

# Occlusal Splints and Periodontal/Implant Therapy

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## Abstract

**Background:** Occlusal trauma, defined as an injury to the tooth or implant supporting tissues, is a resultant of parafunctional habits such as bruxism. It has been shown to accelerate periodontal breakdown and also contribute to implant complications, thereby adversely affecting the long-term success of periodontal and implant therapy. This literature review aims to discuss the effects of bruxism on periodontal and implant treatment. In addition, the effectiveness of occlusal splints to manage bruxism will be examined.

**Methods:** An electronic literature search using PubMed and Scopus databases and a manual search for relevant papers published in English from January 1965 up to August 2017 was performed.

**Results:** An occlusal splint appears to be effective in reducing symptoms related to temporomandibular disorder and bruxism. However, high quality evidence is severely lacking to support its use. Therefore, as it is a non-invasive and reversible therapy, its use in patients with bruxism is proposed.

**Key words:** *Bruxism, dental implants, occlusal splints, tooth, bite force*

## Introduction

Trauma from occlusion is defined as a tissue injury in the periodontium due to occlusal forces (Hallmon, 1999). It can be categorized into primary and secondary forms. In primary occlusal trauma, teeth with normal periodontal support are subjected to excessive occlusal forces, while in secondary occlusal trauma, teeth with reduced periodontal support are exposed to excessive or normal occlusal forces (Hallmon, 1999). Traumatized teeth may reach a state of physiological adaptation and remain hypermobile yet stable over time. It is not of major concern because animal and human models showed that trauma from occlusion does not initiate periodontitis (Ericsson *et al.*, 1977; Lindhe *et al.*, 1976; Svanberg *et al.*, 1974; Pihlstrom *et al.*, 1986). However, occlusal trauma will accelerate disease progression in individuals with existing periodontitis through a proposed pathway called the theory of co-destruction (Glickman *et al.*, 1962). It is thus considered a contributing factor

of periodontal breakdown. As such, it is recommended to perform occlusal adjustments or equilibrium, splinting, and/or orthodontic treatment to ease the traumatic contacts on symptomatic teeth (Ramfjord *et al.*, 1981; Burgett *et al.*, 1992).

Occlusal trauma can occur as a result of parafunctional habits, which are characterized by muscle hyperactivity. One such common habit is bruxism. It is defined as the repeated activity of the jaw muscles characterized by clenching and grinding of teeth, and/or bracing or thrusting of the mandible (Lobbezoo *et al.*, 2013). The exact etiology is unclear but it has been linked to stress, trauma, smoking, sleep apnea, genetics, and medications such as selective serotonin reuptake inhibitors (Murali *et al.*, 2015). It can occur during sleep (nocturnal bruxism), when one is awake (diurnal bruxism), or both (Lobbezoo *et al.*, 2013). Interestingly, more adults have diurnal bruxism (22.1 - 31.0%) compared to nocturnal bruxism (12.8%; Manfredini *et al.*, 2013) with both males and females equally at risk.

During bruxism, the neuromuscular reflexes that protect the dentition are less reactive (Reddy *et al.*, 2014). Therefore, when the dentition is exposed to a bite force that often exceeds the amplitude of maximum voluntary bite force by 53.1%, changes to the periodontium may occur (Nishigawa *et al.*, 2001). Also, tooth wear, tooth or root fractures, tooth mobility, prosthetic complications, e.g. abutment and implant fracture, and muscle soreness may occur (Murali *et al.*, 2015).

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However, there is a dearth of literature examining the effect of bruxism on the periodontium around teeth or dental implants. Therefore, this paper aims to provide an overview regarding the effect of bruxism in periodontal and implant treatment and the use of an occlusal bite-splint as an adjunct to alleviate any occlusal trauma consequential to bruxism.

## Material and methods

An electronic search of the PubMed and Scopus database and a manual search for relevant literature published in the English language from January 1965 to August 2017 were conducted by one examiner (P.S.). The search terms used were occlusal splint, bite splint, occlusal appliance, bruxism, dental implant, implant failure, periodontal therapy, occlusion or parafunctional habit.

## Results and discussion

### *Bruxism in periodontology*

Classic periodontal literature has extensively studied the role of occlusal trauma in healthy periodontium, healthy but reduced periodontium, and experimental periodontitis (Svanberg and Lindhe, 1974; Glickman, 1965; Ericsson and Lindhe, 1977; Ericsson *et al.*, 1982). It was concluded that occlusal trauma alone did not cause periodontal breakdown, however, it could aggravate periodontal tissue destruction in a plaque-associated dentition. Also, occlusal trauma might be perpetuated by bruxism (Ramfjord and Ash, 1981).

The effect of bruxism on the periodontium has been reported in several studies. Nocturnal bruxism has been shown to reduce the inter-occlusal tactile threshold for periodontal sensation as well as increase clenching induced tooth displacement (Ono *et al.*, 2008). It is also associated with clinical attachment loss, increased tooth mobility, non-carious cervical lesions, and tooth hypersensitivity (Tokawa *et al.*, 2008). However, a strong causal relationship between bruxism and periodontal damage cannot be established, as the available literature is limited in both quality and quantity (Manfredini *et al.*, 2015). Nonetheless, if the patient presents with a complaint about a tooth, the clinical and radiographic presentation should be carefully evaluated. If signs of occlusal trauma, for example, progressive tooth mobility, widening of periodontal ligament space, radiographic bone loss, and/or root resorption, are present, occlusal adjustments should be performed to alleviate the patient's discomfort (Ramfjord and Ash, 1981).

### *Bruxism in dental implant therapy*

Fundamental biophysiological differences between the attachment of alveolar bone to the natural tooth and dental implant make each entity respond to occlusal forces differently. Natural teeth are attached to the

alveolar bone by a periodontal ligament, which acts as a shock absorber to dissipate heavy occlusal forces applied to the surrounding bone, thus protecting the teeth from injury (Nanci *et al.*, 2006). On the other hand, the dental implant that replaces the root of a tooth is osseointegrated to the bone and thus behaves more like an ankylosed structure. As such, without a functional periodontal ligament, there is less tactile sensibility and occlusal awareness with respect to dental implants (Jacobs *et al.*, 1993). Consequently, overloading has been identified as a potential contributing factor in biomechanical complications and peri-implant bone loss (Fu *et al.*, 2012; Chang *et al.*, 2013).

It is clear from the literature that biomechanical implant complications, which include screw loosening or fracture, implant fracture, veneering material fracture, and prosthesis failure (Goodacre *et al.*, 2003), are often a result of occlusal overload. However, the relationship between occlusal overloading and biological complications is inconclusive (Grossi, 2014). This is because bacterial biofilm is the primary etiological factor in cases with peri-implantitis (Pontoriero *et al.*, 1994). There is emerging evidence that indicates a close association between failing/failed implants and the presence of parafunctional habits (Fugazzotto, 2001; Quirynen *et al.*, 1992; Misch *et al.*, 2002). A recent multilevel survival analysis on 3549 implants in 994 patients demonstrated that bruxism might be associated with an increased risk of dental implant failure (Chrcanovic *et al.*, 2016). Also, the odds ratio of implant failure in bruxers was 2.71 comparing to non-bruxers (Chrcanovic *et al.*, 2017). Therefore, occlusion, especially when bruxism is present, should be carefully assessed and managed in implant therapy so as to minimize complications.

### *Occlusal splint in bruxism*

An occlusal splint is a removable dental appliance designed to minimize the damaging effect of bruxism and other parafunctional habits. It can be used for multiple purposes in periodontal and implant therapy (*Table 1*).

**Table 1.** Indications for the use of an occlusal splint in periodontal and implant therapy

Patient with temporomandibular joint and/or muscle disorders and pain
Severe bruxism
Diagnostic tool
Treatment of trauma from occlusion
Tooth stabilization
Promote periodontal wound healing
Prevent heavy occlusal load on dental implant-supported prostheses
Retainer following orthodontic treatment
Temporary tooth disclusion for orthodontic or other purposes

It can be used as a diagnostic tool to analyze potential neutral zone impingements, parafunctional habits, and anterior guidance requirements, as well as obtain information on the vertical dimension. If the diagnosis of bruxism is reached, these patients may use the occlusal splint to manage any associated temporomandibular joint disorders or muscular pain. The splint allows the condyle and disc to be in the centric relation position, thus promoting muscle relaxation by providing a platform for the teeth to have equal distribution of tooth contacts (Wood *et al.*, 1984). Also, the anterior guidance will disclude the posterior teeth during physiological jaw movements and reduce stresses on the joint (Ramfjord *et al.*, 1994).

The occlusal splint is found to be very effective in reducing headaches in patients experiencing temporomandibular disorders (Wenneberg *et al.*, 1988; Quayle *et al.*, 1990). It also alleviates muscular pain at rest by reducing the masseter muscular activity (Kawazoe *et al.*, 1980). In addition, the occlusal splint help to protect teeth from further occlusal wear caused by bruxing (Macedo *et al.*, 2007). It is, however, important to note that the occlusal splint does not stop the act of bruxing or decrease its intensity, but is able to reduce the frequency of bruxing (Holmgren *et al.*, 1993; Karakis *et al.*, 2014; Restrepo *et al.*, 2011; Macedo *et al.*, 2007).

### Occlusal splint design

The occlusal splint can be fabricated with a hard or soft resin material. However, for patients with bruxism, a hard acrylic splint is preferred. This is because the muscle activity is significantly increased when a soft splint is used instead of a hard one (Okeson, 1987). A full coverage occlusal splint is also favored in bruxers because it can help to relieve symptoms related to myofascial pain-dysfunction syndrome in 87% of patients, stabilize the mandible, and protect the teeth during bruxing (Greene *et al.*, 1972). Prior to the splint fabrication, the type of bruxism has to be identified. A full coverage maxillary occlusal splint with complete tooth contacts is better suited if the patient clenches isometrically, whereas a mandibular occlusal splint with canine guidance may be beneficial in a patient with lateral and protrusive parafunctional movement.

### Occlusal scheme

Elimination of posterior tooth contact by appropriate anterior guidance was shown to effectively reduce the elevating activity of the temporal and masseter muscles, thus resulting in relaxation of the muscle (Williamson *et al.*, 1983). A steep canine guidance built into the occlusal splint provides the advantage of reducing muscle activity significantly, but there is a disadvantage whereby the freedom in lateral excursive movement is limited.

### Vertical height

An occlusal splint is in general 1-2 mm thick in the molar region (Ramfjord and Ash, 1994). This increase in vertical dimension may exceed the physiologic rest position, which fortunately does not lead to greater muscular tonus or hyperactivity of jaw muscles. Moreover, elongation of the elevator muscle to or near the vertical dimension showed the least masseter electromyographic activity after splint therapy, thereby demonstrating that the splint is effective in producing neuromuscular relaxation (Manns *et al.*, 1983). Adjustment of the splint to centric relation every 2-3 weeks for several months is extremely important because usage of the appliance will change the position of the centric relation. Therefore, it is necessary to emphasize a regular follow-up and maintenance after occlusal splint delivery (Ramfjord and Ash, 1994).

### Effect of occlusal splint in periodontal therapy

The use of an occlusal splint as an adjunctive aid in the management of periodontal disease is beneficial in several clinical scenarios (Table 2). It is useful in the control of tooth mobility both for patient's comfort and improved regenerative outcomes (Cortellini *et al.*, 1995). It helps to improve the prognosis of teeth. A Cox proportional hazards regression model suggested that patients with increasing tooth mobility or parafunctional habits and no occlusal splint are twice as likely to lose their teeth (McGuire *et al.*, 1996). A 10 - 18-year follow up of the same group of patients revealed that those with bruxism who did not use a splint had worse prognosis than those who did wear a splint (Nunn *et al.*, 2012). Patients with a reduced periodontium had greater maximum bite force with the use of the posterior extended occlusal splint (Kleinfelder *et al.*, 2002).

**Table 2.** Effects of occlusal splint on periodontal therapy

Decrease risk of tooth loss
Improve periodontal prognosis
Increase maximum bite force in reduced periodontium
Stabilize tooth in function

### Effect of occlusal splint on dental implant therapy

Without the periodontal ligament, the patient has a reduced ability to detect occlusal discrepancies (El-Sheikh *et al.*, 2004). As such, the mean occlusal force required to stimulate the threshold perception was approximately nine times greater for the implant crown compared to a tooth (Hammerle *et al.*, 1995). Because of this discrepancy in biomechanical and neurosensory input between implants and teeth, metal ceramic prostheses (single crown or fixed partial dentures) had approximately seven times higher odds of porcelain fracture and 13 times greater odds of a fracture

**Table 3.** The effect of occlusal splint on dental implant therapy

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To protect the implant restoration from complications or failure, e.g., screw loosening or fracture, abutment fracture, veneering material fracture, implant fracture
To decrease occlusal stress to minimize peri-implant crestal bone loss
To harmonize occlusal force distribution among teeth

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requiring either repair or replacement when in occlusion with another implant-supported restoration, as compared to opposing a natural tooth (Kinsel *et al.*, 2009). In addition, it was found that patients who exhibited bruxism had approximately seven times higher odds, and those not wearing an occlusal device had approximately two times higher odds of porcelain fracture when compared to patients without bruxism and patients who were wearing an occlusal device (Kinsel *et al.*, 2009). Therefore, fractures were significantly associated with opposing implant-supported metal ceramic restorations, bruxism, and not wearing a protective occlusal device (Kinsel *et al.*, 2009).

Finite element analysis showed that occlusal overload caused stress at the implant neck area (Gore *et al.*, 2014), and an occlusal splint could decrease the stress and prevent peri-implant crestal bone loss (Dos Santos Marsico *et al.*, 2017). Several case reports also showed that splints provided good force distribution as well as implant and prosthesis protection (Goiato *et al.*, 2014; Zeighami *et al.*, 2015). However, the availability of high quality evidence to support a routine recommendation of occlusal splints in bruxers who had dental implant rehabilitation is severely lacking (Perel *et al.*, 1994; Mesko *et al.*, 2014; Table 3). Therefore, the use of an occlusal splint, although not necessary, may be helpful in protecting the dentition after delivery of an implant-supported fixed restoration.

## Conclusion

Although high quality evidence is lacking, the occlusal splint appears to be a useful device to treat patients with temporomandibular disorder or parafunctional habit-related symptoms because it is considered non-invasive and reversible. Therefore, one should consider recommending occlusal splints as part of the comprehensive dental care in patients who have bruxism.

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