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ORIGINAL RESEARCH

Adverse effects of orthodontic treatment

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Abstract
Dental malocclusions rank as the third most prevalent oral pathology, following tooth decay and periodontal diseases, thus holding a significant position globally. The transmission of orthodontic forces through the strained tissue matrix to neighboring cells within the periodontal ligament and alveolar bone results in the release of pro-inflammatory, angiogenic, and osteogenic factors by these cells, thereby initiating the remodeling process of both the periodontal ligament and alveolar bone Orthodontic treatment, similar to other medical interventions, may entail certain adverse effects. It is crucial for both the orthodontist and the patient considering such treatment to be well-informed about these potential side effects.
Key words: Orthodontic, Adverse

Introduction

Dental malocclusions rank as the third most prevalent oral pathology, following tooth decay and periodontal diseases, thus holding a significant position globally. While malocclusion is not classified as a disease or a life-threatening condition, it is widely recognized for its potential physical, social, and psychological repercussions that can adversely affect an individual's quality of life.[1, 2] The physical appearance of a person is often the most influential factor on self-esteem, behavioral norms, and interpersonal interactions. Individual perceptions, along with physical and psychosocial capabilities, as well as opportunities for a fulfilling life and social engagement, are essential for evaluating the impact of healthcare services on an individual. Young adults, in particular, tend to be more concerned about their behavior, appearance, and how they are perceived by others.[3, 4]

Classification of Malocclusion

Dr. Edward Hartley Angle, widely recognized as the "father of modern orthodontics," introduced a classification system for malocclusion based on the positional relationship of the mesiobuccal cusp of the upper first molar to the buccal groove of the lower first molar. The Angle Class I molar classification, referred to as neutroclusion, occurs when the mesiobuccal cusp of the maxillary first molar aligns with the buccal groove of the mandibular first molar. In contrast, Class II molar classification, known as mesoclusion, is characterized by the mesiobuccal cusp of the maxillary first molar occluding mesially to the buccal groove of the mandibular first molar. Finally, Class III molar classification, or distoclusion, is defined by the mesiobuccal cusp of the maxillary first molar occluding distally to the buccal groove of the mandibular first molar. Class I malocclusion is further subdivided into three types according to Dewey. Dewey type 1 features crowded incisors, labially positioned canines, or both. Dewey type 2 is characterized by protruded maxillary incisors. Type 3 involves anterior teeth that occlude edge to edge, the presence of a crossbite, or both. Additionally, the Anderson classification expands upon Class I malocclusion by introducing types 4 and 5. Type 4 is identified by a posterior crossbite, which may be unilateral or bilateral, while type 5 describes a Class I molar relationship accompanied by mesioversion of the permanent first molar, often resulting from the extraction of a second deciduous molar or premolar. Approximately 32% of individuals with malocclusion present with a Class II relationship, which occurs when the mandible is positioned retrognathically relative to the maxilla. The Class II interarch relationship is further divided into two categories. Class II division 1 is characterized by protruded maxillary incisors, an excessive overjet, and a deep overbite. The maxillary arch in this division is

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typically v-shaped and narrow in the canine region, while being broader between the molar regions. Patients exhibiting a Class II molar relationship in division 1 often have a shorter upper lip and may struggle to close their anterior lip completely.[5]

Class II division 2 malocclusion is characterized by the palatal inclination of the maxillary central incisors, which may be partially obscured by the maxillary lateral incisors. This classification is further defined by a pronounced overbite and a wide maxillary arch. Notably, there is a normal upper lip seal accompanied by a prominent mental groove. In contrast to division 1, division 2 is associated with a mandible of standard size.[5]

A Class III molar relationship is identified when the mandible is situated anteriorly to the maxilla, resulting in the mandibular teeth extending beyond the maxillary teeth. Class III malocclusion can be categorized into three distinct types based on tooth alignment. Class 3 type 1 features an irregular arch shape, while class 3 type 2 is characterized by the lingual tilting of the mandibular teeth. Class 3 type 3 involves the lingual tilting of the maxillary teeth.[5]

Effect of orthodontic dental treatment on gingiva

The effects seen clinically following the insertion of orthodontic appliances into the oral cavity can contribute to chronic infection, inflammatory hyperplasia, irreversible loss of attachment (permanent bone loss), and gingival recession. Although an association between orthodontic tooth movement and gingival recession has been mentioned in both the orthodontic and the periodontal literature, many of these studies are relevant to mandibular incisor teeth. Some investigators have shown gingival recession to be associated with labial movement of the mandibular incisors and have therefore considered this movement as a risk factor for gingival recession, while others have found no such association between orthodontic tooth movement and gingival recession. Moreover, it is argued that preexisting mucogingival problems can be exacerbated with orthodontic force application.[6, 7]

The transmission of orthodontic forces through the strained tissue matrix to neighboring cells within the periodontal ligament and alveolar bone results in the release of pro-inflammatory, angiogenic, and osteogenic factors by these cells, thereby initiating the remodeling process of both the periodontal ligament and alveolar bone. Existing literature indicates that fixed orthodontic appliances (FA) are linked to significant clinical attachment loss and modifications in the subgingival bacterial microbiota, as well as increased gingival inflammation, independent of the patient's oral hygiene practices. The presence of orthodontic brackets and elastic modules obstructs effective plaque removal, thereby increasing the risk of gingivitis. Self-ligating brackets (SLBs) are often claimed to offer advantages over conventional brackets (CB), such as better bacterial retention and less plaque accumulation.[7, 8]

Previous studies have suggested that poorly managed orthodontic treatment can adversely affect the inflammatory response and contribute to the deterioration of the periodontium, resulting in considerable attachment loss. While it is commonly believed that SLBs facilitate improved oral hygiene compared to CB, numerous studies have called this assumption into question, leaving the discussion on this matter unresolved. An alternative to fixed orthodontic appliances (FA) is the use of clear aligners, which may provide several benefits, including decreased plaque accumulation and improved gingival and periodontal health parameters, potentially offering advantages over traditional FA.[8-10]

Dental caries that develops in patients who have received orthodontic treatment can cause inefficient mastication as well as premature tooth loss, thereby impacting quality of life. Furthermore, caries in the anterior teeth compromise the aesthetic enhancement achieved by orthodontic treatment, even in the early demineralization stage.Although the prevalence of dental caries is decreasing globally, orthodontic treatment is still recognized as a strong risk factor for dental caries. Fixed orthodontic appliances allow accumulation of dental plaque, which promotes demineralization of enamel and results in dental caries.

Orthodontic treatment and caries

Several factors associated with orthodontic treatment, including the presence of fixed appliances and altered oral hygiene practices, have been implicated in the development of dental caries. Fixed appliances, in particular, can create niche areas that facilitate plaque accumulation, potentially leading to enamel demineralization and caries formation. Moreover, the challenges posed by maintaining optimal oral hygiene during orthodontic treatment may contribute to increased susceptibility to caries. Understanding the intricate relationship between orthodontic treatment and caries incidence is crucial to inform clinical practice and guide patient management. This study sought to contribute to this body of knowledge by conducting a prospective cohort investigation into the potential associations between orthodontic treatment and the incidence of new carious lesions among adolescents.[10]

Chauhan A et al investigated the relationship between orthodontic treatment and the incidence of new carious lesions among adolescents.A prospective cohort design involving adolescents aged 12-18 years was employed. A total of 82 patients met the inclusion criteria. In addition, an age-matched control group of 82 participants who did not undergo orthodontic treatment was included. The study included both a treatment group undergoing orthodontic treatment (braces or aligners) and an age-matched control group

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that did not undergo any orthodontic intervention. Demographic characteristics, orthodontic treatment details, and oral hygiene practices were documented at baseline and throughout the study period. Dental examinations at six-month intervals post-treatment were conducted to track the incidence and progression of carious lesions.The demographic characteristics, baseline oral health status, orthodontic treatment details, and oral hygiene practices were comparable between the treatment and control groups. Post-orthodontic treatment assessment revealed a slightly higher incidence of new carious lesions in the treatment group than in the control group (9.8%), although this difference was not statistically significant. Dental examinations at six-month intervals demonstrated a gradual increase in caries incidence over time in both groups, with no substantial disparities observed. They study provided a comprehensive examination of the relationship between orthodontic treatment and the incidence of new carious lesions among adolescents. While a trend towards higher caries incidence in the treatment group was observed, the difference was not statistically significant.[11]

A thorough evaluation of the risk of caries is therefore needed before any appliance is put in place and further evaluations should then be performed regularly throughout the course of treatment. In addition, preventive measures should be taken, involving first and foremost educating and motivating patients regarding the need for good oral hygiene. Prevention also implies adequate usage of the various sources of local fluoride administration, notably the application of fluoride-rich varnish. Other prophylactic measures such as using chlorhexidine varnish and sealing dental grooves are also recommended. Finally, the orthodontist can reduce to a minimum the use of items likely to retain dental plaque such as bands and elastomeric ties.[12]

Orthodontic treatment and root resorption

Root resorption is common during orthodontic tooth movement. Limited root resorption, involving a number of teeth, can be considered a consequence of orthodontic treatment. If the patient develops additional pathosis, such as periodontal disease, this may further compromise the support of the tooth and the patient can eventually loose that tooth. However, no reports in the literature have documented tooth loss caused by root resorption. A long-term case report documented a follow-up of a case of severe root resorption that occurred for 33 years, and the affected teeth were found to be functional. However, lack of reports in the literature on tooth loss due to root resorption does not exclude this as a potential risk.[13- 15]

The etiology of root resorption still remains unclear and is complex, including genetic predisposition and environmental factors. The genetic predisposition makes root resorption associated with orthodontic treatment more predictable.[13- 15]

The best approach toward root resorption is to consider the risk factors, discuss the identified factors with the patient seeking orthodontic treatment, and include these factors in the treatment consent form. These risk factors include the duration of treatment. The risk for root resorption increases with the length of treatment. Treatment of impacted canines can extend treatment time or the movement of these canines may lead to an increase in the risk for root resorption. Thin, tapered, and dilacerated root morphology, results in roots that are more prone to resorption. Additionally, history of trauma associated with the anterior teeth increases the risk for root resorption. Therefore, documentation of the condition through pre-treatment periapical radiographs of the maxillary and mandibular incisors is necessary. Potential extraction of maxillary and mandibular first or second premolars as well as the use of intermaxillary elastics during treatment should also be considered. Root resorption from previous orthodontic treatment is a risk that may result in further root shortening. Orthodontic re-treatment of such cases should be performed with caution and treatment objectives should be limited. Some habits, such as thumb sucking, occlusal trauma, or history of chronic bruxism, may increase the risk for root resorption.[13- 15]

Orthodontic treatment and pulp tissue

Cell destruction, inflammation, and wound healing are all aspects of the pulpal response to orthodontic treatment that may have a negative impact on the tooth pulp. Published histological studies show that pulp exhibits reactions ranging from circulatory vascular stasis to necrosis in response to orthodontically exerted pressures. Orthodontically exerted forces are associated with a decrease in the respiratory rate of tissue cells, along with a decrease in the activity of alkaline phosphatase, and other processes, including apoptosis, aspiration, vacuolization of odontoblasts, and tissue injury. An increase in micro-vessels and the discovery of angiogenic alterations in human dental pulp point to higher levels of angiogenic growth factors in the pulpal tissue. Many variables, including the type/direction of movement, and the distribution, intensity, and duration of the force, affect how much the tooth pulp changes. The pulp conditions may also be impacted by the tooth's inherent characteristics, including age, past orthodontic treatment, and trauma history.[16]

Recently, researchers have studied a number of aspects of how orthodontic forces affect the dental pulp, including blood flow in the pulp, response to tooth sensitivity testing, the expression/activity levels of various enzymes and neuropeptides, in addition to changes in the histology and morphology of the tissue. Blood flow in the pulp is a sign of the vitality

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of the pulp. The pulpal sensory responses and tooth sensitivity may decline due to reduced pulpal blood flow or brief ischemia. In such cases, indirect testing may be utilized to determine pulpal vitality, since the pulp is enclosed in a calcified cavity. Because noninvasive procedures are easy for clinical use, they can be used during orthodontic therapy to check the state of the pulp. In order to repeatedly clinically measure the flow of blood and conduct sensitivity tests without causing damage to the tissues, laser Doppler flowmetry and electric/thermal pulp tests (EPTs) are performed. Clinicians must therefore be aware of the clinical symptoms and indicators that could indicate pulp changes brought on by an orthodontic force.[16, 17]

When an orthodontically generated force is exerted on the pulp tissue, it results in the release and accumulation of inflammation-associated mediators. This causes odontoblasts and associated cells to respond in a resorptive or reparative manner, which can result in either resorption or tertiary dentin deposition. Neuropeptide production calcitonin gene-related peptide (CGRP) and substance P (SP) are higher in inflamed pulpal tissue, in comparison to normal pulpal tissue. Such occurrences may lead to internal alterations in the pulp cavity. The dentist should have imaging diagnostic tests during patient treatment to monitor these alterations.[17]

Conclusion

Orthodontic treatment, similar to other medical interventions, may entail certain adverse effects. It is crucial for both the orthodontist and the patient considering such treatment to be well-informed about these potential side effects.

References

1. Brito DI, Dias PF, Gleiser R. Prevalence of malocclusion in children aged 9 to 12 years old in the city of Nova Friburgo, Rio de Janeiro. Brazil R Dent Pres Orthod Ortop Facial. 2009;14:118–24.
2. Nagarjun S, Krishnappa P. The relationship of malocclusion as assessed by the Dental Aesthetic Index (DAI) with perceptions of aesthetics, function, speech and treatment needs among 14-15 year old school children of Bangalore, India. Oral Health Prev Dent. 2010;8:221–8.
3. Oliveira CM, Sheiham A. Orthodontic treatment and its impact on oral health-related quality of life in Brazilian adolescents. J Orthod. 2004;31:20–7.
4. Locker D, Gibson B. The concept of positive health: A review and commentary on its application in oral health research. Community Dent Oral Epidemiol. 2006;34:161–73.
5. Ghodasra R, Brizuela M. Orthodontics, Malocclusion. [Updated 2023 Apr 23]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2024 Jan-. Available from: https://www.ncbi.nlm.nih.gov/books/NBK592395/
6. Djeu G, Hayes C, Zawaideh S. Correlation between mandibular central incisor proclination and gingival recession during fixed appliance therapy. Angle Orthod. 2002;72:238–45.
7. Geiger AM. Mucogingival problems and the movement of mandibular incisors: A clinical review. Am J Orthod. 1980;78:511–27.
8. Robertson L., Kaur H., Fagundes N.C.F., Romanyk D., Major P., Flores Mir C. Effectiveness of clear aligner therapy for orthodontic treatment: A systematic review. Orthod. Craniofac. Res. 2020;23:133–142.
9. Shokeen B., Viloria E., Duong E., Rizvi M., Murillo G., Mullen J., Shi B., Dinis M., Li H., Tran N.C., et al. The impact of fixed orthodontic appliances and clear aligners on the oral microbiome and the association with clinical parameters: A longitudinal comparative study. Am. J. Orthod. Dentofac. Orthop. 2022;161:475–485.
10. Yamaguchi M., Fukasawa S. Is Inflammation a Friend or Foe for Orthodontic Treatment? Inflammation in Orthodontically Induced Inflammatory Root Resorption and Accelerating Tooth Movement. Int. J. Mol. Sci. 2021;22:2388.
11. Chauhan A, Mishra N, Patil D, et al. Impact of Orthodontic Treatment on the Incidence of Dental Caries in Adolescents: A Prospective Cohort Study. Cureus. 2024;16(3):e55898
12. Wennstorm J. Mucogingival considerations in orthodontic treatment. Semin. Orthod. 1996;2:46–54.
13. White L.W. Pain and cooperation in orthodontic treatment. Clin. Orthod. 1984;18:572–575.
14. Yamaguchi M., Kasai K. The effects of orthodontic mechanics on the dental pulp. Semin. Orthod. 2007;13:272–280.
15. Scheurer P., Firestone A., Bürgin W. Perception of pain as a result of orthodontic treatment with fixed appliances. Eur. J. Orthod. 1996;18:349–357