



Fixed orthodontic therapy and plaque formation: a systematic review

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Abstract

Many authors associated fixed orthodontic treatment with an increase in plaque formation and periodontal disease. Aim of this review is to investigate the correlation between fixed orthodontic treatment, change in subgingival microflora and periodontal pathologies such as gingivitis and periodontitis and also if there is a difference in subgingival microflora between self-ligating brackets and conventional brackets. During fixed orthodontic treatment, increased plaque formation is common but transient and reversible with appliance removal. There is no difference in microflora formation between different types of brackets and ligating systems.

Introduction

Fixed orthodontic treatment is a common method for correcting malocclusions. Plaque accumulation and gingival inflammation, including bleeding, swelling and hyperplasia, are common during orthodontic treatment¹.

On this basis, a fixed appliance may increase the risk of gingivitis, or even periodontitis during treatment. Gingivitis and periodontitis are due to a microbial infection, resulting in an imbalance between the host and the microorganism and a change in the subgingival microflora.²

During past years, the orthodontic patient was considered as a low-risk patient and orthodontic procedures were considered noninvasive³⁻⁷. However, these appliances may be associated to difficulty in cleaning. During treatment, retentive areas with biofilm accumulation and bacterial growth are formed⁵. One important issue in orthodontics is to maintain proper oral hygiene during treatment³. Brackets, bands and other accessories further aggravate these conditions by retaining dental plaque, which can lead to gingivitis and enamel demineralization, causing white spots and caries.⁸

Many authors reported changes in dental plaque composition during orthodontic therapy with fixed appliances¹⁻⁹, others stated that change in oral microflora and gingivitis are due to bad oral hygiene habits and not to orthodontic therapy¹⁰⁻¹¹.

Microorganisms most frequently isolated from subgingival microflora are bacteria such as *Streptococcus mutans*, *Lactobacillus* spp, *Actinobacillus actinomycetemcomitans*, *Porphyromonas gingivalis*, *Fusobacterium nucleatum*, *Prevotella nigrescens*, *Campylobacter rectus* and fungi like *Candida*.¹³⁻¹⁶

On this basis, the objective of this study was to perform a systematic review of the literature to investigate the correlation between fixed orthodontic treatment, change in subgingival microflora and periodontal pathologies such as gingivitis and periodontitis and also if there is a difference in subgingival microflora between self-ligating brackets and conventional brackets.

Methods

A systematic review of literature has been conducted on the most important medical databases: PubMed (Medline), Scopus. The following keywords were used: *Orthodontic Appliances and Subgingival Plaque*, *Orthodontic Appliances and Gingivitis*, *Orthodontic Appliances and change in microflora*. After this search, 33 articles were selected.

Review

Change in subgingival microflora during and after fixed orthodontic treatment

Several studies stated that the microbial changes in subgingival plaques during orthodontic treatment might be transient¹³. Some periodontopathogens that increased immediately after appliance placement returned to normal levels several months later.^{1,9,10,17-24}

These studies investigate principally the levels in subgingival plaques of following bacteria: *Aggregatibacter actinomycetemcomitans* (Aa), *Porphyromonas gingivalis* (Pg), *Prevotella intermedia* (Pi) and *Tannerella forsythia* (Tf).

Following orthodontic appliance placement, the frequencies of Pg and Aa showed no significant change whereas the frequency of Tf significantly increased ($P < 0.01$) during short-term observation (0-3 months). The frequency of Pi

showed a tooth-specific difference, as it presented no significant difference at the site of the first molar but was significantly increased ($P = 0.01$) at the incisor. During long-term observation (6 months), two studies reported that the levels of subgingival periodontopathogens exhibited a transient increase but decreased to the pretreatment levels afterwards. After removal of the orthodontic appliance, the four periodontopathogens showed no significant difference compared with before removal.

There are many factors affecting the level and the content of microorganisms in subgingival plaques during orthodontic treatment, such as plaque accumulation, metal corrosion, host immunity, hormonal levels, the microbial baseline of participants and tooth movement.²⁵⁻²⁹

A study performed in Sapienza University in patients motivated to oral hygiene showed that patients with fixed appliances, despite good oral hygiene, had increased levels of bacteria after 6-7 months of orthodontic therapy.¹⁵

Regarding fungine levels, Khanpayeh et al showed that patients with fixed appliances had more susceptibility to colonization with non-albicans *Candida* species, less susceptible to common antifungal drugs than *C. albicans* and responsible of serious infections in ill or immunodepressed patients.¹⁴

Impact of different brackets and ligatures on plaque formation

Analyzing if different brackets have different risk of plaque formation, there is disagreement between authors.

Brusca et al stated that metallic brackets decreased yeast adherence and composite brackets facilitated it⁴; however, Saloom et al found that appliances with high esthetic appearance, sapphire brackets and coated arch wire had less adherence of *S. mutans* and *Candida albicans* in comparison to other appliances with less esthetic and more metal components.³

Brackets are associated with the use of either elastomeric or stainless steel ligature to keep the orthodontic wire inside the slot. In Orthodontics, the term self-ligating (SL) refers to orthodontic brackets that have their own mechanism for opening and closing the slot, and do not require any metal or elastomeric ligature as a method for wire ligation. Conventionally, to attach the wire to the brackets, three methods are used: metal ligature, elastomeric ligatures, and the open-close devices of SL brackets. With regard to the accumulation of biofilm, the literature suggests that elastomeric ligatures favor the retention of biofilm in comparison with the other

two methods of ligatures.³⁰⁻³¹

Pellegrini et al showed that self-ligating brackets had lower concentrations of oral total bacteria and oral streptococci, comparing with elastomeric ligating brackets.³¹

However, some other studies suggested that self-ligating brackets are associated with a greater number of bacterial colonies than conventional esthetic brackets and that the difference in plaque formation isn't associated to ligature system but to bracket material and surface.³²

Even though self-ligating brackets eliminate the ligatures, they incorporate intrinsic opening and closing mechanisms that can provide additional opportunities for local plaque retention, where calcification of the plaque can lead to obstacles in the functioning of the opening and closing mechanism.

On the other hand, some studies stated that there is no difference in plaque formation between self-ligating brackets and elastomeric ligature brackets.³³

Conclusions

During fixed orthodontic treatment, increased plaque formation with risk of periodontal diseases is common but transient and reversible with appliance removal. At this time, there are no documented difference in plaque formation between metallic brackets and esthetic brackets and between self-ligating brackets and elastomeric ligature brackets.

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