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EFFECT OF ACRYLIC REMOVABLE DENTURES ON EDENTULOUS PATIENTS' LOCAL IMMUNITY AND OXIDATIVE HOMEOSTASIS STATE

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Annotation. *The aim of the present research was to study the effect of the removable dentures, the bases of which are made of acrylic plastics, on local immunity and the state of oxidative homeostasis in edentulous patients. It was examined 100 patients before, in 1 week and in 1 month after complete removable prosthetics. The condition of the mucous membrane of the prosthetic bed was studied using the technique of macrohistochemical staining. In oral fluid the levels of S IgA, superoxide dismutase (SOD), catalase (CAT) and glutathione reduced (GR) were determined.*

In a week after prosthetics, the inflammation of the mucous membrane was determined in 100 % of patients, while, in a month, it was diagnosed in 28.0 % of cases according to visual manifestations and in 82.0 % – according to the data of the macrohistochemical staining. It was established that the use of dentures causes the growth of the level of S IgA and the activation of the enzymatic chain of oxidative homeostasis ($p < 0.05$).

Key words: *complete removable dentures, acrylic plastics, local immunity, oxidative homeostasis.*

Removable dentures with rigid bases made of acrylic plastics remain the most popular method of treatment for edentulous patients. Thus, among Ukrainian population aged 40 and over, the production of complete removable dentures requires about 15 %, and after 60 years – up to 25% [1]. Moreover, the need for prosthetics because of complete absence of teeth increases, which is due to the pronounced demographic shift causes the growth of the number of elderly people who don't have indications for dental implantation [2].

At the same time, it is noted about the aggressive influence of components of acrylic plastics, which are antigens, and affect both the organism as a whole and directly on the mucous membrane of the prosthetic bed. The residual monomer is a protoplasmic poison, extremely active in contact with tissues; it is also able to stimulate hydrolytic destructive processes, affects the functional state of neutrophils of the oral cavity and inhibits their activity [3].

In this regard, in our opinion, a certain scientific interest is in the study of the reaction of the mucous membrane of the prosthetic bed on acrylic plastics. In turn, immune metabolic indicators can be used as objective criteria for changes in its functional state, in particular, under the influence of the residual monomer [4, 5]. It's known, that oral fluid is a very indicative object for study, because its composition is influenced by various biochemical changes occurring in the oral cavity [6].

Thus, the aim of the present research was to study the effect of the removable

dentures, the bases of which are made of acrylic plastics, on local immunity and the state of oxidative homeostasis in edentulous patients.

Materials and methods of research. In the work, 100 edentulous patients, middle age and elderly (60-82 years), equal to men and women, were examined. The persons with severe forms of somatic and endocrine diseases, as well as cancer patients, were excluded from the study. Selected patients were made of complete removable dentures with rigid bases from the acrylic plastic "Ftorax" (Stoma, Ukraine) on both jaws according to the traditional technology.

Patient examination included complaints, anamnesis and clinical study that consists of examination and palpation of the organs and tissues of the oral cavity before prosthetics, in 1 week and in 1 month after. In addition, the condition of the mucous membrane of the prosthetic bed was determined using the method of macrohistochemical staining. For this purpose, the prosthetic bed was lubricated with a solution of Schiller-Pisaryev, then – with a 3% solution of toluidine blue. After 30-60 seconds, the intensity and the colour of staining according to the type of mucous membrane were evaluated. Planimetric mesh was used to determine the area of inflammation zones. The assessment was carried out according to the following criteria: no inflammation; the area of inflammation ≤ 1 cm2; the area of inflammation is more than 1 cm2. In addition, the average total area of inflammation zones of the mucous membrane of the prosthetic bed was calculated [7].

The object of the biochemical study was the oral fluid of patients, which was collected on an empty stomach, before delivery of protective designs, then in 1 week and in 1 month. The level of secretory immunoglobulin A (S IgA) was determined using the standard method of immunoassay [8]. As indicators of oxidative homeostasis, the content of superoxide dismutase (SOD), catalase (CAT) and glutathione reduced (GR), which was established in spontaneous biochemical reactions, was studied [9].

Statistical processing of the data was performed using the Statistica 6.0 (Statsoft Inc., USA) package with the Student's t-criteria in normal data distribution and the non-parametric Mann-Whitney criteria – under abnormal distribution. The normal distribution was assessed using the Shapiro-Wilk test.

Results and discussion. A week after the delivery of complete removable dentures, the signs of inflammation of the mucous membrane were observed in 100 % of patients (Fig. 1). According to the clinical examination, the process was predominantly local (74.0 %) and most often coincided with areas of traumatic effect of the bases of dentures. In the examined patients, hyperemia prevailed, which was encountered in 82.0 % of observations, while the traumatic erosive-ulcerative mucosal lesions in the areas of transitional folds and the bottom of the oral cavity were detected in the remaining 18.0 %.

On the contrary, according to the results of macrohistochemical staining, inflammation occurred in 100% of cases. The process has a sharp, generalized nature. It characterized by a brownish coloration of the mucous membrane of the prosthetic bed of varying intensity (the most pronounced coloration coincided with the inflammatory foci found during visual examination). The distribution of patients for the prevalence of inflammatory process on the mucous membrane of the prosthetic bed is given in Fig. 2.

As can be seen from this figure, among the surveyed patients, those ones prevailed in whom the area of inflammatory changes in the mucous membrane as a result of colouring was more than 1 cm2. The average value of the area of the inflammation of the mucous membrane of the prosthetic bed was 1.93 ± 0.25 cm2.

It should be noted that during the first three weeks after the delivery of dentures, we corrected their bases in accordance with the determined traumatized areas of the mucous membrane.

Accordingly, after 1 month the number of cases of inflammation of mucous membrane of the oral cavity due to the use of dentures was reduced to 28.0 % (see Fig. 1). Among them 78.6 % had focal and diffuse hyperemia of the mucous membrane of the prosthetic bed, 10.7 % – petihia and 10.7 % – erosive-ulcer defeat.

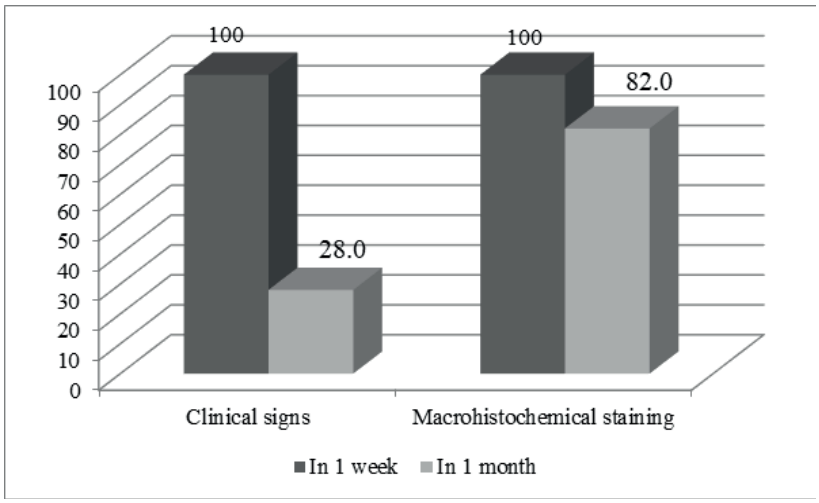

Fig. 1. The proportion of patients with inflammatory changes in the mucous membrane of the prosthetic bed in 1 week and in 1 month according to the clinical examination and the results of macrohistochemical staining (%, n=100)

However, based on the results of macrohistochemical staining, signs of inflammation were diagnosed in the vast majority of observations (82.0%). In these patients, due to macrohistochemical coloration, the mucous membrane at the I class by Soupplee acquired a blue colour, while in the second class – a blue one but less intensity. In hypertrophied mucous membrane (classes III and IV) its dark blue colouring was recorded. Among these cases, the part of acute inflammatory process, which was characterized by brownish coloration of different intensity, depending on the type of mucous membrane, was 19.5 %. In the remaining patients, the inflammation was of a chronic nature.

As it can be seen from Fig. 2, in the examined patients the generalized nature of inflammation, when the area of process exceeds 1 cm2, prevailed. At the same time, the average value of the area of defeat was 1.37 ± 0.20 cm2 and was significantly lower compared to the results obtained in 1 week after the beginning of using of the dentures

($p < 0.05$). Also, based on the results of studying the topography of the paint, it was found that the greatest traumatic effect created those areas of the denture which covered the alveolar processes of both jaws.

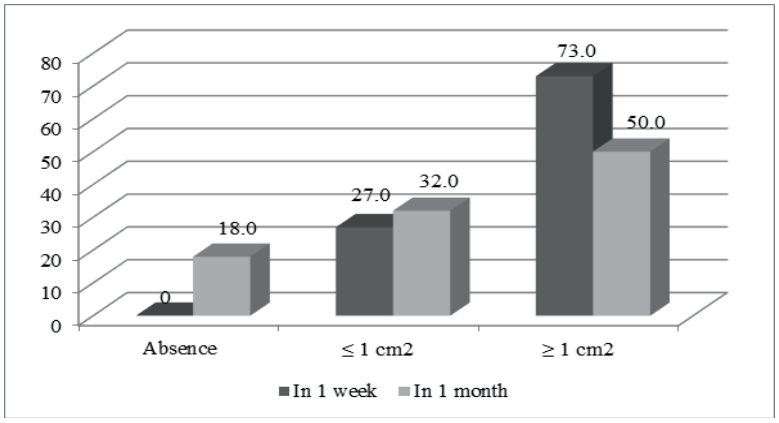

Fig. 2. Dynamics of the area of inflammation in the mucous membrane after prosthetics in 1 week and in 1 month (%, n=100)

According to the analysis of the nature and localization of the inflammatory process on the mucous membrane, after 1 week the inflammatory response from the mucous membrane was caused by both mechanical and toxic effects of the bases of dentures, whereas in 1 month, after the correction of their edges, inflammatory phenomena could be considered as a consequence of the negative effects of acrylic plastics, which were confirmed by the results of biochemical studies (Table 1).

Table 1

Dynamics of indicators of local immunity and oxidative homeostasis in the dynamics of use of complete removable dentures (M±m)

Term of observation	Indexes			
	S Ig A, mg/ml	GR, SU/min	SOD, SU/min	CAT, SU/min
Before (1)	0.74 ± 0.02	24.2 ± 0.8	1410.0 ± 37.0	4.2 ± 0.3
In 1 week (2)	0.82 ± 0.03	27.0 ± 1.0	1517.5 ± 40.2	6.0 ± 0.4
In 1 month (3)	0.80 ± 0.03	26.8 ± 1.0	1470.5 ± 41.1	5.2 ± 0.3
p 1-2	< 0.05	< 0.05	< 0.05	< 0.001
p 2-3	> 0.05	> 0.05	> 0.05	> 0.05
p 1-3	> 0.05	< 0.05	> 0.05	< 0.05

Before prosthetics, concentration of secretory immunoglobulin in the oral fluid was 0.74 ± 0.02 mg / ml (Fig. 3). Then, after 1 week of use of dentures, it increased to 0.82 ± 0.03 mg / ml ($p < 0.05$) and it was maintained at increased levels (0.80 ± 0, 03

mg / ml) and later, after 1 month ($p < 0.05$).

The data of the evaluation of indicators that characterize the state of oxidative homeostasis proved an increase in their level in the contingent of the studied patients.

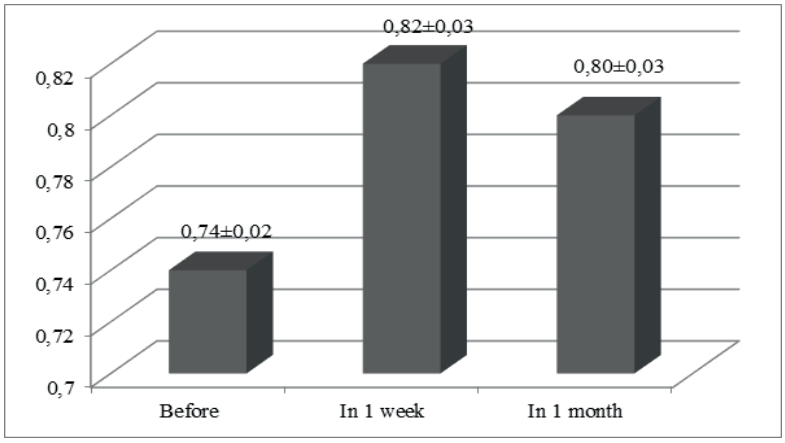

Fig. 3. Dynamics of concentration of secretory immunoglobulin in the oral fluid during observation (mg / ml, M±m, n=100)

Thus, the content of glutathione reduced (GR) in the oral fluid increased from 24.2 ± 0.8 SU/min before the use of dentures to 27.0 ± 1.0 SU/min in 1 week after and up to 26.8 ± 1.0 SU/min in 1 month after ($p < 0.05$) (Fig. 4). In turn, the content of superoxide dismutase (SOD) in the oral fluid also increased due to prosthetics. So, if the value of this indicator before the beginning of use of dentures was 1410.0 ± 37.0 SU/min, then in 1 week after they equalled 1517.5 40.2 SU/min, somewhat decreasing in 1 month to 1470.5 ± 41.1 SU/min ($p<0.05$) (Fig. 5).

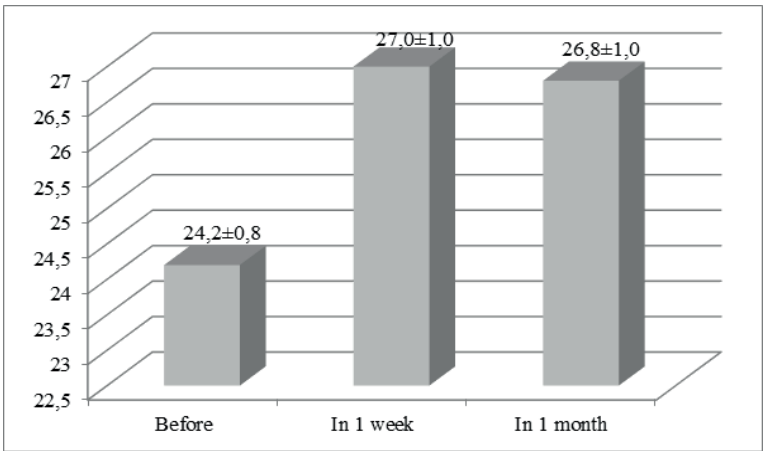

Fig. 4. Changes in the concentration of glutathione reduced (GR) in the oral fluid during observation (SU/min, M±m, n=100)

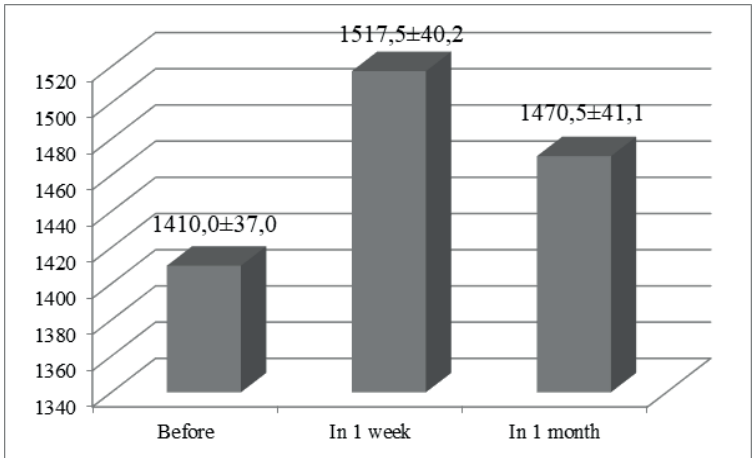

Fig. 5. Dynamics of the content of superoxide dismutase (SOD) in the oral fluid during observation (SU/min, M±m, n=100)

We also recorded a similar dynamics of catalase (CAT) content in the oral fluid (4.2 ± 0.3 SU/min before prosthetics and 6.0 ± 0.4 SU/min – in 1 week after ($p < 0.001$) and 5.2 ± 0.3 SU/min – in 1 month ($p < 0.05$) (Fig. 6). Obviously, the content of catalase in the oral fluid was the most informative marker of the reaction of oxidative homeostasis in the process of use of prostheses.

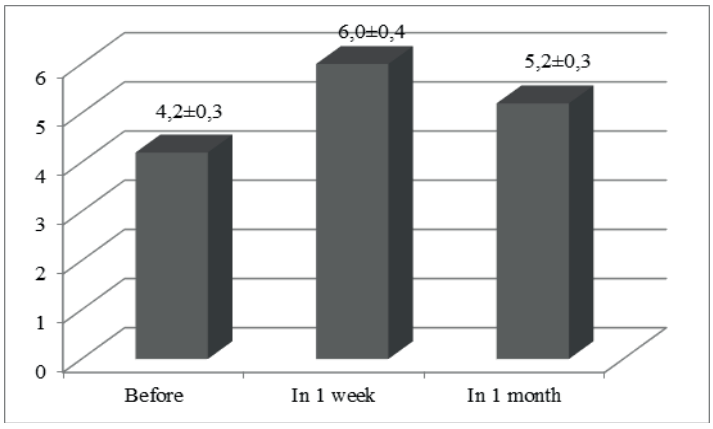

Fig. 6. Changes in the catalase (CAT) content in the oral fluid during observation (SU/min, M±m, n=100)

It should be noted that there are no reliable differences between male and female indicators ($p > 0.05$).

So, according to the results of the study of the level of secretory immunoglobulin A and the indicators, characterized the state of the enzymatic chain of oxidative homeostasis, it can be attributed to the expressed compensatory reaction from the oral

cavity mucosa to the use of removable dentures with acrylic bases.

At once, within 1 week after the delivery of the dentures, the levels of the studied indices are significantly increased ($p < 0.05$), while in 1 month there is a tendency towards their decrease ($p < 0.05$). The inserted dynamics of biochemical markers proved the lack of compensatory possibilities of the oral mucous membrane in normalizing the immune-metabolic status.

Conclusions. 1. The use of complete removable dentures with acrylic bases in the immediate period of observation leads to the development of inflammatory processes in the mucous membrane of the prosthetic bed. If the mechanical factor can be eliminated by correction of the bases, then the influence of the toxic factor continues and causes a predominantly chronic inflammation in 82.0% of cases.

2. Compared to baseline, after 1 week of the use of acrylic dentures has a rise in the content of indicators that characterize the activation of the enzymatic chain of oxidative homeostasis of the mucous membrane, as well as the local immunity.

3. The most informative is the increase in the content of catalase in the oral fluid as a marker for functional rearrangement and activation of compensatory reactions ($p < 0.001$).

4. The mechanism of functional response of the mucous membrane of the prosthetic bed to the negative influence of acrylic bases can be characterized as a compensatory reaction, which is manifested by the restructuring of the enzymatic chain of oxidative homeostasis against the background of an increase in the level of secretory immunoglobulin A.

5. The obtained results point on the necessity of searching for methods of reducing the negative influence of the bases of complete removable dentures made of acrylic plastics on the mucous membrane of the prosthetic bed.

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