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ABSTRACT

of the dissertation for the degree of Doctor of Philosophy

RATIONAL USE OF ACRYLIC PLASTICS IN REMOVABLE DENTAL PROSTHETICS

Specialty: 3226.01 – Dentistry

Field of science: Medicine

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GENERAL CHARACTERISTICS OF THE RESEARCH

Relevance of the topic. The growth of chronic diseases of various organs and systems of the organism in recent decades and their spread among the representatives of the elderly and senile age population make it very important to solve the problem associated with the diagnosis and prevention of complications of prosthetics and intolerance to basic prosthetic acrylic materials[1].

The authors note that the quality of dental prosthetics has significantly improved the quality of life for patients related to oral health; however, the installation of new dental prosthetics did not affect chewing efficiency[2].

Currently, new acrylic plastic technologies are being developed in dentistry. Although this material has been used for dental prosthetics for over 80 years, in the form of discs, it has been produced using computer-aided design/computer - aided manufacturing technology for more than 15 years[3]. Plastics are self-curing sealing materials based on acrylic and epoxy monomers[4].

When worn for a long time, these materials can be released into the oral cavity environment in the form of various chemical compounds, which, under favorable conditions, due to their direct contact with the mucous membrane of the oral cavity or prosthetic bed, can cause side effects of a toxic-allergic nature[5].

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Allergic diseases and their complications, the number of which is constantly growing, occupy a special place in the structure of pathology of an infectious and non-infectious nature [6,]

With removable dental prosthetics, the main pathogenetic risk factors for the development of the above problems can be both traditional old materials and materials developed in the course of the development of dental materials science for the manufacture of dental plate structures, and some chemicals in their composition become immunosuppressive and can cause allergic reactions[7].

The oral cavity is an environment that allows the development of complex ecosystems; the placement of prosthetic devices due to partial or complete tooth loss can alter the diversity of microbial communities [8].

Biofilms on the surfaces of materials used in dental prostheses can contribute to significant changes in the mechanical and aesthetic properties of the material itself and may cause both local and systemic diseases in prosthesis users.

However, to this day, this issue remains relevant in the development of scientifically based recommendations for orthopedic patients, especially those of advanced and elderly age.

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Object of the research. The study involved groups of 160 and 155 patients who attended the Dental Clinic of AMU and district and rural polyclinics for repeated dental prosthetics.

The adaptive capacity of the tissues of the oral cavity after the orthopedic treatment was assessed in patients with prostheses on both the upper and lower jaws based on the analysis of complaints, examination results, and laboratory parameters of mixed saliva.

Forty-eight common rabbits weighing in the range of 2.0-2.9 kg and aged 1-2 years were used. The test animals were divided into 4 different groups of 12 rabbits in each group.

The aim of the research: evaluate the degree of toxic action of various base acrylic materials used in complete removable dentures and justify the use of the recommended material.

Research Objectives:

1. Study the effect of various base materials on the biochemical indicators of the oral cavity during complete denture prosthetics.
2. Study the oral microflora in a comparative aspect during the wearing of complete removable dentures made from different base plastics.
3. Determine the degree of influence of comprehensive orthopedic treatment on the quality of life of patients with removable dentures.
4. Evaluate the histomorphological changes in the surrounding soft tissues in response to the influence of various acrylic base plastics using an experimental model.
5. Based on the study of the effectiveness of therapeutic and preventive agents, develop recommendations to reduce the degree of side effects of base polymer materials on the tissues of the oral cavity.

Research methods. The research methods included the following parameters:

- measuring the rate of salivation
- pH measurement of saliva
- microbiological and biochemical examination of saliva
- morpho-histological examination of tissues of experimental rabbits

– clinical examination of patients, also using the OHIP-14 questionnaire

– statistical processing of the received data

The main provisions submitted to the defense of the dissertation:

– The high percentage of clinical and technological errors, complications, and simultaneously the high demand for removable dentures among the population necessitates a thorough study of the advantages and disadvantages of the base materials used in modern dentistry. This study is based on the results of a detailed retrospective analysis of the quality and deficiencies of removable prosthetic designs made from these materials.

– The functional condition of the organs and tissues of the oral cavity during removable denture prosthetics depends on the type of acrylic plastic used. A base material with a low residual monomer content practically has no negative effect on the structural components of the oral cavity of prosthetic wearers.

– The non-uniform biological indifference of dentures made from various acrylic plastics was revealed based on the results of clinical, laboratory, and experimental studies.

– When signs of reduced adaptation of the oral cavity to wearing removable dentures appear, along with symptoms of side effects related to the toxic-allergic impact of base materials, it is important to assess the quality of life of the prosthetic wearers before and after the implementation of therapeutic and preventive measures.

Scientific novelty of the study.

- In the experiment, using histomorphological studies as well as clinical and laboratory investigations in a comparative aspect, the degree of side effects of certain dental base materials has been identified.
- The effectiveness of incorporating the anti-inflammatory gel "Metrogyl Denta" into the comprehensive treatment and prevention of complications from removable denture prosthetics of traumatic and inflammatory origin has been identified.

Practical significance.

1. Based on the analysis of errors and shortcomings in removable denture prosthetics, their spectrum has been identified, which is crucial for assessing the level of dental orthopedic care provided to patients.

2. A strategy for optimal selection of acrylic base plastics, possessing lower toxicity and fewer side effects, has been proposed for orthopedic dental care. This is especially important in prosthetics for individuals with allergic conditions, as well as elderly and senile patients.

3. The use of effective anti-inflammatory agents in the complex treatment of inflammatory complications in prosthetics will significantly improve the results of dental orthopedic care and enhance the quality of life of prosthetic wearers.

Approbation. The main points of the dissertation were reported and discussed at: a scientific congress dedicated to the 90th anniversary of the Azerbaijan Medical University and the 80th anniversary of higher pharmaceutical education in Azerbaijan "Modern problems of pharmacy" (Baku-2021), as well as at a scientific conference called "Theoretical and applied issues of science and education", Tambov, 2020.

The main aspects of the research are set out at an expanded meeting of the department of prosthodontics dentistry with the participation of employees of other specialized dental departments of the Azerbaijan Medical University (26.12.2024, protocol № 45), discussed at the scientific seminar of the Dissertation Council ED 2.50 operating at Azerbaijan Medical University (28.02.2025, protocol № 12).

Implementation of research results. The results of this study introduced into the practice of the dental clinic of AMU, as well as into the educational process at the department of prosthodontics dentistry.

The name of the organization where the dissertation has been accomplished. The research work was carried out at the department of prosthodontics dentistry of the Azerbaijan Medical University, on the basis of the Dental Clinic and SRC of AMU.

Publications. Based on the results of the dissertation, 22 scientific works were published, 16 of which are articles and 6 are theses, including 5 articles and 3 theses in foreign publishing houses.

Volume and structure of the dissertation. The dissertation is presented on 187 pages of computer text (215049 characters) and consists of an introduction (6655 characters), a literature review (54555 characters), a description of the materials and methods of the research (11713 characters), chapter of the results of our own research and their discussion (60655 characters), chapter of experimental research (23613 characters), results(55945 characters), conclusions(1758 characters) and practical recommendations (1155 characters), a list of scientific literature containing 171 sources, both domestic and foreign scientists. The dissertation includes 34 tables, 19 charts and 8 figures.

MATERIALS AND METHODS OF THE RESEARCH

At the first stage of the work, groups of 160 and 155 patients were formed, who attended the Dental Clinic of the AMU, district, and rural polyclinics for repeated dental prosthetics. In our studies, we used removable dentures manufactured from base materials made of acrylic plastics. When studying the reasons for repeated prosthetics, subjective reasons, complications, and disadvantages of prosthetics were revealed. The adaptive capacity of the oral cavity tissue after the orthopedic treatment was assessed in 140 patients with prostheses on the upper, and lower jaws based on the analysis of the complaints, the results of examinations, and laboratory parameters of mixed saliva (10, 15 days, 1 and 2 months after orthopedic treatment). The collection of mixed saliva was carried out by spitting into a glass tube for 5 minutes (the rate of secretion and pH of saliva were determined).

Microbiological studies were carried out in relation to two groups of oral microorganisms: the resident group, which plays a stabilizing role in the microbiocenosis of the oral cavity, and the pathogenic group, which has virulence factors and can support the development of various inflammatory processes in the oral cavity (Candida albicans). To study the qualitative and quantitative composition of the microflora of the oral cavity, the following nutrient media were used: 5% blood agar to determine the total level of microbial contamination of the oral cavity, yolk-salt agar, sugar broth, Sabourau medium, and "Mitis Salivarius Agar". The collected samples were immediately placed in Stuart

Transport Medium and sent to the research laboratory for further study. The study of the quality of life, which in international medical practice is considered to be a very informative and reasonable method for assessing the health of patients, was carried out to assess the degree of influence of the performed removable prosthetics and supportive conservative therapy. A specialized questionnaire was used to determine the Oral Health Impact Profile (OHIP-14, Slade G.D. (1997)), which contains 14 questions reflecting the impact of removable prosthetics on the daily life of patients.

According to the purpose of the research, the studied acrylic materials were experimentally introduced into the femoral region in the subcutaneous tissues of common rabbits, and the biomaterials taken were subjected to histological examinations to assess changes in the surrounding tissues for 4 weeks. Common rabbits (48 animals), weighing in the range of 2.0-2.9 kg and aged 1-2 years were used in the experiments. After local anesthesia with 1% novocaine solution, the subcutaneous tissue was opened with a small incision, where plates from previously prepared acrylic dentures measuring 0.5x1.0x2.0 cm were fixed, after which the section of the dissected skin was removed with a surgical suture. The experimental animals were observed for 28 days from the beginning of the experiment. During the experiment, the test animals were divided into 4 different groups of 12 rabbits in each group. During the study, in 3 rabbits from each group, at the end of the first, second, third, and fourth weeks under local anesthesia, skin areas with the material injected previously and subcutaneous tissues were cut out. The primary surgical debridement of the wound was carried out.

After the created experimental model, the test animals were divided into 4 groups of 12 rabbits in each: Group I (control) - consisted of 12 rabbits on which colorless plastic was used; Group II (control) - consisted of 12 rabbits on which “Ftorax” was used; Group III (comparison group) - consisted of 12 rabbits on which “Meliodent HC” was used; Group IV (main) - consisted of 12 rabbits on which "Belacril" was used. During 4 weeks of the research, the skin and subcutaneous tissue areas were fixed in a 10% formalin solution for a day, after which the samples were taken for a macroscopic examination.

The effectiveness of preventive measures at various stages after the treatment was assessed based on the analysis of anamnestic data, complaints, examination results, bacteriological data, and biochemical parameters of mixed saliva. Besides, in the groups of orthopedic patients, the volume, rate, and pH of secreted saliva were determined. In general, a laboratory study of 46 samples of biological material was conducted.

The research results were processed by the method of variation statistics. To characterize a group of homogeneous units, their arithmetic mean values (M), standard error (m), and the range of changes (min-max) were determined. For statistical data processing, the nonparametric U test (Wilcoxon-Mann-Whitney) and the parametric Student's t-test were used as a method for assessing the differences in indicators. The statistical difference between the groups was considered significant at $p < 0.05$. Statistical processing of the obtained data was carried out on a personal computer using modern software and the Statistica 7.0 application package.

RESEARCH RESULTS AND THEIR DISCUSSION

Analysis of the structure of objective and subjective reasons for the repeated appeal of patients regarding replacement of old prostheses showed that in Baku, the main reason for replacement of prostheses was aesthetic disorders (48.8±3.95%) and the subjective desire of the prosthesis wearers themselves (45.0±3.93%), which were most often associated with the desire to replace the existing structures with more modern ones.

The minimal reasons for repeated prosthetics in this group were a pain in the area of the prosthesis base and plaque formation on the surface of the removable structure (for both factors – 15.0±2.82%). Fracture of the prosthetic plate, requiring immediate replacement, was noted in 29.4±3.60% of cases. The third most frequent reason for repeated prosthetics among patients who attended the city dental clinic was a poor fixation of the prosthesis, the main cause of which was atrophy of the alveolar ridge of the upper and lower jaws (33.1±3.72%).

Thus, in the city, the most frequent reasons that prompted patients to seek orthopedic care again were subjective reasons.

In the course of our studies, the level of prevalence and intensity of various general somatic pathologies was assessed, i.e. the general state of the organisms of orthopedic patients who applied for removable dentures and had been using acrylic structures for a long time.

The detection of common diseases is important, because, having a negative effect on various organs and systems of the organism of prosthesis wearers, in particular on immunological reactivity, they can serve as a predisposing pathogenetic factor for the development of certain complications in the process of wearing orthopedic structures made of acrylic plastics.

In a statistical analysis of the results obtained after the installation of prostheses, as well as anamnestic data in all examined patients, general pathologies affecting the organs of the cardiovascular, endocrine systems, and gastrointestinal tract were previously diagnosed.

A comparative analysis of the incidence of certain diseases revealed that the most frequent among prosthesis wearers with experience in using prosthetic structures were pathologies of the cardiovascular system (CVS) – 37.8±2.73%; the minimum indicators were recorded for diseases of the nervous and endocrine systems – 1.9±0.77% and 5.7±1.31%, respectively. Chronic diseases in medical history occurred in 26.7% of cases. Pathologies of organs and tissues of the respiratory system were the background for 14.0±1.95% of patients and the results were almost similar in terms of the complication frequency of gastrointestinal tract diseases, on average 15.6±2.04%. A total of 13.0±1.90% of persons matched the group of orthopedic patients without any general somatic diseases.

The analysis of the bacteriological research data revealed a high level of microbial contamination of the oral mucosa of patients, both for the first time prosthetics and those who use removable acrylic structures for many years, compared to the control group, which consisted of practically healthy persons without dentures. The sampling of material for laboratory studies was carried out in three

groups: the 1st group (control group) consisted of 8 practically healthy persons who did not use any prosthetic structures; the 2nd main group (11 patients) included patients who received prosthetics for the first time, and the comparison group (3rd group) included 9 orthopedic patients who used removable prosthetic structures for a long time.

A comparative assessment of the indicators of oral microbiocenosis in first-time prosthetics and orthopedic patients with many years of experience revealed significant differences in the frequency of contamination with enterococci and fungi of the Candida genus, which, colonizing the inner surface of removable plate prostheses and the mucous membrane of the prosthetic bed, contribute to the occurrence of so-called prosthetic stomatitis and further chronicity of the inflammatory process. An unfavorable factor, often contributing to the emergence and development of prosthetic stomatitis, was some aggressive types of fungal infections frequently detected in oral fluids of prosthesis wearers of both groups, in the first-time prosthetics and in persons with many years of experience in wearing acrylic-based plates.

For an accurate assessment of the quality of life of the examined orthopedic patients in all age and sex groups, an extensive comparative analysis of the data obtained using a specialized questionnaire envisaged for dental patients was carried out

Thus, as indicated above, the number of individuals with poor quality of life in the age group of 44-50 years and 51 years and older was on average 23.1±11.7% and 20.0±12.7%, respectively, contrary to the majority of respondents in the first age group, where only 16.7±10.8% of life quality cases were marked as negative.

Besides, the total number of orthopedic patients who were completely dissatisfied with the quality of life was almost similar to the indicators for a good level, except for the second age group, where the obtained values were almost 1.5 times higher.

The clinical condition and characteristics of the microflora of the oral mucosa were assessed in 43 patients at the age of 25 to 67 years with removable dentures on the upper and lower jaws. For a comparative analysis, bacteriological studies of the microbial colonization features of the mucous membrane of the prosthetic bed

were carried out in three groups of prosthesis wearers. “Meliodent HC” - 15 persons; the other type of base material was a PMMA-based hot polymerization plastic belonging to graft copolymers based on acrylic resins with cross-linked polymer chains "Vertex Rapid Simplified" - 13 patients. In the examined orthopedic patients of the third group, the microbial colonization characteristics of the mucous membrane of the prosthetic bed were studied when wearing removable plate prostheses made of “Ftorax”, which belongs to graft copolymers based on acrylic resins.

Microbiological studies were carried out in relation to representatives of the normal stabilizing microflora of the oral cavity (*S.sanguis, S.salivarius, P.anaerobius, E.faecialis, Prevotella oralis)* and the pathogenic group of bacteria responsible for the onset and development of the inflammatory process in the soft and hard tissues of the oral cavity (actinomycetes, Prevotella gingivalis, Fusobacterium spp. Candida albicans). The material was taken at a certain time after the installation of prostheses - on the 5th and 10th days, as well as after 1 month.

The study of the microbiocenosis of the oral cavity was carried out using aerobic and anaerobic cultivation techniques at a temperature of 37°C. To assess the degree of colonization of the mucous membrane of the prosthetic bed and the basis of the prosthetic structure, the content of the studied bacteria was determined per 1 cm^2 of the adhesive film (lgCFU / sm^2).

We conducted a comparative assessment of the frequency of isolation of one of the priority microorganisms, specifically Candida species, which are capable of supporting the onset and development of pathological changes in the oral cavity during removable denture prosthetics. As a result, a correlation between their quantitative indicators and certain differences depending on the type of base material was identified (Table 1).

The base material used for prosthetizing patients in the first group demonstrated minimal side effects on the surrounding tissues, which was associated with the lowest yeast-like fungus Candida species isolation rates 10 days after the placement of the denture – 2.08±0.056 CFU/cm^2, compared to the types of acrylic plastics used in the dentures for patients

in the second and third groups – 4.10±0.095 and 5.14±0.036, respectively, at similar time points in the second and third groups (p=0.0001).

Table 1.

Intergroup comparison of the levels of Candida albicans in the oral cavity of denture wearers

Groups	5th day	10th day	p	1st month	p
Group I, (n=13)	-	2,08±0,056	-	3,25±0,043	-
Group II, (n=15)	2.06±0.042	4.10±0.095	0.0001*	5.08±0.050	0.0001*
P_1	-	0.0001*		0.0001*	
Group III, (n=15)	3.10±0.046	5.14±0.036*	0.0001*	7.22±0.093*	0.0001*
P_1	-	0.0001*		0.0001*	
P_2	0.0001*	0.0001*		0.0001*	

Note: P – statistical significance of the difference relative to day 1 in the group (Wilcoxon paired test); $P_{1,2}$ – statistical significance of the difference relative to the 1st or 2nd group, respectively (Mann-Whitney test, independent samples); * – the difference is statistically significant, $p<0.05$.

Thus, when evaluating the quantitative parameters of the degree of contamination of the soft tissues of the oral cavity with Candida species, it was found that the levels in patients wearing dentures made of Ftorax exceeded those in patients using removable dentures made from the previous base material. This often predisposes, under favorable conditions, to the onset and progression of pathological processes and inflammatory complications.

Thus, the prosthetic base materials discussed, although not to the same extent, may serve as risk factors for the progressive increase in the frequency of isolation of pathogenic, aggressive, and virulent bacterial species in the oral cavity.

In the course of the clinical and laboratory studies of prosthetics of patients for the manufacture of removable plate structures, materials from acrylics were used with the hot polymerization method, in particular, "Vertex Rapid Simplified", the powder of which is a fine, suspension copolymer of methacrylic acid methyl ester and a liquid part, represented by methyl ester of methacrylic acid. At the first stage of the research, the frequency of contamination and primary adhesion of

microorganisms were determined to develop diagnostic criteria and predict the development of dysbiosis, the increase of the risk of stomatitis against the background of increased colonization of soft tissues of the oral cavity of prosthetic wearers by representatives of opportunistic pathogens and pathogenic microbial flora, the degree of their adhesion in the process of wearing prostheses. Statistical analysis of the obtained laboratory data revealed certain disorders in the microbiocenosis of the oral cavity of the examined patients already on the 10th day after the completion of orthopedic treatment. During the research, significant differences were found in the level of colonization of the mucous membrane by some representatives of virulent and stabilizing types of microorganisms.

The data obtained show that the most important stabilizing and virulent types of microbial flora have the ability to colonize the soft tissues of the oral cavity of prosthesis wearers to varying degrees, depending on the characteristic features of the base material. Besides, the quantitative and qualitative parameters of colonization of pathogenic flora in the first and second groups of orthopedic patients using structures based on “Ftorax” and “Vertex Rapid Simplified” significantly exceed those for the same types of microorganisms in the third group of patients. The statistical analysis of the results of a comprehensive evaluation of biochemical indicators in saliva proves that the adaptation of denture wearers to wearing prostheses may depend on the properties of the base material used. This adaptation occurs more quickly in patients of the first group, where "Meliodent HC" was used as the base material. Practically identical results were obtained by other authors when comparing the effectiveness of the use of the aforementioned material. Compared to the results of orthopedic treatment based on other acrylic base materials, minimal negative changes were observed in the biochemical indicators of oral fluid, with a particularly more pronounced positive dynamic in the alkaline phosphatase (ALP) levels.

The concentration of IgA in the mixed saliva of nearly healthy orthopedic patients significantly increased on the 14th day after the placement of the prosthetic structure ($p<0.001$). However, this trend did not persist by the end of the observation period in the prosthetic groups where Vertex and Meliodent plastics were used as the base material. A

statistically significant increase ($p<0.001$) in the amount of IgA in the mixed saliva of patients in the third group was observed at nearly all observation time points, namely the 2nd week and 1 month after the start of wearing the prosthetic structure made from Ftorax acrylic plastic. The study and analysis of the quantitative indicators of IgM immunoglobulin in the mixed saliva of patients revealed a nearly identical pattern to the previous type, in terms of the comparative frequency of detection of this element in the saliva at the same time points and in the same groups of orthopedic patients. In other words, the adaptation process at the initial stage of observations during denture wear in patients from all three groups occurred against the backdrop of a significant increase in the level of IgM in the oral cavity ($p<0.001$), specifically in the mixed saliva, one week after wearing the prosthetic structure. However, with more prolonged use of the removable denture, certain intergroup differences were identified, with more favorable or positive changes in the amount of IgM in the saliva. Thus, when using dentures made from ‘’Ftorax’’, at this stage of observation, a high concentration of IgM was still recorded compared to the initial data ($p<0.001$). This suggests, based on the level of this immunoglobulin and the presence of IgA in the mixed saliva, a relatively more pronounced and significant response from the cells of nonspecific immune defense in response to the introduction and wear of the removable dental prosthesis made from the before mentioned acrylic plastic. These findings are consistent with data from other authors. At the same time, wearing prosthetic structures made from the other plastic, Meliodent, for the same period resulted in a statistically significant decrease in the amount of IgM in the mixed saliva, almost returning to the baseline levels ($p<0.01$). There was also a significant reduction in the IgA levels, bringing them below the initial values ($p<0.05$).

Thus, after removable denture prosthetics, the strongest reaction during the early adaptation period was observed with removable dentures made from Ftorax and Vertex, which was associated with an increase in the levels of transaminases ALT and AST, as well as ALP and immunoglobulins A and M in the mixed saliva. At later stages of clinical observation, the tissue response in the oral cavity decreased or was completely absent when removable dentures made from Meliodent and Vertex were used.

To establish changes in the microbiocenosis of one of the main biotopes of the mouth, both prosthesis wearers without the presence of inflammatory changes on the mucous membrane of the prosthetic bed, and those having them in the form of hyperemia and edema were selected. Further identification of bacteria was carried out according to biochemical properties using test systems.

Medical treatment was carried out for 46 denture wearers aged 45 to 55 years, of whom 32 patients showed signs of inflammatory changes in the soft tissues adjacent to the denture base. The I control group consisted of 14 denture wearers who had no signs of inflammation. In the II comparison group, 15 orthopedic patients were recommended to rinse their mouths with a traditional antiseptic, a 0.05% solution of chlorhexidine digluconate, according to the recommended treatment standards. In the III main group (17 patients), treatment was carried out using applications of the drug "Metrogyl Denta" three times a day for 10–14 days. In the above-mentioned groups, the collection of mixed saliva was performed by spitting into a glass test tube for 5 minutes, determining the volume of saliva secretion, its secretion rate, and the acid-base balance (saliva pH).

Microbiological examination of the microflora state of the oral mucosa was carried out before and, on the 7th, and 60th days of using removable acrylic prosthetic structures in patients of the control and main groups, as well as the comparison group.

When analyzing the state of the microbiocenosis of the oral cavity of prosthesis wearers, significant differences were revealed in the qualitative and quantitative indicators of various microorganism groups in all examined patients. Significant changes were recorded in the contamination frequency of representatives of both normal resident microflora and opportunistic pathogens and pathogenic bacteria: streptococci, lactobacilli, and fungal infection (Table 2). Thus, streptococci were isolated from the oral mucosa of 42.9±13.2% of orthopedic patients of the first group before the prosthetics, regarding other microorganisms, in patients of the same group, lactobacilli were found in 35.7±12.8% of the patients and pathogenic staphylococci, i.e. S.aureus, were not detected at all in patients of this group before the prosthetics. In the comparison

group, the abundance indicators of pathogenic microorganisms in the same period were significantly higher.

Table 2.
The state of the oral cavity microflora before and after prosthetics with removable dental structures

Treatment period	Patients with removable dentures					
	Group 1 control (n=14)		Group 2 comparison (n=15)		Group 3 main (n=17)	
	Abs	%	Abs	%	Abs	%
S. salivarius (excretions %)						
Before treatment	6	42.9±13.2	4	26.7±11.4	6	35.3±11.6
After 1 week	5	35.7±12.8	7	46.7±12.9	9	52.9±12.1
After 2 months	7	50.0±13.4	6	40.0+12.7	12	70.6±11.0
S. epidermidis (excretions %)						
Before treatment	5	35.7±12.8	8	53.3±12.9	11	64.7±11.6
After 1 weak	4	28.6±12.1	7	46.7±12.9	10	58.8±11.9
After 2 months	4	28.6±12.1	6	40.0±12.7	9	52.9±12.1
S. aureus (excretions %)						
Before treatment	0	0	2	13.3±8.8	3	17.6±9.2
After 1 week	1	7.1±6.9	2	13.3±8.8	3	17.6±9.2
After 2 months	0	0	2	13.3±8.8	0	0
Enterococcus spp. (excretions %)						
Before treatment	0	0	0	0	0	0
After 1 week	0	0	1	6.7±6.4	2	11.8±7.8
After 2 months	0	0	1	6.7±6.4	2	11.8±7.8
Lactobacillus spp. (excretions %)						
Before treatment	6	42.9±13.2	8	53.3±12.9	3	7.6±9.2
After 1 week	5	35.7±12.8	7	46.7±12.9	10	58.8±11.9
After 2 months	5	35.7±12.8	6	40.0+12.7	6	35.3±11.61
C. albicans (excretions %)						
Before treatment	1	7.1±6.9	1	6.7±6.4	3	17.6±9.2
After 1 week	1	7.1±6.9	4	26.7±11.4	9	52.9±12.11
After 2 months	1	7.1±6.9	2	13.3±8.8	3	7.6±9.2

Established as a result of clinical and laboratory studies, more intensive rates of decline in dental health in prosthesis wearers

with pathological changes in the soft tissues of the oral cavity surrounding the base of the prosthetic structure indicate that risk factors for oral health, often accompanying the process of wearing acrylic prostheses, have a pronounced negative effect on the general condition of the patient, contributing to a decrease in the adaptive capabilities of the organism and a deterioration in the quality of life. In orthopedic patients of the main group, fungi of the genus Candida (52.9±12.11%) were recorded comparatively more often than in other examined groups of prosthesis wearers for the same periods. However, it is very important to note that their number in the same group sharply decreased by the end of observations, i.e., at the final stage of microbiological studies, and amounted to 7.6±9.2%. An increase in the frequency of occurrence and the number of Enterococcus spp. was registered.

Thus, the identification of the species composition of the oral cavity microflora at different stages of prosthetics and the complex supportive therapy will allow timely implementation of prophylactic measures and adequate antimicrobial therapy, taking into account the microbial nature and sensitivity to various drugs.

Besides, in the above groups of orthopedic patients, the volume and the rate of saliva secretion, and the pH of saliva were determined. In total, a laboratory study was carried out on 46 samples of biological material.

The effectiveness of orthopedic treatment and preventive measures at various stages after the treatment was assessed based on the analysis of anamnestic data, complaints, examination results, bacteriological data, and biochemical parameters of mixed saliva. Collection of biological material was carried out 5 minutes before, then 1 week and 2 months after orthopedic treatment.

Analysis of the rate of salivation and the state of acid-base balance of the activity of hydrogen ions in the oral fluid of prosthesis wearers revealed a significant decrease in these indicators in the process of wearing acrylic structures and before the therapeutic and prophylactic measures. Probably, the presence of an inflammatory process on the mucous membrane of the prosthetic bed to a certain extent contributes to the depletion of the

adaptive capabilities of the oral cavity, which is reflected in the rate of background salivation and activity, associated with the ecological balance of hydrogen ions (pH) in the oral cavity.

According to pH values of saliva in the examined orthopedic patients, at the initial stage of the research, the activity of hydrogen ions shifted to the relatively acidic direction in all three groups – 6.67±0.016 and 6.70±0.020, in the control and main groups, respectively.

We studied the effect of acrylic plastic materials of various compositions used in dental prosthetics on soft tissues. According to the goal of the study, the considered acrylic plastic materials of various compositions were experimentally introduced into the subcutaneous tissues of common rabbits and, using a histological study, the changes that occurred in the tissues surrounding these materials were examined during 4 weeks (28 days) of the study.

In our research, 48 common rabbits were used with a weight in the range of 2.0-2.9 kg and an age of 1-2 years. As already noted, an experimental model was formed on all rabbits in order to study the effect of acrylic plastic materials on soft tissues. For the experiment, the femoral region of rabbits was selected. For this purpose, first of all, 1% Novocain solution was injected into the corresponding area for local anesthesia. The subcutaneous tissues at the site of the experimental model were opened with one incision.

Particles of previously prepared acrylic plastic materials of various compositions with dimensions of 0.5x1x2.0 cm were placed in the subcutaneous areas of the femoral region of animals. Then the incision in the skin was removed with a surgical suture. The experimental animals were observed for 4 weeks (28 days). According to the different compositions of acrylic plastic materials used in the experiment, the test animals were divided into 4 groups with 12 rabbits in each group.

Throughout the study, on 3 rabbits from each group, at the end of the first, second, third, and fourth weeks, the experimental model was suspended. For this, anesthesia of the corresponding zone was performed again with a 1% solution of Novocain.

Acrylic materials embedded in the subcutaneous areas along with the skin and subcutaneous tissues were removed by excision. Primary surgical debridement of the wound was performed. The purpose of stopping the study in each of the 4 groups at different stages was to assess the effects of the same material on soft tissues at these stages. Euthanasia was not performed during the study; besides, there were no cases of death or exclusion of animals from the study for any other reasons. After the experimental model creation, the test animals were divided into 4 groups with 12 rabbits in each: Group I - consisted of 12 rabbits on which colorless plastic was used; Group II - “Ftorax” group with 12 rabbits, Group III - “Meliodent HC” group with 12 rabbits; Group IV - "Belacril" group with 12 rabbits.

According to the degree of reliability, depending on the significance, three degrees were determined - weak (<0.05), high (<0.01), and very high (<0.001).

The results of the histological studies were analyzed for each parameter separately. In all biopsy specimens in different groups, changes were found directly in the tissues surrounding the acrylic plastic materials. Changes in tissue areas farther from acrylic-plastic materials were in the minority.

Besides, in the samples of the group where colorless plastic was used, more severe changes were noted, and minimal changes were detected in the group where "Meliodent HC" was used.

The dynamic observation did not reveal any regularities in the increase or decrease in the number of giant multinucleated cells. In most samples, giant multinucleated cells, along with histiocytes and lymphocytes, formed aggregates - formations of granulomas. Giant multinucleated cells and granuloma formations were most noted in the Meliodent HC group (Figure 1).

Observations showed that infiltration with histiocytes, as well as the formation of giant multinucleated cells and granulomas, occurred in the form of a nonspecific reaction, regardless of the type of acrylic materials.

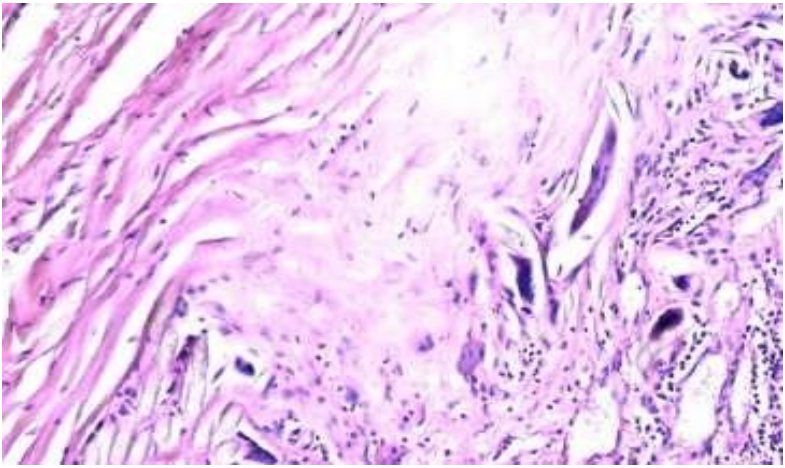

Figure 1. Lymphocytes and multinucleated giant cells with fibrosis in the Meliodent HC group, the fourth week of the study (color: hematoxylin-eosin, magnification: x40).

These changes occur only due to the presence of foreign objects in the tissues. The rate of occurrence of giant multinucleated cells and granulomas throughout the study in different groups is shown in table 3.

Table 3.

The intensity of the appearance of giant multinucleated cells and granulomas in different groups at different weeks of the study

Groups / Weeks	I	II	III	IV
1	1.00±0.00	0.66±0.57	1.66±0.57	0.66±0.57
2	1.33±0.57	0.33±0.57	2.00±1.73	1.00±0.00
3	1.33±0.57	0.66±0.57	1.66±1.15	1.66±1.52
4	1.00±0.00	1.00±0.00	2.33±0.57	1.00±1.73

I – colorless plastic group;
II – “Ftorax” group;
III – “Meliodent HC” group;
IV – “Belacril” group.

Similar to neutrophil infiltration, which characterizes acute inflammation, necrotic changes characteristic of acute tissue damage were observed sporadically in only a few samples. In the Meliodent HC group, without exception, none of the samples showed necrosis. In the remaining groups, only one sample of each group had foci of focal necrosis.

CONCLUSIONS

1. After removable denture prosthetics, the strongest reaction during the early adaptation period was observed with removable dentures made from "Ftorax" and "Vertex Rapid Simplified," which was associated with an increase in the levels of transaminases ALT and AST, as well as alkaline phosphatase (ALP) and immunoglobulins A and M in the mixed saliva [16];
2. The base material used for prosthetizing patients from "Meliodent HC" demonstrated minimal side effects on the surrounding tissues, which was associated with the lowest yeast-like fungus Candida species isolation rates 10 days after the placement of the denture – 2.08±0.056 CFU/cm², compared to the types of acrylic plastics used in the dentures for patients from "Vertex Rapid Simplified" – 4.10±0.095 CFU/cm², and the third group "Ftorax" – 5.14±0.036 CFU/cm² at similar time points ($p=0.0001$) [13, 8, 6];
3. After wearing the prosthetic structure, during the follow-up clinical examination of the oral cavity and patient survey to assess quality of life, the indicators in the main group after the course of supportive therapy as an additional preventive measure decreased from the baseline level and amounted to 2.58±0.041 points [5,15];
4. Fibrous changes, circulation disorders, sclerotic changes in the arterial vessels, as well as infiltration of lymphocytes and plasma cells were observed to a lesser extent in the third group, where "Meliodent HC" was used. In this same group, the damage to the soft tissues around the acrylic plastic materials was comparatively mild, and no infiltration of eosinophils was observed in any of the samples ($p \leq 0.05$) [7,9,10,12];

5. Due to its relatively high "compatibility" with surrounding tissues and improvement in clinical and laboratory indicators, an important condition for enhancing the effectiveness of removable denture prosthetics can be considered the use of "Meliodent HC" as a base material, as well as the use of the dental gel "Metrogyl Denta" in the treatment and prevention of inflammatory complications of prosthetics [13,15].

PRACTICAL RECOMMENDATIONS

1. Among patients requiring prosthetics, especially the elderly and senile, the individual selection of the base material for removable dentures should be carried out with consideration for reducing the risk of inflammatory complications.
2. When evaluating base materials widely used in modern prosthetic dentistry and based on clinical and laboratory studies of the oral cavity, the plastic "Meliodent HC" can be recommended as a base material.
3. To reduce the side effects of denture base materials and manage inflammatory processes in the soft tissues of the prosthetic bed, it is recommended to apply a thin layer of Metrogyl Denta gel to the denture base in the morning and afternoon after meals and completion of oral hygiene procedures.
4. Quality-of-life data obtained can serve as an objective criteria for the comparative assessment of the body's adaptive capacity during prosthetic treatment using different denture base materials.
5. In cases where patients experience intolerance to removable prosthetic constructions with bases made of certain plastics following prosthetic treatment, it is recommended to replace them with prostheses made from more biocompatible materials that have significantly fewer adverse effects on the oral cavity and overall health.

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