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Orthodontic treatment and periodontal disease – between advantages and disadvantages

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Abstract: *Orthodontic treatment and periodontal disease can have an inter-conditional relationship, particularly when the accumulation of bacterial plaque, favoured by orthodontic appliances and poor oral hygiene can cause periodontal inflammation. The objective of the study is to highlight the influence of the risk factors' polymorphism on the therapeutic response in periodontal disease. 64 patients with mixed or definitive dentition and poor oral hygiene were included in the study, of whom 22 patients followed treatment with fixed orthodontic dispensers, 22 patients were treated with mobile orthodontic braces and 20 were non-attendants. From all patients gingival crevicular fluid was collected and assessed, before and after applying a chlorhexidine-based gel antiseptic agent.*

Keywords: *periodontal disease, orthodontic treatment, chlorhexidine gel, gingival fluid*

INTRODUCTION

Periodontal disease inflicts a wide range of oral changes, ranging from gingival tissue inflammation to tooth loss. During some orthodontic treatment protocols patients may not to compliant to keeping a good oral hygiene, possibly due to the difficulties that certain orthodontic appliances may impose on efficient teeth brushing [1]. Microbiological patterns involved in the genesis of periodontal disease are more common in orthodontic treatment patients, so the bacterial plaque is left undisturbed for a long period of time around the orthodontic appliances and can grow in bacteria number and pathogenic potential. Microbial periodontal pathogens, especially Gram-negative bacteria, are more frequently found around fixed/mobile orthodontic appliances [2]. Periodontal disease may have different clinical forms, with a wide range of manifestations, from gum tissue damage to periodontitis, which can even lead to tooth loss in some cases [3].

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The clinical manifestations and evolution of periodontal disease may vary in accordance with the intensity of the bacterial challenge. In orthodontic treatment patients, the periodontal tissues are also challenged by the orthodontic forces which generate teeth movement. During teeth movement, all periodontal structures, including the gingival, the periodontal ligament and the alveolar bone are under constant mechanical stress [4]. This mechanical stress can cause a decrease of the tissue's defensive capabilities. Combined with the increased bacterial challenge, caused by poor oral hygiene, this creates very favourable conditions for the onset of periodontal disease [5]. Consequently, a good understanding of the periodontal disease's existing aetiology and risk factors is required for a correct diagnosis and

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treatment plan for a patient undergoing orthodontic therapy.

The objective of this study was to highlight the influence that certain risk factors have on the therapeutic response in periodontal disease in orthodontic patients and to assess the local impact that the use of an anti-plaque agent has in these patients.

MATERIAL AND METHOD

The study included a group of patients who were clinically examined and expressed similar symptoms during the first visit to the dental office. In order to collect the data obtained from the anamnesis, observation charts were prepared for each patient. The inclusion criteria used for the study were the following: (1) patients who were treated or not with orthodontic braces/mobile dispensers; (2) age 12-20 years; (3) the presence of mixed or definitive dentition; (4) the presence of gingivitis subjective and objective clinical signs (gingival bleeding, gingival oedema, halitosis). Following the clinical examination, a bacterial plaque index was calculated for the participating patients, its values being directly proportionate with the degree of gingival inflammation.

A total of 64 patients with mixed or definitive dentition and poor oral hygiene were selected, being divided into 3 study groups: (1) 22 patients carrying a mobile orthodontic device; (2) 22 patients with fixed orthodontic appliances and (3) 20 patients who did not require or have refused orthodontic treatment.

Before initial periodontal therapy (airflow cleaning and professional brushing) gingival crevicular fluid was sampled from the gingival sulcus of the participating patients. For sampling sterile paper, cones of 20 mm were kept for 30 seconds in the periodontal pocket/gingival sulcus, after the pre-removal of the supragingival bacterial plaque, in order to avoid contamination of the sample with supragingival bacteria. The collection and transport of the biological products and the stages of microbiological diagnosis were performed by the clinician and their assistant.

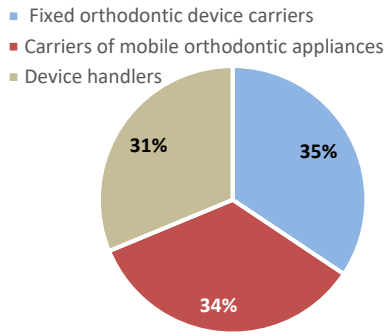
The results of microbiological investigations depend to a large extent on the quality of the sampling procedure, which needs to follow specific rules:
(a) the patient was informed about the aimed analysis and about the correct way of sampling procedure;
(b) the sampling instruments were sterile, disposable and adapted to the investigation;
(c) the pathological product was harvested prior to administration of any topical or general topical treatment; it is harvested from areas where it is most likely to find the bacterium that produced the infection;
(d) the outside of the container was disinfected if it has been contaminated during sampling procedure;
(e) the name of the patient and his provenance, the type of biological product, the date and time of collection was written on the container;
(f) each pathological product was accompanied by a bulletin containing information about the sample and the patient;
(g) transport was as quick as possible to the laboratory to prevent the degradation of the pathological product;
(h) transport media used ensured good survival of bacteria;
(i) for the oral cavity, the sampling procedure consisted in carefully cleaning the edge of the gum and tooth surface to remove saliva and food debris, afterwards a periodontal scalpel was used and the lesion secretion was removed;
(j) transport was carried out using an anaerobic transport system in less than 2 hours from sampling.

Microbiological tests were performed to detect aerobic and anaerobic gram-positive and gram-negative bacteria. After the initial periodontal treatment, the patients were randomly re-divided into two groups, as follows: (1) 12 patients with orthodontic devices (six fixed devices, six mobile devices) and (2) 12 appliance donors, who received applications of a chlorhexidine-based gel (Elugel 0.02%, Pierre-Fabre, France). The other 24 patients were only instructed for good oral hygiene and monitored. The ethical standards of medical research and GDPR (Global Data Protection) and the approval of the Ethics Committee of the Faculty of Dentistry of the "Titu Maiorescu" University in Bucharest were followed by the present study.

RESULTS

The distribution of the participating patients regarding orthodontic treatment type was similar between the patients with mobile and fixed orthodontic appliances (Figure 1).

Figure 1: Selection criteria: fixed/mobile orthodontic handlers/ carriers



The microbiological assessment revealed bacteria of the violet periodontal complex: (Veillonella parvula,

Actinomyces odontolyticus), yellow complex (Streptococcus spp), green complex (Eikenella corrodens, Capnocytophaga spp.) red complex (Porphyromonas gingivalis, Tannerella forsythia, Treponema denticola) and of the orange complex (Prevotella intermedia/nigrescens, Micromonas micros, Campylobacter rectus, Fusobacterium nucleatum) (Figure 2). Compared to the microbial flora normally found in gingival tissue of healthy individuals with no periodontal problems, microbiological tests revealed the exaggerated growth of germs in the case of fixed carriers and a significant increase in the case of mobile carriers, as shown in Table 1.

Streptococcus spp, P. gingivalis, and F. nucleatum predominantly occured in fixed-bearer carriers, while Treponemma is constantly present whether or not the patient is treated with fixed or mobile devices. The Actinomyces spp were present within the saprophytic flora and does not develop during orthodontic treatment.

Figure 2: Bacteria type frequency in periodontal heath vs. gingival inflammation (%)

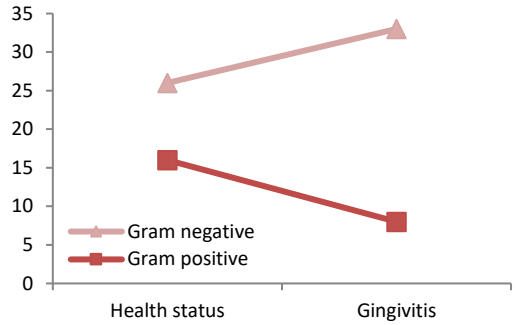
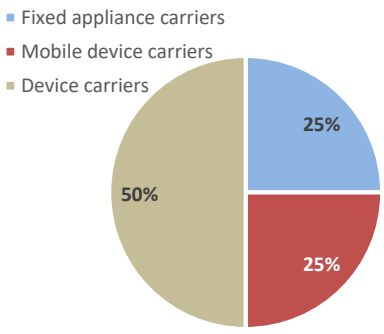


Table 1: Distribution of bacterial pathogens according to study groups

Pathogen	Health	Not carriers of orthodontic braces	Carriers of orthodontic braces	Carriers of mobile devices
Streptococcus	+++	+	+ ++	+ +
Actinomyces	+++	+	+	+
Veillonella	+	+	+	+
Aggregatibacter actinomycetemcomitans	-	++	+	?
Capnocytophaga	+/-	+/-	+/-	+/-
Treponeme orale	+/-	+++	+++	+++
Porphyromonas gingivalis	-	+	+++	++
Prevotella intermedia	+/-	+	+++	++
Tannerella forsythia	-	++	++	?
Fusobacterium nucleatum	+	++	+++	++

Figure 3: Patients treated with chlorhexidine-based gel antiseptic substance



Following the application of the chlorhexidine-based gel antiseptic substance to orthodontic patients, it was found that after two weeks the results of the microbiological analysis of the gingival sulcus exudate revealed a reduction of the number of pathogenic bacteria in the orthodontic treated subjects and their disappearance in the non-attendant devices (Figure 3).

For the patients who did not benefit from the application of chlorhexidine-based gel substance, it was found that for the orthodontic handlers the microbial flora was still highly present. After 30 days, when the patients were reassessed, it was discovered that the pathogenic flora disappeared in all patients treated with chlorhexidine-based gel antiseptic substance, both with orthodontic treatment or not.

DISCUSSION

According to the literature, a study by Al-Bazi et al. from 2016 demonstrated that the formation of dental biofilm is a result of the increase in the number of microorganisms on the tooth surface, which was found to be 2-3 times higher in patients under orthodontic treatment than in young people without orthodontic treatment [6]. Previous studies have shown that regular dental brushing and the use of dental floss alone do not decrease levels of S. mutans in patients

treated with fixed orthodontic appliances [7]. In our study, subjects treated with mobile orthodontic devices, compared to healthy individuals without periodontal problems, revealed an exacerbated growth of germs in the case of fixed-bearer carriers and a significant increase in the case of the mobile-bearer carriers. Some bacterial species (Streptococcus, Porphyromonas, Prevotella and Fusobacterium) are found mainly in fixed-bearer carriers, while Treponemma is constantly present whether or not the patient is a carrier of fixed or mobile devices and Tannerella forsytia is absent in patients' exudates.

Different protocols have shown the ability of CHX (Chlorhexidine) to inhibit the formation of dental biofilm and to reduce plaque development [8]. Randomized, controlled clinical trials demonstrated the efficacy of 0.50% and 0.75% CHX to control gingivitis and bleeding in orthodontic patients, concluding that lower concentrations of chlorhexidine may reduce the risk of tooth colouring, without compromising its effectiveness level against pathogenic bacteria [9]. In our study, applying the chlorhexidine-based gel antiseptic substance significantly reduced the number of bacterial colonies in all patients of the study. However, antiseptic treatment should not replace dental mechanical treatment, but be applied in a complementary manner [10]. Combining mechanical treatment with local application of antiseptics gives statistically better results than each of them taken separately does.

CONCLUSIONS

Given the results of the study, we can conclude that for the patients treated with orthodontic appliances, either fixed or mobile, it is impossible to completely clean all oral surfaces and to decrease the number of microbial colonisation without the application of local antiseptics during the treatment. The results of the study can be used to prevent periodontal disease in patients with orthodontic treatment.

Conflict of interest:
Nothing to declare.

Contribution Note:
All the authors equally contributed to the drawing up of the present paper.

Patient participation at the study respects ethical standards in medical research and GDPR.

References:

1. Kinane DF, Podmore M, Ebersole J. Etiopathogenesis of periodontitis in children and adolescents. Periodontol 2000, 2001, 26(1):54-91.

2. Kim K, Heimisdottir K, Gebauer U, Persson GR. Clinical and microbiological findings at sites treated with orthodontic fixed appliances in adolescents. Am J Orthod Dentofacial Orthop, 2010, 137(2):223-228.

3. Thornberg MJ, Riolo CS, Bayirli B, Riolo ML, Van Tubergen EA, Kulbersh R. Periodontal pathogen levels in adolescents before, during, and after fixed orthodontic appliance therapy. Am J Orthod Dentofacial Orthop, 2009, 135(1):95-98.

4. Van Schepdael A, Geris L, Vander Sloten J. Analytical determination of stress patterns in the periodontal ligament during orthodontic tooth movement. Med Eng Phys, 2013, 35(3):403-410.

5. Gkantidis N, Christou P, Topouzelis N. The orthodontic–periodontic interrelationship in integrated treatment challenges: a systematic review. J Oral Rehabil, 2010, 37(5):377-390.

6. Al-Bazi SM, Abbassy MA, Bakry AS, Merdad LA, Hassan AH. Effects of chlorhexidine (gel) application on bacterial levels and orthodontic brackets during orthodontic treatment. J Oral Sci, 2016, 58(1):35-42.

7. Lundström F, Krasse B. Streptococcus mutans and lactobacilli frequency in orthodontic patients; the effect of chlorhexidine treatments. Eur J Orthod, 1987, 9(1):109-116.

8. Van Strydonck DA, Slot DE, Van der Velden U, Van der Weijden F. Effect of a chlorhexidine mouthrinse on plaque, gingival inflammation and staining in gingivitis patients: a systematic review. J Clin Periodontol, 2012, 39(11):1042-1055.

9. James P, Worthington HV, Parnell C, et al. Chlorhexidine mouthrinse as an adjunctive treatment for gingival health. Cochrane Database Syst Rev. 2017;3(3):CD008676.

10. Slots J. Low-cost periodontal therapy. Periodontol 2000, 2012, 60(1):110-137.