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ABSTRACT

of the dissertation for the degree Doctor of Philosophy

**PREVENTION OF PERIODONTAL DISEASES BY USING
HERBAL ORIGIN REMEDIES DURING ORTHODONTIC
TREATMENT WITH FIXED APPLIANCES**

Specialty: 3226.01 – Dentistry

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GENERAL REVIEW OF THE WORK

Actuality of the problem. Dental anomalies are at the forefront among dental pathologies, and due to, raising the standard of living of the population, the interest in this problem has increased in recent times

The results of dental studies conducted in several countries of the world have shown that Dental anomalies are widespread among the population. The fact that the prevalence of some forms of dental-alveolar anomalies has increased even to 90% makes it necessary to think about it seriously. According to recent studies, the prevalence of various forms of Dental anomalies among 12-17-year-old adolescents in the Republic of Azerbaijan was $63.09 \pm 0.7\%$, while 71.4% of them needed active orthodontic treatment using removable and fixed orthodontic appliances¹.

Anomalies in the craniofacial system, additionally causing defects and changes in a person's appearance, chewing function, and speech, can also become an etiological factor of periodontal diseases, so in this case, distribution of unequal revolve among teeth, groups of teeth, and dental arches are the main pathogenetic factor which is considered as one of the mechanisms^{2,3}

During treatment with fixed orthodontic appliances, it is possible to perform tooth movements that can be controlled in all three directions of space. Also, with these appliances, it is possible to achieve various movements of teeth - intrusion, extrusion, rotation,

¹ Pənahov, N.A. Azərbaycan Respublikasında yeniyetmələr arasında diş-cənə anomaliyalarının və deformasiyaların epidemiologiyası, ortodontik və ortopedik yardıma ehtiyacın öyrənilməsi, kompleks müalicə və profilaktika tədbirlərinin 285 əsaslandırılması: / tibb üzrə elmlər doktoru dissertasiyanın avtoreferatı / – Bakı, - 2013, - s.40

² Гасымова, З.В. Оптимизация методов диагностики, лечения и профилактики вертикальных зубочелюстных аномалий / З.В.Гасымова, О.Ф.Гасымов // Azərbaycan Tibb Jurnalı, –Bakı,–2016.– № 3, – с.158-163.

³ Novruzov Z., Behruzoglu M., Gurel H., Evaluation of the effects of distal malocclusion activators on the craniofacial complex. Journal of Dental Research and Review. 2022.səh.111-117

parallel displacement. High patient cooperation is not required during treatment with fixed orthodontic appliances. It should be noted that during treatment with fixed orthodontic appliances such as brackets and archwires these elements allow food residues to stick to the surfaces, which in turn increases the risk of caries and inflammation of periodontal tissues^{4,5,6,7}.

Saliva has different protective functions due to its physical properties and chemical composition. The immune response in the oral cavity is related to the presence of extensive and specialized mucosa-associated lymphoid tissue. Antimicrobial proteins of saliva are immunoglobulins, lactoferrin, lysozyme, mucins, histatins, and non-immunoglobulins such as lactoperoxidase⁸. There is no doubt that immunological mechanisms play an important role in the pathogenesis of periodontal diseases. Pathogenic microorganisms attack periodontal tissues directly or indirectly. And causes its damage. Local immune factors activate defense mechanisms as a response to this effect and eventually eliminate the effect of pathogenic microorganisms. Immunoglobulins are local immune factors they slow down bacterial adhesion and colonization, enhance bacterial phagocytosis, and play a protective role against bacterial infections by helping to detoxify bacterial toxins.

Lysozyme protein ensures the stability of the oral ecosystem. It can also inhibit the adhesion of bacteria, limit the attachment of

⁴ Dixit A, Paul S, Lakhani S, et al. A Study to Assess and Evaluate the Gingival Response During and after the Fixed Orthodontics Treatment Experienced by Adult Patients. *J Pharm Bioallied Sci.* 2023

⁵ Quinzi V, Carli E, Mummolo A, De Benedictis F, Salvati SE, Mampieri G. Fixed and removable orthodontic retainers, effects on periodontal health compared: A systematic review. *J Oral Biol Craniofac Res.* 2023;13(2):337-346.

⁶ Müller LK, Jungbauer G, Jungbauer R, Wolf M, Deschner J. Biofilm and Orthodontic Therapy. *Monogr Oral Sci.* 2021;29:201-213.

⁷ Santonocito S, Polizzi A. Oral Microbiota Changes during Orthodontic Treatment. *Front Biosci (Elite Ed).* 2022;14(3):19.

⁸ Sharma A., Subramaniam, P., Moiden Sh., Analysis of Salivary IgA, Amylase, Lactoferrin, and Lysozyme Before and After Comprehensive Dental Treatment in Children: A Prospective Study. *Contemporary Clinical Dentistry* 8(4):p 526-530, Oct–Dec 2017.

planctonic bacteria to the biofilm and affect the development of dental biofilms⁹.

Plant materials are commonly and widely used to treat periodontal disease. Herbal products are often preferred over conventional drugs due to their complex biological activity, often favourable safety profile, lower therapy costs, biocompatibility, and low impact on the environment. Plants contain phytochemicals such as alkaloids, essential oils, flavonoids and tannins with strong antimicrobial, anti-inflammatory, antibiotic, analgesic and antioxidant effects^{10,11,12}.

When orthodontic treatment is carried out using different appliances at different ages, the risk of developing periodontal diseases, which is one of the main dental diseases, has not been sufficiently evaluated. For this reason, the optimal reduction of the unpleasant consequences of orthodontic appliances has not yet been found, as well as the sequence of preventive measures depending on the condition of the oral cavity has not been developed. For this reason, we set ourselves the goal of conducting our current research work.

The object of the study. 120 dental patients aged 12-25 years without periodontal pathology who were treated with orthodontic appliances and did not have periodontal pathology were included in the study.

The aim of this study: was to increase the effectiveness of the treatment and prevention measures for gingivitis and periodontitis

⁹ Shadlinskaya R.V. The role of homeostatic disorders in development of periodontal generalized inflammatory diseases in patients with β -thalassemia major. *Meditsinskiy sovet = Medical Council*. 2019;(20):115-120.

¹⁰ Шадлинская Р.В. Применение биологического растительного препарата при лечении воспалительных заболеваний пародонта (ВЗП) на фоне β -талассемии. *Вестник науки и образования*, –Москва:–2019. №9 (63), –с 80-85

¹¹ Chatzopoulos GS, Karakostas P, Kavakoglou S, Assimopoulou A, Barmplexis P, Tsalikis L. Clinical Effectiveness of Herbal Oral Care Products in Periodontitis Patients: A Systematic Review. *Int J Environ Res Public Health*. 2022

¹² Pasupuleti MK, Nagate RR, Alqahtani SM, Penmetsa GS, Gottumukkala SNVS, Ramesh KSV. Role of Medicinal Herbs in Periodontal Therapy: A Systematic Review. *J Int Soc Prev Community Dent*. 2023;13(1):9-16.

during the treatment of dental anomalies with fixed orthodontic appliances.

Research objectives:

1. To study the oral cavity hygiene state of patients who gets orthodontic treatment along with measures to prevent the periodontal diseases;
2. To determine the rate of plaque formation and bleeding indice in patients who gets orthodontic treatment along with measures to prevent the periodontal diseases;
3. To determine prevalence of periodontal diseases and gingival inflammatory status during orthodontic treatment in patients undergoing periodontal disease prevention measures
4. To investigate the dynamics of changes in the local immunity factors of the oral cavity during treatment in patients undergoing periodontal disease prevention measures during orthodontic treatment.

Research methods:

The research was conducted including clinical, laboratory, radiological, photometric and biometric, and statistical methods.

The main provisions for the defense:

- A plan of measures developed for the comprehensive prevention of periodontal diseases during the treatment of dento-facial anomalies with fixed orthodontic appliances will reduce the probability of the occurrence of periodontal diseases.
- It will be possible to reduce the complications that can be caused by orthodontic techniques that do not come out by using biologically active substances that increase the activity of local factors of oral cavity immunity.
- The proposed set of measures can be successfully applied in the daily work of orthodontists, in addition to increasing the efficiency of orthodontic treatment of teeth and dento-facial anomalies.

The scientific novelty of the research.

- The diagnosis of periodontal diseases in patients treated with fixed orthodontic appliances has been improved by applying the study of immunological indices along with clinical indices.

- Improvement of oral cavity local immune factors (lysozyme activity and concentration of secretory A-immunoglobulin) was determined during the use of the proposed complex of measures ("Fitooil buckthorn oil with tpropolis" and "Immunotea") in patients treated with fixed orthodontic appliances.
- The basics for effective organization of treatment and prevention of periodontal diseases for different periods of orthodontic treatment has been developed and justified.

The practical significance of the study.

- The mechanism of prevention of periodontal diseases by increasing the activity of local immunity factors with use of biologically active means such as " Fitooil buckthorn oil with tpropolis and "Immunotea" has practical importance
- During orthodontic treatment with fixed orthodontic appliances, the use of plant-based remedies ("Fitooil buckthorn oil with propolis " and "Immunotea") has practical importance in terms of improving the quality of life of patients, as well as reducing the time of orthodontic treatment, in addition to the prevention of periodontal diseases.
- Improved individual oral hygiene measures can be successfully used in practice using a comprehensive action plan during treatment with fixed orthodontic appliances.

Approbation of the study results. The main provisions of the dissertation Current Problems of Dentistry XX International Dental Conference, Baku, October 16-17, 2015; "In the collection of theses of the scientific-practical conference dedicated to the 100th anniversary of V.Y.Akhundov / Baku 2016; At the international scientific-practical conference dedicated to the 100th anniversary of the Azerbaijan People's Republic, Actual problems of medicine, Baku, May 28, 2018; It was reported and presented at the scientific conference dedicated to the 90th anniversary of the establishment of the Azerbaijan Medical University, Dedicated to professor A.M. Efendiyev's 80th anniversary, "Actual problems of biochemistry and medicine" In the thesis collection of the scientific-practical conference Baku-2023; "Actual Problems of Medicine dedicated to the 100th anniversary of the birth of the national leader Heydar Aliyev" was

presented in the thesis collection of the international scientific-practical conference, Baku-2023.

The initial defense of the dissertation was held at the extended meeting of the Children's Dentistry Department of the Azerbaijan Medical University with the participation of employees of other specialized dentistry departments (01.07. 2022, protocol No 11) and ED 2.50 under the AMU It was discussed at the Scientific seminar of the Dissertation Council in Dentistry (01.11. 2023, protocol No 3).

Implementation of research results into practice.

Scientific work at the Children's Somatology Department of AMU, Teaching Dental Clinic, and Immunology Laboratory of the Scientific Research Center.

The name of the organization where the dissertation has been carried out.

The obtained results of the research work are applied in the educational process of the Children's Dentistry Department of the Azerbaijan Medical University, and the practical work of the Teaching Dental Clinic of the. The results of scientific research are also applied during the treatment and prevention of patients in the "Dental park" clinic and the "Mirvari dish" dental clinic.

Publications.. 18 scientific articles and theses were published on the main provisions of the work. Among them, 7 articles and 5 theses were published in the local press and 4 articles and 2 theses were published in the foreign press.

The structure and volume of the dissertation. The dissertation is presented in the form of computer-compiled text on 161 pages (207362 marks) and includes an introduction (13734 marks), chapter I literature review (54894 marks), chapter II materials and methods of research (39443 marks), chapter III personal results (44052 marks), conclusion (52527 points), conclusions (2139 points), and practical recommendations (569 points). 231 sources are included in the bibliography list. 7 graphs, 7 tables, and 36 figures are included in the thesis work.

MATERIAL AND RESEARCH METHODS

Clinical, instrumental, X-ray, microbiological, and immunological examinations of 120 patients aged 12-25 years who were treated with fixed orthodontic appliances for various forms of dental anomalies before treatment, during treatment, and at the end were conducted. Patients were divided into three groups, including 40 people in each. At the same time as orthodontic treatment in the second and third groups, a complex plan of measures was applied for the prevention of periodontal diseases, using antibacterial drugs and biologically active substances that increase the activity of local factors of the oral cavity immunity, while in the patients of the first group only orthodontic treatment was carried out.

In the patients included in the first group, before orthodontic treatment, professional hygiene measures were taken in the oral cavity, as well as the basics of hygienic care of the oral cavity were taught to the patients. In this group of patients, in addition, a comprehensive action plan using antibacterial drugs and biologically active substances that increase the activity of local factors of oral cavity immunity was not applied.

In the patients included in the second group, before orthodontic treatment, professional hygiene measures were taken in the oral cavity, as well as the basics of hygienic care of the oral cavity were taught to the patients. During the period of orthodontic treatment, every night after brushing the teeth before going to bed, it is recommended to swish 1 teaspoon of the "Fitooil Buckthorn oil with propolis" solution produced by the local "Herba Flora" company in the oral cavity for 1 minute, and then not to rinse the mouth by spitting.

In the third group of patients, professional oral hygiene measures were taken before orthodontic treatment, as well as the basics of oral hygiene care were taught to the patients. During the period of orthodontic treatment, every night after brushing the teeth before going to bed, swish 1 teaspoon of the "Fitooil Sea Buckthorn oil with propolis" solution produced by the local "Herbaflora" company in the oral cavity for 1 minute, then do not rinse the mouth by spitting, as well as "Immunotea" once a day. It was recommended to brew and drink the tea and use such local immunity-boosting agents together.

Clinical examination and assessment: Facial examination and oral cavity examination were done and the results of the examinations were recorded in the medical history.

The clinical examination of patients included the traditional methods of collecting life and medical history from orthodontic patients. During the examination, patients' complaints were heard, living conditions, date of birth, presence of common diseases, harmful habits, dento-facial anomalies and periodontal diseases in other family members were determined. Information was collected from the patient about whether or not orthodontic treatment was performed before, at what age and by what methods, its results, whether or not it treated periodontal diseases, when and by what methods the treatment was performed, and its results.

Clinical examinations were carried out in the following order: survey, facial examination, oral cavity examination. The results of the examinations were recorded in the medical history. Examinations were carried out according to the WHO methodology, in mixed natural and artificial lighting, with the help of a standard set of tools - mirror, probe and tweezers. The data of the examinations were included in the dental examination card. During the examination, the condition of primary and permanent teeth, the sequence of eruption, and the shape of the dental arch were evaluated. Occlusal contacts in front and side teeth were examined.

X-ray studies were carried out to clarify the diagnosis, determine the treatment plan and prognosis, and study the changes in the treatment process.

The depth of the gingival pocket in the vestibular, oral, distal, and mesial directions was determined with the help of a specially calibrated probe. The GI (Green Vermilion) index was used to evaluate the hygienic condition of the oral cavity, and the Bleeding index, plaque formation speed index.

To conduct a photometric study on patients, photos of the face and oral cavity were taken in the front and side projections at the beginning, during, and at the end of the complex treatment.

Laboratory examinations were held as follows. The activity of lysozyme in the mixed saliva was taken by spitting into a sterile test tube at the same time of the day - on an empty stomach in the morning,

without stimulating the salivary glands, and was determined (%). Lysozyme activity in mixed saliva V.G. It was determined by the photonephelometric method proposed by Dorofeichuk (1968). The determination of lysozyme activity by the nephelometric method is based on the ability of the lysozyme enzyme to lyse mucopolysaccharides of the cell walls of the *Micrococolysodeikticus* strain. m. A phosphate buffer suspension with pH = 7.2 - 7.4 was prepared from *Micrococolysodeikticus* test culture. This suspension was then filtered and standardized according to the FEC - 56 standard using a green light filter (wavelength 540 nm) in a cuvette with a working length of 3 mm. By nephelometry, the light transmittance of the initial suspension was increased to 20% (4 billion bacteria). 0.03 ml of the substrate to be examined was added to 1.47 ml of the prepared microbial suspension. After the test bottles were kept at +37°C for 60 minutes, nephelometry was performed again using the method of standardizing the initial suspension, and the light intensity of the initial microbial suspension was measured to determine the percentage of lysozyme activity. the transmittance percentage (20%) is subtracted from the transmittance percentage of the test suspension. The studied saliva was diluted with a phosphate buffer solution at a ratio of 1:20. Thus, the saliva of 120 patients treated with fixed orthodontic appliances was examined and the concentration of lysozyme was determined.

The salivary IgA levels were determined by radial immunodiffusion method using Diffu-Plate kit .2 ml of saliva samples were centrifuged at 2000 rpm for 10 min. Then 5 microlitre of sediment was placed in each well of immune diffusion plates. One control was placed in each plate. Again after 15 minutes the 5 microlitre sediment was placed in each well. These plates were incubated at room temperature for 24 hours. The radial immunodiffusion phenomenon in the form of ring was seen. The diameter of each ring was compared with the diameter of the control well . The salivary IgA levels were calculated by using standard table given in the Diffu-Plate kit. Whole salivary IgA levels were determined by using radial immunodiffusion phenomenon.

The average value of the results obtained as a result of the research and their honesty from a statistical point of view was

determined by the method of variation statistics, with the help of parametric and non-parametric methods: t (Student), U (Wilkinson-Manna-Whitney), χ^2 (correlation coefficient) criterion.

RESEARCH RESULTS AND THEIR DISCUSSION

Our study aimed to increase the effectiveness of treatment and prevention measures for gingivitis and periodontitis, which occur during the treatment of dental anomalies with fixed orthodontic appliances.

Clinical, instrumental, X-ray, biochemical and immunological examinations were carried out in 120 patients aged 12-25 years old, who were treated with fixed orthodontic appliances for various forms of dental anomalies before treatment, during treatment, and at the end. was conducted. Patients were divided into three groups, including 40 people each.

The hygienic condition of the oral cavity was periodically checked by us with hygienic indices at different time intervals. Before starting orthodontic treatment, 1 month, 6 months, 12 months after the start of treatment, and at the end of treatment, the GI index was used to study the hygienic condition of the oral cavity during treatment with fixed orthodontic appliances. The calculation was made based on the formula.

As it is described in table 1 before the start of orthodontic treatment, the oral hygiene status of the patients included in all three groups was statistically honestly ($p < 0.05$) evaluated as "inadequate", and individually, the first group had 2.46 ± 0.11 points, the second group had 2.39 ± 0.11 points, and in the third group it was 2.53 ± 0.11 points. Despite professional cleaning measures before fixing the elements of the straight wire technique in the oral cavity, 1 month after the start of orthodontic treatment, this indicator was 3.25 ± 0.12 points in the first group ($t=4.76$; $P < 0.001$), and 3.17 in the second group. ± 0.12 points ($t=4.70$; $P < 0.001$), increased to 3.46 ± 0.14 points ($t=4.89$; $P < 0.001$) in the third group. This gave us a reason to assess the hygienic situation as "bad". The fact that there was such a tendency of the hygienic index indicators to rise 1 month after the fixation of the fixed orthodontic appliances, on the one hand, was related to the

forced change of the patient's previously accustomed eating habits at the beginning of the orthodontic treatment, and on the other hand, to the unusual situation in the oral cavity, in other words, discomfort. has directly manifested itself in compliance with the rules.

Table1

Hygienic indexes of the oral cavity in patients during different periods of treatment with fixed orthodontic appliances

Different periods of orthodontic treatment	Hygienic indices, with point		
	The first group	The second group	The third group
Before beginning orthodontic treatment	2,46±0,11	2,39±0,11	2,53±0,11
1 month after starting orthodontic treatment	3,25±0,12**	3,17±0,12**	3,46±0,14**
6 months after starting orthodontic treatment	2,34±0,09*	2,27±0,09*	2,40±0,10*
12 months after starting orthodontic treatment	1,77±0,07**	1,85±0,07**	1,72±0,07**
At the end of orthodontic treatment	1,14±0,04**	1,07±0,04**	0,99±0,04**

Note: Integrity of difference (by Student's criterion) for different periods of treatment in each group. * P>0.05; ** P<0.01; *** P<0.001

However, it should be noted that 6 months after the start of treatment, the indicators of the hygienic index in all three groups decreased to the level of the indicator at the first start, and were again evaluated as "insufficient". Thus, the hygienic index in the first group was 2.34±0.09 points (t=0.86; P>0.05), in the second group it was 2.27±0.09 points (t=0.86; P>, 05), and in the third group, it was 2.40±0.10 points (t=0.87; P>0.05).

During the subsequent periods of orthodontic treatment, the dynamics of the hygienic index value were observed to decrease positively, and 12 months after the start of the treatment, the hygienic index was 1.77±0.07 points in the first group (t=5.31; P<0.001), and 1.85±0 in the second group. 0.07 points (t=4.15; P<0.001), and 1.72±0.07 points (t=6.23; P<0.001) in the third group, it was evaluated as "sufficient" in all three groups.

Conducting preventive procedures in the second and third groups led to a significant decrease in this index compared to the previous indicators, which gave us a reason to assess the hygienic condition as satisfactory.

Even at the end of the orthodontic treatment, the dynamics of the hygienic index continued to decrease, in the first group it was 1.14 ± 0.04 points ($t=11.0$; $P<0.001$), in the second group it was 1.07 ± 0.04 points ($t=11.0$; $P<0.001$), and in the third group it was 0.99 ± 0.04 points ($t=12.8$; $P<0.001$), and it was evaluated as "good" in all three groups

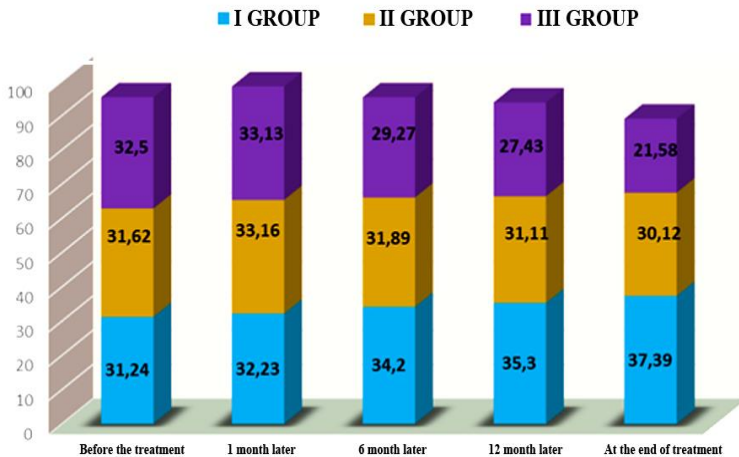
In the course of our study, the rate of formation of dental plaque and bleeding indices of the gums were studied in all the patients who were treated with this or that form of denta-fasial anomalies with permanent orthodontic technique and divided into 3 groups.

Before starting orthodontic treatment, it was determined that the rate of plaque formation index was $31.24 \pm 1.14\%$ in the first group, $31.62 \pm 1.16\%$ in the second group, and $32.5 \pm 1.18\%$ in the third group.

As graph 1 shows when studying this indicator at different time intervals, i.e. 1 month, 6 months, 12 months after the start of orthodontic treatment, and at the end of the treatment, it was found that the rate of plaque formation decreased in the second and third groups and increased in the first group.

1 month after the start of orthodontic treatment, the rate of plaque formation in the first group was $32.23 \pm 1.18\%$ ($t=0.60$; $P>0.05$), in the second group it was $33.16 \pm 1.19\%$ ($t=0.93$; $P>0.05$), it was found to be $33.13 \pm 1.19\%$ ($t=0.38$; $P>0.05$) in the third group. 6 months after the start of orthodontic treatment, the rate of caries formation in the first group was $34.20 \pm 1.21\%$ ($t=1.78$; $P>0.05$), in the second group it was $31.89 \pm 1.16\%$ ($t=0.16$; $P>0.05$), in the third group it was $29.27 \pm 0.99\%$ ($t=2.1$; $P<0.05$).

The rate of plaque formation did not change much after 12 months after the start of orthodontic treatment and was $35.30 \pm 1.24\%$ ($t=2.42$; $P<0.05$) in the first group, and $31.11 \pm 1.15\%$ ($t=0.31$; $P>0.05$), and $27.43 \pm 0.81\%$ ($t=3.54$; $P<0.01$) in the third group.



Graph 1. Indices of plaque rate in patients during different periods of treatment with fixed orthodontic appliances

At the end of orthodontic treatment, the caries rate index increased to $37.39 \pm 1.31\%$ ($t=4.79$; $P<0.001$) in the first group, while it increased to $30.12 \pm 0.99\%$ ($t= 0.99$; $P>0.05$), and in the third group it decreased to $21.58 \pm 0.54\%$ ($t=8.40$; $P<0.001$).

Thus, based on the results obtained during the dynamic study of the rate of dental plaque before the start of orthodontic treatment, 1 month, 6 months, 12 months after the start of treatment, and at the end of the treatment, we can say that, as in the first group, additional treatment - If preventive measures are not applied, the rate of occurrence of oral plaque increases.

Only in the second group of patients who rinsed the oral cavity with "Fitooil Sea Buckthorn chaitikani oil with propolis" did the rate of tooth decay decrease within 1 month after starting orthodontic treatment and then stabilized.

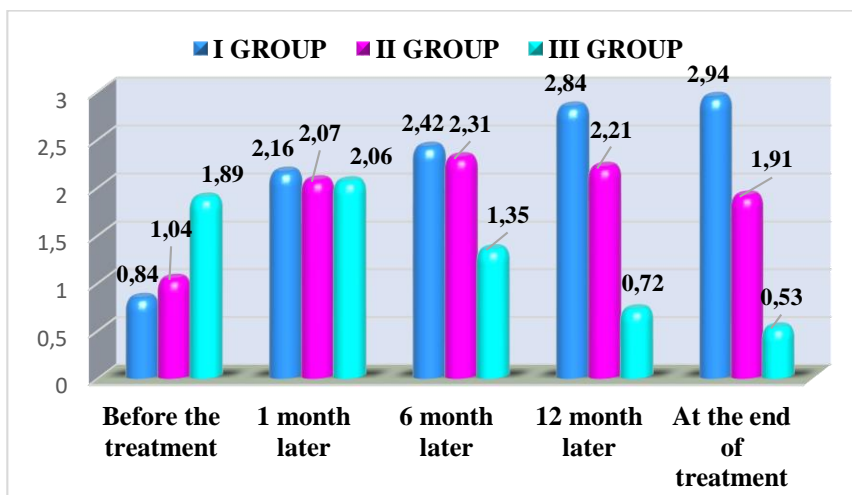
In the third group of patients, in which oral cavity gargle with "Fitooil Sea Buckthorn oil with propolis " and local immunostimulators such as "Immunotea" are applied together, the rate of occurrence of dental plaque decreases from the beginning to the end of the treatment.

Because of the study of the intensity of inflammatory processes in the periodontium during the treatment of dental-facial anomalies with fixed orthodontic appliances, the dynamics of changes in the bleeding indices of the gums were investigated before starting the orthodontic treatment, 1 month, 6 months, 12 months after the start of the treatment and at the end of the treatment.

As it is described in graph 2 a result of studying the gingival bleeding index before starting orthodontic treatment, it was found that at the beginning of the treatment, these indices were 0.84 ± 0.45 points in the first group, 1.04 ± 0.48 points in the second group, and 1.89 ± 0.52 points in the third group. 1 month after the start of treatment, this index increased to 2.16 ± 0.62 ($t=1.71$; $P>0.05$) points in the first group, and 2.07 ± 0.58 ($t=1.37$; $P>0.05$) in the second group. >0.05) and increased to 2.06 ± 0.58 ($t=0.22$; $P>0.05$) points in the third group. All these increases indicate the beginning of inflammatory processes in the periodontium.

6 months after starting the treatment with fixed orthodontic appliances, the bleeding index in the first group increased slightly and reached 2.42 ± 0.76 ($t=1.79$; $P>0.05$) points. The same trend was maintained in the second group as well, so this indicator increased to 2.31 ± 0.76 ($t=1.41$; $P>0.05$) points. Only in the third group, the bleeding index significantly decreased compared to the previous indicator and was 1.35 ± 0.22 ($t=0.96$; $P>0.05$) points. 12 months after the start of treatment, the gingival bleeding index was 2.84 ± 0.92 ($t=1.97$; $P<0.05$) points in the first group and 2.21 ± 0.71 ($t=1.38$; $P<0.05$) in the second group. >0.05) score, and in the third group, it was a 0.72 ± 0.25 ($t=2.02$; $P<0.05$) score.

At the end of the treatment with fixed orthodontic appliances, the bleeding index of the gums in the first group remained significantly higher than in the previous months and was 2.94 ± 0.93 ($t=2.04$; $P<0.05$) points. Although not at the same level, the bleeding index of the gums in the second group was high at the end of the treatment, 1.91 ± 0.52 ($t=1.24$; $P>0.05$) points. Only in the third group, at the end of the complex treatment, the bleeding index of the gums was significantly lower than the previous indicators and was 0.53 ± 0.02 ($t=2.43$; $P<0.05$) points.



Graph 2. Bleeding indices of gums in patients during different periods of treatment with fixed orthodontic appliances

Based on the results obtained during the dynamic study of the bleeding indices of the gums before starting the orthodontic treatment of teeth-jaw anomalies with fixed appliances, 1 month, 6 months, 12 months after the start of the treatment and at the end of the treatment, we can say that when using the fixed orthodontic technique, as in the first group, If additional treatment and prevention measures are not applied, the bleeding index of the gums increases.

Only in the second group of patients who rinsed the oral cavity with "Fitooil Buckthorn oil with propolis ", the bleeding index of the gums decreases 12 months after the start of orthodontic treatment but does not reach the previous level.

In the third group of patients, in which oral cavity gargle with " Fitooil Buckthorn oil with propolis " and local immunostimulators such as "Immunotea" are applied together, the bleeding indices of the gums decrease from the beginning to the end of the treatment. Thus, when the complex treatment is prescribed, the bleeding of the gums normalizes 1 month after the start of the treatment, and this indicator does not normalize even at the end of the treatment in the other groups.

A comparative analysis of the dynamics of the checked indices in all three groups clearly shows that along with regular and controlled personal hygiene and professional hygiene measures, the treatment measures honestly improve the condition of the periodontal tissues and reduce the risk of complications.

Table 2 shows that before starting orthodontic treatment, the prevalence index of periodontal diseases was almost similar across groups, it was $18.76 \pm 0.84\%$ in the first group, $19.66 \pm 0.85\%$ in the second group, and $19.03 \pm 0.84\%$ in the third group. 1 month after starting the treatment with fixed orthodontic appliances, this indicator increased to the maximum and was $91.28 \pm 3.36\%$ ($t=20.96$; $P<0.001$) in the first group, while in the second group it was $75.12 \pm 2.98\%$ ($t=17.89$; $P<0.001$), and in the third group it was $72.49 \pm 2.96\%$ ($t=17.36$; $P<0.001$).

6 months after the treatment, the prevalence of periodontal inflammatory diseases decreased to $81.16 \pm 3.09\%$ ($t=19.50$; $P<0.001$) in the first group, where only hygienic measures were taken without additional treatment and prevention measures. During this period, the prevalence of periodontal inflammatory diseases decreased to $46.43 \pm 2.09\%$ in the second group of patients who only rinsed their mouths with "Fitooil Buckthorn oil with propolis". In the same period, the prevalence of periodontal inflammatory diseases was $46.43 \pm 2.09\%$ ($t=11.84$; $P<0.001$).

12 months after starting treatment with fixed orthodontic appliances, the prevalence of periodontal inflammatory diseases in the first group of patients was $71.03 \pm 2.95\%$ ($t=17.03$; $P<0.001$), while in the second group this indicator was $38.17 \pm 1.46\%$. ($t=9.79$; $P<0.001$), and in the third group, it decreased to $23.32 \pm 1.21\%$ ($t=3.02$; $P<0.01$). At the end of orthodontic treatment, when examining the prevalence of inflammatory diseases of the periodontium, while examining the prevalence of diseases of the first group of patients, this index remained high at $58.51 \pm 2.22\%$ ($t=16.70$; $P<0.001$) in the first group of patients, while the second group remained high. it was found to be $30.22 \pm 1.39\%$ ($t=6.52$; $P<0.001$) in the group, but it did not reach the index before the start of orthodontic treatment. Only in the third group of patients, at the end of orthodontic treatment, the prevalence of periodontal inflammatory diseases was found to be $15.81 \pm 0.79\%$

(t=2.80; P<0.05), which was approximately the same as before the orthodontic treatment.

Table 2
Prevalence of inflammatory diseases of the periodontium in patients during different periods of treatment with fixed orthodontic appliances

Different periods of orthodontic treatment	Prevalence of periodontal inflammatory diseases, in percentage		
	The first group	The second group	The third group
Before beginning orthodontic treatment	18,76±0,84	19,66±0,85	19,03±0,84
1 month after starting orthodontic treatment	91,28±3,36***	75,12±2,98***	72,49±2,96***
6 months after starting orthodontic treatment	81,16±3,09***	46,43±2,09***	29,06±1,38***
12 months after starting orthodontic treatment	71,03±2,95***	38,17±1,46***	23,32±1,21**
At the end of orthodontic treatment	58,51±2,22***	30,22±1,39***	15,81±0,79*

Note: Integrity of difference (by Student's criterion) for different periods of treatment in each group. * P<0.05; ** P<0.01; ***P<0.001.

Thus, it was possible to reduce the spread index of inflammatory periodontal diseases to the previous level only in the third group of patients, in which "Fitool Buckthorn oil with propolis" gargled the oral cavity and simultaneously used local immunity-raising agents such as "Immunotea".

Graph 3 shows study the intensity of inflammatory processes in the periodontium during the treatment of denta-fasialanomalies with fixed orthodontic appliances, the dynamics of PMA index changes in Parma modification were investigated before starting orthodontic

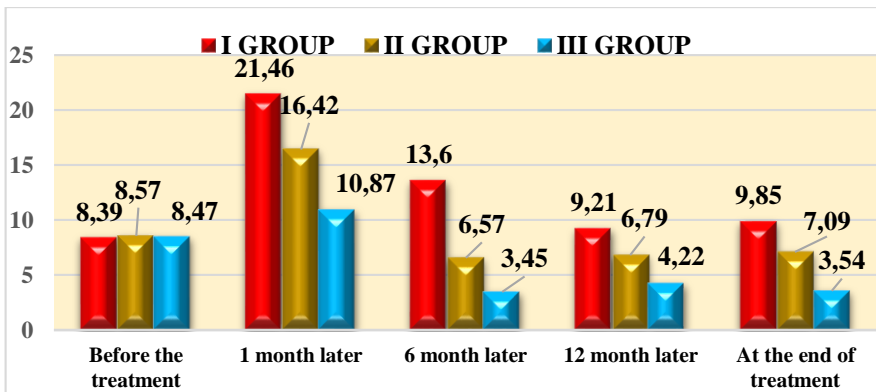
treatment, 1 month, 6 months, and 12 months after the start of treatment, and at the end of treatment.

Before starting orthodontic treatment, the Parma modification PMA index was almost similar across groups, 8.39±0.41% in the first group, 8.57±0.45% in the second group, and 8.47±0.43% in the third group.

A sharp increase of the PMA index 1 month after the start of treatment with fixed orthodontic appliances indicates the occurrence of inflammatory changes in the periodontium, correspondingly, in the first group this index was 21.46±1.12% (t=10.98; P<0.001), in the second group 16.42±0.98% (t=7.27; P<0.001), and 10.87±0.52% (t=3.58; P<0.001) in the third group.

6 months after the start of treatment, the PMA index in the first group decreased slowly and was 13.60±0.68% (t=6.59; P<0.001). During this period, the PMA index in the second group decreased more actively and became 6.57±0.38% (t=3.39; P<0.001), and in the third group it decreased very actively and became 3.45±0.21% (t=10.45; P<0.001).

Later, after 12 months from the beginning of the treatment of maxillofacial anomalies with fixed appliances, this indicator was 9.21±0.49% in the first group (t=1.28; P>0.05), and 6.79±0.41 in the second group. % (t=2.92; P<0.05) and 4.22±0.24% (t=8.67; P<0.001) in the third group.



Graph 3. PMA indices in patients during different periods of treatment with fixed orthodontic appliances

At the end of the orthodontic treatment, the results of the examination of the patients, after the elements of the technique that did not come out were removed from the oral cavity, showed the following results. In the first group, the indicators remained at the previous level, being $9.85 \pm 0.52\%$ ($t=2.21$; $P<0.05$). In the second group, the PMA index decreased to $7.09 \pm 0.42\%$ ($t=2.43$; $P<0.05$), while in the third group, the last index decreased to $3.54 \pm 0.21\%$ ($t=11.10$; $P<0.001$).

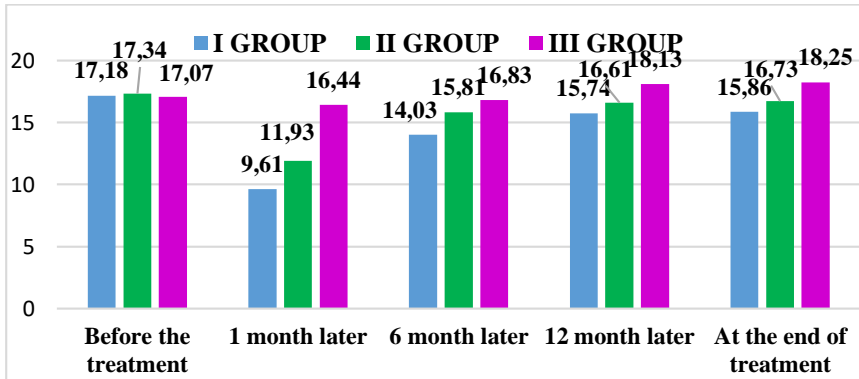
All this shows the stabilization of the results obtained in the complex treatment. In general, it can be concluded that when the complex treatment is prescribed, the PMA index returns to its previous indicators approximately 1 month after the start of the treatment, but when only "Fitooil Buckthorn oil with propolis" is prescribed to gargle the oral cavity, a decrease in the index indicators is observed after 6 months. In the third group of patients, in which "Fitooil Buckthorn oil with propolis" gargled the oral cavity and at the same time, local immunity-raising agents such as "Immunotea" were used together, positive dynamics were recorded 1, 6, and 12 months after the complex treatment, and the intensity of inflammation in the periodontium was 5.56 It decreases to the level of ± 0.22 , while this situation does not occur in the second group of patients who were prescribed only "Fitooil Buckthorn oil with propolis" to gargle the oral cavity.

Graph 4 shows that before starting orthodontic treatment during treatment with fixed orthodontic appliances, 1 month, 6 months, and 12 months after the start of treatment, biochemical analysis of mouth water was performed to determine the activity of lysozyme in mouth water.

Before starting orthodontic treatment, the results of the determination of lysozyme activity in the mouth water of the patients included in all three groups were almost the same, $17.18 \pm 0.80 \mu\text{g}/\text{mg}$ in the first group, $17.34 \pm 0.80 \mu\text{g}/\text{mg}$ in the second group, and $17.34 \pm 0.80 \mu\text{g}/\text{mg}$ in the third group. It was $17.07 \pm 0.80 \mu\text{g}/\text{mg}$.

1 month after the start of treatment with fixed orthodontic appliances, the activity of lysozyme remained low in the first group and was 9.61 ± 0.39 ($t=8.50$; $P<0.001$) $\mu\text{g}/\text{mg}$. Accordingly, the amount of lysozyme in saliva in the second group was 11.93 ± 0.49 ($t=5.75$;

$P < 0.001$) $\mu\text{g}/\text{mg}$, and in the third group it was 16.44 ± 0.79 ($t = 0.56$; $P > 0.05$) $\mu\text{g}/\text{mg}$ remained at a low level.



Graph 4. Activity of lysozyme in saliva of patients during different periods of treatment with fixed orthodontic appliances

6 months after the start of treatment, the activity of lysozyme in saliva was 14.03 ± 0.64 ($t = 3.09$; $P < 0.01$) $\mu\text{g}/\text{mg}$ in the first group, 15.81 ± 0.76 ($t = 1.39$) in the second group ; $P > 0.05$) $\mu\text{g}/\text{mg}$ and 16.83 ± 0.79 ($t = 0.21$; $P > 0.05$) $\mu\text{g}/\text{mg}$ in the third group.

12 months after the start of orthodontic treatment, the activity of lysozyme in saliva was 15.74 ± 0.76 ($t = 1.31$; $P > 0.05$) $\mu\text{g}/\text{mg}$ in the first group, and 16.61 ± 0.79 ($t = 0, 65$; $P > 0.05$) $\mu\text{g}/\text{mg}$ and 18.13 ± 0.82 ($t = 0.93$; $P > 0.05$) $\mu\text{g}/\text{mg}$ in the third group.

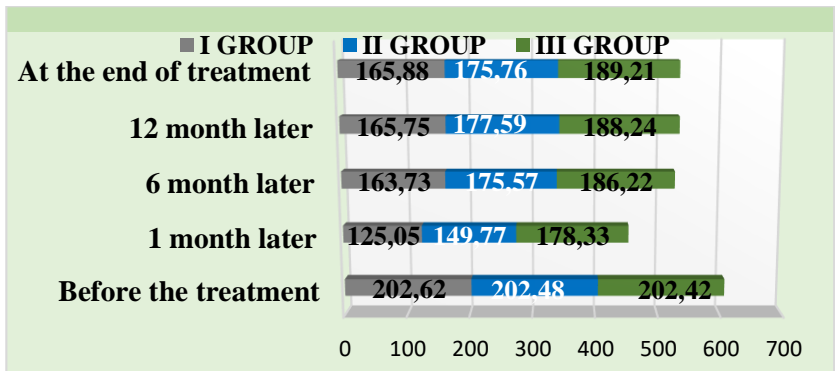
At the end of the treatment with fixed orthodontic appliances, the activity of lysozyme in saliva was low in the first group and was 15.86 ± 0.76 ($t = 1.20$; $P > 0.05$) $\mu\text{g}/\text{mg}$. In the second group, the activity of lysozyme in saliva was low and was estimated as 16.73 ± 0.79 ($t = 0.54$; $P > 0.05$) $\mu\text{g}/\text{mg}$. Only in the third group, the activity of lysozyme in saliva increased to 18.25 ± 0.83 ($t = 1.03$; $P > 0.05$) $\mu\text{g}/\text{mg}$, but this indicator did not statistically differ from the previous indicators.

Graph 5 shows that before starting orthodontic treatment, 1 month, 6 months, 12 months after the start of treatment, and at the end of treatment, biochemical analysis of mixed saliva was carried out to study the changes in the concentration of secretory A-immunoglobulin in saliva during treatment with fixed orthodontic appliances.

The study of secretory A-immunoglobulin in the mixed saliva showed that the amount of secretory A-immunoglobulin in the mixed oral saliva before starting orthodontic treatment was almost similar in all groups, 202.62±8.71 mg/l in the first group, 202.48±8, in the second group. 64 mg/l, and in the third group it was 202.42±8.49 mg/l. 1 month after the start of orthodontic treatment, the amount of secretory A-immunoglobulin in the first group decreased significantly and was 125.05±4.03 (t=8.08; P<0.001) mg/l. In the second group, this indicator decreased to 149.77±6.28 (t=4.93; P<0.001) mg/l. Also, in the third group, the amount of secretory immunoglobulin A decreased to 178.33±7.67 (t=2.10; P<0.05) mg/l.

6 months after the start of treatment of maxillofacial anomaly with fixed appliances s, this indicator was 163.73±7.34 (t=3.41; P<0.001) mg/l in the first group, and 175.57±7.65 (t=2) in the second group .33; P<0.05) mg/l and in the third group this indicator was 186.22±7.87 (t=1.40; P>0.05) mg/l.

12 months after the start of treatment, the amount of secretory immunoglobulin A in mixed saliva was 165.75±7.35 (t=3.24; P<0.01) mg/l in the first group and 177.59±7.66 (t=3.24; P<0.01) mg/l in the second group. =2.14; P<0.05) mg/l, and in the third group it was 188.24±7.88 (t=1.22; P>0.05) mg/l. These indicators honestly do not differ from the indicator at the moment of starting orthodontic treatment.



Graph 5. The concentration of secretory A-immunoglobulin in the saliva of patients during different periods of treatment with fixed orthodontic appliances

At the end of the treatment with fixed orthodontic appliances, the amount of secretory A-immunoglobulin in the mixed saliva was lower in the first group and was 165.88 ± 7.35 ($t=3.22$; $P<0.01$) mg/l. In the second group, the amount of secretory A-immunoglobulin in mixed saliva was low and was estimated as 175.76 ± 7.66 ($t=2.31$; $P<0.05$) mg/l. Only in the third group, did the amount of secretory A-immunoglobulin in mixed saliva increase to 189.21 ± 7.89 ($t=1.14$; $P>0.05$) mg/l, but this indicator was not statistically significantly different from the previous indicators. In the first group of patients, even 6 months after the fixation of the elements of the days-technique, the activity indicators of lysozyme and secretory A-immunoglobulin in the mixed saliva remained at a low level, and the indicators approached the norm only after 6 months. Presumably, the reduction of local defense factors such as lysozyme and secretory immunoglobulin A leads to the activation of oral cavity flora. In turn, low lysozyme activity and secretory immunoglobulin A concentrations were observed in the second group of patients from the first days of the study. In our opinion, professional hygienic measures before the fixation of fixed orthodontic technique on the teeth lead to the development of aseptic inflammatory processes. However, these changes were less noticeable compared to the indicators in the first group of patients. It should be noted that 6 months after fixation, all studied indicators did not differ from previous indicators. Thus, the preventive procedures carried out in the second group did not reduce the "traumatic" effect of appliances that did not come out.

In the patients included in the third group, during the study of the composition of the mixed saliva, a slight but statistically significant decrease in the activity of lysozyme was recorded one week after the fixation of the fixed orthodontic apparatus.

However, the level of secretory A-immunoglobulin was almost no different from the previous indicators. The decrease in the activity of lysozyme was related to the inflammatory reaction caused by the professional cleaning of the teeth and the impact of orthodontic forces on the periodontal tissues. A significant decrease in the amount of secretory A-immunoglobulin 1 month after the start of the complex treatment was much less compared to the patients of the first and

second groups. We believe that at this time, " Fitooil Buckthorn oil with propolis " oral cavity gargle and the simultaneous application of local immunity-raising agents such as "Immunotea" are more effective than the previous two groups in terms of eliminating the symptoms of aseptic inflammation. A sharp deterioration of oral hygiene was caused in the first month by a slight activation of the phagocytic cells of the oral cavity. However, this activation should not be considered a sign of an inflammatory reaction, but rather an increase in phagocytosis aimed at maximum cleaning of the oral cavity as a result of changes in nutrition and hygiene. This is evidenced by the decrease in the amount of secretory A-immunoglobulin in mixed saliva and its increase 1 month after the start of complex treatment. During the next 6 months and 12 months, the

The absence of significant clinical and biochemical signs of inflammation in the third group of patients was due to the inclusion of " Fitooil Buckthorn oil with propolis " oral cavity gargle and the simultaneous application of local immune boosting agents such as "Immunotea" in the treatment process.

Our results show that the hygienic condition of the oral cavity deteriorates from the first days after the appliances is fixed. Despite professional hygienic cleaning measures, in the first days of orthodontic treatment, patients experienced discomfort in the oral cavity, pain caused by orthodontic forces, and a change like nutrition from hard to soft. All of this created difficulties for patients to follow the desired hygiene measures. However, after the end of the period of adaptation to the fixed appliances , the indicators of the hygienic index began to decrease in all three groups. This confirms the opinion of some authors that restoration of the normal oral care regimen is possible 3-4 weeks after fixation of the orthodontic apparatus.

Thus, the results of the conducted research objectively substantiated the effectiveness of the proposed method in preventing the occurrence of inflammatory processes in the periodontium in patients treated with unsuccessful orthodontic techniques - gargling the oral cavity with " Fitooil Buckthorn oil with propolis " and, in addition, local immunity-raising agents such as "Immunotea".activity of lysozyme, the concentration of secretory A-immunoglobulin, did not differ from the previous indicators in the third group.

CONCLUSIONS

1. At the end of the orthodontic treatment, positive dynamics of the hygienic index (OHI-S) were found in all three patient groups. The change was more noticeable in the third group using "Fitooil buckthorn oil with propolis " and "Immunotea" in addition to individual hygiene measures. Before treatment it was $2,53 \pm 0,11$ and at the end of treatment it is more decreased to $0,99 \pm 0,04$ ($t=12,8$; $P<0,001$).
2. During the period of orthodontic treatment, there is a change in the dynamics of plaque formation rate (PFRI) and gingival bleeding index (GBI), at the beginning of the treatment, it was respectively $31,24 \pm 1,14\%$ and $0,84 \pm 0,45$, in the first group; $31,62 \pm 1,16\%$ and $1,04 \pm 0,48$ in the second group; while in the third group it was determined to be $32,5 \pm 1,18\%$ and $1,89 \pm 0,52$, at the end of the treatment these indicators increased and were respectively $37,39 \pm 1,31\%$ ($t=4,79$; $P<0,001$) and $2,94 \pm 0,93$ in the first group, stabilized and were $30,12 \pm 0,99\%$ and $1,91 \pm 0,52$ in the second group to $30,12 \pm 0,99\%$ and $1,91 \pm 0,52$ ($t=$ stabilization to $1,24$; $P>0,05$) ($t=0,99$; $P>0,05$), and most decrease happened in the third group it were $21,58 \pm 0,54\%$ ($t=8,4$; $P<0,001$) and to $0,53 \pm 0,22$ ($t=2,43$; $P<0,05$) .
3. At the end of orthodontic treatment, the indicators of periodontal inflammatory disease prevalence (CPI) and periodontal disease severity (PMA) indices confirm the positive effect of the use of biologically active substances. However, compared to the previous indicators, at the end of orthodontic treatment, these indicators are the lowest in the third group, respectively 1, 2 (; $P<0,05$) and 2.5 ($P<0,001$), times decreased, in the second group it increased by 1.5 ($P<0,001$) and 0.82 ($P<0,05$) times and in the first group it increased by 3.1 ($P<0,001$) and 1.2 ($P<0,05$) times
4. In saliva of patients included in all three groups before starting orthodontic treatment the results of the lysozyme amount and the activity of sIgA were approximately the same .At the end of the treatment, positive changes in dynamics of these indicators were observed in the groups using biologically active substances

such as "Fitooil buckthorn oil with propolis" and "Immunotea", respectively, these indicators were higher only in the third group respectively $18.25 \pm 0.83 \mu\text{g}/\text{mg}$ ($t=1.03$; $P>0.05$) and $189.21 \pm 7.89 \text{ mg}/\text{l}$ ($t=1.14$; $P>0.05$), in the second group , $16.73 \pm 0.79 \mu\text{g}/\text{mg}$ ($t=0.54$; $P>0.05$) and $175.76 \pm 7.66 \text{ mg}/\text{l}$ ($t=2.31$; $P<0.05$), while it was lower in the first group that did not use biologically active substances , respectively were $15.86 \pm 0.76 \text{ mg}/\text{l}$ ($t=1.20$; $P>0.05$) and $165.88 \pm 7.35 \text{ mg}/\text{l}$ ($t=3.22$; $P<0.01$).

PRACTICAL RECOMMENDATIONS

1. Prevention of periodontal diseases should be definitely carried out regularly under the supervision of a doctor immediately after starting treatment with fixed orthodontic appliances
2. It is very effective to use biologically active substances such as "Fitooil buckthorn oil with propolis " and "Immunotea" biologically active substances during treatment with fixed orthodontic appliances
3. It is recommended every evening after the last tooth brushing, to keep 1 teaspoon of the "Fitooil buckthorn oil with propolis" solution in the oral cavity for 1 minute, but not to rinse the mouth with water after splitting out the solution, and in addition, to drink "Immunotea" tea once a day during the treatment with fixed orthodontic appliances.

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