



Hypofunctional Tooth Transformation – The Effect of Orthodontic Tooth Movement on the Enhancement of Human Periodontal Ligament Tissue



BTU
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Introduction

The term “hypofunctional teeth” refers to teeth which are not in intercuspation, such as high-positioned canines, open bite incisors, and impacted teeth.^{1,2} Compared with normal teeth, hypofunctional teeth have greater periodontal ligament (PDL) atrophy.² Previous studies have suggested that application of orthodontic force before extraction increases PDL width, eases the extraction, and may prevent root resorption after replantation.^{3,5} However, the effect of orthodontic tooth movement on the enhancement of human PDL tissue of hypofunctional teeth has never been investigated.

Aim of Study

To examine the amount of PDL tissue on the root surface of extracted third molars following pre-application of orthodontic force.

Materials and Methods

The subjects were thirteen orthodontic patients who required third molar extraction before or during treatment and had mesio-angular impacted mandibular third molars on one side and mandibular third molars which could be removed by simple extraction on the other side. The experimental mesio-angularly impacted third molars (n= 13) received orthodontic force using a special appliance, while the contralateral third molars (n= 13) received no force application as a control. Alterations in angulation and position of the third molars were assessed using panoramic radiographs (Figures 1 and 2). The extracted teeth were stained with toluidine blue to determine the amounts of remaining PDL on the root surface under stereomicroscopy (Figures 3-5).



Figure 1: A special appliance applied orthodontic force to the experimental tooth. (A) initial (B) one month after activation (C) uprighted tooth after completed activation

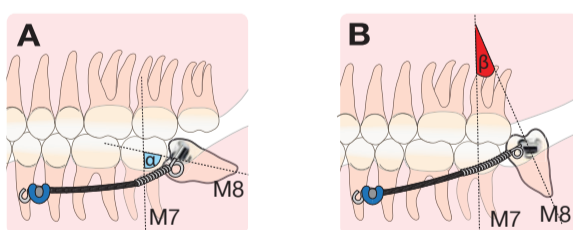


Figure 2: Diagrams of tooth displacement: the measurement of angulation (degrees) between M7 and M8 (A) before activation (B) after activation

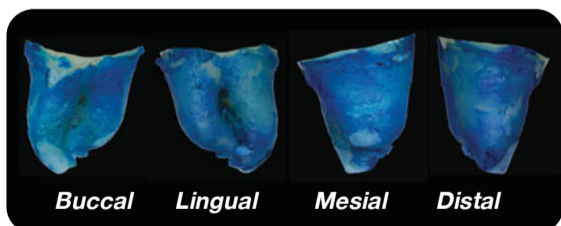


Figure 3: An example of stained tooth with more PDL from the experimental group

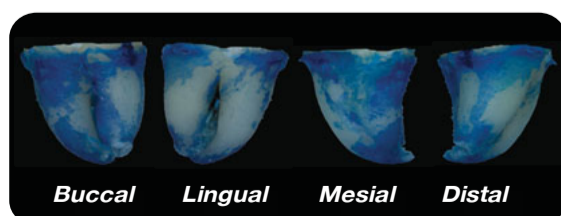


Figure 4: An example of stained tooth with less PDL from the control group

The percentages of stained PDL areas were then compared between the experimental and control groups using the independent t-test.

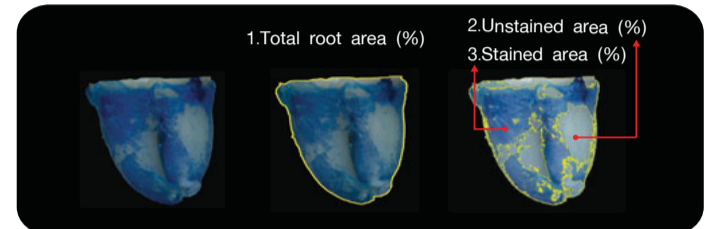


Figure 5: Analyzing process of each side: the measurement of 1. total root area (%), 2. unstained area (%), and 3. stained area (%)

Results

- The mean angulation of experimental third molars was decreased to 54.4% (± 6.3) of that before applying force (Table 1).
- The mean duration of the orthodontic force application was 14.6 (± 8.1) weeks (Table 1).
- The mean percentage of PDL tissue on preloaded teeth was significantly higher than that on unloaded teeth ($p < 0.05$) (Figure 6).

Table 1: Means and standard deviations (SD) of changed angulations

	Age	Mesio-angulated Third Molar		Changed angulations		Duration (Weeks)	Ratio (Degrees/week)
		Before (Degrees)	After (Degrees)	(Degrees)	(%)		
Mean	23.8	48.3	22.1	26.2	54.4	14.6	2.0
SD	4.3	23.9	13.7	17.0	16.3	8.1	1.1

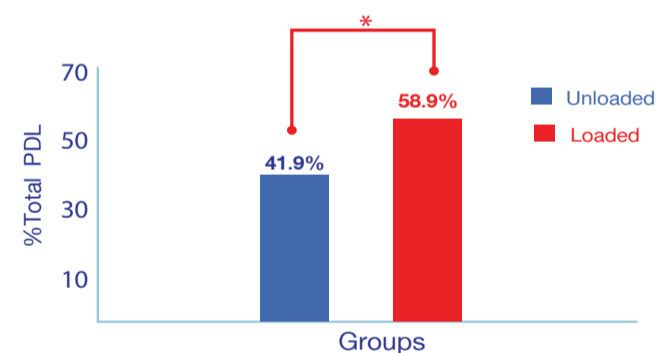


Figure 6: Comparison of PDL tissue between two groups. *, $p < 0.05$

Discussion and Conclusions

The effects of orthodontic force on increased PDL width, the ease of extraction, and the reduced risk of root resorption, have previously been reported.³⁻⁵ This study directly assessed the increased amount of proliferative PDL which contributed to orthodontic force application. The application of orthodontic force leads to tooth movement, which, consequently, increases the amounts of PDL tissue on impacted third molars. Therefore, this study suggests that the effect of orthodontic movement of hypofunctional teeth is an improvement in the quality of their PDL. In other words, **orthodontic tooth movement can transform useless teeth into usable teeth**. However, this application for specific purposes, such as tooth autotransplantation, still requires further clinical study.



References

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