gender, brushing of the teeth, household income, residency, school attended and parents' education. Collected data were analysed using Pearson's chi-square, independent *t*-test and one-way analysis of variance. The level of significance was set at $P < 0.05$.

Results: The number of participants in each communication group was 37, 35, 36 for G1, G2, G3 respectively. The results showed no baseline difference between the three communication groups based on age, gender, residency and household income. The results showed a pattern of reduction in the treatment duration and total number of breakages from G1 to G3, but the reduction was not statistically significant. The incidence of breakage between the groups showed a significant difference ($P = 0.016$) for which G1 had a significantly higher incidence of breakage (2.92 ± 1.28) compared with G3 (1.92 ± 1.65).

The results of the comparison of the treatment compliance indicators based on gender, baseline oral hygiene habits and sociodemographic variable showed a significant difference between genders for the incidence of breakages and total number of broken brackets, with females having significantly lower incidence and total number of breakages. The low household income group had a significantly longer treatment time and a greater incidence of failing appointments, incidence of breakage and total number of breakages compared with the high household income group.

Conclusion: Supplementing written and verbal information with weekly audiovisual reminders through email could enhance patient compliance during fixed orthodontic treatment. Female patients, high household income and high parent education are associated with better compliance. The strength of this study was that the authors used a prospective randomised controlled trial in an attempt to address a question that is contemporary and clinically useful. There was a clear outline of the sample size calculation, randomisation, concealment and blinding. However, there was no detail regarding the actual information conveyed in the email message or audiovisual link. In addition, there were no details regarding the traditional communication of verbal and written information and whether all groups received the same standardised information and time allocated to relay this information. Another limitation of this study was that it was a single centre randomised controlled trial

performed by one orthodontist, thus the generalisation of the result could be limited.

Yasi Gu

Large overjet as a risk factor of traumatic dental injuries: a prospective longitudinal study

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Background: Children with an increased overjet often have high aesthetic, functional and psychosocial needs. The orthodontic management of an increased overjet in the mixed dentition is commonly justified to prevent dental trauma. Prior to this prospective longitudinal study, only case-control and cross-sectional studies have been performed to investigate this causal relationship.

Aim: To evaluate if school children with an increased overjet experience a greater risk of traumatic dental injuries compared to children with a normal or reduced overjet.

Materials and methods: A longitudinal prospective study was carried out in a sample of 1,413 Swiss children aged 6–13 years old (723 boys, 690 girls). The sample accounted for 5.6% of the school children enrolled in Geneva's Public Primary Schools. An increased overjet was defined as ≥ 6 mm, and children undergoing active orthodontic treatment were excluded from the sample. The measurements were recorded by an experienced orthodontist who recorded the overjet and clinical (non-radiographic) evidence of dental trauma based on the National Index of Dental Research (NIDR) Index. A semi-structured interview was performed when positive reporting of dental injuries sustained in the preceding 12 months were identified.

Results: At baseline, dental trauma was present in 172 children (16.1% of boys, 12.1% of girls). Fifty-three of the children had an overjet ≥ 6 mm, which lead this cohort to a 4.03 times higher risk of sustaining trauma compared to children with an overjet < 6 mm.

After one year, 98 children presented with an increased overjet and 14 children exhibited dental trauma. There was a statistically significant risk of sustaining dental trauma if the overjet is ≥ 6 mm, with a Relative Risk of 3.37 (CI 1.81–6.27). One hundred

and four injured teeth were identified in 76 children. There was no statistically significant correlation in gender or age and the risk of sustaining a traumatic dental injury. Of the children who sustained dental trauma, 88.5% and 11.5% involved the maxillary and mandibular incisors, respectively. Injuries confined to enamel involved 28.9% while 39% involved enamel and dentine. Luxation or subluxation injuries affected 32.1%. There was no relationship between the time of the injury and the type of trauma experienced.

Conclusion: The presence of an overjet ≥ 6 mm has a significant impact on the development of dental trauma. The findings of this prospective longitudinal study support orthodontic intervention to correct an increased overjet in the mixed dentition to reduce the prevalence and sequelae of traumatic dental injury.

Critique: Unlike retrospective trials assessing the relationship between increased overjet and trauma, this longitudinal trial excluded recall bias through prospective data collection. The main limitation was that no radiographic information was available to identify and assess signs of dental trauma, which may not otherwise be clinically apparent. This may result in an incorrect classification of the dental injury, and potentially under-report the incidence of trauma.

Monica Mullane

The effect of sandblasting and acid etching on survival rate of orthodontic miniscrews: A split-mouth randomised controlled trial

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Background: The success of orthodontic miniscrews relies on the mechanical locking of the threads, rather than osseointegration. As the success rate varies substantially, ranging from 60–91%, innovations in changing surface topography have been proposed to increase the interdigitation between miniscrew and bone.

Aim: The aim of this study was to investigate whether surface roughening and acid etching affected the clinical success rate, as well as the removal and insertion torque of orthodontic miniscrews.

Materials and methods: This study was a single-blinded, split-mouth randomised clinical trial, consisting of 31 orthodontic patients (8 male, 23 female; with a mean age of 18.5 years). All patients required en masse retraction of the six maxillary anterior teeth. The 62 mini-screws (Dual-Top Anchor system, 1.6-mm diameter, 10-mm length, self-drilling style, Jeil Medical Co, Seoul, Korea) were split into two groups: a sandblasted acid-etched (SAE) group and a control group. The SAE miniscrews were treated by the sandblasting of alumina particles of 250 μm at the pressure of 4 MPa and etched with 0.11 HF mol/l and 0.09 mol/l HNO₃ solution at 25°C for 10 min. The miniscrews were randomly assigned the right or left and placed between the second premolar and the first permanent molar. A force of 250 g was applied with a NiTi closing coil six weeks after insertion. Patients were followed up at three, six, 10, and 14 weeks and then at four weeks interval. Failure of a miniscrew was defined as mobility that hindered clinical performance, or greater than 1 mm of movement. At the end of the space closure, the miniscrew was removed and the removal torque was measured.

Results: The overall success rate was 87.09% (54 out of 62 miniscrews) and 87.50% of the failures occurred in the first four months. The sand-blasted and acid-etched mini-screws required a statistically significantly higher removal torque at 15.71 ± 5.563 Ncm compared with the control group of 8.08 ± 2.481 Ncm. However, the SAE group (90.32%) did not have a statistically significantly higher survival rate than the control group (83.87%). In addition, patients under 15 years of age had a significantly decreased success rate of 66.7% compared to those above 15 years old which had a 95.5% success rate.

Conclusions and limitations: Surface roughness of orthodontic miniscrews by sand-blasting and acid etching made no influence on the success rate but increased removal torque significantly. This was a prospective study design with no sample size calculation performed, therefore it was possible that the study may be under-powered. Further studies are required to ascertain why removal torque had no significant relation to success rate.

Matthew Wong