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Index Assessment of Periodontal Tissues and Oral Hygiene in Persons with Dental Alveolar Anomalies

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Abstract The article describes diseases of periodontal tissues and oral hygiene level that occur in people with dental alveolar anomalies, their prevalence and provides a comparative analysis of the prevalence of periodontal diseases in people who do not suffer from orthodontic pathologies.

Keywords Periodontium, Periodontitis, Gingivitis, Orthodontics, Dental anomalies

1. Introduction

Orthodontic appliances make it difficult to clean teeth and, thus, create favorable conditions for the rapid accumulation of plaque [1]. The more complex the devices used, the more difficult it is for patients to maintain oral hygiene. As a result, enamel demineralization and gingivitis are considered the most common consequences of biofilm formation, affecting 50% to 70% of orthodontic patients, especially with fixed appliances [2,3]. Studies have shown that poor oral hygiene can prolong treatment times and even compromise treatment results [2,3]. To make matters worse, the progression of periodontal disease can lead to irreversible loss of supporting tissues [4]. These unwanted potential side effects can lead to unsatisfactory results or even premature cessation of orthodontic therapy - 5-10% of patients were unable to complete treatment due to oral hygiene problems [5].

To prevent the development and progression of dental diseases, orthodontists recommend their patients maintain an optimal oral hygiene regimen, including the use of mouth rinses, toothpastes and flosses, etc. However, most often, patients do not comply with these recommendations, which leads to inadequate oral hygiene and the need for monitoring in this high-risk group [6].

2. The Purpose of the Study

The goal was set: to assess oral hygiene and the condition of periodontal tissues even before the start of orthodontic treatment in people with dental anomalies in order to determine the need for this category of patients to develop preventive measures aimed at improving or preventing the deterioration of periodontal status and maintaining optimal level of oral hygiene during subsequent treatment.

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3. Materials and Methods

The study took place in 2020-2022 in Tashkent. The study involved 136 people aged 18 to 49 years, of both genders; 121 orthodontic patients and 25 people in the comparison group (persons without dental alveolar anomalies). Among patients with dental alveolar anomalies, men accounted for 35.13±2.24%, and women – 64.87±2.24%. In the comparative group, men accounted for 36.0±3.3%, and women – 64.0±3.3%. The distribution of those examined did not differ statistically between the groups ($p>0.05$). Patients underwent orthodontic treatment with fixed (braces) or removable (aligners) devices.

Of the total number of patients with dentofacial anomalies (100%), the largest number were anomalies of the dentition, which amounted to 44.7%, malocclusion was detected in 9.4%, anomalies in the position of individual teeth in 9.1% of people and combined pathology in 36 .8% people. 81.5% of those examined with dentition anomalies were diagnosed with crowded teeth, 7.4% were persons with concomitant pathology, 1.5% had anomalies in the shape of teeth, 7.6% had diastemas, 2.0% were persons with other anomalies.

4. Results and Discussion

4.1. Periodontal Indices

To assess the degree of inflammation in periodontal tissues, the PMA index was used. The values of the PMA index showed that in those examined with orthodontic pathology, moderate inflammation predominated (52.1%), and in the comparison group, mild inflammation predominated (50.9%). A severe degree of inflammation was detected in

25.5% of examined individuals with dental alveolar anomalies, which was 3.4 times more common than in individuals without orthodontic pathology.

Analysis of the data presented in Table 1 showed that the average value of the PMA index in the main group was significantly higher than in the comparison group ($p<0.001$).

Among those examined in the main group aged 18-29 years, the average severity of inflammation prevailed, which was detected in 58.07±3.16% of cases, which is significantly more often than in the comparison group - 21.23±5.82% ($p<0.001$), and the average PMA index was significantly more intense (38.16±0.45% versus 27.11±0.37%, respectively, $p<0.001$). The number of people with mild inflammation in this age category prevailed in the comparison group, however, the average value of the PMA index was significantly higher in the main group and amounted to 23.15±0.14% versus 15.01±0.56% in the comparison group ($p<0.001$).

Severe gingivitis in the age range of 18-29 years was diagnosed only in 4.67±0.81% of those examined in the comparison group and was significantly lower than in the main group - 12.53±2.57% ($p<0.05$), and the average value of the PMA index indicators similarly prevailed in those examined in the main group - 65.67±2.12% versus 61.5% in patients in the comparison group.

In patients of the main group, aged 30-39 years, a severe degree of inflammatory process was predominantly noted - in 56.2±5.41% of people, which significantly exceeded similar data in the comparison group - 11.40±3.74% of those examined ($p <0.001$), with a significantly higher average value of the PMA index in the main group relative to the comparison group (69.51±1.04% versus 62.4±0.85%, respectively $p<0.001$). The average degree of inflammation in this age interval was diagnosed in 29.66±5.30% of those examined in the main group, which was less common than in the comparison group - 61.40±7.45% ($p<0.01$), however, the intensity of the inflammatory process according to the value of the PMA index, it was higher in the main group and amounted to 42.29±0.92% versus 34.44±1.26% in the comparative group ($p<0.001$).

At the age of 40-49 years, a mild degree of inflammation was diagnosed in 9.28±0.37% of patients in the main group with a PMA index value of 28.4±0.98%, while in the comparison group a mild degree of gingivitis was observed in 26.2 ±4.54% of those examined with significantly lower intensity indicators – 21.75±1.39% ($p<0.001$).

An assessment of the gum bleeding index data (Table 2) showed that in those examined in the main group, this symptom of the inflammatory process was more intense than in persons without orthodontic pathology and amounted to 1.95±0.04 points at the age of 18-29 years, 2. 15±0.08 points at the age of 30-39 years and 2.34±0.08 points at the age of 40-49 years versus 1.45±0.03 points, 1.65±0.07 points and 1.75± 0.06 points, respectively ($p<0.001$).

In people of the main group aged 18-29 years, with a mild degree of gum inflammation, the bleeding index was 1.34±0.06 points, which was significantly higher than the corresponding values in the comparison group - 0.86±0.04 points ($p<0.001$).

With an average degree of inflammation in people of the main group of this age category, the bleeding index was 1.96±0.03 points, which also exceeded the similar value in the comparison group of 1.33±0.04 points ($p<0.001$). In case of severe inflammation, the average value of the bleeding index was 2.55±0.03 points in patients of the main group and 2.15±0.07 points in those examined in the comparison group ($p<0.001$).

Table 1. Severity of the inflammatory process in periodontal tissues and the average value of the PMA index in the study groups depending on age (M±m)

PMA Index (%)		Mild degree	Average degree	Severe degree
Main group, age				
18-29	Prevalence, %	29.40±3.87	58.07±3.16	12.53±2.57
	PMA (%)	23.15±0.14	38.16±0.45	65.67±2.12
30-39	Prevalence, %	14.14±0.56	29.66±5.30	56.2±5.41
	PMA (%)	25.2±1.12	42.29±0.92	69.51±1.04
40-49	Prevalence, %	9.28±0.37	25.34±4.27	65.38±4.39
	PMA (%)	28.4±0.98	47.11±0.52	71.27±0.56
Comparison group, age				
18-29	Prevalence, %	74.1±6.12*	21.23±5.82*	4.67±0.81***
	PMA (%)	15.01±0.56*	27.11±0.37*	61.5***
30-39	Prevalence, %	27.2±3.57**	61.40±7.45**	11.40±3.74*
	PMA (%)	19.63±1.26***	34.44±1.26*	62.4±0.85*
40-49	Prevalence, %	26.2±4.54**	62.24±6.24**	11.56±2.56*
	PMA (%)	21.75±1.39***	37.43±0.94*	65.5±0.67*

Note: Significance of the difference between the indicators of the main and comparative groups: * – $p<0.001$; ** – $p<0.01$; *** – $p<0.05$.

Table 2. Indicators of the gum bleeding index at different degrees of severity of gum inflammation in the study groups depending on age (M±m)

AGE	18-29	30-39	40-49
Main group			
Severity of the inflammatory process	SBI points		
Light	1.34±0.06	1.32±0.04	1.35±0.07
Average	1.96±0.03	2.15±0.11	2.34±0.08
Heavy	2.55±0.03	2.97±0.06	3.32±0.07
Average value	1.95±0.04	2.15±0.08	2.34±0.08
Comparative group			
Severity of the inflammatory process	SBI points		
Light	0.86±0.04*	1.01±0.03*	1.1±0.04*
Average	1.33±0.04*	1.7±0.07*	1.83±0.07*
Heavy	2.15±0.07*	2.23±0.07*	2.31±0.06*
Average value	1.45±0.03*	1.65±0.07*	1.75±0.06*

Note: Significance of the difference between the indicators of the main and comparative groups: * − p<0.001.

In the age range of 30-39 years, mild severity of inflammation was determined at the level of the bleeding index of 1.32±0.04 points and this indicator exceeded the average index value in the comparison group - 1.01±0.03 (p<0.001). With an average degree of inflammation at this age, the bleeding index in the main group was 2.15±0.11 points and exceeded the corresponding value in the comparison group - 1.7±0.07 points (p<0.001). With severe inflammation, the bleeding index in those examined in the main group aged 30-39 years was 2.97±0.06 points, which was significantly higher than in the comparison group - 2.23±0.07 points (p<0.001).

In the age range of 40-49 years, mild severity of inflammation was determined at a bleeding index level of 1.35±0.07 points against the average index value in the comparison group - 1.1±0.04 (p<0.001). With an average degree of inflammation at this age, the bleeding index in the main group was 2.34±0.08 points and exceeded the corresponding value in the comparison group - 1.83±0.07 points (p<0.001). With severe inflammation, the bleeding index in those examined in the main group aged 40-49 years was 2.34±0.08 points, which was significantly higher than in the comparison group - 1.75±0.06 points (p<0.001).

4.2. Oral Hygienic Indices

The OHI-S and API indices were used to assess the hygienic state of the oral cavity.

Analysis of the OHI-S index indicators (Table 3) showed that among those examined in the main group, an unsatisfactory state of oral hygiene prevailed (49.36±3.57%), which was almost twice as often as in the comparison group (25.36±5.24%). Poor oral hygiene was noted in 24.41±3.14% of those examined in the main group, which was also significantly more than in the comparison group – 7.26±2.15% (p<0.001). In the comparative group, the majority of those examined had a satisfactory state of oral hygiene (56.14±5.01%), while in the main group this figure was 20.1±2.89% of people (p<0.001).

Table 3. State of oral hygiene in study groups according to the OHI-S index (M±m)

Oral hygiene status	Main group, %	Comparative group, %
0-0.6 points – good	6.13±0.44	11.24±3.54**
0.7-1.6 points – satisfactory	20.1±2.89	56.14±5.01*
1.7-2.5 points – unsatisfactory	49.36±3.57	25.36±5.24*
> 2.6 points – bad	24.41±3.14	7.26±2.15*

Note: Significance of the difference between the indicators of the main and comparative groups: * − p<0.001; ** − p<0.01.

Assessment of dental plaque on the approximal surfaces according to the API index (Table 4) showed a satisfactory state of hygiene in the interdental spaces in the majority of those examined in the main group - 53.34±3.56%, which was significantly more often than in the comparative group - 38.69±5.91% people, respectively (p<0.05). An unsatisfactory level of interdental cleansing was detected in 31.08±3.34% of those examined in the main group, while in the comparative group only in 7.26±2.14% (p<0.001). An optimal and sufficient level of hygiene on approximal surfaces was more common in individuals without dental alveolar anomalies (p<0.01).

Table 4. Assessment of dental plaque on approximal surfaces in study groups according to the API index, (M±m)

Plaque on proximal surfaces	Main group, %	Comparative group, %
<25% – excellent	3.7±1.39	13.69±4.27**
25-39% - good	11.88±2.25	40.36±5.78*
40-69% - satisfactory	53.34±3.56	38.69±5.91***
70-100% - unsatisfactory	31.08±3.34	7.26±2.14*

Note: Credibility differences between the indicators of the main and comparative groups: * −p<0.001; ** − p<0.01; *** − p<0.05.

In order to compare the state of oral hygiene during orthodontic treatment, the average values of hygiene indices were determined (Table 5).

Table 5. Average indicators of hygiene indices OHI-S and API in the groups

	OHI-S points	API, %
Main group		
Before orthodontic treatment	1.10±0.05 p1<0.001	49.02±1.28 p1<0.001
During orthodontic treatment	1.24±0.05 p1<0.001 p2<0.001	70.54±1.44 p1<0.001 p2<0.001
Comparison group	0.72±0.03	37.8±2.02

Note: p1 – reliability of differences between the indicators of the main and comparative groups; p2 – significance of the difference between the indicators of the main group before and during orthodontic treatment.

As a result of the studies, it was established that the average OHI-S index in those examined in the main group during orthodontic treatment was 1.24±0.05 points, which

corresponded to the average state of oral hygiene and was significantly higher than before orthodontic treatment (1.10±0.05 points), and also significantly exceeded this indicator in the comparison group (0.72±0.03 points), where the state of hygiene was assessed as good ($p<0.001$).

The average index for assessing plaque on the approximal surfaces of the API in those examined in the main group during orthodontic treatment was 70.54±1.44%, which corresponded to an unsatisfactory level of interdental cleaning and was significantly worse than before orthodontic treatment (49.02±1.28%), where a satisfactory state of hygiene in the interdental spaces was determined, and significantly worse than in the comparison group (37.8±2.02%), where the level of hygiene in the proximal areas was sufficient ($p<0.001$).

5. Conclusions

Based on the results of determining oral hygiene indices in the study groups, it can be concluded that people with orthodontic anomalies have an unsatisfactory level of oral hygiene, which significantly worsens during orthodontic treatment with fixed appliances.

Limitations

There are some limitations to this study. Although the study was carried out during 3 years, the sample size was small. Future studies could consider broadening the recruitment range to account for potential influences of all factors on participants' oral health. Further investigations should analyze the effects of repeated motivation on periodontal indices score trends during the entire duration of orthodontic treatment in order to evaluate an orthodontic hygiene protocol. Even though a certain degree of bias exists in any randomized clinical trial, we tried to minimize major potential biases. In particular, an independent statistician who was not aware of the name of the participants and group assignment analyzed all our results.

Practical Implications

The obtained research results, relevant for different age groups, can be used to prevent the development of caries and periodontal diseases when treating orthodontic patients with different types of orthodontic appliances.

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