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An Evidence-Based Treatment Guide for Trauma from Occlusion: Essential Guidelines for Dental Students

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KEYWORDS

Fremitus, occlusion, periodontitis, trauma

ABSTRACT

Trauma resulting from occlusion is a common clinical issue that can lead to significant discomfort, dysfunction, and long-term dental complications. This article is designed to offer a simplified, evidence-based overview of the pathophysiology of occlusal trauma, diagnostic approaches, and a treatment guide, making the management of occlusal trauma more accessible and easier to understand. Emphasis is placed on the importance of an individualized treatment planning, offering clinicians practical insights to optimize outcomes and minimize the adverse effects. The findings support the need for evidence-based decision-making in the management of occlusal trauma, ensuring both short-term relief and long-term dental health preservation.

INTRODUCTION

Historically, trauma resulting from occlusion has been a contentious issue in periodontology. Researchers have been unable to conclusively link occlusal forces to periodontal disease due to difficult research and inconclusive results. It is important to recognize that trauma from occlusion (TFO) and periodontal disease can be understood in many different ways, as depicted in Table 1.

Nevertheless, it is currently understood that excessive occlusal forces are not responsible for plaque-induced periodontal disease or attachment loss [5]. Previous studies have shown that healthy periodontium with normal or reduced height demonstrated physiological adaptation without loss of clinical attachment in response to excessive occlusal forces [6,7]. However, diseased periodontium demonstrated continuing loss of attachment [8-10].

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TRAUMA FROM OCCLUSION VS OCCLUSAL TRAUMA

Trauma from occlusion (TFO) is defined as pathologic alterations or adaptive changes which develop in the periodontium as a result of excessive force produced by the masticatory muscles or teeth of the opposing jaw [11]. Meanwhile, occlusal trauma is a term referring to injury to periodontium as a result of excessive occlusal forces [5]. Periodontal tissues undergo several stages in response to increased occlusal forces: tissue injury, repair and adaptive remodelling of the periodontium [12,13]. The injury to periodontium happens when occlusal forces applied is greater than the reparative capacity of the periodontium [11,14,15].

There are two types of occlusal trauma [5,16]. First, primary occlusal trauma refers to an injury to periodontium resulted from undue occlusal forces that act on teeth with normal support. It occurs in the presence of normal bone and attachment level with excessive forces. Second, secondary occlusal trauma is an injury to periodontium resulted from excessive occlusal forces that act on teeth with reduced periodontal support. It occurs in the presence of bone loss, attachment loss and with normal or excessive occlusal forces.

Table 2 summarizes the differences between primary and secondary occlusal trauma.

Table 1 Various concepts of understanding related to TFO

	Stillman [1, 2]	**Glickman** [3]	**Waerhaug** [4]
Aetiology	Occlusal trauma as the main cause of periodontal disease	Occlusal trauma as a co-destructive factor in progression of existing periodontal disease	Periodontal disease is unaffected by occlusal trauma
Conceptual belief	Occlusal therapy was mandatory for the control and treatment of periodontitis	Excessive occlusal force alone does not cause periodontal disease; however, it exacerbates the progression of existing periodontal disease	Bone loss was associated with plaque downgrowth, and excessive occlusal forces did not contribute to periodontitis progression

Table 2 Comparison between primary and secondary occlusal trauma

	Primary occlusal trauma	**Secondary occlusal trauma**
Periodontal support	Normal	Reduced
Occlusal forces	Excessive	Normal or excessive

ETIOLOGICAL FACTORS OF TRAUMA FROM OCCLUSION

Traumatic occlusal force refers to any occlusal force that results in injury to the teeth and/or the periodontal attachment apparatus [5]. Any condition that can trigger the occurrence of traumatic occlusal force may lead to TFO. Among the aetiologies involved are parafunction habits such as bruxism and tooth clenching habit [5,17,18,19]. The generated force can lead to damage not only to the tooth itself, potentially causing wear, fractures, or looseness, but also to the surrounding periodontal attachment apparatus, including the ligaments, cementum, and bone. This can result in periodontal breakdown, mobility of the tooth, and even eventual tooth loss if left untreated [5]. Meanwhile, habits such as biting pencils or other foreign objects can lead to localized damage of the supporting periodontal structures. Over time, these repetitive forces can cause inflammation, weakening of the tooth's attachment to the bone, and increased susceptibility to periodontal disease [20].

Faulty restorations also have been reported as iatrogenic aetiology of TFO as they may cause high bite, leading to excessive and traumatic occlusal force. Meanwhile, an improperly designed partial denture that exerts undue pressure on the abutment teeth may cause gingival irritation and contribute to the accelerated loss of these abutments. This can lead to further periodontal damage, compromising the stability and function of the remaining teeth [20,21]. Additionally, malocclusion is also one of the recognized aetiologies of TFO. For example, an extreme anterior overbite can lead to palatal recession of the maxillary incisors due to direct trauma from the incisal edges of the mandibular incisors. Additionally, functional trauma caused by an anterior crossbite can result in marginal recession of the labial gingiva of the mandibular incisors, further compromising the health and stability of the affected teeth [22-24].

CLINICAL EXAMINATION TO CONFIRM THE DIAGNOSIS

A thorough clinical examination is essential to confirm the diagnosis and assess the extent of TFO. One of the procedures that can be conducted is an occlusal analysis to identify the presence of any occlusal interference, which may affect the proper distribution of forces across the teeth. Occlusal interference is defined as any tooth contact that prevents the occluding surfaces from achieving stable and harmonious contacts. As a consequence, it may predispose to TFO. Ideally, the features of desirable functional occlusion are 1) presence of no more than 1mm slide between retruded contact position (RCP) and intercuspal position, 2) canine guidance or group function on working side and no contact on non-working side upon lateral excursion, and 3) absence of posterior contacts upon protrusion. Steps of occlusal analysis is depicted in Figure 1. It is also worthy to note that while assessing the RCP, the amount of overbite and overjet, presence of crossbite, missing teeth, over erupted teeth and their opposing contacts, tooth alignment, any open proximal contacts, and the resting position of the lower lip in relation to the upper anterior sextant should all be carefully evaluated [25,26].

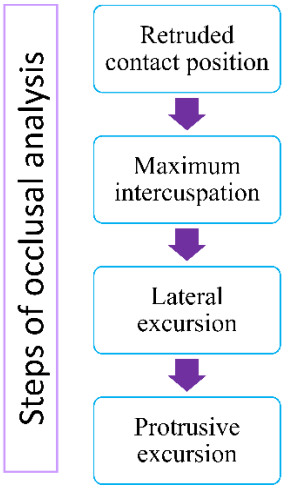

Figure 1 Steps of occlusal analysis

Next, fremitus test can be performed on the suspected teeth affected with TFO. The term fremitus is used to describe the movement of a teeth that can be felt or seen when occlusal forces are applied. It can be assessed by placing a finger on buccal aspect of the tooth and tooth movement is palpated while patient taps lightly up and down [5,27]. A positive fremitus test indicates presence of TFO.

CLINICAL AND RADIOGRAPHIC SIGNS OF TFO

Identifying clinical and radiographic signs of TFO can offer crucial insights into the condition, aiding in the detection of any damage or abnormalities in the teeth and supporting structures [5]. Among the clinical signs are presence of fremitus, increased/progressive tooth mobility, and occlusal discrepancy/interference. In addition, recognizing wear facets can help determine whether the tooth has been subjected to traumatic occlusal forces. The most common tooth wear that can be associated with TFO are attrition and abfraction. Attrition can result from parafunctional habits, such as bruxism, while abfraction typically occurs at the cervical region of the teeth, presenting as wedge-shaped lesions with sharp internal and external line angles. Abfraction results from excessive occlusal forces that induce flexure, leading to microfractures and subsequent enamel loss [15,28]. Additionally, excessive occlusal forces also predispose to fractured tooth and later leads to tooth hypersensitivity [15]. Other clinical signs of TFO documented are presence of pathologic tooth migration and discomfort/ pain upon chewing [5].
Radiographic investigation serves an adjunct to clinical examination. Among the radiographic signs of TFO are angular or vertical bone loss, widening of periodontal ligament (PDL) space with thickening of lamina dura, root resorption and cemental tear [5].

CLINICAL MANAGEMENT OF TFO

Once the diagnosis of occlusal trauma is confirmed, an appropriate management plan can be developed for the patient. Occlusal adjustment, also known as occlusal equilibration, selective grinding or coronoplasty, refers to reshaping the occluding surfaces of teeth by grinding or selective coronal tooth modification [29,30]. The main goal of the procedure is to achieve a stable occlusal contact relationship between maxillary and mandibular teeth in maximum intercuspation and in all functional excursive contact positions [30]. It is beneficial for tooth with increased mobility due to widening of PDL space [14]. Occlusal adjustment on teeth with mobility and/or premature contacts can also lead to improved clinical attachment level by reducing abnormal forces and allowing the periodontal tissues to stabilize and heal [31]. The most common method utilized at chairside is by grinding or adjusting only those teeth that appear to be in heaviest contact [30]. Figure 2 summarizes the occlusal adjustment procedure [26].

Figure 2 Occlusal adjustment procedure. (A) ASSESSMENT: Identification of any bite discrepancies during RCP, excursive movements, and protrusion; (B) CONTACT POINT IDENTIFICATION: Identification of high spots using thin, coloured plastic foils or articulating paper; (C) OCCLUSAL ADJUSTMENT / SELECTIVE GRINDING: Elimination of heavy contacts by using a diamond or white stone bur to selectively grind excessive contact for balanced occlusion

Splinting is also an option in managing this condition. In contrast to occlusal adjustment, it is beneficial for tooth with increased mobility due to reduced height of the periodontium and with normal width of PDL space [11,32]. However, it may not improve survival of mobile teeth associated with advanced periodontitis [31]. The main goal of the procedure is to gain stability, reduce or eliminate the mobility, and relieve the pain and discomfort. When splinting is considered, its indications and contraindications should be justified. It is indicated for controlling secondary TFO, improving the patient's comfort and function, and stabilizing teeth that are increasingly mobile and have not responded to occlusal adjustment or periodontal therapy. Meanwhile, it is contraindicated when patients have inadequate oral hygiene as it is difficult to perform oral hygiene procedures while wearing a splint. Patients with insufficient non-mobile teeth to stabilize mobile teeth adequately, occlusal interference and a high level of caries activity are also contraindicated [33,34]. In order to ensure the longevity of the splint and the health of the teeth, it is critical to maintain effective plaque control, professional caries risk assessment, and periodontal maintenance. Tooth prognosis that is generally poor and splint placement that may be compromised by crowding and misalignment of teeth also are generally contraindicated [33,35].

The splint should be designed according to the fundamental principles of its fabrication. It should 1) be durable, efficient, and easy to repair, 2) allows for good plaque control, 3) not interfere with periodontal instrumentation, 4) not cause tissue irritation, 5) be visually appealing and 6) be at least two firm teeth for every mobile tooth [33,34]. There are two types of splints to be considered, either provisional or definitive splint. Provisional splint provides temporary stabilization for limited amount of time [34,35]. The most common and easiest technique utilized at the clinic is bonding techniques with restorative materials such as composite resin with ligature wire splinting (round stainless steel wire of 0.25 or 0.3 mm in diameter) [20,35]. It is placed apical to proximal contacts and incisal to the cervical one-third on the facial surface or cingulum on the palatal surface of the anterior teeth [35]. Other example is bite appliance such as "night guard" or occlusal splint that is used to eliminate or reduce occlusal trauma and helps to stabilize mobile teeth caused by parafunctional habit such as bruxism [12,15,20,35]. It provides cushioning contact forces between the teeth to prevent teeth from grinding together and relieve stress on the jaw points. Heat- or cold-cured hard acrylic is recommended over a soft acrylic material.

Meanwhile, permanent splint is indicated for progressive trauma from occlusion following periodontal treatment and occlusal adjustment such as continuous migration or tipping of teeth and continuous alveolar bone resorption [20,35]. Since permanent splinting is long lasting and includes technical and financial consideration, it should only be considered when other forms of occlusal treatment has been done and found to be inadequate [20]. Permanent splint includes conventional fixed prostheses as they provide definitive rigidity and is better in controlling and directing occlusal forces than removable splints. The definitive splint of choice is a complete coverage fixed partial denture as it will not only stabilize the affected teeth, but they also improve aesthetic and may prevent tooth loss [35]. However, tooth with loss of supporting structure up to apical level may not be able to withstand masticatory forces even though a proper

periodontal treatment and occlusal adjustment have been done [32]. One of the ways to preserve such dentition is by construction of fixed splint of cross arch design. The objective of this treatment is to create a situation in which the mobility of the entire bridge is either "normal" or at least non-progressive. With this design, the lever effect of occlusal forces are reduced as the forces are distributed evenly [32].

Next, orthodontic treatment, with the primary goal of eliminating abnormal occlusal forces that may contribute to TFO, is also an important part of the management plan. Orthodontic treatment helps relieve traumatic occlusal contacts by realigning the teeth and correcting any malocclusions [36]. Among the conditions that may require orthodontic treatment following periodontal therapy are 1) functional anterior crossbite that leads to unstable jiggling movement, 2) extensive open bite that exerts excessive forces on posterior teeth and 3) extruded anterior teeth with periodontal disease and mobility. This orthodontics option is planned only after active periodontal treatment is completed as orthodontic tooth movement in unstabilized periodontium will further compromise the tooth stability and its long term prognosis [12,15].

Additionally, occlusal reconstruction can also be considered by providing restorations such as crowns, bridges or implant supported prosthesis to help in achieving complete occlusal scheme and distributing occlusal forces more evenly throughout the dentition [12,20]. Although extraction is an appropriate treatment for extremely mobile teeth and advanced bone loss, it may not resolve all the underlying pathology if the aetiology of mobility is not established first. Tooth extraction is the last option that can be considered in managing TFO. For example, extraction of tooth with extensive periodontal destruction and poor prognosis that may improve prognosis of the remaining teeth [12,35]. However, the underlying cause of tooth mobility should be identified prior to extraction as occlusal adjustment or splinting may prevent tooth loss and restore patient's comfort and function. Figure 3 illustrates the treatment decision algorithm for patients with TFO.

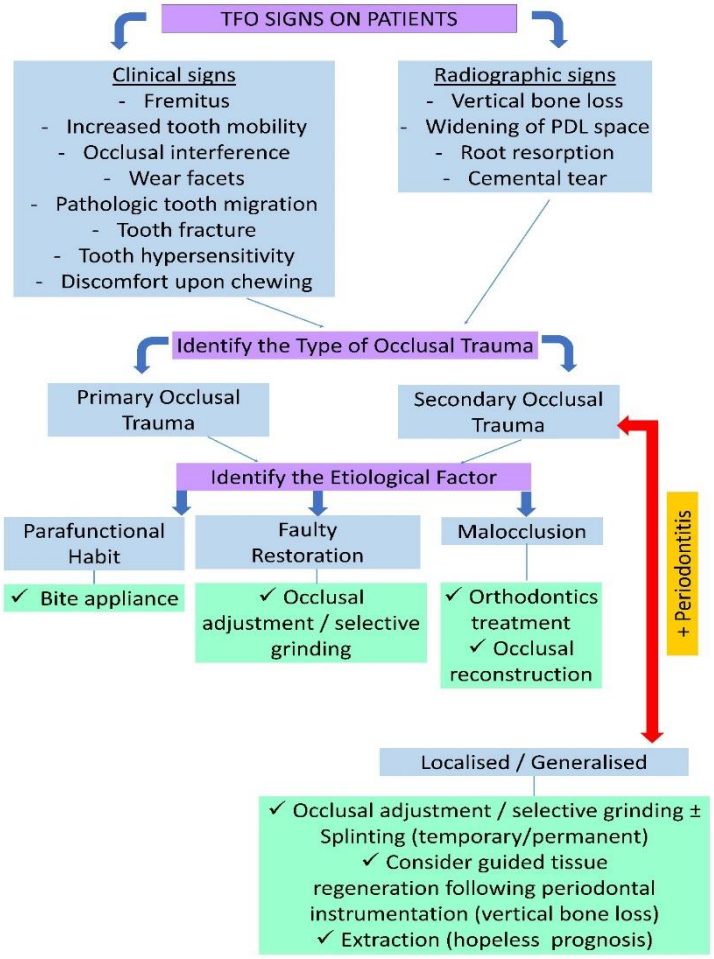

Figure 3 Treatment decision algorithm for TFO

EXAMPLE OF CASES MANAGEMENT

Case 1

A 58-year-old, healthy, non-smoker female, came with the complaint of mobile tooth on lower left front region. The mobility has gradually worsened over the past two years. The patient denied any history of trauma or pain in that area.

Intraoral examination revealed generalized clinical attachment loss, an anterior crossbite and premature contact between teeth 11 with 31 and 41 (Figure 4a), indicating occlusal interference. Bone loss up to the apex was recorded on the periapical radiograph (Figure 4b). Additionally, tooth 31 showed positive fremitus and grade III tooth mobility. These findings confirm a diagnosis of secondary occlusal trauma of tooth 31, with malocclusion as an aetiology. Due to hopeless prognosis, tooth 31 was extracted and the anterior crossbite was corrected using an upper removable appliance (Figure 5a & 5b).

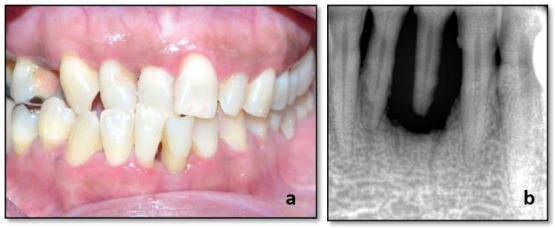

Figure 4 (a) Anterior crossbite between teeth 13 - 43, 12 - 42, 11 – 41 & 31; (b) Radiographic bone loss up to the apex

Figure 5 (a) Construction of upper removeable appliance; (b) Correction of the malocclusion

Case 2

A fit and healthy 62-year-old Chinese lady presented with complaints of mobile upper front teeth and discomfort when chewing. She also noticed that her teeth had become more protruded than before (Figure 6a). Clinical examination revealed grade II tooth mobility on the upper central and lateral incisors, with pathologic tooth migration and fremitus. A periapical radiograph revealed horizontal bone loss involving half of the root length of the teeth, along with widening of the PDL space (Figure 7).

These findings confirm a diagnosis of secondary occlusal trauma in teeth 12, 11, 21, and 22. Besides that, periodontal examination was performed, and the patient was diagnosed with generalised periodontitis Stage III Grade C. Occlusal adjustment and splinting were performed to manage the occlusal trauma, stabilize the upper anterior teeth, and prevent further migration of the teeth (Figure 6b). The patient was very satisfied and more comfortable following the procedure, especially when eating. Additionally, non-surgical periodontal treatment was carried out to treat periodontitis.

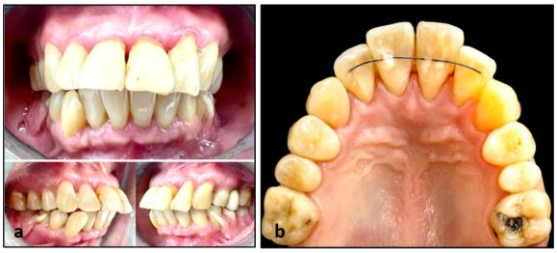

Figure 6 (a) Clinical photograph; (b) Splinting on upper anterior teeth

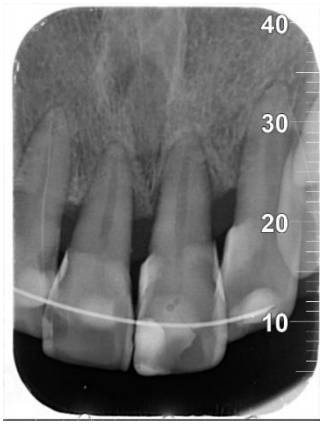

Figure 7 Periapical radiograph revealed horizontal bone loss involving half of the root length with widening of PDL space

CONCLUSION

To conclude, TFO per se is not able to induce periodontitis in healthy periodontium, but it may enhance progression of periodontal disease on periodontally diseased tooth. It is reversible once the abnormal forces are removed. A comprehensive approach to manage occlusal trauma is essential, involving accurate diagnosis, thorough clinical and radiographic assessments, and appropriate interventions. Nevertheless, initial treatment of periodontal disease by oral hygiene control and non-surgical periodontal therapy is still the prime importance in the management of patients. Addressing abnormal occlusal forces is crucial to prevent further damage to the teeth and

supporting structures, ultimately improving the patient's oral health and comfort.

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DECLARATION OF INTEREST

Authors declare no conflict of interest.

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