The effect of an educational/preventive program on adolescents undergoing fixed orthodontic treatment:A Clinical study

ABSTRACT

Aim: To evaluate the effect of educational/preventive measures in adolescents who wore fixed orthodontic appliances.

Study design: Prospective, controlled, and randomized clinical study.

Place and Duration of Study: The adolescents were evaluated in a private dental clinic in the city of Ibiporã - PR for 12 weeks in 2015.

Methodology:A randomized design, with records of plaque, gingival and bleeding indices. In total 40 adolescent patients, with an average age of 14 years, of both genders were selected at a private orthodontic clinic. Mechanical biofilm control was performed and oral hygiene kits were distributed. Clinical evaluations were made at the beginning of the study (baseline) and at time intervals of 30, 60 and 90 days, in a total of 12 weeks. Means of indices were compared throughout the study period. Among the educational/preventive measures used were photograph albums, verbal oral hygiene guidance and disclosing of dental plaque. Records were made of the participants' oral hygiene habits.

Results: The girls presented a higher dental plaque reduction value of 30.8% whereas the boys presented 25.3%. The plaque index showed significant reduction in the initial evaluation (baseline) and in the following re-evaluations at 30, 60 and 90 days.

Conclusion: The educational/preventive measures used were shown to be effective, in view of the significant reduction in gingival inflammation and dental plaque indices, with improvement in the oral health of adolescents who wore fixed orthodontic appliances.

Key Words: Preventive Dentistry; Oral Health; Oral hygiene; Orthodontics, Preventive; Dental Plaque.

1. INTRODUCTION

Dental biofilm control is difficult in patients submitted to fixed orthodontic treatment, especially in children and adolescents [1].Biofilm accumulation around the brackets, associated with the difficulty of performing interproximal brushing increases the risk of gingival inflammation [2]. Furthermore, this condition can lead to a decrease in pH, shifting the demineralization/remineralization in the enamel favoring the development of initial carious lesions [3].

As the scope of orthodontic treatment lies within the satisfactory correction of occlusion, orthodontists do not expect to change the pre-existent health of the teeth and supporting tissues. However, findings have pointed out that many patients have been shown to be unprepared as regards their oral hygiene, even before the fixed orthodontic appliance is placed, and it is the professionals' responsibility to provide instruction about these habits and motivate their implementation [4]. Nevertheless, the difficulty of the patients in adhering to all these instructions and maintaining their oral health is recognized.

Age has been pointed out to be an important predictor of risk for dental caries in orthodontic patients, with a higher level of occurrence in volunteers in the younger age group [5].Studies about this condition have attracted much attention, particularly as to how to eliminate these risks [6,7,8]. A systematic review about oral health promotion in orthodontic patients pointed out the importance of professionals instituting strategies to reduce dental biofilm accumulation to improve gingival health and prevent carious lesions in enamel [9]. However, few studies [10] have presented the behavior of these patients towards an oral health program and its clinical effectiveness, without involving interventions other than the educational type.

Therefore, this work aimed to evaluate the effectiveness of an educational/preventive program in adolescents who wore fixed orthodontic appliances, by means of plaque and gingival bleeding indices. The study hypothesis was that an educational/preventive program would promote a reduction in dental biofilm in the studied public.

2. MATERIALS AND METHODS

2.1 Experimental Design

This prospective clinical study was approved by the Research Ethics Committee of UNOPAR,

No. 208971. A prospective, controlled and randomized study was conducted, with the data presented secondary to a clinical research. The clinical exams and oral hygiene instructions were carried out at the beginning of the study (baseline), and in time intervals of 30, 60 days and on conclusion of the experimental period (90 days), with a total duration of 12 weeks. Among the educational/preventive measures, photograph albums, verbal instructions, dental plaque revelation and mannequins were used to demonstrate correct toothbrushing procedures and the use of dental floss around orthodontic brackets. Records were made of the participants' oral hygiene habits and the following indices: gingival, bleeding, dental plaque. After the initial exam, all the volunteers received professional prophylaxis with removal of all the supragingival plaque, stains and calculus. They were informed that during the period of 3 months, they must not have new dental prophylaxis performed, and must not use other oral hygiene products than those provided in the kits.

The volunteers' adhesion to the oral hygiene measures were evaluated by a researcher during the experimental stage, without the loss of any participant during the study. At the end of the 3-month period, another questionnaire was applied about their present oral hygiene habits, diet and opinions about the educational/preventive measure used in this study. After that, all the volunteers were submitted to professional prophylaxis.

2.2 Sample Selection

A random sample was used, representative of patients from 12 to 18 years of age, from a private dental clinic in a small city in the south of Brazil (Ibiporã - PR). The data analyzed in this study were secondary from an initial clinical research, that use a sample calculation with the G*Power (G*Power 3.0.10, Franz Faul, Universität Kiel, Germany), a population of 200 patients in the recommended age range, test power of 95%, $\alpha = 0.05$ and $\beta = 0.05$, based on the means and standard deviations of a similar study [11]. The calculation resulted in a total of 40 participants, foreseeing possible losses. For allocation of the volunteers, each patient received a numerical code, randomly distributed by a computer-generated table. Respecting the ascendant numerical order, the patients were invited to participate in the study, by telephone, and invitations were concluded when the sample size originally proposed was attained. The patients who intended to participate in the research were adequately informed and signed the term of Free and Informed Consent.

Those included were volunteers between 12 and 18 years of age; undergoing fixed orthodontic treatment planned to last longer than six months, permanent dentition, and in good general health. The following were the exclusion criteria adopted: smokers, pregnant women, individuals with cavitated caries lesions; history of use of systemic antimicrobial agents in the three months preceding the beginning of the study; diabetes, asthma and medication that altered salivary flow.

2.3 Operationalization

The examiner received practical training in the use of the instruments selected. A group of 10 patients was evaluated by the researcher who conducted the procedures, for calibration of the parameters of the clinical indices and their scores. To begin the study, the calibrated examiner recorded the following clinical Indices: bleeding (BI) [12],Gingival Inflammation (GI) [13], Plaque (PI) [14,15]. Dental biofilm was revealed with fuchsin (Figure 1)to allow volunteers to visualize the areas with greatest biofilm retention and clinical aspects of the gingival condition. Afterwards, with the intention of standardizing the measurements of the indices in the following sessions, supragingival plaque, stains and calculus were removed with the use of a micromotor, Robinson brush, pumice stone and water, and jet of bicarbonate solution. The volunteers were instructed no to receive professional prophylaxis during the course of the research.

Fig 1. Bacterial plaque visible with the basic fuchsin-based revealing solution.

Source: Authors

The volunteers answered a questionnaire about oral hygiene habits (how they performed it

and frequency of doing so). Oral hygiene instructions were given by means of albums containing clinical photographs of cases of gingivitis and active white spot caries lesions in orthodontic patients. Verbal and practical instructions were provided with the use of mannequins to demonstrate the correct toothbrushing technique and use of dental floss around orthodontic brackets. Oral hygiene kits were provided (Colgate Orthodontic® tooth brush, Colgate Total®12 toothpaste with 1500 ppm F and triclosan, Colgate Interdental Retpack® 2mm interdental brush and dental floss holder mounted with dental floss). The patients were instructed not to use other oral hygiene products than those provided. The volunteers were re-evaluated at time intervals of 30, 60 and 90 days after the study began, when the bleeding, gingival inflammation and plaque indices were collected again. Adhesion of the studied group to the oral hygiene measures was evaluated by a researcher during the experimental phase. At the end of the 3-month period, another questionnaire was applied about their present oral hygiene habits, diet and opinions about the educational/preventive measures provided (Figure 2).

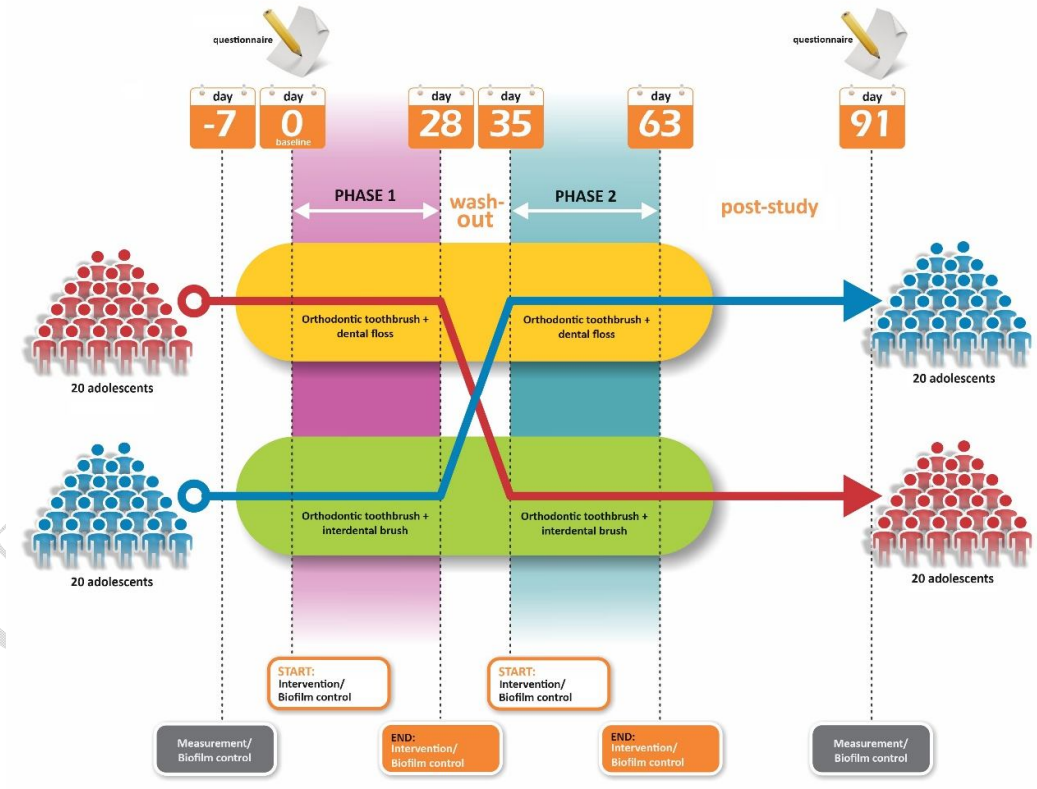

Fig. 2 - Flowchart of the study design (time, groups and phases).

2.4 Statistical Analysis

For the gingival bleeding index, the presence or absence of bleeding on probing in teeth and papilla (anterior/ posterior; maxillary /mandibular) was considered, while for the gingival inflammation index, the sum of the indices was divided by the total number of teeth. Whereas, for the dental plaque index the mean for each patient was calculated in each follow-up visit, according to the sum of individual scores and number of gradable sites. The InStat GraphPad® program was used. For comparison of the different time intervals of the following variables: plaque index and gingival inflammation index, the Analysis of Variance (ANOVA), with the Tukey post-hoc tests were used, and the level of significance adopted was 5%.

3. RESULTS

The initial questionnaire responded by the volunteers about the frequency of daily toothbrushing showed the following data: 40.42% twice; 38.09% three times; 9.52% four times and 9.52% once. The participants reported having received instructions about dental floss using a floss holder, but only 50% reported doing so. When considering the initial time interval of the study, the authors observed that the dental plaque index was similar without being related to sex.

The results shown in Table 1 pointed out that for the gingival bleeding index (BI) no significant changes were observed during the study period. Whereas, for the gingival index (GI) a significant reduction occurred after the study began. In the time intervals that presented difference corresponded to baseline, 30 days and 90 days (conclusion of study) (P<0.01). In the plaque index (PI) analysis, the authors observed a significant reduction compared with the initial evaluation (baseline) for the following re-evaluations at 30, 60 and 90 days (conclusion of study) (P<0.01). When considering sex, the girls presented reduction in comparison with the first measurement (5.01%), while the boys showed an increase of 4.57% in the bacterial plaque index. Considering the mean values of the indices in the study period, the girls (n=12) showed a higher reduction in dental biofilm values (30.8%), while the boys (n=9) showed 25.3%.

Table 1. Means, standard deviation, median of the following indices: bleeding (BI), Gingival (GI) and Plaque (PI) among study time intervals (baseline, 30, 60 and 90 days)

Time	BI	*P* = 1.000	GI	*P*<0.001*	PI	*P*<0.001*
Baseline	1.00 (0.00) [a]		1.35 (0.48) [b]		2.26 (0.46) [b]	
30	1.00 (0.00) [a]		1.85 (0.35) [a]		1.90 (0.42) [a]	
60	1.00 (0.00) [a]		1.69 (0.46) [b]		1.87 (0.42) [a]	
90	1.00 (0.00) [a]		1.78 (0.47) [a]		2.06 (0.41) [a]	

Different letters in the same column indicate statistically significant differences, as analyzed by ANOVA and Tukey tests (*P*<0.05) n=40.

To correlate the 4 time intervals of each response variable (BI, GI, and PI) with the variable frequency of toothbrushing, the Spearman Correlation Coefficient was used. In the findings, no significance was found (*P*>0.005) between the frequency of toothbrushing and the clinical indices. Patients' report after conclusion of the study is described in Table 2 by means of descriptive distribution. The authors observed that 21 adolescents reported having improved their oral hygiene, although 4 had not changed their habits. The remaining patients pointed out other benefits to their oral health after participating in the educational/preventive program.

Table 2. Descriptive analysis (absolute and relative values) of variable changes recorded in final time interval of program (90 days/12 weeks)

Description of adolescents after educational/preventive measures (Final Time Interval)	Frequency	
	N	%
Learning	2	4.76%

Greater agility with cleaning	1	2.38%
Cleaner teeth	2	4.76%
Improved Oral Hygiene	21	50.0%
Did not change	4	9.52%
Started using dental floss	2	4.76%
Cleaner teeth with esthetic appearance	1	2.38%
Overall improvement	1	2.38%
Better brush	1	2.38%
Improved gingival condition	2	4.76%
Much change	3	7.14%
Need for Program	1	2.38%
Greater frequency of oral hygiene	1	2.38%

4. DISCUSSION

Clinical studies have shown special interest in strategies that benefit the oral hygiene of adolescents with orthodontic appliances, in view of their limitation relative to plaque control, habits and priorities [10,16,17,18,19] and thereby, the increase in risk of enamel demineralization and gingival inflammation [20] this being the reason why this study investigated this age group. This study adopted a prevention protocol for adolescents who wore fixed orthodontic appliances, consisting of professional prophylaxis and educational/preventive measures, such as photograph albums, verbal instruction, dental plaque revelation, mannequins to demonstrate the correct toothbrushing technique, and use of dental floss around the orthodontic brackets. After the oral hygiene instructions, oral health kits were provided to standardize the method and evaluate the effect of the educational measures. Disclosing dental plaque allowed volunteers to visualize the areas with greater dental plaque retention, bearing in mind that the tooth brush is not sufficient for adequate cleaning in orthodontic patients [6].

Oral hygiene conditions were evaluated by the presence of gingival bleeding, since it can be considered a predictive factor of caries disease, due to the maturation of supragingival biofilm [21]. The clinical study of Bardal et al. [10], presented a significant reduction in all the indices verified (BI, GI, PI). Their results pointed towards a significant reduction in the gingival inflammation index (GI) up to

the final exam. However, in the bleeding index (BI) analysis no significant changes were observed during the studied period. In the plaque index (PI) analysis, the authors observed a significant reduction compared with the initial evaluation (baseline) for the following re-evaluations at 30, 60 days and on conclusion of study. The initial PI was significantly reduced after the institution of the preventive protocol. Other authors [9, 22] also found high plaque indices in orthodontic patients, which were reduced by means of different motivational techniques, without however, attaining ideal values.

The present findings pointed out the importance of motivation in this public. Kossack and Jost-Brinkmann [16],observed a lower level of motivation over the course of the study, perhaps because of the less strict approach to oral health, identified by the absence of effect of the devices for interdental hygiene. For the authors the question was that the patients who had good oral hygiene would not present changes, whereas those with poor oral hygiene continued not using dental floss. As support for oral hygiene, three-monthly professional prophylaxis is recommended for orthodontic patients [23].Preventive aspects related to gingivitis and periodontal disease may be achieved with the daily use of dental floss and less excess of resin around the orthodontic brackets [6].

Considering that treatment with fixed orthodontic appliances covers a larger number of adolescents, administrating dental caries risk in this public is an important challenge. The patients' age appears to play a crucial role in the advent of these lesions; the younger they are when treatment begins (10-12 years) the higher the risk of developing caries lesions [23]. Obtaining the patient's cooperation is the first condition for the success of treatment. Therefore, it is necessary to educate patients and reinforce cooperation and motivation.Diverse methods for motivating orthodontic patients relative to improving their oral hygiene have been developed and tested. For Opshal et al. [23] the factor that appears to be determinant in relation to the patients' oral health, irrespective of the method, is the consistent motivation from the orthodontist, as observed by Bardal et al [10]. When considering sex, the girls presented reduction, while the boys showed an increase in the bacterial plaque index. Therefore, it has been suggested that behavioral aspects could interfere in the oral health condition [6]. The study of Zanatta, Moreira and Rõsing [6] also pointed out that patients of the male gender had a higher probability of developing gingivitis than those of the female gender. On the other hand, Zingleret al. [20] observed no differences between genders.

As in the study of Bardal et al. [10] the large majority of patients reported having received instructions about toothbrushing and the use of dental floss. However, in view of the findings observed

at the beginning of the study (baseline), the authors suggest that only the instructions provided by the professional at the beginning of treatment were not sufficiently effective to guarantee a satisfactory oral hygiene.

Although the frequency of tooth brushing was shown to be an important aspect in the oral health of patients undergoing orthodontic treatment, with a recommendation of a minimum of brushing twice a day [23], the quality of the execution is the decisive factor during the time of oral cleaning [10]. Thus, with the intention of evaluating the relationship between the frequency of toothbrushing with each response variable (BI, GI and PI) during the period of this study, the authors analyzed their correlation. The findings showed no significance between toothbrushing and the clinical indices, perhaps because the present group evaluated had a regular oral health condition. Nevertheless, the participants reported improvement in their oral hygiene habits at the end of the study.

The findings of this study pointed towards a reduction in the PI, with benefits to both periodontal support and prevention of white spot carious lesions. A systematic review conducted by Gray and McIntyre [9] pointed out that oral hygiene programs for orthodontic patients must be an integral part of the treatment, and patients must receive the educational measures before beginning their treatment. Although this benefit was observed in the short term, due to the difficulty of conducting long clinical studies [19],the authors recommend that all individuals submitted to orthodontic therapy must receive the educational/ preventive oral health program, regardless of the efficacy of plaque control at the beginning of treatment.

In a critical review by Opshal et al [23] about educational and preventive measures in orthodontic patients, the authors inferred the need for follow-up visits throughout the entire course of treatment, with periodical re-evaluations that considered the risk for caries disease, measures of professional prophylaxis and analysis of patients' behavior. In this regard, control of plaque, gingivitis and bleeding must be frequent and efficient in orthodontic patients [10].

The systematic review carried out by Oliveira Júnior et al. [24] evaluated studies in which oral health instructions were disseminated through online social networks. Their findings indicated a reduction in Gingival Index scores and an improvement in patients' oral health knowledge. It seems viable to use such instructions in face-to-face consultations and reinforce them through digital platforms, as visual aids are important to improve patient understanding [25].

The orthodontic treatment period may provide an opportunity for motivating patients with regard to their oral hygiene [10]. In this study, the educational measures proposed were shown to be effective in these adolescents, because there was reduction in the mean PI and GI values, however, this must be continuous and regular for the maintenance of adequate oral health. A possible limitation of the study was the short duration, therefore long-term comparative clinical studies are desirable to evaluate the relative effectiveness of various toothbrushes for the prevention of caries disease and gingivitis.

5. CONCLUSIONS

Based on the methodology of this study, the authors were able to conclude that:

- The educational/preventive measures used were shown to be effective, in view of the significant reduction in gingival inflammation and dental plaque indices, with improvement in the oral health of adolescents who wore fixed orthodontic appliances.

- The adolescents who wear fixed orthodontic appliances require educational/preventive support for the maintenance of oral health, because they constitute a group with difficulties in the mechanical control of dental plaque.

CONSENT

All authors declare that a written informed consent was obtained from the patients for publication of this study.

ETHICAL APPROVAL

All authors hereby declare that all experiments have been examined and approved by the appropriate ethics committee (Research Ethics Committee of UNOPAR, CAAE No: 208971) and have therefore been performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki.

REFERENCES

1. Cantekin K, Celigoklu M, Karadas M, Yildirim H, Erdem A. Effects of orthodontic treatment with fixed appliances on oral health status: A comprehensive study. J Dent Sci. 2011;6:235-238. DOI:10.1016/j.jds.2011.09.010
2. Corbacho de Melo MM, Cardoso MG, Faber J, Sobral A.Risk factors for periodontal changes in adult patients with banded second molars during orthodontic treatment. Angle Orthod.2012 Mar;82(2):224-8. DOI: 10.2319/030911-172.1
3. Salerno C, Grazia Cagetti M, Cirio S, Esteves-Oliveira M, Wierichs RJ, Kloukos D, et al. Distribution of initial caries lesions in relation to fixed orthodontic therapy. A systematic review and meta-analysis. Eur J Orthod. 2024;46(2):1-15. DOI: 10.1093/ejo/cjae008
4. Noble J, Cassolato S, Karaikos N, Wiltshire WA. Point of care. Preventive and interceptive measures for improving and maintaining good oral hygiene and cariogenic control in orthodontics patients. J Can Dent Assoc. 2009;75(6):441-3.
5. Chaussain C, Opsahl Vital S, Viallon V, Vermelin L, Haignere C, Sixou M, et al. Interest in a new test for caries risk in adolescents undergoing orthodontic treatment. Clin Oral Investig. 2010 Apr;14(2):177-85. DOI: 10.1007/s00784-009-0276-2
6. Zanatta FB, Moreira CH, Rösing CK. Association between dental floss use and gingival conditions in orthodontic patients. Am J Orthod Dentofacial Orthop. 2011;140(6):812-21. DOI: 10.1016/j.ajodo.2011.06.028
7. Miethke RR, Vogt S. Comparison of the periodontal health of patients during treatment with the Invisalign® system and with fixed orthodontic appliances. J OrofacOrthop. 2005;66(3):219-29. DOI: 10.1007/s00056-007-0655-8
8. Gehlen I, Netuschil L, Berg R, Reich E, Katsaros C. The influence of a 0.2% chlorhexidine mouthrinse on plaque regrowth in orthodontic patients. A randomized prospective study. Part I: clinical parameters. J OrofacOrthop. 2000;61(1):54-62. DOI: 10.1007/BF02340932
9. Gray D, McIntyre G. Does oral health promotion influence the oral hygiene and gingival health of patients undergoing fixed appliance orthodontic treatment? A systematic literature review. J Orthod. 2008;35(4):262-9. DOI: 10.1179/14653120722770
10. Bardal PAP, Olympio KPK, Bastos JRM, Henriques JFC, Buzalaf MAR. Education and motivation in oral health: preventing disease and promoting health in patients undergoing orthodontic treatment. Dental Press J Orthod. 2011;16(3):95-102.

11. Smiech-Slomkowska G, Jablonska-Zrobek J. The effect of oral health education on dental plaque development and the level of caries-related *Streptococcus mutans* and *Lactobacillus* spp. Eur J Orthod. 2007;29(2):157-60. DOI: 10.1093/ejo/cjm001
12. Ainamo J, Bay I. Problems and proposals for recording gingivitis and plaque. Int Dent J. 1975;25(4):229-35.
13. Löe H, Silness J. Periodontal disease in pregnancy. Acta Odontol Scand. 1963;21(6):533-51. DOI: 10.3109/00016356309011240
14. Quigley GA , Hein JW. Comparative cleansing efficiency of manual and power brushing. J Am Dent Assoc. 1962;65(1):26-9. DOI: 10.14219/jada.archive.1962.0184
15. Turesky SS.What is the role of dental calculus in the etiology and progression of periodontal disease? J Periodontol. 1970;41(5):285-6.
16. Kossack C, Jost-Brinkmann PG. Plaque and gingivitis reduction in patients undergoing orthodontic treatment with fixed appliances – comparison of toothbrushes and interdental cleaning aids. A 6-month clinical single-blind trial. J OrofacOrthop. 2005;66(1):20-38. DOI: 10.1007/s00056-005-0344-4
17. Goh HH. Interspace/Interdental brushes for oral hygiene in orthodontic patients with fixed appliances. Cochrane Database Syst Rev. 2007;18(3): CD005410. DOI: 10.1002/14651858.CD005410.pub2
18. Klukowska M, Bader A, Erbe C, Bellamy P, White DJ, Anastasia MK, et al. Plaque levels of patients with fixed orthodontic appliances measured by digital plaque image analysis. Am J Orthod Dentofacial Orthop. 2011;139(5):e463-70. DOI: 10.1016/j.ajodo.2010.05.019
19. Erbe C, Klukowska M, Tsaknaki I, Timm H, Grender J, Wehrbeinf H. Efficacy of 3 toothbrush treatments on plaque removal in orthodontic patients assessed with digital plaque imaging: a randomized controlled trial. Am J Orthod Dentofacial Orthop. 2013;143(6):760-6. DOI: 10.1016/j.ajodo.2013.03.008
20. Zingler S, Pritsch M, Wrede DJ, Ludwig B, Bister D, Kneist S, et al. A randomized clnical trial comparing the impacto f diferente oral hygiene protocols and sealant applications on plaque, gingival, and carie index scores. Eur J Orthod. 2014;36(2):150-63. DOI: 10.1093/ejo/cjt043
21. Ekstrand KR, Bruun G, Bruun M. Plaque and gingival status as indicators for caries progression on approximal surfaces. Caries Res. 1998;32(1):41-5. DOI: 10.1159/000016428

22. Hadzic S, Gojkov-Vukelic M, Pasic E, Jahic IM, Muharemovic A, Redzepagic-Vrazalica L, et al. Evaluation of Periodontal Changes in Patients Before, During, and After a Fixed Orthodontic Therapy. Mater Sociomed. 2022;34(2):121-125. DOI: 10.5455/msm.2022.34.121-125.
23. Opshal Vital S, Haignere-Rubinstein C, Lasfargues JJ, Chaussain C. Caries risk and orthodontic treatment. Int Orthod. 2010;8(1):28-45. DOI: 10.1016/j.ortho.2009.12.003
24. de Oliveira Júnior AJ, Oliveira JM, Bretz YP, Mialhe FL. Online social networks for prevention and promotion of oral health: a systematic review. Can J Dent Hyg. 2023 Jun 1;57(2):83-97.
25. Karkazi F, Antoniadou M, Demeterová K, Konstantonis D, Margaritis V, Lysy J. Orthodontic Risk Perspectives among Orthodontists during Treatment: A Descriptive Pilot Study in Greece and Slovakia. Healthcare (Basel). 2024;12(4):492. DOI: 10.3390/healthcare12040492.