

Original Research

Investigating the Impact of Intrusive Orthodontic Force on Dental Pulp: A Comparison between Adults and Adolescents

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ABSTRACT:

Aim-The impact of orthodontic force application on dental pulp tissue lacks conclusive evidence. This study aimed to compare the early and delayed histological effects of intrusive forces on the dental pulp of both adolescents and adults. **Materials and methods-** In this investigation, all participants necessitated the extraction of a mandibular premolar for orthodontic purposes. The participants were then categorized into two age groups: adolescents aged 12–18 years (n = 15) and adults aged 25–35 years (n = 15). **Results-** No significant differences were observed in histological parameters between the intrusive and control groups at both the 1-week and 4-weeks marks after intrusion in both adolescents and adults. **Conclusions-**Applying a mild orthodontic intrusive force to closed apex teeth does not result in significant histological changes in both adolescents and adults. Nevertheless, it becomes evident that inflammatory-related pulpal histological changes tend to be more pronounced in adults after one month of intrusion.

Keywords- premolar, intrusion, pulp

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INTRODUCTION

In recent years, considerable research has been dedicated to exploring the relationship between orthodontic force application and dental pulp tissue.^{1,2} Despite the abundance of studies, a definitive consensus on the impact of orthodontic forces on pulpal tissue remains elusive, prompting continued investigation over many years.³ Proffit et al.'s findings suggest that light continuous forces exert little to no discernible effect on dental pulp. Conversely, existing literature indicates a broad spectrum of reactions in dental pulp to orthodontic forces, ranging from mild hyperaemia to complete necrosis.^{4,5} Several contributing factors come into play, including the type of force applied, the duration and magnitude of the force, the age of patients, and the size of the apical foramen.⁴ Notably, studies have observed more pronounced pulpal changes in response to intrusive orthodontic forces with a heightened likelihood of irreversible pulpal reactions in teeth boasting complete root formation.^{5,6} Despite the wealth of research, the intricacies of this complex relationship continue to warrant ongoing exploration. This study aims to assess

alterations in the dental pulp of human canines when subjected to intrusive forces and to compare these pulpal changes between two distinct age groups (adults and adolescents). Additionally, the study seeks to evaluate both early responses (after one week) and delayed responses (after 4 weeks) of the pulp to intrusive forces.

MATERIALS AND METHODS

In this investigation, all participants necessitated the extraction of a mandibular premolar for orthodontic purposes. Prior to the commencement of the study, a written informed consent form was duly signed by each participant. Exclusion criteria were applied to individuals with a history of systemic disease and marginal bone resorption. Additionally, premolars exhibiting incomplete root formation, caries, restorations, or previous endodontic treatment were omitted from the study. The participants were then categorized into two age groups: adolescents aged 12–18 years (n = 15) and adults aged 25–35 years (n = 15).

In each participant, a randomly selected the mandibular premolar underwent the application of intrusive force, while the contra lateral premolar served as an untreated control tooth. Orthodontic bands were affixed to the mandibular first molars, and orthodontic brackets were bonded to the center of the buccal surface of both the first and second lower premolars on the experimental side. To enhance anchorage, a stainless steel wire was inserted into the molar tube and the bracket on the first premolar. The experimental design included two groups: adults and adolescents. After specific time intervals, 10 teeth from each group (adults and adolescents) were extracted after one week, while the remaining 5 were extracted after 4 weeks. All extractions were performed by an experienced dentist with the utmost care to minimize trauma. Following extraction, the root tip of each tooth was carefully cut with a bur to facilitate fixation. The teeth were then immersed in 10% formalin and subsequently, they underwent immersion in a decalcifying solution, consisting of nitric acid, formalin, and 95% alcohol, for a period of 10 days immediately after removal. The specimens were further processed through decalcification and embedding in paraffin and were meticulously cut and stained using hematoxylin and eosin dye. The examination of these specimens revealed histological changes, and the observed alterations were documented as follows: Degree of inflammation, type of inflammation, fibrous tissue formation, and necrosis.

RESULTS

No significant differences were observed in histological parameters between the intrusive and control groups at both the 1-week and 4-weeks marks after intrusion in both adolescents and adults. However, notable distinctions emerged 5 weeks after intrusion, with adults exhibiting significantly higher levels of inflammatory cell response intensity and a greater frequency of chronic inflammation compared to adolescents.

DISCUSSION

Several studies have highlighted that pulpal changes are predominantly associated with intrusive forces in comparison to other orthodontic movements.^{7,8} In our current investigation, we explored pulpal reactions to orthodontic forces at both 1 week and 4 weeks after force application to examine both immediate and delayed pulpal responses. In this study, mild inflammation was only observed in adolescents after 4 weeks of force application. In contrast, adult patients exhibited cases of moderate and severe inflammation after just 1 week. Additionally, a noteworthy difference in the extent of chronic inflammation was identified between adolescents and adults. These findings underscore the significance of employing lighter forces with appropriate intervals, particularly when treating adult patients.

Several studies have indicated that hemodynamic changes represent the initial observable signs following orthodontic movements^{9,10}. Additionally, there is conflicting evidence regarding pulpal blood flow changes after intrusion, with some studies reporting a substantial decrease^{11,12} while others show an increase or no change^{13,14}. In our current study, we did not identify a significant difference in vascular dilation between adolescents and adults at both the 1-week and 4-week marks after intrusion. Furthermore, no notable distinctions were observed between the control and intrusive groups. This lack of significant difference may be attributed to the relatively light force application utilized in our study.

No significant difference in disruption of odontoblastic layer between the studied groups. This can be the result of applying light force in our study. In contrast, Ramazanadeh et al¹⁵ reported more cases with odontoblastic layer disruption in the intrusive group compared to controls. Mostafa *et al*¹⁶ reported that disruption of odontoblastic layer is associated with pulpal blood flow changes. Certain pulpal tissue reactions, such as the disruption of odontoblasts, aspiration of odontoblasts into dentinal tubules, and the resorption of dentin or cement, exhibit a significant delay in adults when compared to the adolescent group. Graber et al.¹⁷ suggested that there is typically a longer lag phase before tooth movement in adults compared to younger patients. The delayed pulp reactions observed in the adult group in contrast to adolescents may be linked to an extended lag phase in these adult patients.

The 4-week duration employed in this experiment aligns with the typical interval between orthodontic treatment consultations and is deemed adequate for a tooth to undergo movement and complete the cycle of bone formation and resorption, assuming optimal orthodontic forces. Additionally, certain studies have reported pulpal changes as early as 7 days after the application of orthodontic force.^{18,19,20} Consequently, we chose to explore immediate pulpal reactions to force application after 1 week. It's essential to interpret the results of the present study with caution due to the limited number of cases in each group.

CONCLUSION

Applying a mild orthodontic intrusive force to closed apex teeth does not result in significant histological changes in both adolescents and adults. Nevertheless, it becomes evident that inflammatory-related pulpal histological changes tend to be more pronounced in adults after one month of intrusion. This underscores the significance of employing gentle orthodontic forces with appropriate rest intervals, particularly when dealing with older individuals.

REFERENCES

1. Proffit WR, Fields HW, Sarver DM. Contemporary Orthodontics. 4th ed. St. Louis: Mosby Co.; 2007. pp. 94pp. 331–48.

2. Andreasen JO, Andreasen L. Textbook and Atlas of Traumatic Injuries to the Teeth. 4th ed. Oxford: Blackwell Munksgaard; 2007. pp. 848–50.
3. Lazzaretti DN, Bortoluzzi GS, Torres Fernandes LF, Rodriguez R, Grehs RA, Martins Hartmann MS. Histologic evaluation of human pulp tissue after orthodontic intrusion. *J Endod.* 2014;40:1537–40.
4. Stenvik A, Mjör IA. Pulp and dentine reactions to experimental tooth intrusion. A histologic study of the initial changes. *Am J Orthod.* 1970;57:370–85.
5. Seltzer S, Bender IB. The Dental Pulp, Biologic Considerations in Dental Procedures. 3rd ed. Philadelphia: JB Lippincott Co.; 1984. pp. 295–318.
6. Ersahan S, Sabuncuoglu FA. Effects of magnitude of intrusive force on pulpal blood flow in maxillary molars. *Am J Orthod Dentofacial Orthop.* 2015;148:83–9.
7. Choi YJ, Kim KH, Lee KJ, Chung CJ, Park YC. Histomorphometric evaluation of maxillary molar roots and surrounding periodontium following molar intrusion in rats. *Orthod Craniofac Res.* 2015;18:12–20.
8. Dermaut LR, De Munck A. Apical root resorption of upper incisors caused by intrusive tooth movement: A radiographic study. *Am J Orthod Dentofacial Orthop.* 1986;90:321–6.
9. Butcher EO, Taylor AC. The vascularity of the incisor pulp of the monkey and its alteration by tooth retraction. *J Dent Res.* 1952;31:239–47.
10. Villa PA, Oberti G, Moncada CA, Vasseur O, Jaramillo A, Tobón D, et al. Pulp-dentine complex changes and root resorption during intrusive orthodontic tooth movement in patients prescribed nabumetone. *J Endod.* 2005;31:61–6.
11. Reitan K. Tissue behavior during orthodontic tooth movement. *Am J Orthod.* 1986;89:453–68.
12. McDonald F, Pitt Ford TR. Blood flow changes in permanent maxillary canines during retraction. *Eur J Orthod.* 1994;16:1–9.
13. Kvinnsland S, Heyeraas K, Ofjord ES. Effect of experimental tooth movement on periodontal and pulpal blood flow. *Eur J Orthod.* 1989;11:200–5.
14. Veberiene R, Smailiene D, Baseviciene N, Toleikis A, Machiulskiene V. Change in dental pulp parameters in response to different modes of orthodontic force application. *Angle Orthod.* 2010;80:1018–22.
15. Mostafa YA, Iskander KG, El-Mangoury NH. Iatrogenic pulpal reactions to orthodontic extrusion. *Am J Orthod Dentofacial Orthop.* 1991;99:30–4.
16. Ramazanzadeh BA, Sahhafian AA, Mohtasham N, Hassanzadeh N, Jahanbin A, Shakeri MT. Histological changes in human dental pulp following application of intrusive and extrusive orthodontic forces. *J Oral Sci.* 2009;51:109–15.
17. Graber TM, Rakosi T, Petrovic AG. Dentofacial Orthopedics with Functional Appliances. 1st ed. St. Louis: Mosby Co.; 1997. pp. 268–98.
18. Han G, Hu M, Zhang Y, Jiang H. Pulp vitality and histologic changes in human dental pulp after the application of moderate and severe intrusive orthodontic forces. *Am J Orthod Dentofacial Orthop.* 2013;144:518–22.
19. Perinetti G, Varvara G, Salini L, Tetè S. Alkaline phosphatase activity in dental pulp of orthodontically treated teeth. *Am J Orthod Dentofacial Orthop.* 2005;128:492–6.
20. Veberiene R, Smailiene D, Danielyte J, Toleikis A, Dagys A, Machiulskiene V. Effects of intrusive force on selected determinants of pulp vitality. *Angle Orthod.* 2009;79:1114–8.