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Orthodontic Treatment for Children with History of Dental Trauma: Timing and Clinical Considerations

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Abstract
Traumatic dental injuries in children present significant challenges for subsequent orthodontic treatment. This review illustrates the timing and clinical considerations for successful orthodontic management of traumatized teeth in pediatric patients. The successful integration of orthodontic treatment in children with a history of dental trauma depends on precise timing based on injury type, healing phases, and careful monitoring of pulpal and periodontal status. Some important considerations include understanding that inflammatory root resorption constitutes an absolute contraindication for orthodontic treatment, while pulp canal obliteration typically does not require intervention beyond radiographic surveillance. Furthermore, orthodontic forces must be carefully modulated when applied to teeth undergoing regenerative endodontic procedures, as premature loading may disrupt the regenerative process and compromise treatment outcomes.

I. Introduction

Traumatic dental injuries can have significant and long-lasting effects on teeth and surrounding tissues. These injuries often occur due to accidents, falls, sports or other impacts and can range from minor infraction or fractures to more severe damage such as avulsions or root fractures. The consequences of such trauma extend beyond immediate pain and aesthetic concerns, potentially affecting the development, function and health of the teeth and surrounding tissues. In primary dentition, trauma can influence the growth of the developing permanent teeth and lead to issues like delayed eruption, malformation or ankylosis. In permanent teeth injuries may result in pulp damage, root resorption or even tooth loss if not properly managed(Laforgia et al., 2025).

For children with a history of dental trauma, orthodontic treatment is not only feasible but often necessary to restore function, aesthetics and proper occlusion. However, the key to success lies in choosing the precise timing and method based on the type of injury and its healing phase(Çelik and Camcı, 2025).

A considerable proportion of patients seeking orthodontic treatment have experienced previous traumatic dental injuries to their permanent incisors, many of which remain untreated. Reports indicate a high prevalence of 10.8% for orthodontic candidates with prior TDIs before beginning orthodontic therapy (Bakkari and Salamah, 2022). Treating such teeth orthodontically may pose an increased risk of further pulpal and periodontal complications, particularly in cases where root resorption has already been initiated following trauma. Planning orthodontic treatment for teeth that have undergone endodontic therapy can also be complex; therefore, clinicians must be knowledgeable about appropriate techniques and the optimal timing for movement of traumatized or endodontically treated teeth, whether the trauma resulted from deep carious lesions or injuries(Sandler et al., 2021). Understanding the potential risks involved is crucial for safe and effective treatment.

Search strategy:

The following electronic databases were searched: PubMed / MEDLINE, Cochrane Library and Google Scholar.The search strategy combined the following words:

("orthodontic treatment" OR "orthodontic management" OR "tooth movement") AND ("dental trauma" OR "traumatic dental injur*" OR "avulsion" OR "luxation") AND ("child*" OR "pediatric" OR "adolescent"). The included studies were published in the English languageonly, human clinical studies and studies focusing on children and adolescents. Animal and *in vitro* laboratory studies were excluded.

Challenges of traumatized teeth that may complicate orthodontic treatment:

Pathological inflammatory external root resorption can result from infectionfollowing dental trauma and/orimproper orthodontic treatment. Orthodontic treatment is contra-indicated in this situation as it may lead to loss of the

tooth.Inflammatory external root resorption is caused by damage to the protective cementum layer leading to surface resorption and exposure of the underlying dentine.This creates a direct connection with the root canal system. When pulpal necrosis occurs, superimposed infection prevents the normal repair process of cementum, allowing the resorptive activity to continue unchecked due to the ongoing passage of bacteria and their byproducts. This persistent inflammatory response activates resorptive cells resulting in the resorption of both tooth structure and surrounding bone.It is particularly challenging because sometimes it can be asymptomatic and becomedifficult in early detection. This type of resorption occurs when microorganisms invade the root canal system or periodontal tissues, causing inflammation, stimulating osteoclastic activity, and leading to the degradation of tooth structure. Infections within the pulp often originating from pulp necrosis or trauma or those originating from periodontal disease can initiate this destructive process. The tooth may become tender when touched, accompanied by swelling or a discharging sinus on the surface.Radiographic evaluation may reveal bowl-shaped radiolucencyaround the tooth. This can lead if not managed early to sever mobility and loss of the affected tooth (Kiran et al., 2025).

Ankylosis followed by replacement resorption occur following the death of viable periodontal ligament cells which is caused by severe trauma such as luxationor avulsion which results in either intense compression after trauma or drying of the cells after avulsion. This tooth does not respond to orthodontic movement due to absence of periodontal ligament.Progressive replacement of the tooth structure by alveolar bone can ultimately lead to tooth loss. The formation of an interface lacking viable periodontal ligament cells between the bone and dentine triggers normal remodeling processes similar to skeletal bone turnover but at the expense of the dentine. Ankylosis develops with complete loss of mobility which is characterized by a distinctive highpitched metallic percussion sound and failure to passive eruption leading to infra-occluded tooth. At this stage, there is no loss of root dentine or cementum. After several years, the continual replacement of the tooth structure by surrounding bone leads to the eventual loss of the tooth(Patel, 2016).

Orthodontic treatment during regenerative endodontic procedures after dental trauma can cause direct interference with the regenerative processand can significantly impact the success of regenerative endodontic procedures. Disruption of the blood clot or scaffold is a main concern as regenerative endodontic procedures depend on the formation of a stable intracanal blood clot that serves as a framework for new tissue growth. Even light orthodontic forces can induce micro-movements and vascular changes that may disturb this fragile clot and lead to regenerative failure. Additionally, applying orthodontic forces prematurely can impair root development by halting or arresting ongoing root lengthening, thickening and apical closure in immature teeth. This premature interference results in a weak, short root with an open apex, interfering with the purpose of the regenerative endodontic procedures. Moreover, the regeneration of the pulp-dentin complex involves the formation of delicate, limited-vascularity and poorly innervated pulp-like tissue. Orthodontic loading can induce ischemia or necrosis in this newly formed tissue risking internal resorption or loss of vitality (Figure 1)(Bucchi et al., 2023, Yoshpe et al., 2025).

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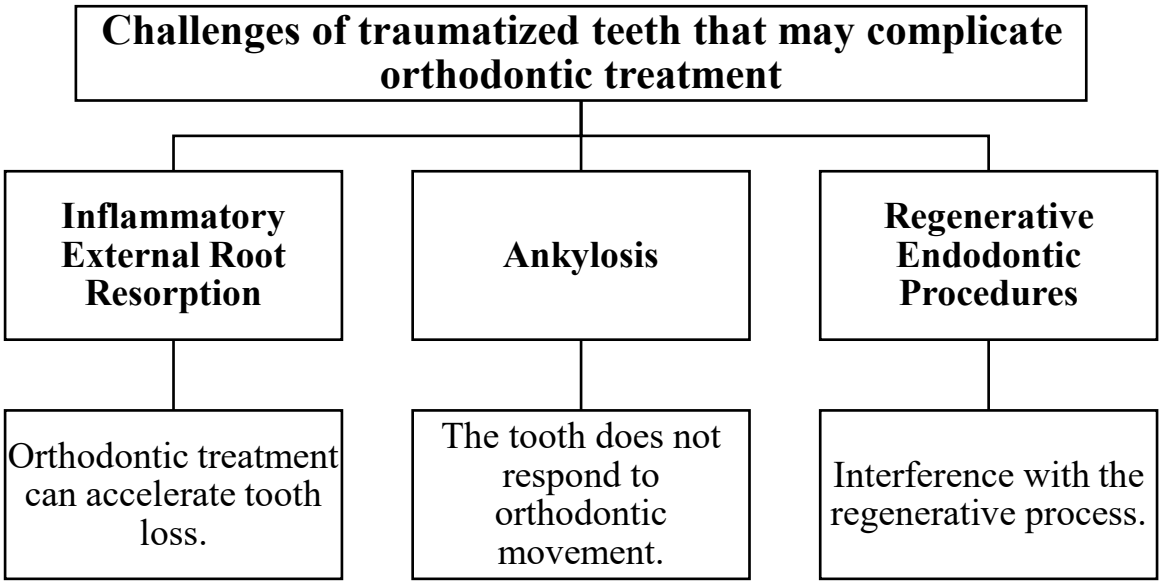

Figure 1: Summary of challenges of traumatized teeth that may complicate orthodontic treatment.

Clinical considerations during orthodontic treatment of traumatized teeth

Risk of root resorption:

Dental trauma can lead to root resorption without the any orthodontic intervention. In addition, teeth that have experienced previous traumatic dental injuries and exhibit root resorption are more susceptible to further root structure loss when subjected to orthodontic movement. Research on the impact of prior traumatic dental injuries on root resorption during orthodontic treatment presents mixed results and is limited in number(Kindelan et al., 2008, Bakkari and Salamah, 2022, Sapna et al., 2025). One study reported an average resorption of 1.07 mm in teeth with traumatic dental injuries that underwent orthodontic movement, compared to 0.64 mm in sound teeth (Linge and Linge, 1983). It has also been noted that there is no relation between the length of orthodontic treatment and the amount of root resorption (Bakkari and Salamah, 2022).

Endodontic Treatment:

The researchespresent conflicting findings regarding the risk of root resorption in endodontically treated teeth during orthodontic treatment. These discrepancies may be attributed to variations in the causes of pulp necrosis. It has been demonstrated that provided the root shape is normal, there is no significant difference in root resorption between endodontically treated teeth and vital teeth when subjected to identical orthodontic forces(Kindelan et al., 2008, Beck et al., 2013).

Orthodontic treatment recommendations for traumatized teeth:

An observation period of six to twelve months before starting orthodontic treatment is recommended to ensure that the periodontal ligament is healed and any pulpal adverse reaction has been definitively managed. Also, to prevent the extra-inflammatory stimulithat may be caused by orthodontics immediately after trauma which may increase the risk for inflammatory root resorption(Sandler et al., 2021, Bakkari and Salamah, 2022).

Intermittent light forces are considered a safer approach to minimize significant root resorption. This is because intermittent forces allow time for repair of damaged root cementum. In contrast, continuous forces do not provide sufficient time for periodontal tissues and blood vessels to recover, potentially leading to greater root resorption. Moreover, jiggling movements and the use of intermaxillary elastics likely increase the risk of root resorption(Ren et al., 2003, Owtad et al., 2015).

In teeth that have healed from root fractures orthodontic treatment can lead to separation of fractured segments especially if healing was by connective tissue not by hard tissue formation. Unless the fractured segments are splinted together by post, orthodontic treatment is not recommended (Figure 2)(Bakkari and Salamah, 2022).

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Figure 2: Separation of fractured segments few weeks after the start of orthodontic treatment. In such cases splinting the two fractured segments by a post before the start of orthodontic treatment is highly recommended.

II. Conclusion:

Orthodontic management of children with dental trauma can be very challenging as it must adopt a conservative and individualized treatment strategy characterized by the application of light-controlled forces, periodic radiographic and clinical evaluations, and a willingness to delay or modify treatment plans based on individual healing responses. Moreover, successful outcomes depend heavily on interdisciplinary collaboration among paediatric dentists,orthodontists and endodontists to ensure that biological integrity and tooth preservation remain the main objective.

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