

Gingival Enlargement and Inflammatory Processes in Periodontal Tissues Among Orthodontic patients

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Abstract

Background: Orthodontic appliances induce both quantitative and qualitative changes in oral microbiome, which, combined with the weakening of periodontal tissue integrity and functional overload on teeth caused by applied forces, contribute to the development of inflammation in periodontal tissues.

Aim: The purpose of this review was to assess the impact of orthodontic appliances on periodontal tissues and oral microflora. Specifically, we explored the role of orthodontic treatment in triggering inflammatory processes, gingival enlargement, and compromised oral hygiene. Moreover, we emphasized the significance of preventive and prophylactic measures to mitigate these effects and preserve oral health during orthodontic treatment.

Methods: We used the Google Scholar, PubMed, and Science Direct databases to gather articles for our review. Articles addressing the significance of preventive measures in orthodontic patients were also included. In total, 80 articles were reviewed, with 33 of them selected for in-depth analysis.

Results: The review revealed both removable and fixed orthodontic appliances significantly influence the oral environment and significantly alter oral status. These changes impact the qualitative and quantitative variables of the oral microbiome and may result into the onset of inflammatory processes. Due to the deteriorated oral hygiene contributed by the presence of these appliances inflammatory processes were initiated in the periodontal tissues, manifesting as teeth-gingival junction disorders, bleeding, and gingival overgrowth.

Conclusions: Our findings highlight that it is essential to assess the status of the oral cavity and the health of the periodontal tissues before initiating orthodontic treatment. The quality of oral hygiene must be of utter importance. An individualized protocol should be established, with prophylactic and preventive measures implemented throughout the treatment process. This approach helps maintain a healthy oral microflora and prevents both qualitative and quantitative changes that can lead to inflammatory processes of the periodontal tissues and gingival overgrowth. (TCM-GMJ June 2025; 10 (1): P36-P39)

Keywords: Orthodontic treatment, gingival overgrowth, inflammation of periodontal tissues

Introduction

Removable and non-removable orthodontic appliances are actively used for treatment of various oro-facial anomalies (1).

Orthodontic appliances play a crucial role in correcting dental anomalies, which in turn enhance phonetics, face aesthetics, have a beneficial effect on oral health, personal comfort, self-esteem and quality of life (2). Treatment with orthodontic appliances is not

limited to by age (3), however, criterias such as Dental status, Periodontal status, General health, Orthodontic technique, thickness of the cortical bone and the density of the trabecular bone need to be considered (3). Despite this, complications in orthodontic patients may arise at any age (4). Anomalies related to tooth positions can worsen oral hygiene, potentially leading to both local and generalized gingivitis and periodontitis (5). While orthodontic treatment aims to correct the occlusal anomalies, the oral cavity health status is expected to improve, however, studies have shown that during treatment pathological processes may still be initiated or provoked during the treatment (6). This is not solely due to changes in the qualitative and quantitative variables of the bacterial flora, but also because the proliferation of pathogenic bacteria disrupts the tooth-gum

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connection. This disruption may eventually cause several complications and pathologies, including dental decay, reduction of the alveolar ridge height, and inflammatory processes (7).

In response to the qualitative and quantitative changes of microorganisms, proteolytic enzymes destroy the collagen fibers of periodontal tissues, leading to the destruction of the dento-gingival junction or, in some cases, the proliferation of periodontal tissues (8).

In areas of inflammation, leukocytes, platelets, monocytes – along with the macrophages derived from them – secrete prostaglandins, which activate osteoclasts and subsequently develop destructive processes in periodontal tissues (9).

As early as 1 or 2 months after the start of orthodontic treatment, inflammatory processes can be observed, often accompanied by gingival overgrowth in periodontal tissues (6). Orthodontic appliances are fixed on the vestibular surface of the tooth using composites and cements. This, together with the metal constructions, increases the intense accumulation of bacterial plaque on the teeth (10).

Dental plaque is directly related to the development of the dental caries and periodontal. Plaque formation is a highly organized and orderly process of accumulation of microorganisms on tooth surface. Dental plaque comprises a variety of bacterial species, with *Streptococcus* demonstrating the highest ability to adhere to tooth surfaces and mucous membranes (12).

As Orthodontic appliances influence the homeostasis of the oral cavity by altering the oral biome by enabling the proliferation of the bacteria, the body's biological response often manifests as the development of inflammatory processes of the periodontal tissues (13). The major causes of inflammatory processes in periodontal tissues are supra- and subgingival dental plaque and calculus (14). When the dental plaque matures enough to be associated with the periodontal disease, the number of gram-negative bacteria are increased (9).

Inflammatory gram-negative anaerobes secrete bacterial products that enhance the migration of leukocytes into the gingival cavity, thereby weakening the connection between the gingival epithelium to the tooth (15). Protein enzymes produced through the interaction of microorganisms cause decomposition of periodontal collagen fibers, leading to their destruction and the formation of periodontal pockets (8).

Methods

We used the Google Scholar, PubMed, and Science Direct databases to gather articles for our review with the key words: Orthodontic treatment, gingival overgrowth, inflammation of periodontal tissues. The review focused on studies that reported the qualitative and quantitative changes due to the impact of orthodontic appliances in oral microbiome, inflammatory processes in periodontal tissues, and gingival overgrowth. Articles addressing the significance of preventive measures in orthodontic patients were also included. In total, 80 articles were reviewed, with 33 of them selected for in-depth analysis.

Results and discussion

Literature review confirmed that the status of the oral cavity changes during orthodontic treatment, leading to different types of complication, such as deterioration of oral hygiene and plaque accumulation, the inflammatory processes of the periodontal tissues, as well as gingival overgrowth. Along with the quantitative changes in oral microflora, there are also qualitative changes, particularly an increase in aggressive forms of both gram-positive and gram-negative bacteria, such as *S. Mutans*, *Lactobacillus spp.* (gram-positive) and *P. gingivalis*, *T.forsythia*, and *T. denticola* (gram-negative) (18).

The initiation of the changes in the orthodontic patients during treatment begins one week after the start of treatment (18).

The Study by Sang-Ho Kim et. al. (2012) demonstrated the negative impact of fixed orthodontic appliances on the status of the oral cavity. The increase in bacterial flora and the deterioration of oral hygiene were associated with the fixed metal components of bracket systems. A rate of 25,8% was detected 3 months after the start of orthodontic treatment, increasing to 36,7% at 6 months. Inflammatory processes were particularly observed in periodontal tissues of the molar areas (18) (Table 1).

The changes in microflora caused by the orthodontic appliances are accompanied by the damage to soft tissues. An increase in *Candida spp* and *S. aureus* in the oral cavity contributes to the initiation of periodontal pocket formation. These microorganisms are abundant in the gingival pockets of orthodontic patients (19) (Table 1).

In orthodontic patients, during the course of treatment, it is possible for a so-called gingival pocket to form during gingival development, or in some cases, a false pocket due to gingival enlargement. These pockets differ from the periodontal pockets, as at this stage the dento-gingival junction is not disturbed, and apical proliferation of connective epithelium is not exposed (20). There is a direct relationship between the accumulation of bacterial plaque around the bracket and gingival overgrowth. It has also demonstrated that, unlike in the case of periodontal pockets, there are no changes in gingival pocket depths associated with gingival overgrowth (21).

Gingival overgrowth in orthodontic patients is primarily related to the duration of treatment and the accumulation of bacterial plaque (20). However, another contributing factor can be age, as hormonal changes and sexual maturation during puberty increase the risk of gingival overgrowth (22).

It is also worth noting the negative impact of nickel in the bracket system on the gingiva. Nickel ions negatively affect gingival epithelial cells and cause their proliferation (23).

Gingival overgrowth presents in different forms: mild gingival enlargement involves the interdental papilla, medium form affects both interdental papilla and marginal gingiva, and severe form involves the enlargement of interdental papilla, marginal and attached gingiva. Depending on the extent, localized gingival enlargement may affect one or several teeth, while generalized gingival

overgrowth involves the entire oral cavity (24).

Because both quantitative and qualitative changes occur in microbial flora due to the impact of

appliances in orthodontic patients, the proliferation of periodontal epithelial cells occurs in response to these changes (21). Study by Shirozaki et. al. (2020) reported inflammatory processes in periodontal tissues, with 70,58% detected in 6 months after the start of orthodontic treatment. This rate increased to 83,23% in 12 months. The study revealed that inflammatory processes were not only manifested by bleeding and gingival enlargement but also by the destruction of the dento-gingival junction, which increased the risk of tooth movement and loss (6) (Table 1). The risk of inflammatory processes of periodontal tissues increased with increasing age (25) (Table 1).

Similarly, the study by Shuang Pan et. al. (2017) showed that 83,61% of patients developed complications in the periodontal tissues 3 months after the start of the orthodontic treatment, which was related to the deterioration of oral hygiene. However, this rate decreased to 42,62% after 6 months. Strict control of oral hygiene and implementation of preventive measures led to a decrease of in these complications (26) (Table 1). In case of gingiva overgrowth, another study has confirmed a close relationship between plaque removal and the rapid suppression of inflammatory processes (27).

During treatment, orthodontic devices exert uneven force on the teeth and periodontal tissues. This force, acting on unstable periodontal tissues, pathologically alters periodontal pockets. Studies confirm the presence of

a traumatic factor, however, pathological processes are further exacerbated by unsatisfactory hygienic conditions. In addition to deepened periodontal pockets, foci of bone resorption appear (28), and the uneven force acting on the teeth leads to tooth root resorption (29).

Conclusion

The microflora of the oral cavity changes under the influence of orthodontic appliances, which, in many cases, is preceded by unsatisfactory oral hygiene. Poor oral hygiene is directly linked to inflammatory processes of periodontal tissues, with negative changes often manifested as gum overgrowth (29).

In orthodontic patients, especially during puberty, the risk of gum overgrowth is high under deteriorated oral hygiene conditions, which is directly related to sex hormones (30). Research confirms that age significantly impacts the status of the oral cavity. The risk of complications is notably higher in patients under 15 years of age compared to those over 16 (31). Through various studies, it can be concluded that in orthodontic patients, several factors negatively influence the health of the oral cavity. These factors include socio-economic status, genetic predisposition, chronic diseases, hygiene habits, bad habits, malnutrition, treatment duration, and age (32). During treatment, it is crucial to accurately assess the oral cavity's condition, taking all these factors into account. Moreover, considering age, the risks of complications in the periodontal tissues must be evaluated, and an individualized treatment protocol should be selected to prevent potential complications (33).

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Table1- Summary of periodontal changes during orthodontic treatment.

Age group (in years)	Male	Female	Months	Periodontal changes (%)	Article
45,5	37	45	12	68,30%	Cuesta AI, et al 2010
15,5	22	39	3/6	83,61%;/42,62%	Pan S, Liu Y, et al 2017
10-30	19	38	12	61,40%	Liu Y, Zhang Y, et al 2013
14-35	18	20	6/12	70,58%;/83,23%	Shirozaki MU, et al 2020
16,7	13	17	3/6	25,8%;/36,7%	Kim SH, Choi DS, et al 2012

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