Australian Society of Orthodontists

THE UNIVERSITY OF SYDNEY

ORTHODONTIC RESEARCH

What it teaches us PART 2

Creating Brighter Futures

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Orthodontic Research - What it teaches us PART 2

This issue of the newsletter continues the look at research in the five Australian post-graduate orthodontic departments. This research is a significant driver of improvements in treatment planning and delivery.

What are the effects of rapid maxillary expansion on anterior teeth with a history of trauma?

Rapid maxillary expansion has been shown to have minimal long term pulpal effects on healthy maxillary anterior and posterior teeth[1,2]. However, a history of dental trauma may increase the risk of loss of pulpal vitality[3]. The objective of this study, undertaken by Lam et al. at the University of Western Australia, was to assess changes in pulp blood flow and pulp sensibility in teeth of patients with a history of dental trauma, when undergoing maxillary expansion.

The pulp status of maxillary anterior teeth, with and without a history of trauma, was assessed using laser Doppler flowmetry, electric pulp testing, and thermal testing (CO2 snow). Each patient was tested at prior to expansion (T1), 2 weeks after expansion (T2), and 3 months after expansion (T3).

The teeth without a history of trauma had significantly lower pulp blood flow 2 weeks after rapid expansion, which returned to pre-expansion levels when measured 3 months after expansion. This contrasted with teeth with a history of trauma. The pulp blood flow significantly decreased 2 weeks after expansion, but did not return to pre-expansion levels. In both groups, pulp sensibility was maintained in almost all teeth (90%).

Based on these findings, teeth with a previous history of trauma may have reduced adaptive capacity when undergoing rapid maxillary expansion. Hence, possible sequelae such as pulp necrosis should be discussed during the informed consent process.

Lam R, Goonewardene MS, Naoum S. Pulp blood flow and sensibility in patients with a history of dental trauma undergoing maxillary expansion: A prospective study. The Angle Orthodontist. 2020 Sep 1;90(5):695-701.

What are the effects of low-level laser therapy on the rate of orthodontic tooth movement?

Low-level laser therapy (LLLT) is a non-invasive technique that exposes tissues and cells to low levels of red and infrared light (600-1000 nm)[1]. This has been shown to have biostimulatory effects and may increase the rate of orthodontic tooth movement (OTM) by increasing fibroblast and osteoblast proliferation and function[2]. Currently, there is very low evidence that LLLT may increase the rate of OTM[3].

The primary aim of this study, by Mistry et al. at the University of Sydney, was to investigate the effect of 4-weekly applications of LLLT on the rate of tooth movement when 150 g distalisation forces are applied to maxillary canines over a 12-week period. A GaAlAs diode laser with a mean wavelength of 808nm and 13J of energy was used on 8 points per canine (4 buccal and 4 palatal sites) and commenced at day 0 (T0), 28 (T1), and 56 (T2) immediately after spring activation in a split mouth, triple blind study.

The total amount of tooth movement was similar in the LLLT (2.55 ± 0.73 mm) and control groups (2.30 ± 0.86 mm), with the 0.25 mm of difference being insignificant (P 0.27). No significant differences were found for anchorage loss or canine rotation. No adverse effects were reported.

It is known that LLLT follows a biphasic dose response curve, in which too little energy will fail to elicit a response and conversely too much energy will inhibit biostimulation[1]. However, with current research, the optimal wavelength, dosage or power is undetermined[4]. Furthermore, previous studies that did show an increase in tooth movement had short time frames between each LLLT application (for example multiple days in a month, the first 3 days of each month or fortnightly application) and hence may not be clinically feasible[5,6].

Application of LLLT every 4 weeks did not result in differences in the amount of tooth movement, anchorage loss, and canine rotation during extraction space closure. This finding may imply that either 13J is too high and/or the LLLT applications at 4-week intervals were not enough to elicit a biostimulatory effect.

Mistry D, Dalci O, Papageorgiou SN, Darendeliler MA, Papadopoulou AK. The effects of a clinically feasible application of low-level laser therapy on the rate of orthodontic tooth movement: a triple-blind, split-mouth, randomized controlled trial. American Journal of Orthodontics and Dentofacial Orthopedics. 2020 Apr 1;157(4):444-53.

What are the best brackets and bonding agents to reduce enamel damage when debonding?

When debonding brackets at the end of orthodontic treatment, one of the primary objectives is to minimise iatrogenic damage to enamel and return the enamel surface to its original state[1]. Unfortunately, bracket debonding may cause iatrogenic enamel damage through cohesive failure such as cracks and tear outs, or during the removal of adhesive remnants[2,3].

The aim of this clinical study, by Cochrane et al. at the University of Melbourne, was to determine the in vivo extent and frequency of iatrogenic enamel damage when debonding metal and ceramic orthodontic brackets attached by various bonding materials.

Brackets from the maxillary canine to canine were collected from each patient (n = 486) (Table 1).

Of the 486 brackets collected, 26.1% exhibited enamel on the bonding material on the bracket base pad. The presence of enamel on the bracket base between each group was significant (p= 0.001): CSEP 38.2%, CEC 30.2%, CGIC 21.2%, MEC 13.3%. Severe iatrogenic damage was largely limited to the ceramic bracket groups. The percentage of the bracket base pad covered in enamel was highly variable, ranging from 0% to 46.1%. (Figure 1.)

Table 1. Combinations of bracket type, bonding agent and adhesive type analysed in the study			
Group	Bracket type	Bonding Agent	Adhesive type
MEC (n= 150)	Metal In-Ovation R brackets	2 step etch and bond technique 37% phosphoric acid etch, Orthosolo bond	Transbond XT
CEC (n= 126)	Ceramic In-Ovation C brackets	2 step etch and bond technique 37% phosphoric acid etch, Orthosolobond	Transbond XT
CSEP (n= 144)	Ceramic In-Ovation C brackets	Pumice with a cup Self etching primer- Transbond Plus Self Etching Primer	Transbond XT
CGIC (n= 66)	Ceramic In-Ovation C brackets	Pumice with a cup 10% Fuji Ortho Conditioner polyacrylic etch	RMGIC

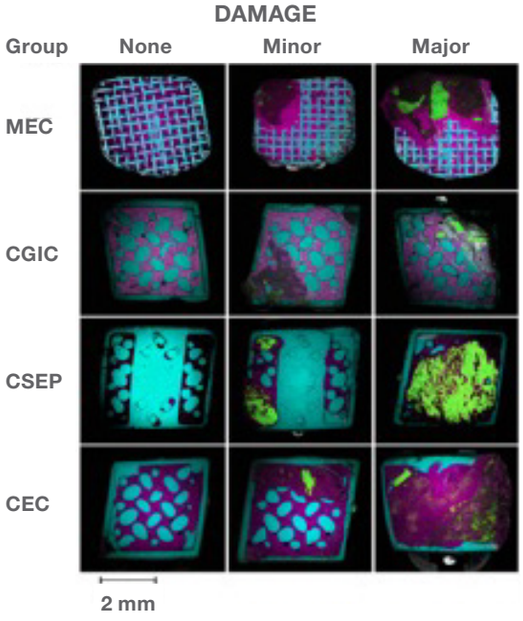


Fig 1. Backscattered scanning electron microscopy images with overlaid elemental maps for representative brackets from each group showing various degrees of damage. In the overlaid images, blue denotes iron or aluminium, purple denotes silicon, green denotes calcium, and orange denotes phosphorus.

Irrespective of the bracket and adhesive combination, a higher proportion of lateral incisors (32.7%) exhibited enamel damage when compared with central incisors (21.0%) and canines (24.1%) (p= 0.031).

Although enamel damage regularly occurs during debonding, major damage is limited to relatively few patients. To minimise iatrogenic damage, the clinician may opt for metal brackets over ceramic, use RM GIC instead of composite resin for ceramic brackets, and take extra care when debonding lateral incisors.

Cochrane NJ, Lo TW, Adams GG, Schneider PM. Quantitative analysis of enamel on debonded orthodontic brackets. American Journal of Orthodontics and Dentofacial Orthopaedics. 2017 Sep 1;152(3):312-9.

What is the quality of web-based information on orthodontic clear aligners?

The use of orthodontic clear aligners (OCA) is increasing among orthodontists and general dentists. The internet provides a vast amount of health information which is easily accessible however the quality of information related to many dental and orthodontic topics is deficient[1-6]. Current research indicates that the readability of information is beyond the level recommended. This may cause misunderstanding of treatment information by patients and parents, potentially impacting effective decision making and treatment management[4,7,8].

The aim of this study, conducted by Meade and Dreyer from the University of Adelaide, was to assess the quality and readability of websites providing information regarding OCA to prospective patients.

The results confirmed the inadequate quality of information related to OCA. Particularly, information regarding the risks of treatment, and the implications of not having treatment, were considered poor. The authors raised concerns regarding the consequences of this, specifically in the case of websites authored by healthcare providers and highlighted the potential for invalid consent or claims of negligence if the information presented was deficient in informing prospective patients of the risks of treatment.

Information was also considered to be 'fairly difficult' to read and was likely only to be understood by those with a higher reading age than that recommended in Australia and other countries[9-11]. Approximately 60% of the adult population in Australia is considered to have insufficient literacy skills to maintain good health[12]. Therefore, the website content related to OCA may be too difficult for prospective patients and parents to comprehend.

Based on these research findings, when presenting information using websites, authors should consider using quality of information instruments and readability tools to ensure the delivery of evidence-based material which is easily readable for prospective patients and their families.

Meade MJ, Dreyer CW. Web-based information on orthodontic clear aligners: a qualitative and readability assessment. Australian dental journal. 2020 Sep;65(3):225-32.

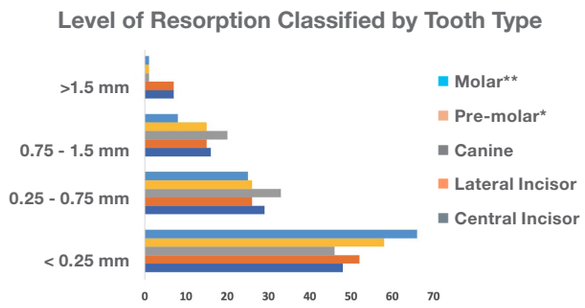
Does clear aligner therapy result in root resorption?

Orthodontic treatment can result in root resorption[1,2]. Previous research to identify risk factors and the severity of orthodontically induced root resorption (OIRR) have focused on fixed appliances. The effects of clear aligner treatment on root resorption is limited.

The aim of this study, by Costello et al. at the University of Queensland, was to investigate the incidence and severity of root resorption with clear aligners.

Root resorption occurs three dimensionally, thus CBCT imaging is a more effective and accurate method for measuring root resorption[3]. In this retrospective study, root resorption was assessed on maxillary and mandibular teeth by comparing pre- and post-treatment CBCT examinations of patients who were treated by a clear aligner system.

The results showed that all teeth demonstrated a reduction in length. Anterior teeth in both arches display more resorption than posterior teeth. The maxillary central incisors underwent the greatest mean reduction in length of 0.5 ± 0.41 mm. The maxillary lateral incisors and canines, and lower anterior teeth, experienced similar levels of resorption, with a 0.4 ± 0.56 mm length reduction. The mesial root of the lower second molar demonstrated the least mean amount of resorption of 0.1 ± 0.19 mm. Most tooth types had resorption <0.25mm. See Figure 2.



***Buccal roots only**
****Mesiobuccal or distobuccal only**

Figure 2- Level of resorption by tooth type

The investigators assessed predictors of resorption and found that the treatment duration and location of the tooth within either the maxilla or mandible were not predictors of resorption.

This research indicates that root resorption occurs with clear aligner therapy, with maxillary central and lateral incisors experiencing the greatest mean reduction. Overall, the amount of resorption is small and mostly clinically acceptable.

Costello CJ, Kerr B, Weir T, Freer E. The incidence and severity of root resorption following orthodontic treatment using clear aligners. Australasian Orthodontic Journal. 2020 Nov;36(2):130-7.

Conclusion

The Editors would like to thank the Heads of the Orthodontic Disciplines and their PG students for providing the opportunity to highlight these 10 outstanding research projects.

In subsequent years we plan to continue to review research undertaken at our universities and accepted for publication in high impact peer reviewed journals. We are proud that this ongoing research results in information which builds on our knowledge to improve the delivery of treatment.

The staff of orthodontic disciplines in Australia are dedicated teachers and deserve our respect and thanks for the high standard of the courses and research they administer. Australian universities are highly respected around the world and rank very highly both as educational and research centres. Many of our universities are ranked in the top 50 in the world. In terms of orthodontic research and publications Australia has even higher ranked programs. The Australian Society of Orthodontists through the Foundation for Research and Education (ASOFRE) provides significant annual funding to support Australian Orthodontic Disciplines to enable the maintenance of these high standards.

References available upon request

Past issues of Brighter Futures can be accessed at:
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