



Pulpal Microvasculature Changes During Orthodontic Loading : A histomorphological Study in Human

Chanakarn RATANAVIDA ¹, Eduardo Yugo SUZUKI ^{1,*}, Boonsiva SUZUKI ¹ and Anchalee TANTIWETRUEANGDET ²

¹ Department of Orthodontics, Faculty of Dentistry, Bangkokthonburi University, Bangkok, Thailand
² Research Center, Faculty of Medicine, Ramathibodi Hospital, Mahidol University, Bangkok, Thailand

Background

Orthodontic loading causes inflammatory responses in the dental pulp that increases the intrapulpal pressure, thus decreasing the pulpal blood flow. The adaptation of pulpal blood flow via angiogenesis or neovascularisation is necessary to avoid hypoxia and necrosis of the pulp. Therefore, the present study aimed to perform a quantitative evaluation of the histological pulpal microvascularity changes following the orthodontic loading application.

Materials and Methods

Twelve third molars were applied orthodontic loading for 1, 3, 4, and 8 weeks before the extraction (n=3 in each group). Three third molars that were not loaded served as a control. The orthodontic loading was performed using a 0.016-inch improved superelastic nickel-titanium alloy wire (Sentalloy®, Tomy International, Inc., Tokyo, Japan) that was engaged to a 0.018 x 0.025-inch slot buccal tube.



Figure 1-1 A longitudinal groove was made with a high-speed diamond bur. Then, a chisel and a hammer were used to separate the tooth and the pulp tissue was collected

Following extraction, pulp tissues were collected and immunohistochemistry staining were done using CD 146 for primary antibodies (Figure 2) and then scanned with the Panoramic MIDI digital slide scanner (3DHISTECH, Hungary). A photomicrograph was taken at pulp proper of coronal pulp randomly 3 times with 20x and 40x magnification. The number of blood vessels was counted and the mean number of blood vessels was calculated.

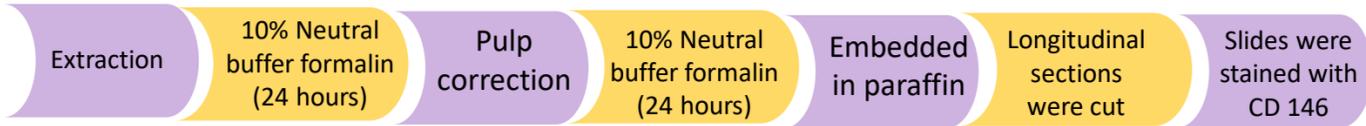


Figure 1-2 The process of pulp tissue collection and immunohistochemistry staining using a primary antibody against CD146

Results

The results showed a quantitative (figure 2-1) and qualitative (figure 2-2) changes of the pulpal microvasculature were significantly increased in 1-week following the orthodontic loading application.

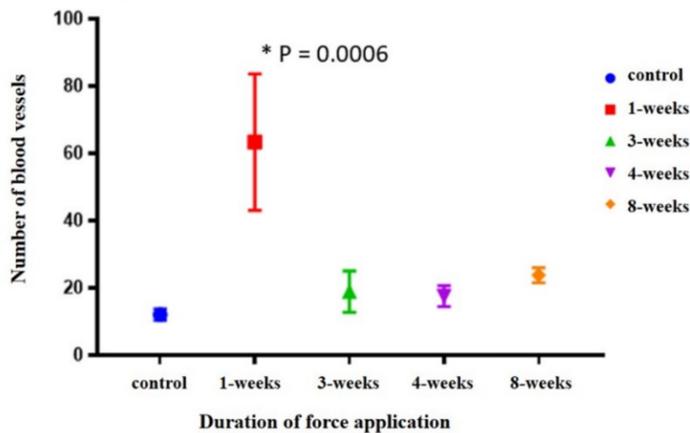


Figure 2-1 A quantitative data: In the 1-week group, the results showed a significant increase in the number of blood vessels when compared to the other groups at p = 0.0006

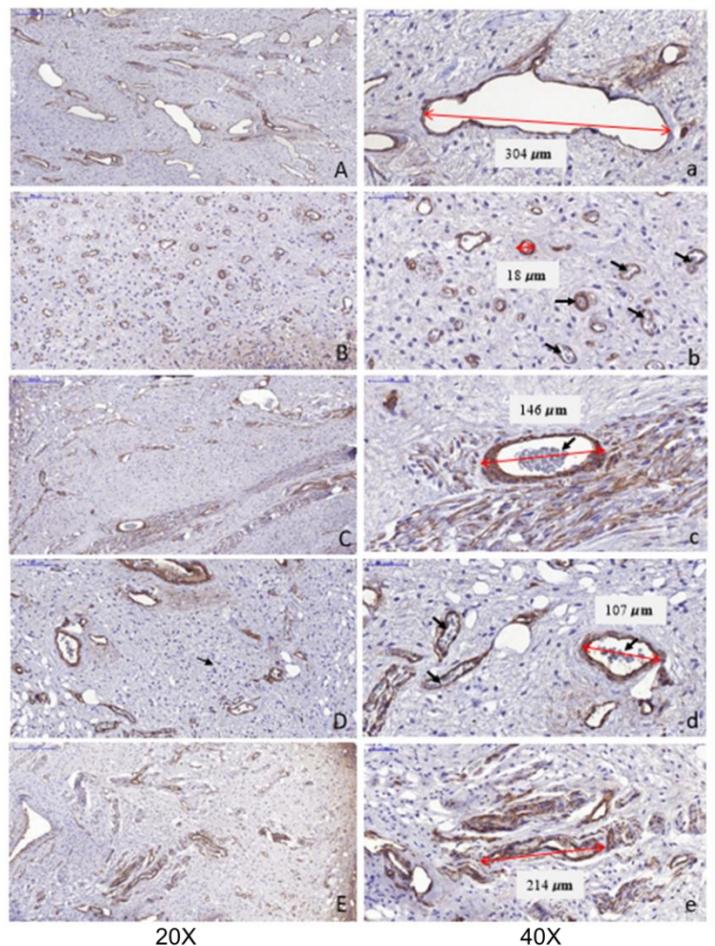


Figure 2-2 A quantitative data: Immunohistochemical staining of CD146 in pulpal vascular endothelial cells in control group (A, a) showed large size blood vessels. In 1-week group (B, b) micro-blood vessels were significantly increased congested blood vessel (black arrow). In 3-week group (C, c) and 4-week group (D, d) the number of blood vessels was decreased. The size of blood vessel were larger than 1 week group. Some congested blood vessel was observed (black arrow). In 8-week group (E), the sizes of blood vessels were larger than in 3-week and 4-week groups with no signs of congestion.

Discussion

- The results of the present study allow us to assume that orthodontic loading stimulates angiogenesis within 1-week in an attempt to reduce hypoxia and increase the pulpal blood flow. The results are in agreement with previous clinical studies that evaluated the blood flow changes after orthodontic loading application with the Laser Dropper flowmetry which showed the pulpal blood flow gradually increased at 1-week.¹
- Moreover, the study have demonstrated a progressive increase in the blood flow similar to the baseline levels at the 4-weeks occurs.¹In our study, it can be assumed that at the 4-weeks the pulpal blood flow started to increased to values similar to the baseline levels since the blood vessel was anastomosed and increased in size.
- In the 8-weeks, the number of blood vessels was similar to the control group. However, no congested blood vessels were seen.
- It is possible to conclude, the actual and complete recovery at the histomorphometric levels does not occur until the 8 weeks.

Conclusion

- At 1-week of force application, angiogenesis occurred.
- From 1 to 4-weeks, congested blood vessels were seen.
- After 8 weeks, the histomorphometric values had fully recovered.