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ORIGINAL PAPER

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Evaluation of Periodontal Changes in Patients Before, During, and After a Fixed Orthodontic Therapy

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ABSTRACT

Background: Periodontal complications are one of the common side effects associated with orthodontic therapy. **Objective:** This study aimed to evaluate the periodontal changes in patients before, during, and after the therapy with a fixed orthodontic appliance. **Methods:** Out of 38 healthy adolescents with permanent dentition who were indicated for fixed orthodontic therapy were included in this study. Patients were selected from Class I, treated by non-extraction methods, by using conventional orthodontic braces. After their examination and treatment by an orthodontist, the patients were referred to the periodontist before the placement of a fixed orthodontic appliance. The patients underwent the application of a periodontal anamnestic-diagnostic protocol, and the clinical-radiological evaluation. After a fixed orthodontic appliance was placed, the respondents were referred to the periodontist for regular mandatory check-ups, initially, after three months, and later on—after 6 months, after 1 year and after 2 years until the end of orthodontic therapy. **Results:** An increase in the mean value of the Plaque Index and Sulcus Bleeding Index was found at each check-up after the placement of a fixed orthodontic appliance. There is a statistically significant difference in the presence of gingival hyperplasia found by monitoring the changes after three and six months, and after one and two years following the start of orthodontic therapy. **Conclusion:** The assessment of periodontal changes in patients before, during and after the completion of fixed orthodontic therapy revealed that there is a strong need for mutual and close cooperation between orthodontist and periodontist during orthodontic therapy.

Keywords: Gingivitis, Gingival hyperplasia, Fixed Orthodontic therapy,

1. BACKGROUND

The microbiological basis of gingival and periodontal tissue diseases has been known for a long time. Dental plaque microorganisms act in two ways: they damage the tissue directly, while indirectly provoking the release of numerous inflammatory mediators (cytokines, prostaglandins) which can then contribute to the occurrence of tissue damage (1). Malocclusion and its impact on periodontal tissues have been the focus of interest to a great number of studies for many years, and the mutual relationship between periodontology and orthodontics is an issue that leaves ample room for further research (2-5).

The American Association of Orthodontists (6) defines orthodontics or dentofacial orthopedics as a branch of dentistry that deals with monitoring, directing, and correcting the growth and development of dentofacial structures. The main goal of orthodontic treatment is to achieve a balanced, functional, and aesthetic occlusion with minimal damage to teeth and surrounding structures. Nevertheless, like any other medical intervention, orthodontic therapy also involves certain risks that are combined with its benefits. Periodontal complications are one of the most common side effects associated with orthodontic therapy. Proper teeth position makes oral hygiene much easier; however, the practice of correcting teeth through orthodontic therapy can harm periodontium by directly irritating the gingiva and by endangering the effectiveness of oral hygiene, particularly in cases of therapy with a fixed orthodontic appliance.

There is a great deal of controversy about the impact of fixed orthodontic therapy on the

health of the patients' periodontium. Most studies have reported an increase in the values of the Plaque Index (PI) within 1-3 months after the placement of an orthodontic appliance (7-12). The presence of gingival changes of varying intensity has been recorded in most patients who receive the therapy with a fixed orthodontic appliance (13). Consequently, the need has arisen to undertake this study, where the most common changes in the periodontium and the most common etiological factors that led to these changes have been recorded by monitoring the periodontal condition from the beginning to the end of the fixed orthodontic therapy.

2. OBJECTIVE

The objective of this study is to evaluate the periodontal changes in patients before, during, and after the therapy with a fixed orthodontic appliance.

3. MATERIALS AND METHODS

The study included 38 patients with permanent dentition under the age of eighteen, who were referred to the Department/Clinic of Orthodontics of the Faculty of Dentistry with Clinics, based in Sarajevo, and who were indicated for fixed orthodontic therapy. According to their medical history, these patients are healthy adolescents without the presence of any systemic diseases and they are non-smokers. To better stratify the sample, the patients were selected from Class I – i.e. those with a slight degree of crowding. It included the patients treated by non-extraction methods, i.e. the non-extraction cases, while the treatment was conducted on both jaws by using conventional orthodontic braces. All respondents (parents/guardians) gave their written consent for treatment at both Departments/Clinics and consent to participate in the research.

After their examination and treatment by an orthodontist, the patients were referred to the Department of Periodontology of the Faculty of Dentistry in Sarajevo before the placement of a fixed orthodontic appliance. The patients underwent the application of a periodontal anamnestic-diagnostic protocol, and the clinical-radiological evaluation (OPG image analysis). The periodontal anamnestic-diagnostic protocol included the evaluation of the following parameters: *Silness-Löe Plaque Index (IPL)*, *Silness-Löe Calculus Index (CI)*, *Silness-Löe Gingival Index (GI)*, *Muhlemann-Son Sulcus Bleeding Index (SBI)*, *Periodontal Pocket Probing Depth (PPD)*, gingival recession (retraction) and the teeth mobility. All patients underwent the complete initial periodontal therapy. After a fixed orthodontic appliance was placed, the respondents were referred to the Department/Clinic of Periodontology of the Faculty of Dentistry in Sarajevo for regular mandatory check-ups, initially, after three months, to evaluate the level of the patient's motivation and do the first periodontal check-up, and later on—after 6 months, after 1 year and after 2 years until the end of orthodontic therapy. The complete periodontal protocol was being applied repeatedly and the previously examined parameters were being recorded continually. Once the fixed orthodontic appliance was removed, a clinical X-ray evaluation was repeated for all patients. All clinically tested parameters and obtained results were entered in the dental records

that were designed specifically for this study.

Statistical analysis

SPSS for Windows (version 21.0, SPSS Inc, Chicago, Illinois, USA) and Microsoft Excell (version 11. Microsoft Corporation, Redmond, WA, USA) were used for statistical analysis of the collected data. The χ^2 test was used to analyze the descriptive statistics. The ANOVA test was used to examine the statistical significance among the groups. The value of $\alpha = 0.05$ was taken as the limit of statistical significance.

4. RESULTS

The achieved results were elaborated and documented in greater detail, presented in absolute figures and relative percentages, as statistical values with the use of statistical indicators, and presented in several simple and comprehensible tables and graphs. An increase in the mean value of the Plaque Index was found at each check-up after the placement of a fixed orthodontic appliance. The mean value of the Calculus Index shows an increase recorded after three and six months and a decrease after one and two years following the placement of a fixed orthodontic appliance. There is no statistically significant difference in the values of the Calculus Index before and two years after

	Sex		
	Male	Female	Total
	Mean	Mean	Mean
Plaque Index at the first check-up	0.9	0.6	0.8
Plaque Index after 3 months	1.1	0.6	0.8
Plaque Index after 6 months	1.1	0.8	0.9
Plaque Index after 1 year	1.1	0.9	1.0
Plaque Index after 2 years	1.4	1.0	1.1

Table 1. Mean value of the Plaque Index

	Sex		
	Male	Female	Total
	Mean	Mean	Mean
Calculus Index at the first check-up	0.2	0.1	0.1
Calculus Index after 3 months	0.2	0.2	0.2
Calculus Index after 6 months	0.4	0.3	0.3
Calculus Index after 1 year	0.2	0.2	0.2
Calculus Index after 2 years	0.3	0.2	0.2

Table 2. The mean value of the Calculus Index recorded in the respondents

	Sex		
	Male	Female	Total
	Mean	Mean	Mean
Sulcus Bleeding Index at the first check-up	1.4	1.2	1.3
Sulcus Bleeding Index after 3 months	2.3	1.7	1.9
Sulcus Bleeding Index after 6 months	2.5	2.3	2.3
Sulcus Bleeding Index after 1 year	2.3	2.5	2.4
Sulcus Bleeding Index after 2 years	2.5	2.4	2.5

Table 3. Mean value of the Sulcus Bleeding Index

the start of therapy. odontitis, and bone resorption recorded in the respondents

		Sex					
		Male		Female		Total	
		N	%	N	%	N	%
Gingival hyperplasia present at the first check-up	No	10	26.3	19	50	29	76.3
	Yes	5	13.2	4	10.5	9	23.7
	Total	15	39.5	23	60.5	38	100
Gingival hyperplasia after 3 months	No	7	18.4	11	28.9	18	47.4
	Yes	8	21.1	12	31.6	20	52.6
	Total	15	39.5	23	60.5	38	100
Gingival hyperplasia after 6 months	No	6	15.8	7	18.4	13	34.2
	Yes	9	23.7	16	42.1	25	65.8
	Total	15	39.5	23	60.5	38	100
Gingival hyperplasia after 1 year	No	4	10.5	5	13.2	9	23.7
	Yes	11	28.9	18	47.4	29	76.3
	Total	15	39.5	23	60.5	38	100
Gingival hyperplasia after 2 years	No	5	13.2	5	13.2	10	26.3
	Yes	10	26.3	18	47.4	28	73.7
	Total	15	39.5	23	60.5	38	100

Table 4. Presence of gingival hyperplasia in the recorded period

		Sex					
		Male		Female		Total	
		N	%	N	%	N	%
Recessions present at the first check-up	No	13	34.2	23	60.5	36	94.7
	Yes	2	5.3	0	0.0	2	5.3
	Total	15	39.5	23	60.5	38	100
Recessions after 3 months	No	12	31.6	22	57.9	34	89.5
	Yes	3	7.9	1	2.6	4	10.5
	Total	15	39.5	23	60.5	38	100
Recessions after 6 months	No	13	34.2	22	57.9	35	92.1
	Yes	2	5.3	1	2.6	3	7.9
	Total	15	39.5	23	60.5	38	100
Recessions after 1 year	No	12	31.6	22	57.9	34	89.5
	Yes	3	7.9	1	2.6	4	10.5
	Total	15	39.5	23	60.5	38	100
Recessions after 2 years	No	12	31.6	22	57.9	34	89.5
	Yes	3	7.9	1	2.6	4	10.5
	Total	15	39.5	23	60.5	38	100

Table 5. Percentage of recessions found in the respondents

The mean value of the Sulcus Bleeding Index shows a constant increase from the moment of placement of a fixed orthodontic appliance to the end of treatment.

There is a statistically significant difference in the presence of gingival hyperplasia found by monitoring the changes after three and six months, and after one and two years following the start of orthodontic therapy.

No statistically significant difference has been found in the presence of gingival recession during the recorded period. The results show that there was no statistically significant difference in the presence of gingivitis, peri-

before the start of therapy and after two years of monitoring of these parameters.

5. DISCUSSION

The objective of this study was to evaluate periodontal changes in patients before, during, and after completion of the fixed orthodontic therapy. The results show an increase in the mean value of the Plaque Index at each check-up after the placement of a fixed orthodontic appliance. The presence of a fixed orthodontic appliance in the mouth makes the maintenance of oral hygiene much more difficult, which

may be the reason for the increase in the value of the Plaque Index. Similar results were published in a retrospective study by Boka et al. (14), and they concluded that the mean value of visible plaque has increased significantly during orthodontic treatment. The results published by Liu et al. (15) were in line with the said findings. In contrast to these studies, Davies et al. (16) have reported that the respondents with an orthodontic appliance had lower Plaque Index values compared to those in the control group, which [control group] did not undergo orthodontic treatment. They believed that more frequent visits to an orthodontist motivate patients to better maintain their oral hygiene.

Another study involving two groups of patients, one with a fixed orthodontic appliance and the other without an orthodontic therapy, has reported similar results, indicating that both groups had low Plaque Index values with no significant differences between the groups (4). As far as the Calculus Index is concerned, although its value has increased slightly after the start of orthodontic therapy, there is no statistically significant difference in these values before and 2 years after the start of orthodontic therapy. The increased Calculus Index values are usually associated with wearing a fixed orthodontic retainer due to its lingual position rather than with wearing a fixed orthodontic appliance (17,18). The next in line of evaluated parameters was the Sulcus Bleeding Index. The mean value of this index shows a steady increase from the moment of placement of a fixed orthodontic appliance to the end of treatment. In a similar study, conducted by Kawsar et al., the conclusion was that the Bleeding Index has increased in the respondents with a fixed orthodontic appliance. The said authors have observed that the value of this index becomes lower with the more intensive use of soft toothbrushes, dental floss, interdental brushes, and mouthwash by the patient (19). A similar conclusion was also reached through a systematic review of the literature, which has also brought to attention the importance of oral hygiene and education and motivation of orthodontic patients to preserve the periodontal health during orthodontic treatment (20). A study examining the Sulcus Bleeding Index in orthodontic patients with conventional orthodontic braces and clear aligners has found that this index, like other periodontal parameters, was considerably lower in those patients who were treated with clear aligners (21).

We can conclude that in periodontally compromised patients, orthodontic therapy with clear aligners is recommended whenever possible. The presence of gingival hyperplasia is the parameter that has recorded the greatest degree of increase during orthodontic therapy. At the beginning of the research, before the placement of a fixed orthodontic appliance, 23.7% of the respondents had gingival hyperplasia, while after the end of a two-year therapy, that percentage has increased to 73.7%. These results were expected to some extent because poor oral hygiene was indicated as the main cause of gingival hyperplasia, while the value of the Plaque Index has also increased in the respondents covered by this study. Results similar to ours have been published by other researchers as well (9, 22). In addition to poor oral hygiene, it has been suggested over the recent years that continually low doses of nickel from

the corrosion of orthodontic appliances, which is released into the epithelium, may be the cause of gingival hyperplasia in orthodontic patients (23–26). Another factor that may be associated with the onset of gingival hyperplasia are hormonal changes that occur during puberty (3), which is why special attention should be paid to oral hygiene in adolescents with a fixed orthodontic appliance. A study conducted by Eid et al. has concluded that the patients with a fixed orthodontic appliance who maintain an adequate level of oral hygiene did not experience gingival hyperplasia (27). As far as the evaluation of the occurrence of gingival recession is concerned, it has been found that there is no statistically significant difference in the presence of gingival recession during the research period. Results similar to ours have been published by Morris J.W. et al., who have concluded that orthodontic treatment is not a major risk factor for the occurrence and development of gingival recessions (28). In contrast to our results, Renkem et al. conclude that the incidence of the gingival recession has increased after orthodontic treatment and that recessions are found more commonly in older than in younger respondents (29). A study that investigated the occurrence of recession in orthodontic patients has also concluded that there is an increased level of risk for their occurrence, particularly in lower incisors (30). The results show that there has been no statistically significant difference in the presence of gingivitis, periodontitis, and bone resorption in the respondents recorded before the start of therapy and after two years of monitoring of these parameters. Consequently, despite several difficulties associated with the maintenance of oral hygiene, resulting from the presence of a fixed orthodontic appliance in the mouth, the respondents did not develop any severe periodontal diseases.

6. CONCLUSION

The evaluation of periodontal changes in patients before, during, and after completion of a fixed orthodontic therapy has found that gingival hyperplasia is the most common periodontal disease.

The patients with a fixed orthodontic appliance have had a high Plaque Index, which shows the importance of education and motivation of patients for better maintenance of oral hygiene, which is necessary for the prevention of periodontal diseases.

There is a strong need for mutual and close cooperation between an orthodontist and a periodontist during orthodontic therapy.

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