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Motivation of Adult Patients with Orthodontic Treatment in Maintaining Oral Hygiene

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ABSTRACT

Background: In the last decades, adult patients require orthodontic treatment as a therapeutic method in an increasing percentage. This treatment has a lot of benefits, but unfortunately it also presents a number of complications and risks, among which favoring the accumulation of bacterial plaque is the most concerning. **Aim of the study:** In this study we aimed to evaluate the effectiveness of using the dark-field microscope as a method of motivating adult patients with orthodontic treatment in maintaining a proper oral hygiene. **Material and methods:** Thirty-six patients were selected based on the inclusion and exclusion criteria. At time T0, patients were divided into two groups: Group 1– microscope and Group 2 – control, in such a way that the groups were as homogeneous as possible. Dental plaque samples were collected and analyzed under a dark field microscope in the presence of the patient for subjects from Group 1 but not Group 2. All patients were then instructed on oral hygiene techniques. The following periodontal indices were recorded of each patient: plaque index (PI), index of bleeding on probing (BOP), probing depth (PD) – at T0 and T1 (after one month). **Results:** Comparing the PI and BOP values before (T0) and after treatment (T1), statistically significant results were detected (PI: p = 0.0020, BOP: p = 0.0297), which denotes that patients who observed the bacterial load of their dental plaque in real time using the dark-field microscope had a better oral hygiene and lower values of periodontal health indices. Regarding the PD index, the difference between time T0 and T1 was not statistically significant (p = 1.4762). **Conclusions:** During the orthodontic treatment, adult patients often present gingival inflammation caused by improper hygiene. The use of the dark-field microscope is effective in motivating patients regarding the rules of maintenance of a proper oral hygiene.

Keywords: adult patients, orthodontic treatment, oral hygiene, dark field microscope, periodontal health

INTRODUCTION

Orthodontic treatment has become a therapeutic method used in an increasing percentage among adult patients in the last decades. Its popularity is a result of oral healthcare and information being more accessible nowadays, the esthetic demands of modern society, and last but not least, the technological breakthroughs that have arisen in the field of orthodontics.

The correction of dento-maxillary anomalies has beneficial loco-regional effects, by improving the morphological and functional balance of the dento-periodontal structures, but also on the general state of health and comfort of the individual, with a positive role in increasing the quality of life.[1–3] From a morphological point of view, through orthodontic treatment, encouraging results can be achieved in terms of aligning the teeth and harmonizing the dento-alveolar and intermaxillary relations in accordance with the individual cranio-facial characteristics.[4,5]

In addition to its benefits, orthodontic therapy can present a number of complications and risks. Wearing a fixed orthodontic appliance will make maintaining oral hygiene more difficult, favoring the accumulation of bacterial plaque. The quality and quantity of bacterial plaque is modified if patients do not maintain a correct oral hygiene around the orthodontic device.[6–8] By appreciating the quantity of dental plaque around orthodontic appliances, which have an extremely retentive surface, bacterial colonization in the oral cavity turns out to be quite fast.[9,10] Orthodontic appliances also affect the microbial structure of the bacterial plaque even in the early stages of the orthodontic treatment, increasing the prevalence of periodontal pathogens, such as *Tanerella forsythia*, *Treponema denticola*, *Fusobacterium nodatum*, *Campylobacter rectus*, *Eubacterium nodatum*, *Eikenella corrodens*, and *Capnocytophaga spp*., in the gingival sulcus, especially in the molar region.[11–13] Over time, these changes in the biofilm can lead to the development of white spots of demineralization or periodontal diseases.[14–17]

To prevent the complications of the orthodontic treatment, which can overshadow its functional and esthetic advantages, it is necessary to institute preventive measures of improving oral hygiene.[18]

A number of studies have shown that poor oral hygiene could prolong the duration of orthodontic treatment, jeopardize its results, and even lead to its premature discontinuation.[19,20] In the absence of appropriate treatment, inflammatory changes installed in the gingival tissue can lead to the irreversible loss of supporting tissues.[21,22]

The success of the orthodontic treatment depends on the quality of the medical act, but also on the effective communication with the patient, as well as on his compliance with the guidelines of oral hygiene. Orthodontists provide instructions on oral hygiene measures, but their effectiveness can be limited, as patient motivation also plays a decisive role.

Starting from these observations, we set out to evaluate the effectiveness of using the dark-field microscope as a method of motivating adult patients who wear orthodontic appliances in maintaining proper oral hygiene.

MATERIALS AND METHODS

Study design

This research was conducted as a case-control study.

Patient selection

The study included 36 patients with orthodontic treatment who visited the private practice CMI Dr. Lazăr Luminița in Târgu Mureș, Romania and met the following inclusion criteria:

- age between 18 and 55 years;
- presence of dentoalveolar disharmony (DAD) with mild crowding;
- presence of dental plaque and signs of gingival inflammation during the orthodontic treatment.

The exclusion criteria were the following:

- presence of systemic conditions that have an impact on periodontal tissues (diabetes, immunological conditions, acute articular rheumatism, tuberculosis etc.);
- history of smoking;
- pregnancy or breastfeeding;
- antibiotic treatment in the last six months;
- the use of non-steroidal anti-inflammatory drugs (NSAIDs).

The patients were informed about the work protocol and the fact that they can leave the study at any time, and they signed an informed consent.

Orthodontic protocol

Patients presenting dentoalveolar disharmony with crowding were examined and received orthodontic treatment using standard edgewise brackets with the same slot size for all subjects (0.22) (American Orthodontics, Sheboygan,

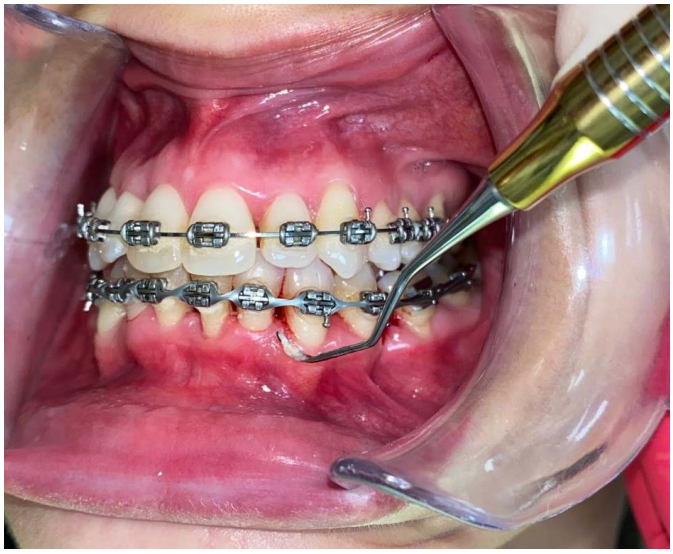


FIGURE 1. Dental plaque specimen collection

WI, USA). The following sequence of archwires was used: NiTi size 0.12 when applying the orthodontic device, and sizes 0.16 for the first activation, 0.16 × 0.16 for the second, and 0.16 × 0.22 for the third (BioForce, Dentsply Sirona, Charlotte, NC, USA).

Periodontal protocol

When showing bacterial plaque accumulation and signs of gingival inflammation (gingivitis) during the activation sessions, the patients underwent a periodontal examination with the recording of the following indices in a periodontal record: plaque index (PI), bleeding on probing (BOP), probing depth (PD) – time T0. After one month (time T1), these examinations were repeated.

The protocol for identifying bacterial plaque and of instructing patients in its removal

At time T0, the patients were divided into two groups: Group 1– microscope and Group 2 – control, in such a way that the groups were as homogeneous as possible in terms of gender, age, and social status.

Bacterial plaque was visualized by staining it using a plaque developer. Dental plaque samples were collected with a Gracey curette from the areas with the largest plaque deposits and analyzed under a dark-field microscope (Figure 1). Plaque samples were examined in the presence of the patient for subjects from Group 1, who observed the images of the periodontal biome on the screen attached to the microscope (Figures 2 and 3). Patients in Group 2 did not have access to this information.



FIGURE 2. The dark-field microscope

All patients were then instructed on oral hygiene techniques, and supra- and subgingival scaling and professional brushing were performed by the same member of the research team.

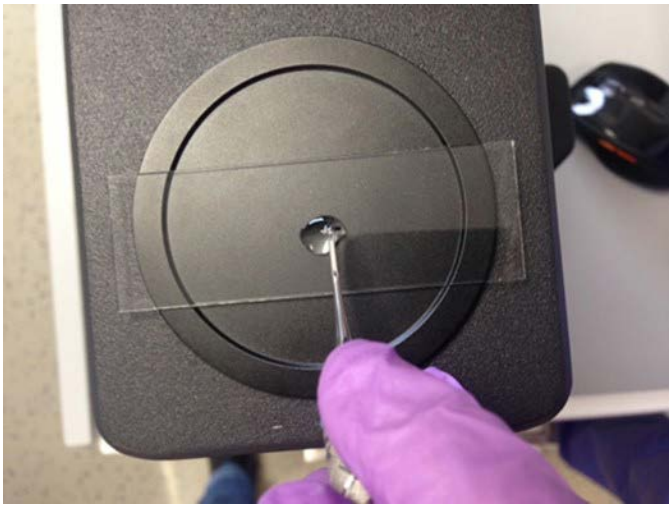


FIGURE 3. Dental plaque specimen ready to be viewed under the dark-field microscope

TABLE 1. The mean values of PI, BOP, and PD

Patients	PI (T0)	PI (T1)	BOP (T0)	BOP (T1)	PD (T0)	PD (T1)
Group 1	73.21	10.48	67.40	6.65	2.62	2.25
Group 2	75.66	35.71	67.85	21.42	2.5	2.43

PI – plaque index; BOP – bleeding on probing; PD – probing depth

Evaluation of results

After one month (T1), periodontal status was reassessed (PI, BOP, PD), and dental plaque was collected and examined under the dark-field microscope for patients belonging to both groups. The values obtained were compared with those previously recorded at time T0.

Statistical analysis

All data was collected in Microsoft Excel work sheets (Microsoft Corporation, 2018, Redmond, WA, USA). The statistical analysis was carried out in GraphPad Prism version 8.0.0 for Windows (GraphPad Software, San Diego, CA, USA). For each group of data, descriptive statistics, such as mean, standard deviation, median, minimum, and maximum value, were assessed. Data normality was determined using the Kolmogorov-Smirnov test. The difference in clinical index values recorded at time T0 and T1 for both groups of subjects was determined using Fischer's test and the Chi-squared test with Yates correction. The significance level was set at 0.05.

This study complied with the Declaration of Helsinki and received the approval of the Medical Ethics Committee of SCJU Târgu Mureș, No. 8321/19.04.2021.

RESULTS

Patients included in this study based on the inclusion and exclusion criteria were aged between 20 and 47 years. Group 1 consisted of nine women with an average age of 34 years and nine men with an average age of 32 years. Group 2 included 10 women with an average age of 35 years and eight men with an average age of 31 years. The mean values recorded for PI, BOP, PD for each group are presented in Table 1.

With the aid of the dark-field microscope, we highlighted, based on the morphological characters, the bacteria that colonize the gingival sulcus. The quantitative analysis of the bacterial load was a subjective one, but being performed by three team members, we consider the results to be realistic. Despite all these shortcomings, this investigation allowed us to observe a rich bacterial load in all patients at time T0, represented especially by bacillary forms. At time T1, we observed a quantitative reduction of the bacterial flora, greater for Group 1 than for Group 2, and the predominance of cocci (Figure 4).

Comparing the PI values before (T0) and after treatment (T1) in the two groups of patients, statistically significant results were detected ($p = 0.0020$). A statistically significant difference was also observed for the compari-

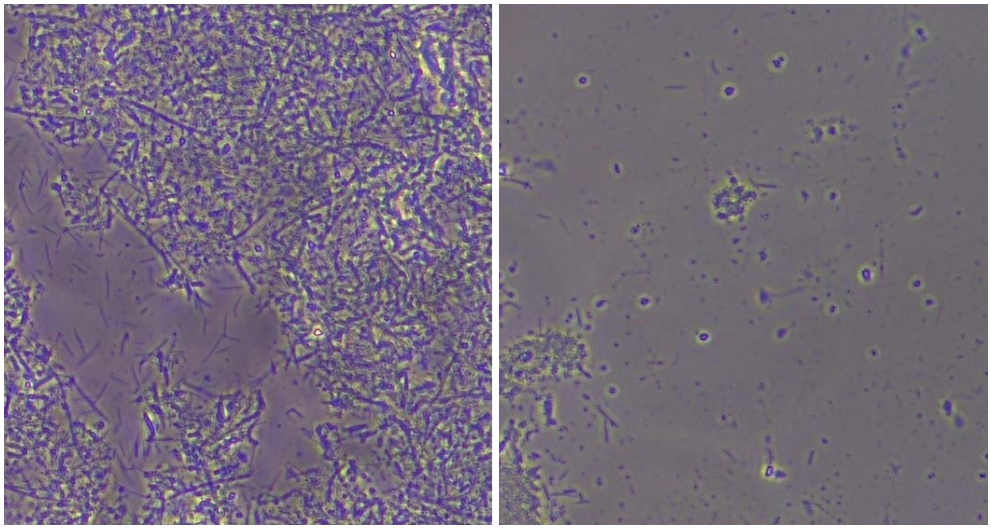


FIGURE 4. Dark-field microscope images of oral bacterial flora at T0 (left) and at T1 (right)

son of BOP values before and after treatment (p = 0.0297), which denotes that patients who observed the bacterial load of their dental plaque in real time using the dark-field microscope had a better oral hygiene and lower values of periodontal health indices. Regarding the PD, the difference between time T0 and T1 was not statistically significant (p = 1.4762).

DISCUSSIONS

To carry out this study, we chose adult patients because recently a growing number of them turn to fixed orthodontic treatment. Patients have different oral hygiene habits; thus, we tried to create the two groups as homogeneous as possible in terms of age, gender, and social status, so that these elements do not influence the results of the study. We excluded from the study patients who benefited from antibiotic treatment in the last six months and those who use non-steroidal anti-inflammatory drugs because this medication can change both the periodontal status and the bacterial load.

During orthodontic treatment, adult patients often present gingival inflammation caused by improper hygiene at the activation sessions (Figure 5). This is either due to a lack of time, due to the fact that patients are not sufficiently well informed about the importance of oral hygiene, or because it is made more difficult by the presence of the orthodontic appliance.

One of the inclusion criteria in our study was that patients presented plaque accumulation (PI >25%) and signs of gingival inflammation (BOP >10%) at the orthodontic appliance activation sessions. At time T0, we recorded high values of PI (73.21% in Group 1 and 75.66% in Group 2) and BOP (67.40% in Group 1 and 67.85% in Group 2) for all patients. This helped us to appreciate to what extent the use of the dark-field microscope can be used as an additional means of motivating patients to maintain oral hygiene. The patients of both groups were trained on the measures and means of removing bacterial plaque by the same periodontology specialist. He provided the patients with all the necessary information and made a practical demonstration, thus helping the patients to understand better the correct oral hygiene techniques. This patient training session proved to be effective for all patients, who at T1 had lower values of PI and BOP. Regarding the PD values, no significant changes were recorded between T0 and T1, because patients who presented PD values >3 mm at the initial clinical evaluation were excluded from the study and referred to a complex periodontal consultation and treatment.

Examining the bacterial plaque under the dark-field microscope gave us the possibility of a quantitative and qualitative assessment and was useful in evaluating the results of the training sessions on removing the bacterial plaque by the patient. Thus, at time T1 we observed a lower bacterial load on the microscope screen compared to time T0, with the predominance of cocci.

A great advantage of this evaluation was that the patients in Group 1, who at time T0 have seen the image on the screen attached to the dark-field microscope, were surprised and worried about the presence of bacteria in the oral cavity. These patients proved to be much more motivated in the application of oral hygiene means, and at T1 they had significantly lower values of PI and BOP compared to patients in Group 2. These clinical results were also confirmed by the images provided by the dark-field microscope, indicating that patients who observed the bacterial load of the plaque in real time had much better hygiene.

A growing number of studies have focused on how doctors can motivate their patients about oral hygiene with



FIGURE 5. Patient wearing orthodontic appliance with bacterial plaque accumulation

additional motivational efforts. Cozzani *et al.* conducted a study in which patients starting fixed orthodontic treatment underwent an oral hygiene session in order to achieve a PI equal to 0. The patients were randomly divided into three groups: the first group served as a control and did not receive post-procedure communication; the second group received a text message offering support, and the third group received a phone call. At the next orthodontic appointment, the PI was calculated for each patient to assess compliance with oral hygiene. The results showed that in terms of oral hygiene compliance, the difference between the control group and the other two groups was significant. The authors claim that the patients' motivation and confidence are guaranteed through post-procedural communication, being crucial factors for improving oral hygiene compliance.[23]

In a similar study, patients with orthodontic treatment received 12 text messages over four weeks, which emphasized the importance of oral hygiene and served as a reminder and encouragement to brush their teeth. After one month, plaque accumulation was compared with patients in the control group, who received no messages. The study demonstrated that the use of automated reminder messages sent from the orthodontic office was effective in improving patient compliance with oral hygiene.[24] A series of other authors recommend the method of sending text messages to motivate patients with orthodontic treatment.[25–29]

Alkadhi *et al.* conducted a study in which subjects undergoing orthodontic treatment with fixed appliances were randomly assigned to two groups using simple randomization. Group I subjects received a mobile application that sent active oral hygiene reminders three times a day, and Group II subjects received verbal oral hygiene instructions during their routine orthodontic visits. To assess the level of oral hygiene at baseline and after four weeks, the PI and gingival index (GI) for Ramfjord teeth were used. PI and GI values decreased significantly after four weeks of using active reminders of oral hygiene instructions on the mobile app compared to patients who received only verbal oral hygiene instructions.[30]

Teaching patients about oral hygiene measures can be done in different ways. A group of researchers from the University of Rennes compared three possibilities for teaching patients about oral hygiene. Group 1 (control) received the recommendations orally; in Group 2, the same recommendations as for Group 1 were supplemented by a tooth brushing demonstration, with the active participation of the patient; in Group 3, the same recommendations as for Groups 1 and 2 were combined with an additional 15-minute session that included viewing an educational video followed by a test. The results of the study showed that in Group 3 the values of the plaque index were lower compared to the other patients, due to the impact that the video presentation had on them.[31]

The hygiene of adult patients wearing fixed orthodontic appliances can also be improved by presenting images of the severe consequences of biofilm accumulation.[32,33]

CONCLUSIONS

1. During the orthodontic treatment, adult patients often present, at the activation sessions gingival inflammation, caused by improper hygiene.
2. Doctors must instruct patients on oral hygiene measures to prevent complications of the orthodontic treatment.
3. Patients are not sufficiently conscious about the oral hygiene rules and the importance of their application.
4. Patient compliance with oral hygiene can be improved by additional motivational efforts.
5. The use of the dark field microscope is effective in motivating patients regarding the rules of maintenance of a proper oral hygiene.

CONFLICT OF INTEREST

The authors declare no competing interests.

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