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Condition of periodontium in patients with fixed orthodontic appliances

Stanje periodoncijuma kod pacijenata sa fiksnim ortodontskim aparatima

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Abstract

Background/Aim. Orthodontic patients should be familiar with techniques of maintaining oral hygiene as well as with proper methods of checking maintenance of oral hygiene. The aim of this study was to determine a correlation between condition of periodontium and techniques of maintaining oral hygiene in patients treated with fixed orthodontic appliances. **Methods.** The research population included 100 patients, aged 15–25, treated by the orthodontist from 2005 to 2010. The maintenance of oral hygiene and the condition of periodontium was assessed using the following indices: plaque index, gingival index, bleeding index and oral hygiene index. The study was carried out using data obtained from the especially designed questionnaire as well as by objective examination of periodontal condition in accordance with the World Health Organization methodology, using adequate indicators and indices. **Results.** The results of the study show a significant correlation between condition of periodontium and oral hygiene in those with fixed orthodontic appliances. The use of interdental brushes and mouthwash liquid, as well as teeth brushing, were among the most significant predictors of healthy teeth and mouth. **Conclusion.** Teeth and mouth hygiene determined by frequency of teeth brushing, using of interdental brushes and mouthwash liquid are the basic preconditions for preservation and promotion of tooth and mouth health in patients with fixed orthodontic appliances.

Key words:
orthodontic appliances; periodontium; oral hygiene; dental plaque index; periodontal index; questionnaires.

Apstrakt

Uvod/Cilj. Ortodonski pacijent mora da poznaje tehnike održavanja higijene usta i zuba kao i metode za pravilnu provjeru održavanja higijene usta i zuba. Cilj rada bio je da se utvrdi korelacija između stanja zdravlja zuba i faktora sredine, odnosno navika kod ispitivanih osoba koje izvjestan vremenski period nose fiksnu protezu. **Metode.** Istraživanje je obavljeno na 100 ortodonskih pacijenata, starosti od 15 do 25 godina, koji su posjećivali ordinaciju ortodonta u periodu 2005–2010. godine. Vršena je procjena zdravlja usta i zuba na osnovu sledećih indeksa: plak indeksa, gingivalnog indeksa, indeksa krvarenja i indeksa oralne higijene. Istraživanje je rađeno na osnovu podataka dobijenih iz posebno napravljenog upitnika i na osnovu objektivnog istraživanja zdravlja usta i zuba, po usvojenoj metodologiji Svetske zdravstvene organizacije, a na osnovu adekvatnih indikatora. **Rezultati.** Utvrđena je statistički značajna povezanost između stanja zdravlja usta i zuba i održavanja oralne higijene kod osoba sa fiksnim ortodonskim aparatima. Kao značajni prediktori zdravlja usta i zuba izdvojili su se korišćenje interdentalne četkice i tečnosti za ispiranje usta, kao i redovno pranje zuba. **Zaključak.** Higijena usta i zuba, koju određuju učestalost pranja zuba i korišćenje interdentalnih četkica i tečnosti za ispiranje usta i zuba, osnovni su preduslovi očuvanja i unapređenja zdravlja usta i zuba osoba za fiksnim ortodontskim aparatom.

Ključne reči:
ortodontski aparati; periodoncijum; usta, higijena; zub, indeks plaka; periodontalni indeks; upitnici.

Introduction

A correct position of teeth in the dental arch as well as a proper relationship between the jaws, are both essential for proper functioning of the orofacial system. This also provides the most favourable decomposition of forces released during mastication and uniform load distribution on teeth and joints. Most people have some degree of malocclusion, but disturbances in function and aesthetics do not require treatment for all of them [1]. Adequate orthodontic treatment is required in cases with the position of teeth causing overloading of jaw joint and individual teeth, as well as more rapid tooth decay due to development of periodontitis and periodontal disease. In addition, incorrect tooth position may also allow retention of food debris and bacteria which can stimulate dental plaque formation and its impact on the development

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of caries and periodontal disease. Aesthetic reason is only the third among the most important reasons for orthodontic treatment, although it is almost the sole reason for patients to visit a dentist. If there is any of the abovementioned reasons for orthodontic treatment it is necessary to ensure integrated activities of a patient, an orthodontist and dentists of other specialties [2]. All of them play a role and have responsibility as complete for adequate mouth and tooth hygiene in orthodontic patients, which is one of the preconditions of oral health. Plaque formation during orthodontic treatment may cause hyperplastic gingivitis with increased pocket depth. The tendency of elevated plaque formation was observed in cases of increase in basic changes on the surface of the enamel. Therefore, the highest standards of oral hygiene should be applied during the orthodontic treatment [3].

Orthodontic patients should be familiar with techniques of maintaining mouth and tooth hygiene, as well as with proper methods of checking mouth and tooth hygiene. All their carious teeth should also be treated so that endodontic treatment of teeth could be done. For orthodontic patients, especially those with fixed appliances, regular check-ups are very important in order to prevent functional and aesthetic improvement at the expense of increased carious activity and gingival tissues diseases [4]. It is a well-known fact that orthodontic patients have problems with a large number of pathogenic microorganisms because wearing an appliance easily increases accumulation of groups of bacteria. Because of that, it is necessary to provide them with adequate information and knowledge regarding proper and complete oral and dental hygiene. It is the duty of orthodontists to involve the patient in a systematic program for prevention of dental caries and periodontal disease with activities directed towards removal of pathogenic microorganisms. In this way possible harmful pathological effect of orthodontic treatment can be prevented [5].

The aim of this study was to determine a correlation between condition of periodontium and techniques of maintaining oral hygiene in patients wearing fixed appliances for a certain period of time.

Methods

The research was conducted on 100 patients, aged 14–26 treated at the Dental Clinic of the Tivat Medical Center by the orthodontist from 2005 to 2010. They were asked to take part in the research and the decision was theirs. For those who were minors their parents were asked and they decided on their behalf. Examinations were conducted during regular dental check-ups of patients with fixed orthodontic appliances (braces). The patients were in good general health and did not receive fluoro-prophylactic treatment. A dentist mirror and a probe were used in accordance with World Health Organisation criteria. The assessment of oral hygiene index (OHI) was carried out in all the examined patients. It included the assessment of soft layers in the following way: 0 indicated that no soft layers on teeth; 1 indicated soft layers covering 1/3 of the tooth surface; 2 indicated soft layers covering 2/3 of the tooth surface.

In order to assess the condition of periodontium the following indices were used [6]: plaque index (PI), gingival index (GI) and gingival bleading index (GBI).

PI refers to examination and probing while determining the presence and quantity of dental plaque in gingival third of vestibular and oral side of each tooth and its numerical marking [6]: 0 point indicates that dental plaque cannot be detected neither with examination nor with probing; 1 point – dental plaque cannot be seen but it can be detected by probing; 2 points – moderate amount of dental plaque that can be detected by both examination and probing; 3 points – a large amount of dental plaque can be easily seen.

PI was calculated by dividing the sum of the obtained values, first by the number of the examined teeth and then by the number of the examined sides.

GI determines the presence and the degree of gingival inflammation. Examination was performed to determine whether there was inflammation [6]. If it was present, the degree of inflammation was numerically graded on the vestibular and oral side of each tooth: 0 – inflammation is not present; 1 – mild inflammation, slight redness and/r mild gingival swelling; 2 – inflammation, redness and/or gingival swelling; 3 – severe inflammation, marked redness and/or gingival swelling.

GI was calculated by dividing the sum of the obtained values first by the number of examined teeth and then by number of examined sides.

GBI determines the presence and the extent of gingival bleeding and indirectly the degree of inflammation [6]. A periodontal probe was pulled through gingival sulcus from the vestibular side of each tooth in the first and third quadrant and from the oral side of each tooth in the second and fourth quadrant. The extent of bleeding was then numerically graded: 0 – no bleeding; 1 – spot bleeding; 2 – line bleeding; 3 – blood fills the entire gingival sulcus; 4 – blood spills out from the sulcus.

GBI was calculated by dividing the sum of the obtained values by the number of the examined teeth.

In addition to clinical examination the questionnaire was used as a research instrument. Data on sociodemographic characteristics of respondents as well as data on their habits related to oral health were obtained from the questionnaire.

Statistical analysis

Statistical analysis was performed by using Statistica version 6 (StatSoft Inc., Tulsa, SAD) statistical package. Each index (OHI, PI and GI) was calculated separately for the maxilla and the mandible for each patient by summing the scores for each sector and dividing the sum by three. Overall oral hygiene index (OOHI) was calculated by summing all the three indexes for each sector for the maxilla or the mandible and dividing the sum by six. Average oral indexes were calculated by summing each of four indexes for maxilla with each for mandible and dividing the sum by two. This was done so that the results for each of the presented index would be comparable with the initially used scale for assessment of the indexes (0–3). The results were presented

as arithmetic means and standard errors of the means (SE). All the variables were normalized using logarithmic transformation before the analysis of variance (ANOVA). The changes in hygiene indexes over time together with changes over time corresponding to different categories of several factors with a possible influence on the level of hygiene indexes (age, gender, type of fixed prosthodontic appliance, constructive material, placement of appliance in maxilla and/or mandible) were analysed using repeated measures ANOVA using only one factor for each analysis. Multifactorial analysis was not done because of the small sample that would result in uneven and incomplete design. When age was used as factor sample was divided into quartiles and age quartiles were used as levels. As gender did not show any significant difference in any of the analyses of hygiene indexes dynamics ($p > 0.20$ for all) these results were not shown. As the calculus index did not show variability at the time point of temporary luting for its analysis Friedman ANOVA was used. The value of $p < 0.05$ was considered as statistically significant for all analyses.

Results

The research included a total of 100 respondents, more than half of them were female, and their education level and occupation varied (Figure 1). The results show a statistically highly significant correlation between PI and the frequency of tooth brushing. Most of the respondents with no plaque brushed their teeth more than twice a day (Table 1).

The results also show a statistically significant correlation ($p < 0.001$) between GBI and the frequency of teeth brushing (Table 2). Gingival bleeding was statistically significantly less frequently diagnosed in patients who brushed their teeth more than twice a day, which was statistically significant. Grades 3 and 4 of the GBI were not found among the patients.

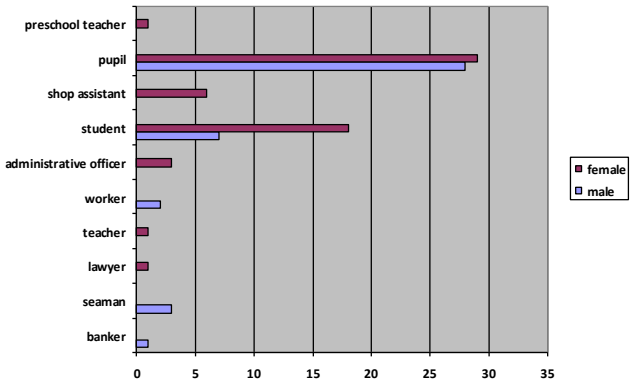

Fig. 1 – Distribution of the patients with fixed orthodontic appliances by sex and occupation.

Table 3 shows a statistically highly significant correlation between OHI and the frequency of tooth brushing. Higher values of OHI were found to be statistically significantly more frequent in the patients who brushed their teeth up to twice a day or less often. In those patients layers of soft tissues were identified on a larger surface of the teeth (Table 3).

Multiple logistic regression models were used to determine a correlation between PI and hygiene habits of respondents with assumed formation of two groups. Plaque was not diagnosed in one group but it was diagnosed in the other one.

The variables which were identified as predictors of risk for diagnosing PI were: use of interdental brushes and mouthwash liquid. Namely, those respondents who regularly used interdental brushes and mouthwash liquid were statistically significantly less frequently at risk of being identified plaque index. The same values were also presented in the risk of occurrence of GI (Table 4).

In the second model with a dependent variable that rep-

Table 1

Prevalence of plaque index (PI) values in patients with fixed orthodontic appliances in dependence of tooth brushing frequency

The clinical sing and PI point	PI		Total
	twice a day	> twice a day	
No plaque (0)	8	26	34
Thin layer of plaque (1)	38	4	42
Moderate amount of plaque (2)	24	0	24
Large amount of plaque (3)	0	0	0
Total	70	30	100
Pearson $\chi^2 = 53.635$; $p < 0.001$			

Table 2

Prevalence of gingival bleeding index (GBI) values in patients with fixed orthodontic appliances in dependence of tooth brushing frequency

The clinical sing and GBI point	Frequency of tooth brushing		Total
	twice a day	> twice a day	
No bleeding (0)	12	28	40
Spot bleeding (1)	38	0	38
Line bleeding (2)	22	0	22
Total	72	28	100
Pearson $\chi^2 = 51.005$; $p < 0.001$			

Table 3

Prevalence of oral hygiene index (OHI) values in patients with fixed orthodontic appliances in dependence of tooth brushing frequency

The clinical sing and OHI point	Frequency of tooth brushing		Total
	twice a day	> twice a day	
No soft layers (0)	13	28	41
Layers up to 1/3 of teeth (1)	37	4	41
Layers from 1/3 to 2/3 of teeth (2)	18	0	18
Total	69	34	100
Pearson $\chi^2 = 56.811$; $p < 0.001$			

Table 4

Variables – predictors of risk groups in the logistic model of plaque index

Risk predictors	B	S.E.	Wald	df	*p*	Exp(B)
Use of interdental brushes	3.897	1.152	11.447	1	0.001	49.246
Use of mouthwash liquid	2.287	0.986	5.379	1	0.020	9.844
Constant	-9.212	5.810	2.514	1	0.113	0.000

B – regression coefficient; S.E. – standard error; Wald – Wald statistical test which tests statistical significance of each coefficient (b); df – degrees of freedom; *p* – statistical significance; EXP(B) – relative risk , that is odd ratio.

resents the risk level for occurrence of GBI, two separate levels were identified: no gingival bleeding and gingival bleeding. This model determined the following sequence of variables – risk predictors: the use of interdental brushes, the use of mouthwash liquid and tooth brushing (Table 5).

In the third logistic regression model dependent variable was the risk measured by OHI in relation to oral hygiene habits. This model singled out the use of interdental brush as a significantly more favourable values of appropriate indicators of oral health.

Clark [7] believes that the knowledge, skills and motivation are the basis of adequate oral hygiene. It is therefore essential that during any dental check-up dentists make comments on patient's oral hygiene, so that they can learn how to apply the knowledge about oral hygiene. Dentists should motivate them in order to get positive feedback [7]. The study results also highlight the importance of adequate and comprehensive information on the application of modern techniques as well as training in their application in order to preserve and improve oral health.

Table 5

Variables – risk group predictors in the logistic model of gingival bleeding

Risk predictors	B	S.E.	Wald	df	*p*	Exp(B)
Tooth brushing	-2.565	1.114	5.302	1	0.021	0.077
Use of interdental brush	3.578	1.153	9.629	1	0.002	35.790
Use of mouthwash liquid	3.354	1.262	7.064	1	0.008	28.620
Constant	-5.437	5.750	0.894	1	0.344	0.004

For explantation of abbriviations, see the note under Table 4.

Table 6

Variables – risk group predictors in the logistic model of OHI

Risk predictors	B	S.E.	Wald	df	Sig.	Exp(B)
Use of interdental brush	3.326	1.044	10.152	1	0.001	27.820
Constant	43.282	12969.702	0.000	1	0.997	6.26618

For explantation of abbreviations, see the note under Table 4.

significant predictor of plaque formation (Table 6).

Discussion

Adequate oral hygiene of patients undergoing orthodontic treatment with a fixed appliance implies the involvement of a specialist (an orthodontist), a general dentist, parents and a patient in the active treatment process. The study shows a statistically significant correlation between the use of modern means of oral hygiene and oral health indicators values. The frequency of teeth brushing significantly determines the condition of oral health measured by appropriate indicators. Patients with a fixed orthodontic appliance who brush their teeth more frequently than twice a day have statistically significant more favourable values of appropriate indicators of oral health.

The results of earlier rescarchs it can be suggest that the condition of oral health in the examined patients with fixed orthodontic appliance could be improved by taking measures such as health education, training and revising. Oral hygiene techniques should also be checked and constant motivation of patients should be provided [8, 9]. The similar results were confirmed by this study which found that only tooth brushing was not enough for the complete protection of oral health when the fixed orthodontic appliances were used. The importance of using interdental brushes and mouthwash liquid

by all patients was also stressed especially by those with a fixed appliance.

Some authors suggest two major factors for orthodontis to take into account specific needs of patients who were the subjects of the examination (disease susceptibility, condition of the mouth) and individual characteristics (preferences, manual dexterity and lifestyle) [10]. However, there is no doubt that taking adequate and concrete measures and following the recommended procedures can significantly preserve oral health of patients who wear fixed orthodontic appliances.

It is very important to consider the efficiency and predictability of psychological and educational methods used to follow the guidelines for maintaining oral hygiene in orthodontic patients as well as the consequences of failure to comply with these guidelines. Consistent application of appropriate knowledge and skills can contribute to saving time and money and reduce the risk of unwanted treatments which are often associated with poor oral hygiene [9].

Conclusion

The study shows oral hygiene as significantly correlated with oral health of patients who underwent orthodontic treatment with fixed appliances. Frequency of tooth brushing correlates with the condition of oral health assessed by the relevant health indicators. Additionally, interdental brush and mouthwash liquid as measures of oral hygiene are significant variables of oral health in patients with fixed orthodontic appliances.

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