Pulp blood flow and sensibility in patients with a history of dental trauma undergoing maxillary expansion: A prospective study

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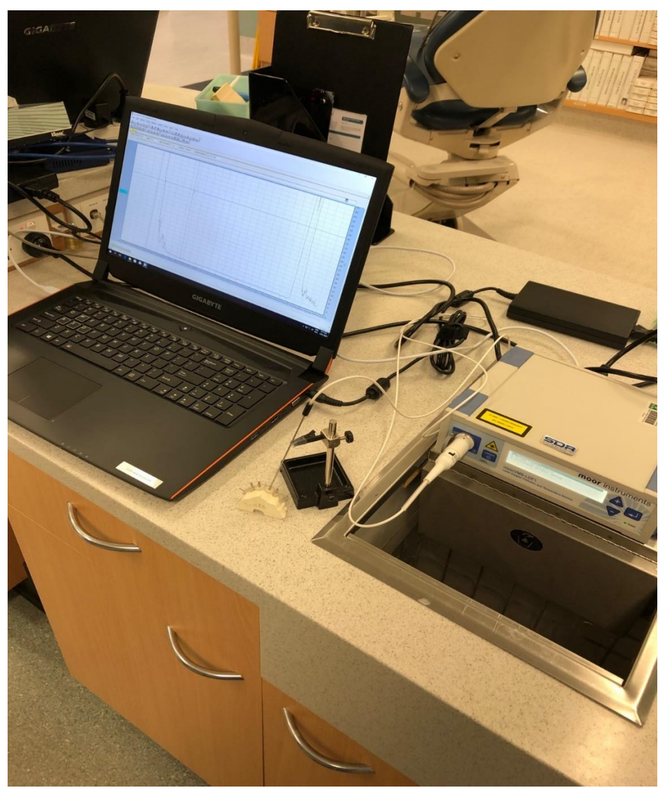
Introduction

Transverse maxillary deficiency is a frequent problem encountered in orthodontics with estimations that almost a third of patients exhibit a component of this disharmony.[1,2] A subset of these problems may be accompanied by posterior crossbite with the propensity to result in permanent skeletal deformity. Rapid maxillary expansion (RME) has a long been established as the preferred modality to address these problems relating to a constricted maxilla.

Due to high forces used in RME, many studies considered the effect on the pulp. Along with an extensive number of studies assessing forces from simple to complex movements in many situations, there is solid consensus that appropriate force systems in orthodontics are not detrimental to the pulp. However, almost all studies have restricted their focus towards heathy teeth with no pathology, trauma or restorative intervention. This bias was highlighted in a recent systematic review with the conclusion "*there is insufficient validation regarding the association between orthodontic forces and pulp vitality… a history of dental trauma is a risk factor for loss of pulp vitality during orthodontic treatment*".[3]

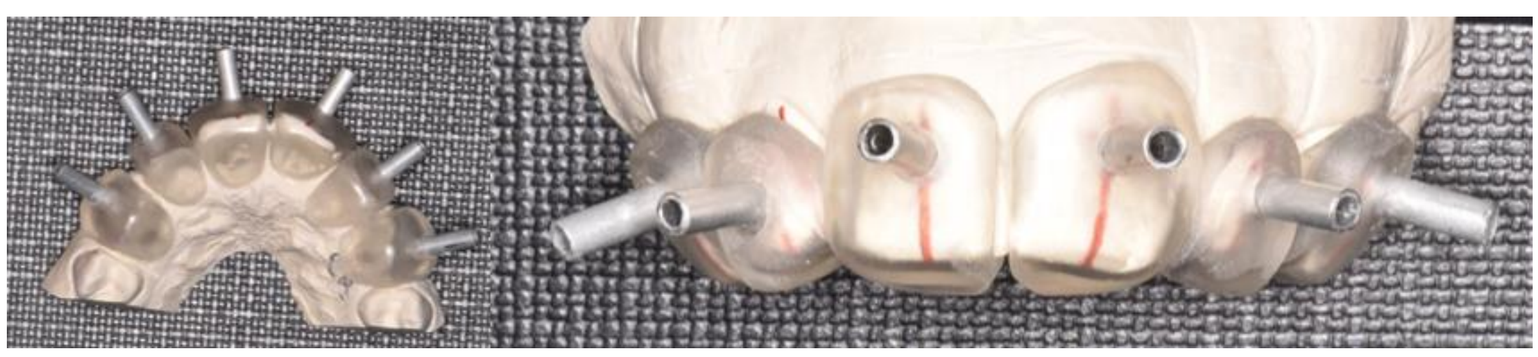
Dental trauma is a unique injury due to its unpredictable nature. No individual is ever at zero risk from these injuries from their activities of daily living. Of particular importance to the orthodontist is that peak periods of trauma risk coincide with the time that maxillary expansion is typically indicated. Therefore, it is not uncommon for patients presenting for orthodontic treatment to exhibit teeth that are compromised.

In a first, this study aims to assess pulp blood flow (PBF) and pulp sensibility (PS) in teeth undergoing maxillary expansion with a history of trauma.

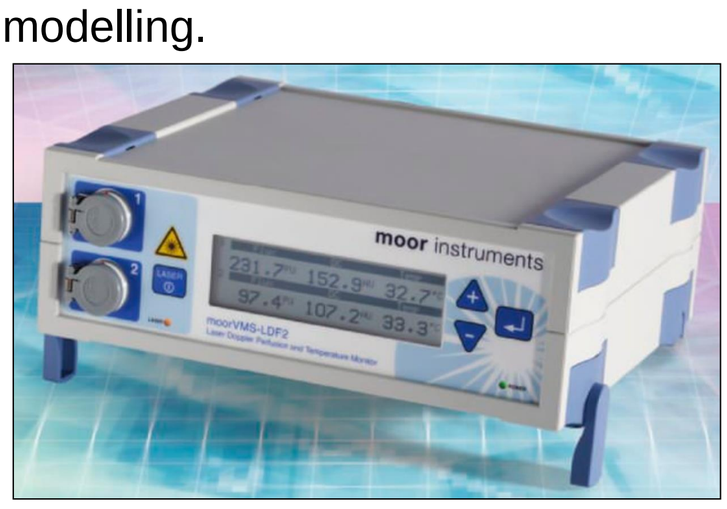


Methodology

Twenty-five patients requiring rapid maxillary expansion (RME) with a hyrax expander had the pulp status of their maxillary anterior teeth assessed using laser Doppler flowmetry (LDF), electric pulp testing (EPT) and thermal testing (CO2 snow).



The study was divided into two groups, Trauma and Non-Trauma, based on the presence/absence of a history of trauma including restorative therapy. Each patient was tested at T1(prior to expansion), T2 (2 weeks after rapid maxillary expansion) and T3 (3 months after expansion). Custom made acrylic jigs were fabricated to ensure reproducibility of testing PBF during each time interval for each assessed tooth. Relationships between PBF, time interval and history of trauma were evaluated using linear mixed modelling.



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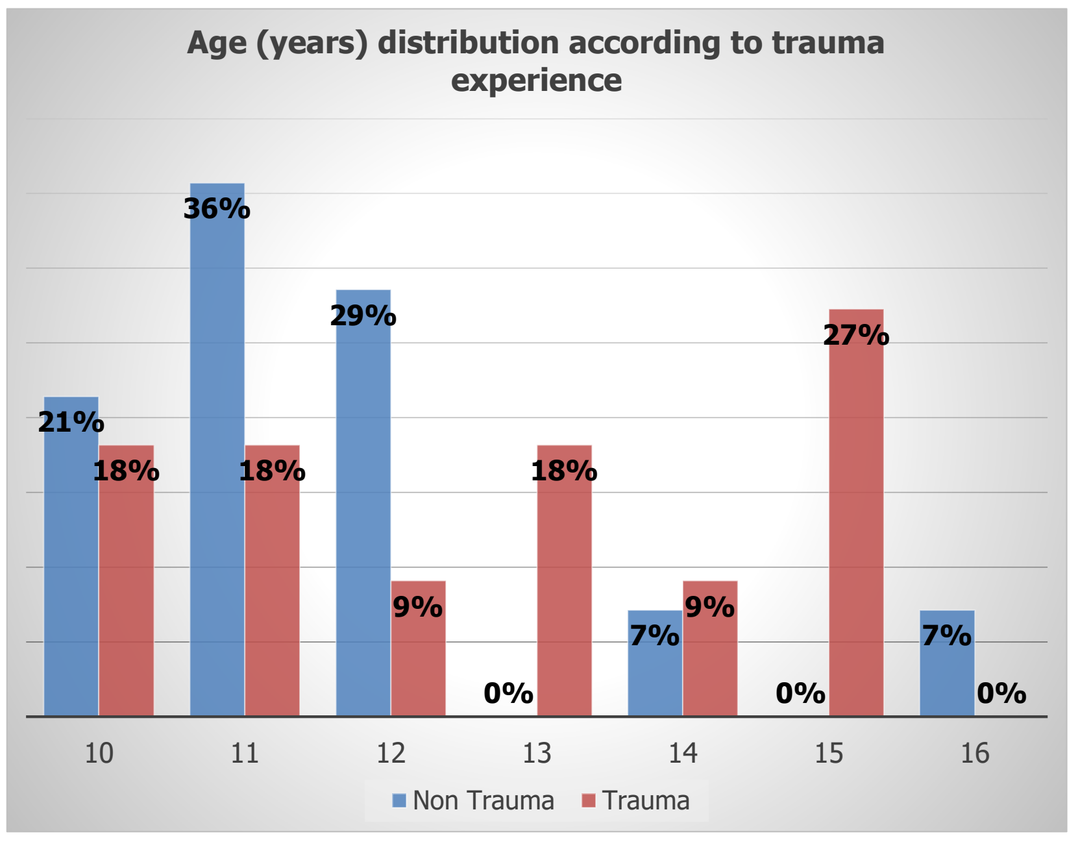
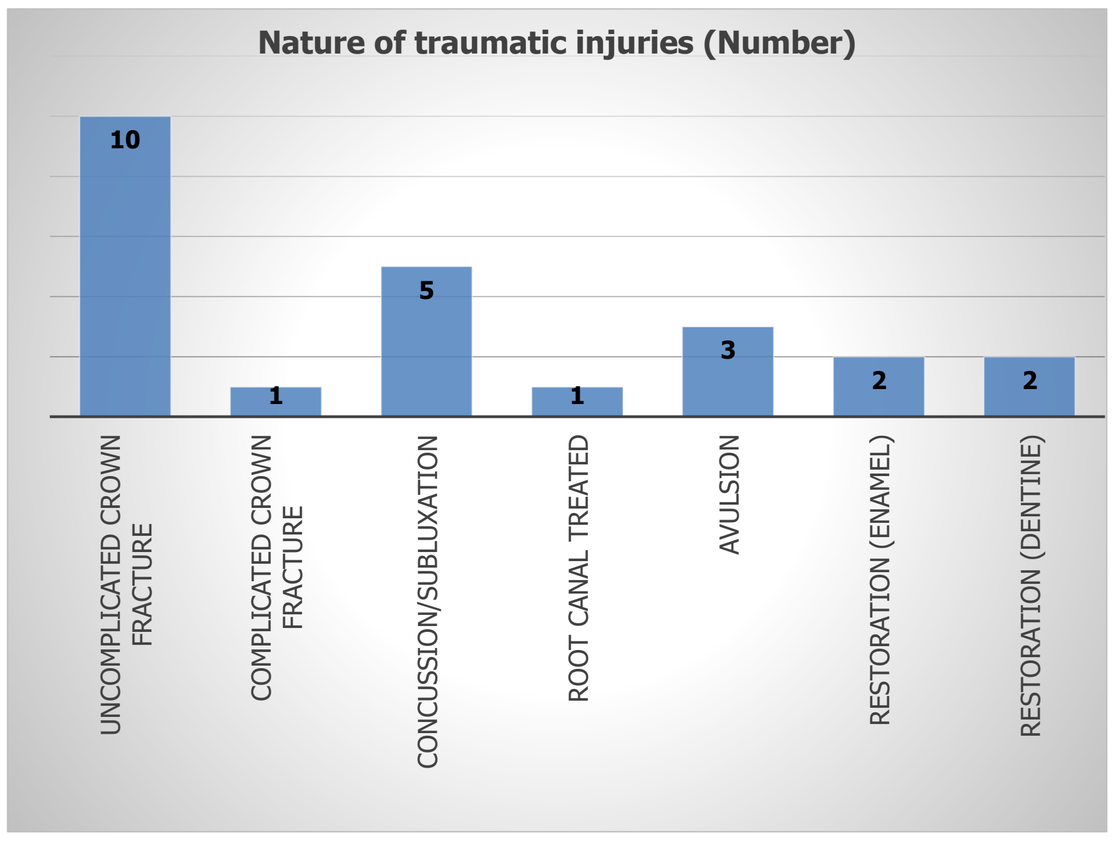
Results

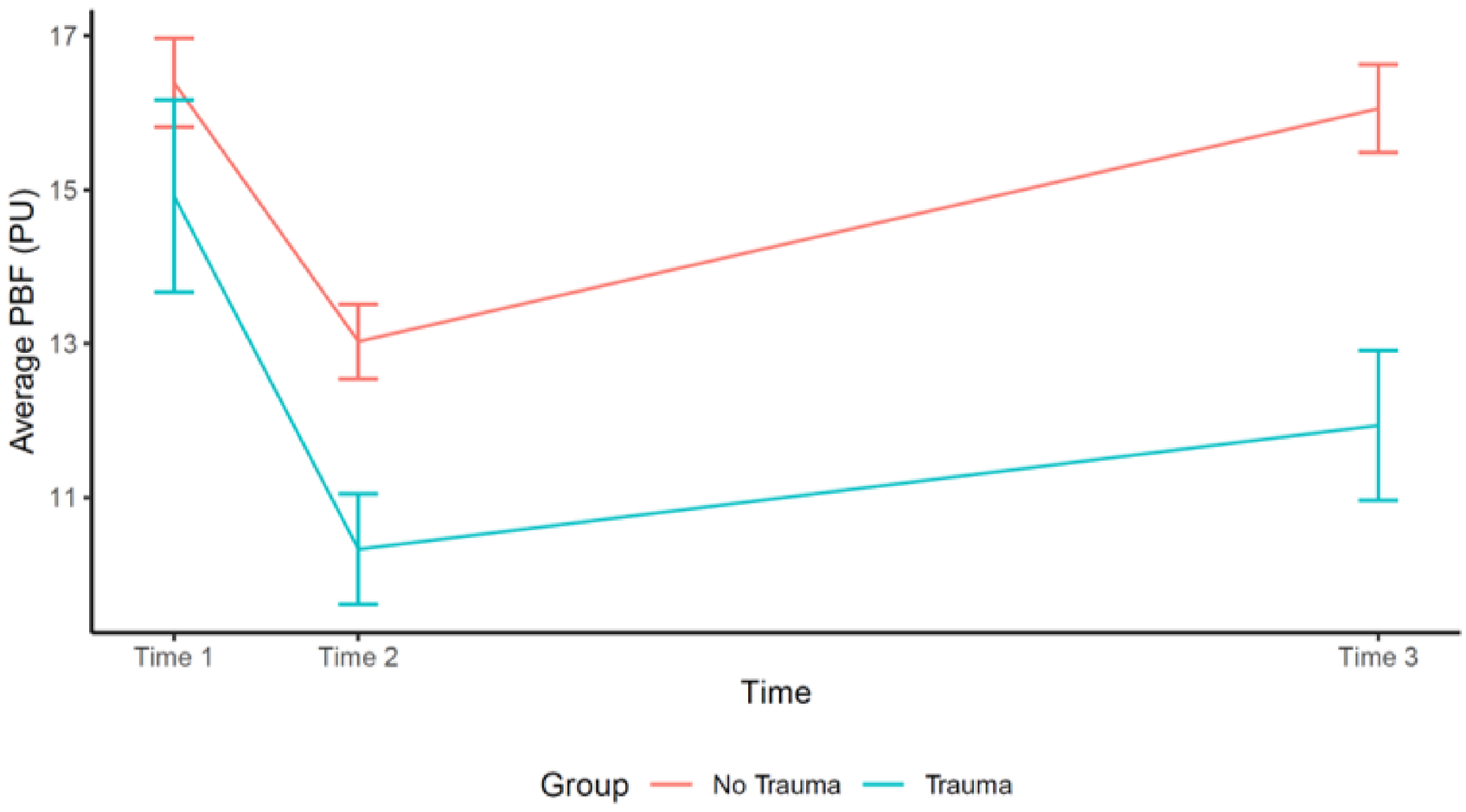
The following tables and figures summarize the results of the study.





Within the Trauma group, pulp blood flow (PBF) was significantly lower (P≤0.05) at T2 and T3 in comparison to T1 and significantly lower (P≤0.05) at T2 in comparison to T3. In the Non-trauma group, PBF at T2 was significantly lower (P≤0.05) than PBF at T1 and T3; but no significant difference (P>0.05) in PBF at T1 and T3. At both T2 and T3, a statistically significant difference (P≤0.05) in PBF was observed between groups. In both groups, PS was maintained in almost all teeth (>95%).

Pulp blood flow with standard error bars at each time interval

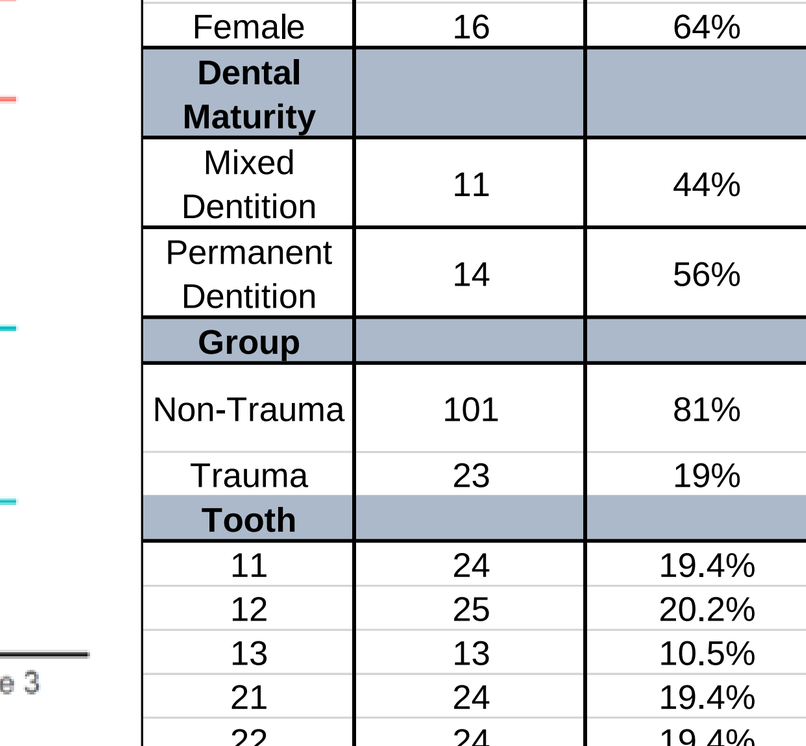


	Frequency	Percentage
Patients	25	
Teeth	124	
Sex		
Male	9	36%
Female	16	64%
Dental Maturity		
Mixed Dentition	11	44%
Permanent Dentition	14	56%
Group		
Non-Trauma	101	81%
Trauma	23	19%
Tooth		
11	24	19.4%
12	25	20.2%
13	13	10.5%
21	24	19.4%
22	24	19.4%
23	14	11.3%

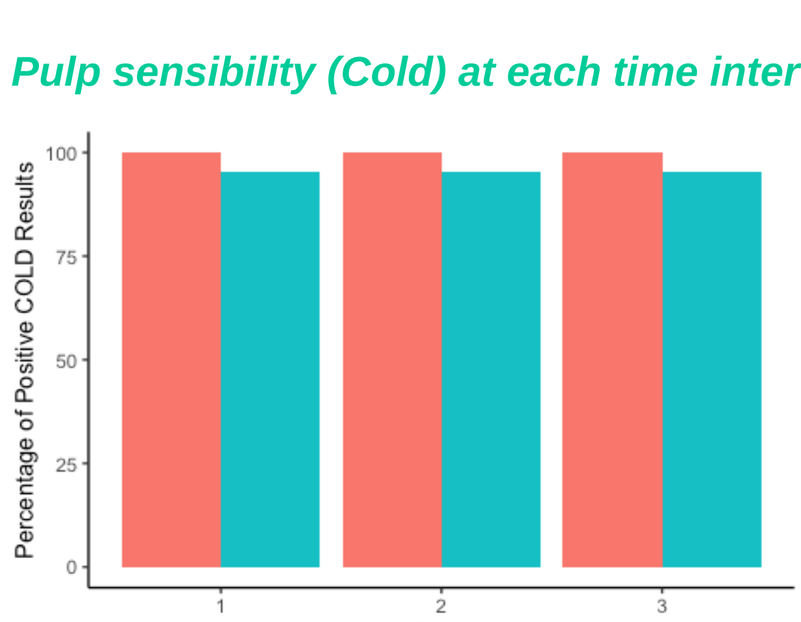
Pairwise comparison of time given trauma/non-trauma groups

	Trauma:		
	Estimate	**95% CI**	**P-value**
T1-T2	4.517	(3.131, 5.904)	<0.001
T1–T3	3.122	(1.735, 4.508)	<0.001
T2–T3	-1.396	(-2.782, -0.009)	0.048
	No Trauma:		
	Estimate	**95% CI**	**P-value**
T1-T2	3.364	(2.703, 4.026)	<0.001
T1–T3	0.339	(-0.323, 1.000)	0.314
T2–T3	-3.026	(-3.687, -2.364)	<0.001

Pulp sensibility (Cold) at each time interval



Pulp sensibility (Electric) at each time interval



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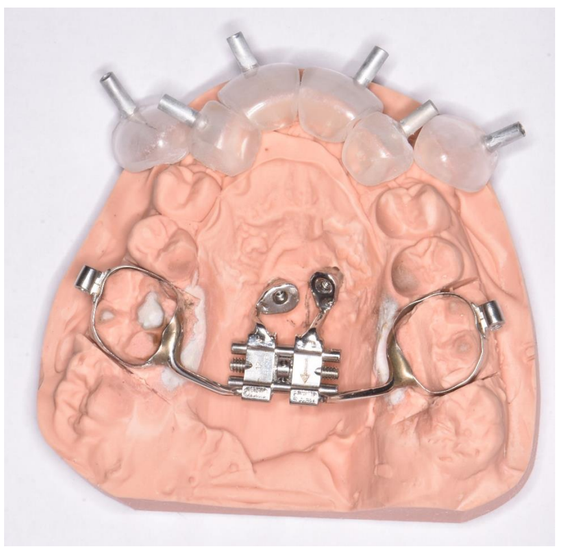
Conclusion and Clinical Implications

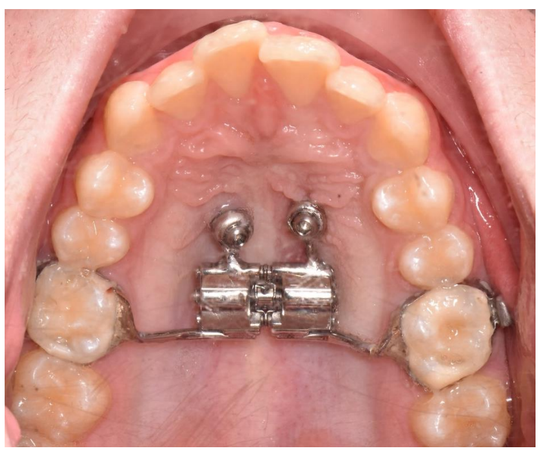
- For healthy teeth, RME causes reduction of PBF before re-establishment to pre-treatment PBF by 3 months.
- For traumatised and/or compromised teeth, RME causes reduction in PBF. However, PBF does not reach pre-treatment levels by 3 months.
- Pulp sensibility is maintained during RME in healthy and compromised teeth. Thus, pulp sensibility testing alone to determine pulp health should be approached with caution.
- Traumatised teeth may have reduced adaptive capacity under further insults such as RME which should be appreciated during the consent process.

Further Research

Skeletal anchorage in the form of mini-screws is becoming an integral component of contemporary orthodontic treatment. In principle, by dissipating reciprocal forces directly to the bony maxilla with fewer attachments of the appliance to teeth presumably reduces the burden of these high lateral forces on the dentition.

In what would be a study first, it would be interesting to assess changes in pulp blood flow and sensibility from mini-screw based frameworks. Ultimately, if traumatised teeth demonstrate compromise in adaptive capacity, would consideration of these frameworks reduce stress on the pulps of compromised teeth in patients requiring expansion? Would this reduce the probability of pulp necrosis?





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References

1.Agostino P, Ugolini A, Signori A, Silvestrini-Biavati A, Harrison JE, Riley P. Orthodontic treatment for posterior crossbites. Cochrane Database Syst Rev. 2014(8):CD000979.
2.Bailey LJ, Haltiwanger LH, Blakey GH, Proffit WR. Who seeks surgical-orthodontic treatment: a current review. Int J Adult Orthodon Orthognath Surg. 2001;16(4):280-92.
3.Javed F, Al-Kheraif AA, Romanos EB, Romanos GE. Influence of orthodontic forces on human dental pulp: a systematic review. Arch Oral Biol. 2015;60(2):347-56

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