



## Comparative Evaluation of Structural and Functional Changes in Periodontal Tissues of Protected Teeth with Metal-Ceramic Prostheses

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### ABSTRACT

To increase the efficiency of prosthetics, the use of metal, metal-ceramic and zircon dentures was determined. The issues of modern methods of dental prosthetics are highlighted. The analysis of the most common errors and complications in prosthetics with the use of fixed structures has been carried out. The assessment of the physical and technical properties of cermet structures remains poorly studied. To exclude ceramic chips, antagonizing dentures are not brought to contact, which can lead to deformation. Thus, the question of the influence of fixed prostheses on the clinical and morphological state in the absence of periodontal tissues remains unstudied.

### Keywords:

Cermet's, Fixed Prostheses, Periodontium, Prosthetics.

### Introduction

Restoration of defects in hard tissues of teeth and dentition is an urgent task not only for orthopedic dentistry, but also for general medicine in general. The pathology of hard tissues of teeth, both carious and non-carious, contributes to a decrease in the quality of chewing food and indigestion, as well as cosmetic defects and speech impairment (1,2,3).

Physiological indicators of the function of the dentition are impaired with the loss of teeth. According to outstanding scientists in the field of orthopedic dentistry professors: V.Yu. Kurtsidsky, Gavrilov, Kopeikin, partial, secondary adentia, depending on the number of lost teeth, can adversely affect the digestive system of the body.

The structural changes in the oral cavity organs with partial loss of teeth were studied. (4,5,6) Changes in saprophytic and pathogenic microflora have been fairly well studied. (7,8)

In case of prosthetics with a non-removable design of dentures, special importance is attached to the abutment teeth. They carry out a large functional load, in connection with which the periodontal tissue undergoes morpho-functional changes. Considering the side effects of artificial crowns, these changes become obvious. (9,10,11). Initial structural changes are observed in the pulp tissue during the preparation of dental hard tissues. (12,13,14).

As stated by Professor Kh.I. Irsaliev during the preparation of the teeth, the temperature of the pulp of the tooth rises due to the high speed of the turbine drill. Electron microscopic observations (12) indicate blood filling, and in some cases hemorrhage of the dental pulp, and this contributes to aseptic inflammation of the dental pulp tissues. (15,16).

In case of prosthetics with various removable and non-removable structures with secondary adentia, the state of the

periodontium depends on the magnitude of the load, the length of the defect, and the choice of the technique for processing hard tissues of the teeth. At the same time, the choice of design features primarily depends on the state and degree of changes in the periodontal tissues. According to certain data [13, 10, 11], pronounced morpho-functional changes are observed in the periodontal microvessels with an increase in functional loads. It should be borne in mind that the problems associated with obtaining reliable information on the condition of the tissues surrounding the tooth (periodontium, periodontium, marginal gum) arise already at the initial stage. The diagnostic methods used are rather approximate and in many cases do not reflect the actual picture of the state of the periodontal tissues.

Numerous works of prof. Irsaliev H.I. evidence of objective criteria for assessing changes in the periodontal tissues are electron microscopic research methods. Transmission electron microscopy reveals pathological changes in periodontal tissue at the ultrastructural level. (sixteen).

Thus, when preparing hard tissues of teeth and design features of fixed structures of dentures with various materials of artificial crowns, they contribute to profound changes in the pathological nature of the periodontal tissues. (10.17).

In orthopedic dentistry, dentures from precious and base metal alloys are widely used to restore defects in crowns and dentition. The latter are composed of cobalt-chrome and nickel-chrome alloys. The problem of the influence of base metals on the organs of the oral cavity and on the body as a whole is urgent. Among them, oral galvanosis is more common. Being in the oral cavity for a long time, a denture, as a foreign body made of a material not characteristic of the human body, causes structural changes in the marginal periodontium. Therefore, modern orthopedic dentistry faces the question of the compatibility of metal dental alloys and the human body. (18).

The phenomenon of "intolerance", galvanosyndromе, galvanosis described in the literature, can be explained by the body's

reaction to the presence of metallic inclusions in the oral cavity, which is expressed not only by intolerance to dentures, but also by the manifestation of a burning sensation of the tongue, hypo- and hypersalivation, changes in taste, etc. etc. [7,9,20,23,24]. In this regard, the study of the state of galvanosis of the oral cavity with fixed prosthetics made of various metals becomes urgent and requires further research in this direction, which will improve the quality of dental care and prevent premature removal of orthopedic structures [12, 18, 19]. The available research in this direction is not numerous and is of a fragmentary nature. Therefore, the identification of the cause-and-effect circumstances that contribute to the occurrence and cause of diseases of oral mucosa when using various types of prostheses (metal crowns, ceramics, zirconium) with the use of histological, electron microscopic and histochemical research methods, will allow developing more effective methods of their treatment and prevention.

#### **Aim of the study**

Is comparative assessment of morphological and functional changes in periodontal tissues when using metal, metal-ceramic and zircon dentures to improve the efficiency of prosthetics.

#### **Materials and methods**

The studies were carried out in 100 people, who were divided into 2 groups: the main observation group - 90 (80.7 ± 3.7%) patients and the comparison group (control group) - 10 (19.3 ± 3.7%) patients. Among the patients of the main group, there are 30 patients with chromium-cobalt, 30 patients with metal-ceramics and 30 patients with zircon crowns. There were examined 144 teeth, which are and will be the abutment teeth of bridges. In the comparison group, studies of 24 teeth with intact periodontium on the upper and lower jaws were carried out in patients aged 30 to 60 years. When examining all patients in both observation groups, the Green-Vermillion hygienic index, Russell periodontal index were determined, and the Kulazhenko test was performed. The Schiller-Pisarev test refers to

the method of intravital staining of gingival glycogen, the content of which increases with chronic inflammation (composition - crystalline iodine 1 g, potassium iodide 2 g, distilled water 40 ml). Intense discoloration after lubrication of the gums indicates inflammation. Oral cavity sanitation, dental plaque removal, and oral hygiene training were carried out. Diagnostic observations of the periodontal condition were carried out in the area of abutment teeth before and after fixation of bridges and crowns, as well as within 1, 3, 6, 12 months after prosthetics. Clinical methods included questioning, casual examination, and armed eye examination (stomatocopy) of the oral cavity. Stomatocopy was performed using an ophthalmic operating microscope at a magnification of 30 times.

For morphological examination,  $1 \times 1.5$  mm tissue pieces were taken for transmission electron microscopy. Pieces of bioplast were fixed in glutaraldehydes. The bone tissue around the abutment tooth was examined using X-ray machines. Computed tomography was performed to assess the bone structure of the upper and lower jaw. To determine the endurance of the periodontal tissue to vertical load, gnathodynamometry was performed using electronic gnathodynamometers. Electroodontometry was performed selectively, and only those teeth that were included in the abutment teeth for bridges and according to indications. The used bridges (cermets, zirconium, metal crowns) create conditions for the development of increased functional load on the periodontal tissues of the supporting teeth. When prosthetics of included dentition defects with bridges, it is necessary to determine possible functional changes in the periodontal tissues, which can largely determine the terms of their use. The change in blood circulation in the periodontal tissues directly depends on the degree of deformation of the dentition, the length of the edentulous and the involvement of bridges in the chewing load. Particular attention during prosthetics (cermets, zirconium) should be paid to changes in the state of the marginal periodontium at the level of microcirculation, which was one of the objectives of this study. To determine the

marginal periodontium of the abutment teeth of the first group, we selected 64 patients, the second group - 10 people.

The study groups consisted of 5 groups: 10 patients ( $16.0 \pm 4.2\%$ ) - with intact periodontal disease, 16 patients ( $24.0 \pm 4.9\%$ ) - gingivitis, 22 patients ( $36.0 \pm 5.5\%$ ) - mild periodontitis, 10 patients ( $13.3 \pm 3.9\%$ ) - periodontitis of moderate severity, 6 patients ( $10.7 \pm 3.5\%$ ) - periodontitis at the stage of abscess formation. The state of the periodontal tissues, in particular the marginal gums, was assessed according to the data of clinical and paraclinical research methods in the field of abutment teeth in the dynamics of observations up to 1 year in patients of the main observation group and the comparison group. Statistical processing of the obtained data was carried out using the variation statistics of the computer programs "MS Excell" and "MS Access" in a standard volume for biomedical research. Before using the technique of electroodontometry, dental deposits were removed. During the second prosthetics, after removing the bridges, the remains of the fixed cement were carefully removed. EOM, intraoral image. The study of the EOM of teeth with a filling in the area of the tooth neck was not carried out in order to avoid the current leaving the soft tissues. The existing amalgam fillings were removed and measurements were taken from the bottom of the carious cavity. Patients with contact fillings on the teeth underwent preliminary isolation of the teeth with a celluloid plate smeared with petroleum jelly, after which the indicators were measured. Electroodontometry was carried out using an EOM-3 apparatus.

If depulpation is necessary for primary or repeated prosthetics, as well as for the control of early filled teeth, we used the generally accepted assessment criteria. Complete filling of root canals up to the apex, not reaching the apical foramen by 1 - 1.5 mm. Unsatisfactory endodontic interventions included cases of root canal filling not to the full length or removal of the seal from the root apex. In each individual case, we paid special attention to X-ray changes in periodontal tissues, the quality of their obturation, both before the fixation of the bridge structures and in the long term up to 1

year. When removing bridges (repeated prosthetics) within a period of up to one year of observation, in addition to clinical and radiological examinations and removal of dental plaque, the state of the electrical excitability of the pulp and periodontium of abutment teeth was studied using the EOM-3 apparatus to preserve their expediency under the bridge structures. To determine the state of the periodontal complex, in particular, the marginal periodontium, the quality of endodontic treatment, and the state of the periapical tissues, additional X-ray intraoral examinations (targeting images) were carried out according to clinical, X-ray and paraclinical indicators. The electrical excitability of the abutment tooth pulp was determined after the removal of the bridge structures. According to the indicators of electroodontometry, the abutment teeth underwent depulcation and endodontic treatment, taking into account the group belonging of the teeth of the upper and lower jaw and control targeted intraoral images or orthopantomogram.

Next, the preparation of the abutment teeth was carried out, the design of the ledge was carried out using retraction sutures, the taking of impressions with a silicone mass with a sandwich technique from each individual jaw. Next, the metal frame was tried on with correction by applying a second layer of silicone mass. After trying on the finished prosthesis, it was fixed and dynamically controlled for one year.

Galvanometer "j0409" (registration 3609) [24] is an electrical measuring device with a non-graduated scale, which has a high sensitivity to current or voltage. It is widely used as zero indicators, as well as for measuring small currents, voltages and quantities of electricity, if the constant of the galvanometer is known. In addition to magnetoelectric, there are some other types of galvanometers, such as electrostatic ones, called electrometers. However, their use is very limited. When removing bridges (repeated prosthetics) within a period of up to one year of observation, in addition to clinical and radiological examinations and removal of dental plaque, the state of the electrical

excitability of the pulp and periodontium of abutment teeth was studied using the EOM-3 apparatus to preserve their expediency under the bridge structures.

Galvanometer "j0409". Material: plastic + electronic component

Sensing range: -30-0-30 $\mu$ A, size: 133x97x100mm, accuracy:  $\leq$  5%

Application:

Ambient temperature: 0 °C + 40 °C

Relative humidity:  $\leq$  85%

It can be used to measure the magnitude of the strength of direct and alternating current, direct and alternating voltage, resistance.

With the help of the **galvanometer "j0409"** semiconductor diodes were checked and electrical circuits were ringed. The measurement results were displayed on a large digital 31/2-digit LCD display. The method can be widely used in practice to diagnose galvanosis of multiple and single metal inclusions. In addition, with the parallel measurement of the potentials of metal prostheses and dental tissues, it is possible to reveal the nature of the interaction of prostheses and oral tissues after prosthetics.

### **Clinical researches**

The collection of clinical material was carried out with the obligatory opening of an outpatient card, entering into it the dental status and the general condition of the body and the diseases transferred. All design features and type of material from which bridges were made, age indicators are given in the section "Material and research methods". In the comparison group (control group), studies of 24 teeth with intact periodontium in the upper and lower jaws were carried out on the basis of basic and paraclinical research methods (percussion, the state of the gingival margin using a bulbous probe), X-ray - overview and sighting images, electroodontometry - to determine condition of the pulp and periodontal. In the main observation group of patients, in addition to determining the type of design features of bridges, all abutment teeth were examined in the same sequence as in the comparison group.

All patients were familiarized with the treatment and manipulation plan (removal of bridges if necessary, the forthcoming stages of treatment, replacement of constructions, excluding possible side and pathological conditions), written consent and financial costs signed by patients.

The errors that we identified were most often associated with the wrong choice of abutment teeth for bridges, the choice of the design of the prosthesis not according to indications (irrational prosthetics), violation of the regime when preparing hard dental tissues, traumatization of the periodontal edge due to non-observance of the immersion of crowns in the periodontal sulcus. Criteria for the quality of crowns were assessed by the inconsistency of anatomical shapes, taking into account the group of teeth, excessive or insufficient insertion of crowns into the gingival groove, causing retraction of the tooth neck or leading to hypertrophic gingivitis, supercontacts - to changes in the periodontal complex. Taking into account the radiological, functional parameters and the state of the periodontal complex, electroodontometry (EOM) was used: the abutment teeth were subjected to depulping or replanting of the root canals with poor-quality obturation. During prosthetics, the abutment teeth were subjected to odontopreparation under cermet or zirconium according to the generally accepted technique: the design of the ledge, retraction of the periodontal edge using the appropriate threads. The impression was obtained using a silicone sandwich technique. Laboratory and clinical stages: fitting of frames, prosthesis, fixation was carried out according to the rules of orthopedic dentistry.

The clinical condition of the marginal periodontium was assessed visually and using an operating microscope, the Schiller-Pisarev test and the papillary-marginal alveolar index (PMA) indexes, where hyperemia, edema, bleeding and vascular pattern were determined.

The clinical picture with partial adentia largely depends on the number of lost teeth, dystopia, type of bite, functional usefulness, the state of hard tissues not only of abutment teeth, but

also of the complex of tissues surrounding the tooth. The appearance of a defect after tooth extraction disrupts its continuity, morphological and functional disorders occur. Shortened periods of wearing fixed bridges resulted in supercontact, while in others the teeth were turned off from the act of chewing. The marginal gum, where the connection with the tooth occurs, is often interpreted as a gingival pocket, a gingival gap, a physiological pocket, a gingival groove. When measuring the gingival gap, the groove depth reached 2-3 mm on average. With bridge prosthetics, when odontopreparation was performed and the gums were injured (periodontal pathology), the depth of the gingival groove in 50% of cases reached 3 mm. These data related to the indicators of the marginal gingiva of the abutment teeth around the defect during repeated prosthetics of patients. The condition of the periodontal gap served as a basis for assessing the marginal periodontium in persons wearing fixed prostheses, both during re-prosthetics and in future orthopedic interventions. We studied the magnitude of the electrochemical potentials in connection with the finding in the oral cavity of prostheses of various design features, as well as the materials from which they were made: solid, cermets, zircon.

It is known that dentures made of various materials lead to disruption of oral homeostasis and have adverse effects on the body as a whole. In particular, there are violations in the triggering mechanisms in the development of allergies, hyperergic conditions, ulcerative and trophic processes. In this regard, the determination and understanding of causal factors in the conditions of the galvanic environment of the oral cavity is based on the use of para-clinical methods, in particular, on the study of electrochemical potentials. Our data on electrochemical potentials (ECP) are consonant with the indicators of numerous studies and are normally up to 50 mV. Analyzing the identified ECP frequencies, it is obvious that wearing metal structures is directly related to an increase in the level of galvanic currents. Thus, when studying ECP in patients using

structures made of dissimilar materials, the average measurement values tended to higher values of the potential difference and reached the level of 100-150 mV. Poor, inadequate endodontic treatment leads to changes in the periodontal complex, ultimately leading to side effects and premature removal of bridges.

When removing bridges from metal brazed-stamped structures, it turned out that in 95% of cases, dark-colored corrosion, covered with nutritive masses, were observed at the places of the rations of the prosthesis body with supporting crowns, and under the prosthesis body there were bedsores of the mucous membrane of bright red color, hypertrophy, bleeding. The errors observed by us in the work of a dentist and a technician at the stages of manufacturing fixed dentures were assessed by the following parameters: modeling of the manufacture of crowns and the intermediate part of the prosthesis body; supercontacts, which, if incorrect, leads to abrasion of the teeth of the antagonists and abrasion of the facing material. The above data of clinical and paraclinical known techniques for fixed bridge prosthetics indicate the presence of pathological conditions that entail the premature removal of bridges.

We evaluated the periodontal complex in 90 patients who received orthopedic treatment. Of these, 38 patients underwent primary and 20 patients underwent repeated orthopedic treatment with fixed bridges, with the complete exclusion of acrylic, plastic veneers. We examined 114 teeth under the supports of bridges and 24 teeth on the upper and lower jaw with healthy intact periodontium in patients of the control group. The dynamics of observations began with planning and coordinating with the patients the design features of bridges and the upcoming therapeutic measures in the dynamics of treatment up to 1 year. Selectively, in terms of up to 3 years and more, after prosthetics, some patients were called for a follow-up examination, where, if necessary, a clinical and X-ray examination was carried out. In patients using for many years (more than 7 years) a fixed construction of dentures made of cobalt alloy coated with titanium sodium, an

unpleasant odor from the oral cavity was noted. The mucous membrane of the gums is hyperemic, sometimes bluish in color, repeats the shape of the neck of artificial crowns. Bleed easily and painful on probing. In some patients (more in men), the titanium coating has worn off on the chewing surfaces of the teeth. Patients with such (metal) dental constructions complained of the appearance of a metallic taste in the mouth and the sensation of unpleasant micro-currents when using aluminum spoons. In the dynamics of observations in terms of up to 1 year and more with repeated prosthetics, we paid special attention to the state of the periodontal edge, the mucous membrane of the entire oral cavity, modeling in accordance with the anatomy of the group of teeth, supercontacts, the state of the intermediate part of the bridge, as well as functional and aesthetic indicators.

Organo-structural changes both in the pulp of the tooth and periodontium, where electroodontometry showed increased indicators: the current strength reached up to 100-150  $\mu\text{A}$  (at a rate of 2 to 5  $\mu\text{A}$ ), which unambiguously predetermined the study of the state of the surrounding tooth of the marginal gum, taking into account the common genesis ... In connection with the significant prevalence of diseases of the oral mucosa caused by a reaction to the materials of dentures, histological and histochemical studies of the oral mucosa using prostheses made of various materials are of great interest. The structural and functional characteristics of the mucous membrane of the marginal gum is of great applied and practical importance, as it allows one to judge the correct choice of materials for dentures, which in the process of being in the oral cavity may be indifferent, excluding possible pathological conditions in the future. In this regard, one should take into account the histological picture of the mucosa, which can become an essential guideline for determining the pathological nature of the oral mucosa with various prostheses.

The aim of this study is the histological and histochemical assessment of the oral mucosa with various types of prostheses: cermets, zirconium, metal crowns. The control group

consisted of marginal gum tissue after tooth extraction. The keratinization process is especially pronounced in the epithelium of the anterior third of the hard palate. The structure of the epithelium of the hard palate is very similar to the leaves that have fallen to the ground in the autumn period of the year. Some of them slough off in the form of completely keratinized scales, while others do not show any signs of keratinization and have a structure typical of squamous epithelium. Regeneration of epithelial cells occurs due to cell division of the basal layers. The pattern of mitosis, as a rule, is observed in the cells of the basal layer, as well as in the adjacent lower rows of cells of the spiny layer. (Irsaliev Kh.I. 1993). The electron diffraction pattern of a transmission microscope shows detachment of cells of the granular layer with penetration of microorganisms into the intercellular space. Destructive changes are also observed in the deep zones of the spiny layers of the epithelium. It should be noted a slowdown in the differentiation of epithelial cells and a sharp decrease in the mitotic activity of the combined zone. In the prickly layers, there is a rupture of dysmosomic connections between epithelial cells.

With the introduction of metals (mainly stainless steel) into the practice of orthopedic treatment, the reactions to these materials were explained by the appearance of galvanic phenomena in the oral cavity. As a rule, the diagnosis was formulated as "galvanosis", "electrogalvanosis". Since there were no sufficiently sensitive research methods to prove the presence of metal corrosion in an aggressive environment. Significant disorders with partial edentulousness occur in the tissues of the periodontal complex, since it is the integrity of the dentition of the jaws that ensures the usefulness of chewing as one of the most important functions of the body. The wide spread of secondary adentia among the adult population makes this problem relevant all over the world (Gozhiy A.G. 1998, Volyntsev V.I. 1996). In the manufacture of a fixed structure of dentures, most of the bridges have to be prepared with abutment teeth for artificial crowns. Dissection of hard dental tissues

without observing the established rules leads to morpho-functional changes in dental pulp tissues. In the monograph of Professor Irsaliev Kh.I. (2001) widely described and illustrated electronograms of the surface of prepared teeth.

The author describes the structure of the paired tooth surface using burs of different dispersion under a scanning electron microscope. Coarsely dispersed burs form deep uneven reliefs of the tooth surface, which lead to burnout and dentin necrosis of the teeth (12,15). The author considers burs with fine-grained diamond coatings to be the most acceptable for preparation. Experimental and clinical studies have shown that when prosthetics of included dentition defects with bridges, it is necessary to carefully determine the indications for the use of various structures, taking into account the reactive changes in the periodontal tissues. The functional state of periodontal tissues is largely determined by their trophism, which is provided by the circulatory system.

In the works of Arslanov O.U. "Compensatory and adaptive processes in the dentition with partial secondary adentia and the ways of their orthopedic correction" (2007), a sharp violation of microcirculation and a decrease in the endurance of periodontal tissues of abutment teeth was proved, which, according to the author, is a contraindication for immediate prosthetics after the removal of decayed teeth or their roots (20).

Laser Doppler flowmetry is a method for diagnosing and monitoring trophic changes in periodontal tissues and during orthopedic interventions to give an idea of the hemodynamic state of the corresponding area. When studying the functional state of periodontal vessels in secondary adentia, many authors have established changes in the marginal gingiva and abnormalities in the pulp of abutment teeth after their preparation (21,22,23). Hemodynamic changes in the microcirculation of the supporting teeth of the marginal gum against the background of single studies cannot give an objective assessment that reflects the true picture when wearing or long-term use of bridges. In our opinion,

special attention should be paid to the measurement of the state of the marginal periodontium in modern types of prosthetics (cermets, metal, zirconium) at the level of microcirculation, adaptation processes, which was the topic of this study.

We studied the state of the marginal periodontium of abutment teeth in 70 people aged 20 to 60 years, who underwent laser Doppler flowmetry as part of the research. Dissection of teeth (depulpated and with live pulp) was carried out in a strict sequence: creating a ledge, reducing the length of the tooth crown taking into account the ceramic and metal layer, removing hard tooth tissues from the vestibular and oral surfaces, and forming a circular ledge at the level of the gingival margin. The work used diamond burs in a certain sequence, taking into account the formation of the ledge. After taking impressions with antagonists with a silicone mass, the teeth were covered with temporary crowns, which were pre-fabricated by taking an impression and making them with plastic. Subsequently, prosthetics were carried out according to the generally accepted technique: fitting a solid frame, choosing a color, eliminating supercontacts, fixing a bridge with glass ionomer cement.

## Results and discussion

Thus, the restoration of dentition defects with various fixed structures of dentures is an orthopedic dental treatment. The loss of teeth and the appearance of various defects in the dentition contribute to the further development of the pathological process in the dento-jaw system and in the body as a whole. The choice of the design of dentures and the materials from which they will be made is of paramount importance in the medical and social sphere of the patient. In our Republic of Uzbekistan and a number of other foreign countries, metal crowns and bridges made of base metals are currently used, sometimes they are coated with titanium nitrate, which further aggravates the protective mechanisms of the oral cavity.

Such materials used for dentures do not meet either the aesthetic or functional

requirements of modern dentistry. This state of the problem dictated the search for the most adequate structures built into the oral cavity, devoid of the above disadvantages. Currently, the most satisfying clinical and functional requirements and aesthetic parameters are dentures made of cermet, zirconium. Undoubtedly, the positive results of orthopedic structures made of cermets and zirconium are largely indifferent for the organs and tissues of the oral cavity. However, there are also negative influences on the marginal periodontium associated with the advancement of the edges of the crowns into the periodontal pocket, causing morphological changes. The present study is devoted to the study of the marginal periodontium when using fixed bridges, cermets, zirconium and chromium-cobalt alloy).

As recommendations for practical health care of the most appropriate optimal designs, it is necessary to use cermets, zirconium in order to improve the quality of dental care. In patients using bridges and crowns made of a cobalt-chromium alloy, edematous with cyanosis of the mucous membrane of the alveolar ridge was observed. As we mentioned above, such a mucous membrane quickly bleeds when touched with a probe and when brushing teeth with a toothbrush.

We also described structural changes in the epithelial cover at the level of light and electron microscopy. We associate all these changes with the appearance of galvanic currents in the mouth in patients. Determination of electrochemical potentials in the mouth in these patients showed the maximum values and were equal to 120-150 mV. A high level of galvanic currents in the oral cavity, exceeding the physiological norm, dictates the implementation of preventive measures to prevent the occurrence of galvanism in the oral cavity, which should include the selection of design features that are tolerant to the physiological homeostasis of the oral cavity, compliance with the complete homogeneity of metal structures and their replacement in the presence of heterogeneity of inclusions. In this regard, the study of the functional state of microcirculation in the tissues of the marginal



gums and the entire periodontal complex is relevant for obtaining further positive results of prosthetics of dentition defects. In this regard, when choosing a plan for orthopedic treatment, the assessment of the functional state of the supporting-retaining apparatus of the teeth comes to the fore. However, problems arise in the first approximation and are associated with an objective assessment of the true picture of the state of the tissues surrounding the tooth. The currently used diagnostic methods are quite subjective: there are no standard measurement techniques, developed protocols, and the available data are contradictory. Thus, the existing methods for assessing the state of the marginal gingiva of the periodontal abutment teeth do not give a true picture of its functional changes in microcirculation at the stages of prosthetics with secondary adentia.

In our opinion, special attention should be paid to determining the state of the marginal periodontium of abutment teeth in modern types of prosthetics (cermets, zirconium), adaptation processes at the level of microcirculation, which was the topic of the study. We have examined by clinical, functional and morphological methods the tissues of the marginal periodontium of abutment teeth in patients using metal-ceramic and zircon bridges.

A different clinical picture was observed in patients using metal-ceramic bridges. Among the examined, 7 patients had gingivitis. These patients have been using metal-ceramic bridges for more than 5 years. Moderate periodontitis was observed in 6 patients. We did not observe severe periodontitis in the acute stage. We observed a completely different clinical picture in the group of patients using zircon bridges. Among the examined patients, gingivitis was observed in 3 patients. Regardless of the terms of using dentures, periodontitis was not observed in this group of patients. The data on indicators of the state of microcirculation of the marginal gingiva included abutment teeth under bridges (main group of observations), as well as intact periodontium of the symmetrical side (comparison group). The analysis of the results

showed that the level of capillary blood flow in the healthy periodontium and marginal gingiva (the results obtained were averaged and taken as the norm) was 20% and 30% higher, respectively, compared with the periodontium of abutment teeth. The coefficient of variation (KV), indicating the state of microvascular activity, was lower in the supporting vessels by 18% in patients with repeated prosthetics. The vasomotor activity of the microvessels of the abutment teeth is slightly reduced (by 4.2%) compared to the indices in the intact dentition, which is possibly due to the high functional load on the healthy side. The data obtained show that in the area of the gum tissue of the marginal periodontium of the supporting teeth, which limits the dentition defect, there was a decrease in the intensity of tissue blood flow and vasomotor activity of microvessels, compared with those of the marginal gingiva of the intact dentition.

In the dynamics of observations before fixation of the bridge with LDF of the supporting teeth, a positive dynamics of microcirculation indices was determined. The level of capillary blood flow (M) increased by 28% and approached the initial level before treatment, vasomotor vascular activity (KV) increased by 32%. After fixation of the bridge in the dynamics of observations of the marginal gingiva of the supporting teeth, the level of capillary blood flow tended to further increase: the vasomotor activity of microvessels (KV) decreased by 10%, which is lower than the initial level. 1 month after fixation of the bridge, the level of capillary blood flow tended to progress and corresponded to normal values. The obtained indicators remained in the dynamics of observations up to 6 months and in more distant periods of observation. According to the results of our research, orthopedic treatment of a partial dentition defect with metal-ceramic structures is important for determining the state of microcirculation of the supporting tissues of the teeth. The data obtained from the study of laser-Doppler flowmetry (LDF) at the stages of orthopedic treatment up to the fixation of a fixed bridge and in the long-term observation period show that this objective assessment of

the functional state of the microcirculation system in the periodontal tissues of the marginal gingiva of the abutment teeth is relevant for predicting near and long-term results prosthetics of partial dentition defects.

The histological picture of the marginal gingiva of the periodontal complex can be essential for determining the pathological state when wearing prostheses of various designs.

When studying the histological picture of the lesion of the marginal gums of the oral mucosa when wearing bridges made of metal-ceramics and zirconium, no pronounced pathological changes were revealed. With metal-ceramic prostheses on the mucous membrane of the marginal gums, there is a sharp destruction of the plumen layer with the preservation of intercellular desmosome connections. In the granular layers, there is an accumulation of intracellular boundaries of glycogen. In patients using zircon bridges, no destructive changes in the tissue of the marginal gum were found, which is similar to an inactive dentition. These data indicate a rigorous approach to the selection of basic dental materials for dentures. The least damaging effect on the marginal periodontium and the intermediate part of bridges compared to metal bridges and crowns was found to be made of cermets and zirconium, which manifested themselves in a mild dystrophy in the surface layers of the epithelium and a lymphoid-cell reaction in the subepithelial layers of the mucous membrane of the dentogingival margin, which with methods of preparation of abutment teeth under one-piece structures.

It should be noted that at present there is no multifactorial approach to the diagnosis, treatment and prevention of diseases caused by the materials of dentures, which significantly complicates the practical work of a dentist. Therefore, the histological diagnosis of the mucous membrane of the marginal periodontium will certainly contribute to the differential diagnosis of diseases caused by the materials of dentures.

## Conclusions

Dental prosthetics in patients using chromium-cobalt pure metal bridges with a

coating of titanium dioxide) have a negative effect on the marginal periodontium and the oral mucosa, manifested by high values of electrochemical potentials, unsatisfactory hygienic state, profound changes in the morphological structures of the marginal periodontal complex in the dentoparodontium. Laser Doppler flowmetry at the stages of orthopedic treatment showed that the functional state of the microcirculation system in the tissues of the marginal gums of the periodontal tissues is relevant for predicting the results of prosthetics of partial dentition defects.

The structural and functional characteristics of the mucous membrane of the marginal gingiva indicated the negative effect of metal dentures in comparison with the weakly expressed inflammation of the epithelium in the surface layers during prosthetics made of metal-ceramics and zirconium. Diagnostics and treatment of an increased level of galvanic currents should involve the removal of metal structures of various inclusions and the conduct of pathogenetic therapy of periodontal tissues before re-prosthetics, with the replacement of basic dental materials with ceramics or zirconium.

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