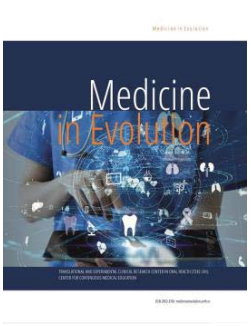
The influence of fixed orthodontic treatment on the microbiology of bacterial plaque



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Abstract

Dental plaque is a complex biofilm organization and is considered to be the primary causal factor of dental caries and periodontal diseases. Fixed orthodontic tretatmentis a risk factor in bacterial plaque accumulation. The purpose of this study was to detect pathogenic bacteria in dental plaque using laboratory tests. The selected patients were in numerr of 48, aged between 11 and 49, both male and female who required orthodontic treatment. After reciveing orthodontic braces, using a manual toothbrush, patients were thaught the correct brushing technique. After 6 months of orthodontic appliance use, plaque samples were collected from the surface of the teeth, and some elastic ligatures. The samples were collected using a transport medium swab, and the analyses were performed at a medical analysis laboratory (Synevo). Analyzing all the data from the tests, it is concluded that orthodontic treatment has a significant impact on the microbiology of bacterial plaque.

Keywords: Orthodontic treatment, dental plaque, oral hygiene, bacteria

INTRODUCTION

The preventive measures for dental caries are well-known both nationally and internationally, for orthodontic appliances as well as other patients. To enhance the effectiveness of individual preventive measures, clinical or laboratory tests are necessary to assess an individual's risk of dental caries, which is very common today. There are numerous studies showing the involvement of certain bacteria, such as Streptococcus mutans, Lactobacillus, and other pathogens in the plaque that develops in caries and in increased numbers in patients with orthodontic appliances, mainly due to dental crowding in these patients, but also due to orthodontic treatment itself, as the tooth surface is covered by the appliance, making optimal hygiene much more difficult. (1)

Aim and objectives

The purpose of this study was to detect pathogenic bacteria in dental plaque using laboratory tests. Additionally, combating bacteria is a top priority for oral health.

The scientific objectives of this work are: Identifying pathogenic changes in the oral flora; discovering and attempting to reduce the number of these parthogens by educating patients about proper oral hygiene techniques.

MATERIAL AND METHODS

Material: The subjects who participated in this study numbered 48, aged between 11 and 49 years, of both male and female genders, who required the initiation of orthodontic treatment. The subjects who participated were from a private environment, from a dental office.

Inclusion Criteria: All subjects presented a very good state of health, without any other medical problems that could influence. They did not receive any antibiotics before or during orthodontic treatment. At the beginning of the study, patients did not show signs of gum inflammation. The study population had permanent dentition, without plaque or tartar, and were eager to maintain adequate hygiene.

Exclusion Criteria: Subjects excluded from this study were those who received treatment for chronic diseases, those who received periodontal treatment at least 3 months before the start of this study, or those with systemic disease that could affect oral microbiology.

The selected patients recived fixed orthodontic appliances. Using a manual toothbrush, patients were taught the correct brushing technique and were motivated to maintain adequate hygiene throughout the study and during orthodontic treatment. After 6 months of orthodontic appliance use, samples were collected from the patients from the surfaces of the teeth, plaque samples, and some elastic ligatures. These samples were collected using a transport medium swab, and the analyses will be performed at the Synevo medical analysis laboratory.

Collection Technique: Patients presented for the control and replacement of elastic ligatures, a control that must be performed every month, using a tissue separator for soft tissue, for better control and visualization of dental tissues. The dental units to be sampled are dried with an air jet. Before sampling, we must check the expiration date of the container to be used for collection. The sterile collection swab container is opened, the cap must be removed, plaque collection from the gingival level is done with the help of a sterile swab, and then it is placed in the transport medium container. The sterile swab and a few elastic ligatures from the patient are also added with the help of sterile forceps. The patient's name,

personal numeric code, the physician who sent the sample to the laboratory for testing, the date and time of collection, and the type of sample collected (in this case, dental plaque) are added to the label on the container. Samples for testing must be sent to the laboratory within a maximum of 24 hours of collection. The most commonly used media for bacterial isolation is 5% Columbia agar. It is incubated aerobically at 37°C in air for 24 hours, which can be extended up to 48 hours if the characteristics of bacterial colonies are not observed on the first plate read. The media were tested to observe the absence or presence of Staphylococcus aureus, beta-hemolytic streptococci, non-fermenting gram-negative bacilli, Enterococcus spp., Enterobacteriaceae. Then, based on the results obtained from the tests, ABG is also performed.

RESULTS

The study began with the collection of patients prior to the initiation of orthodontic treatment, as they did not present pathological changes in plaque. The patients we collected were women and men aged between 11 and 49 years old. After wearing the orthodontic appliance for 6 months, the patients were called back to the clinic for the replacement of elastic ligatures, during which bacterial plaque was also sampled with a swab. The collected samples were sent to the Synevo laboratory within a maximum of 24 hours. From the analyses collected and studied in the laboratory, we had both positive and negative results. Table 1 presents the results of bacteriological analyses of the subjects before orthodontic treatment and at 6 months after the initiation of orthodontic treatment, as well as the percentage results of these tests. Microorganisms were discovered: Klebsiella oxytoca, Staphylococcus aureus, and Group G Streptococcus. Figure 2. shows the results from laboratory tests according to the age of the patients. With the help of the antibiogram, we can discover each microorganism's susceptibility or resistance. In our case, Klebsiella Oxytoca is resistant to ampicillin in some patients, while in others, all diagnosed with the same microorganism, it is sensitive to ampicillin. In the case of the microorganism Staphylococcus aureus, it was found to be resistant to ampicillin, while the Group G Streptococcus microorganism is sensitive to all antibiotics.

Table 1. Bacteriological analysis results performed before and 6 months after orthodontic treatment

Name of the patient (initials)	Results before the orthodontic treatment	Results at 6 months after the initiation of orthodontic treatment
P.A.	NEGATIVE	NEGATIVE
N.K.	NEGATIVE	NEGATIVE
L.P.	NEGATIVE	POSITIVE KLEBSIELLA OXYTOCA
E.P.	NEGATIVE	POSITIVE STREPTOCOCCUS G
D.R.	NEGATIVE	NEGATIVE
T.N.	NEGATIVE	POSITIVE STAPHYLOCOCCUS AUREUS
R.T.	NEGATIVE	NEGATIVE
B.E.	NEGATIVE	POSITIVE KLEBSIELLA OXYTOCA
S.P	NEGATIVE	POSITIVE STAPHYLOCOCCUS AUREUS
M.A.	NEGATIVE	POSITIVE STREPTOCOCCUS G
E.N.	NEGATIVE	NEGATIVE
I.R.	NEGATIVE	NEGATIVE
R.G.	NEGATIVE	POSITIVE KLEBSIELLA OXYTOCA

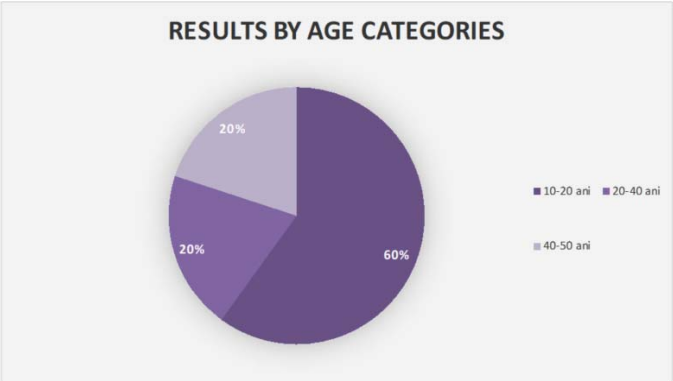

Figure 1. Laboratory Analysis Results by Age

Table 2. ABG (Antibiogram) of Klebsiella Oxytoca Microorganism

Antibiogram of Klebsiella Oxytoca	PATIENT P.A	PATIENT L.P	PATIENT B.E.	PATIENT R.G
AMIKACIN	**SENSITIVE**	**SENSITIVE**	**SENSITIVE**	**SENSITIVE**
AMPICILIN	**SENSITIVE**	**RESISTANT**	**RESISTANT**	**RESISTANT**
AMOXI/CLAV	**SENSITIVE**	**SENSITIVE**	**SENSITIVE**	**SENSITIVE**
CEFTAZIDIME	**SENSITIVE**	**SENSITIVE**	**SENSITIVE**	**SENSITIVE**
CEFUROXIME	**SENSITIVE**	**SENSITIVE**	**SENSITIVE**	**SENSITIVE**
CEFAZOLIN	**SENSITIVE**	**SENSITIVE**	**SENSITIVE**	**SENSITIVE**
CEFOXITIN	**SENSITIVE**	**SENSITIVE**	**SENSITIVE**	**SENSITIVE**
CIPROFLOXACIN	**SENSITIVE**	**SENSITIVE**	**SENSITIVE**	**SENSITIVE**
GENTAMICIN	**SENSITIVE**	**SENSITIVE**	**SENSITIVE**	**SENSITIVE**
MOXIFLOXACIN	**SENSITIVE**	**SENSITIVE**	**SENSITIVE**	**SENSITIVE**
PIPERACILIN	**SENSITIVE**	**SENSITIVE**	**SENSITIVE**	**SENSITIVE**
TRIMETROPRIM+SULFAMETOXAZOL	**SENSITIVE**	**SENSITIVE**	**SENSITIVE**	**SENSITIVE**
PIPERACILIN+TAZOBACTAM	**SENSITIVE**	**SENSITIVE**	**SENSITIVE**	**SENSITIVE**
METROPENEM	**SENSITIVE**	**SENSITIVE**	**SENSITIVE**	**SENSITIVE**
LEVOFLOXACIN	**SENSITIVE**	**SENSITIVE**	**SENSITIVE**	**SENSITIVE**
TETRACYCLIN	**SENSITIVE**	**SENSITIVE**	**SENSITIVE**	**SENSITIVE**

Table 3. ABG (Antibiogram) of Group Streptococcus G Microorganism

Antibiogram **of** Streptococcus grup G	PATIENT E.P.	PATIENT M.A
AMPICILIN	**SENSITIVE**	**SENSITIVE**
AZITHROMYIN	**SENSITIVE**	**SENSITIVE**
CEFTRIAXONE	**SENSITIVE**	**SENSITIVE**
CEFEPIME	**SENSITIVE**	**SENSITIVE**
CEFOTAXIME	**SENSITIVE**	**SENSITIVE**
CLINDAMICYN	**SENSITIVE**	**SENSITIVE**
CHLORAMPHENICOL	**SENSITIVE**	**SENSITIVE**
ERYTROMYCIN	**SENSITIVE**	**SENSITIVE**
LEVOFLOXACIN	**SENSITIVE**	**SENSITIVE**
PENICILIN	**SENSITIVE**	**SENSITIVE**
TETRACYCLIN	**SENSITIVE**	**SENSITIVE**
VANCOMYCIN	**SENSITIVE**	**SENSITIVE**

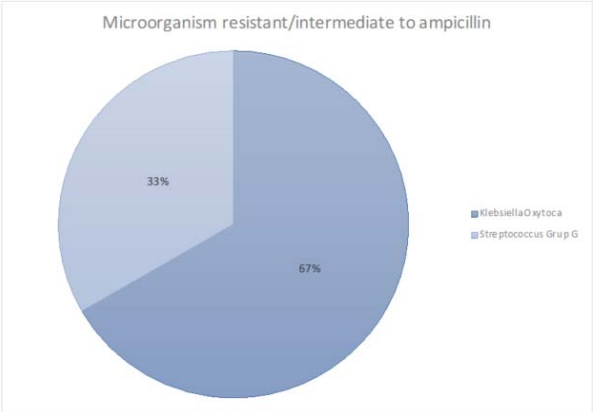

Figure 2. Microorganisms resistant/intermediate to ampicillin

DISCUSSIONS

The application of orthodontic appliances in young patients can lead to adverse reactions such as gingival inflammation, sometimes gingivitis, and late-onset periodontitis. (2) Clinical studies have shown that, in the absence of adequate oral hygiene, periodontal pockets can form due to the increased number of bacteria in dental plaque when fixed orthodontic appliances are used, especially in children. Therefore, plaque microbiology induces not only the onset of caries but also the onset of periodontal diseases, even among young individuals. (3)

The periodontal-orthodontic interrelationship has been subject to numerous investigations to date and remains a controversial issue. It has been demonstrated that malocclusion affects periodontal health, and one of the objectives of orthodontic treatment is to promote better dental health and prolong the lifespan of dentition. (4)

Although orthodontic treatment alleviates dental and osseous problems, placing an orthodontic appliance in the patient's mouth is often associated with changes in oral hygiene habits and periodontal health. Orthodontic appliances, as well as mechanical procedures, are predisposed to evoke local responses of soft tissues at the gingival level. The proximity of orthodontic appliances to the gingival sulcus, plaque accumulation, and the impediments they pose to oral hygiene habits further complicate the process of efficient and healthy orthodontic care. (5)

Closing the orthodontic space of extraction sites can lead to gingival invagination or gingival tissue accumulation.

Dental plaque is an extremely complex biofilm organization and is considered the primary causal factor of dental caries and periodontal diseases. Fixed orthodontic treatment is a risk factor in bacterial plaque accumulation. (6)

Fixed orthodontic appliances have long been associated with increased plaque accumulation, bacterial colonization, and resulting enamel decalcification. These appliances could alter the coronal anatomy of the tooth, leading to an increased number of retention surfaces and positions, difficulty in controlling plaque formation and adherence. They could exacerbate pre-existing periodontal disease, cause enamel decalcification, and develop bacteremia or unwanted infections. (7) Physiochemical characteristics of orthodontic appliances are known to determine the effectiveness of bacterial species in terms of quality and quantity. (8)

CONCLUSIONS

Analyzing all the data from the patients tests, it is concluded that fixed orthodontic treatment has a significant impact on the microbiology of bacterial plaque. As a result of this study, we have reached the conclusion that fixed orthodontic treatments are capable of modifying the composition of bacterial plaque. Even though at the beginning of fixed orthodontic treatment, patients did not present changes in bacterial plaque, after its application, the microbiology of the bacterial plaque changes. Most patients showed pathological changes in the plaque as well as resistance to certain antibiotics.

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