

The Effect of Fixed Orthodontic Appliances Versus Clear Aligner on Periodontal Health: A Review of the Literature

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Abstract: Over the past few decades, orthodontic treatment in adults has become more common. Clear aligner treatment (CAT) has been cited as a safe, aesthetic and comfortable orthodontic procedure for adult patients. The aim of this review is to evaluate the impact of fixed orthodontic appliances (FOA) and clear aligner on periodontal health during orthodontic treatment. Periodontal health, as well as quantity and quality of plaque, were better during CAT than during FOA treatment. FOA promote the accumulation of bacterial plaque as the appliance complicates oral hygiene. The keys to maintenance of a healthy periodontium during orthodontic treatment are oral hygiene instructions reinforcement and a stringent recall system.

Keywords: Clear aligners, Fixed orthodontic Appliance, Removable Appliance, Periodontal health

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I. Introduction

Orthodontic treatment aims at providing an acceptable functional and aesthetic occlusion with appropriate tooth movements. These movements are strongly related to interactions of teeth with their supportive periodontal tissues [1]. In the majority of patients, particularly during childhood and adolescence, fixed orthodontic appliance (FOA) is the treatment of choice. Because of esthetics reasons, this treatment is not very popular for adult orthodontics. Therefore, other orthodontic techniques have been developed to increase esthetics and simplify oral hygiene procedures [2]. Orthodontic therapy may favor an unpredicted accumulation of bacterial plaque on the dental surfaces in particular when fixed appliances are employed during the treatment [3]. The use of removable appliances can minimize the orthodontics-related negative effects on periodontal health allowing patients easier oral hygiene procedures [4]. The aim of this review is to evaluate the impact of FOA and clear aligner on periodontal health during orthodontic treatment.

II. Fixed Orthodontic Appliance

Fixed appliances have become an integral part of comprehensive orthodontic treatment as versatile tools that enable three-dimensional control of tooth movement. Orthodontic treatment of malocclusions and craniofacial abnormalities may improve mastication, phonation, facial aesthetics, with beneficial effects on the general and oral health, individual's comfort and self-esteem. However, orthodontic treatment is associated with a number of adverse effects, such as root resorption, pain, pulpal changes, periodontal disease, and temporomandibular dysfunction [5]. Fixed appliances and rough-surfaced adhesives in the oral cavity act as a plaque trap and gingival irritants [6]. Although new appliances as well as new bonding techniques and material have been developed, it has not yet been possible to decrease dental plaque retention [7].

III. Removable Clear Aligner

The possibility of using clear overlay orthodontic appliances was introduced in 1946, when Kesling devised the concept of using a series of thermoplastic tooth positioners to progressively move misaligned teeth to improved positions [2]. In 1997, Align Technology (Santa Clara, Calif) adapted and incorporated modern technologies to introduce the clear aligner treatment (CAT) rendering Kesling's concept a feasible orthodontic treatment option [8]. Its main components are clear plastic splints that cover all of the teeth and the marginal aspects of the gingiva and gradually move the teeth into an ideal position. A recent systematic review stated that CAT aligns and levels the arches; it is effective in controlling anterior intrusion but not anterior extrusion; it is effective in controlling posterior buccolingual inclination but not anterior buccolingual inclination; it is effective in controlling upper molar bodily movements of about 1.5 mm; and it is not effective in controlling rotation of rounded teeth in particular [1]. CAT seems to be a safe procedure for periodontal tissues with respect to fixed appliance treatment techniques, with particular reference to the amount of possible plaque retention. This seems

to be due to the removable nature of CAT, facilitating oral hygiene procedures, and to the reduced amount of plaque retentive surfaces [4].

IV. Impact of Fixed Orthodontic Appliances Vs. Clear Aligners on Periodontal Health

The entire periodontium, including osseous and soft tissue components, remodels with orthodontic tooth movement [9]. However, the presence of periodontal inflammation may inhibit remodeling and compromise the outcome of treatment through the loss of periodontal connective tissue attachment [10]. The periodontal reaction toward orthodontic appliances depends on several factors, such as host resistance, presence of systemic conditions and quality and quantity of dental plaque. Oral hygiene procedures have a great impact on the periodontal health during orthodontic treatment [5]. Several studies have shown that FOA promote the accumulation of bacterial plaque [11-13]. It limits the patient ability to perform good oral hygiene, which can lead to development of gingival disease [14-16]. It was suggested that up to 10% of past orthodontic patients have greater periodontal connective tissue attachment loss than the general population [17]. On contrary, a long-term clinical study has shown that orthodontic treatment had no discernible effect on periodontal health [18]. It has been previously observed that FOA often cause a significant modification of oral microbiota [19]. Lo Bue *et al.* [20] suggested a pathogenetic role for anaerobic bacteria as responsible of gingivitis during orthodontic therapies. Accordingly, a clinical study showed that FOA promoted the growth of biofilm and colonization by periodontopathic bacteria species such as *P. gingivalis*, *P. intermedia*, *Tannerella forsythensis* and *Fusobacterium* species, which induced severe gingival inflammation and high bleeding scores. However, patients treated with the CAT may maintain a lower level of microbial biofilm mass, even with poor oral hygiene compliance. [21]. Miethke *et al.* [22] showed that periodontal risk was significantly lower in patients treated with CAT, although both teeth and gingiva were covered nearly the entire day with aligners. This could be attributed to the fact that aligners are removable and thus allow unimpeded oral hygiene. A systematic review by Rossini *et al.* [4] concluded that the use of clear aligners treatment may reduce the detrimental effects of orthodontic treatments on periodontal health. Moreover, it was observed that the time needed for brushing teeth was clearly shorter in removable aligner patients than in FOA patients. This difference is certainly due to removal of removable aligners that facilitates an easier and faster tooth cleaning [23]. Accordingly, A clinical study done by Karkhanekia *et al.* [24] to showed that CAT was associated with improved periodontal status as evidenced by decreased plaque levels, gingival inflammation, bleeding upon probing, probing pocket depths, and benzoyl-DL-arginine-naphthylamide test. These results suggest that removable aligners be considered when treatment planning for the adult orthodontic patient at risk for periodontitis [24].

Conflicting results comparing the periodontal status of subjects treated with FOA and CAT have also been reported. A systematic review by Bollen *et al.* [25] stated the absence of reliable evidence about the effects of orthodontic treatment on periodontal health. Furthermore, it was reported that orthodontic treatment itself does not increase the incidence of periodontal disease [26]. A clinical study was done to evaluate the effect of FOA and CAT in patient with periodontal disease. They found that periodontal indices were improved in both groups with meticulous oral hygiene education and repeated plaque control [27]. In addition, Dubey *et al.* [28] compared subgingival plaque levels in patients using fixed or removable appliances and reported that although plaque levels in both treatment groups were higher than that of controls, no statistically significant differences in the levels of subgingival plaque were found between the treatment groups.

4.1 Periodontal Care During Orthodontic Treatment

The most important orthodontic related risk factors for periodontal disease are the increase of plaque retention and the worsening of plaque quality [11,29]. Oral hygiene during orthodontic treatment is the key to maintenance of a healthy periodontium [17]. Therefore, oral hygiene instructions should be given before the initiation of orthodontic treatment and reinforced during every visit [5]. Proper hygiene control leads to little increase in plaque accumulation in orthodontic patients, minimizing the possibility of tooth decalcification and development of inflammatory periodontal disease [6]. Motivation of orthodontic patients may include different educational techniques: oral hygiene instructions, showing images of possible complications, the use of plaque-disclosing tablets, demonstrations of brushing techniques on models, and even showing patients phase contrast microscopy of their plaque samples [30, 31]. According to the recent update of a Cochrane review [32], it was suggested that powered toothbrushes might provide a significant benefit when compared with manual toothbrushes. Several studies in orthodontic patients also supported these findings and demonstrated higher effectiveness of oscillating-rotating toothbrushes in dental plaque removal and gingivitis reduction when compared to manual brushes [33, 34]. Deterioration of the periodontal status during orthodontic treatment can be avoided only when the patient is incorporated in a stringent recall system [23]. Professional monitoring may motivate patients to maintain better self-performed plaque control and proper oral health [35]. Periodontal status in orthodontically treated patients might be assessed not only during therapy and after debonding, but likely also during follow-ups in retention period [36].

V. Conclusion

Periodontal health, as well as quantity and quality of plaque, were better during CAT than during FOA treatment. FOA promote the accumulation of bacterial plaque as the appliances complicate oral hygiene. The keys to maintenance of a healthy periodontium during orthodontic treatment are oral hygiene instructions reinforcement and a stringent recall system.

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