

# MEDICAL SCIENCES

## THE EFFECT OF COMPLETE REMOVABLE DENTURES ON BLOOD MICROCIRCULATION IN THE TISSUES OF THE PROSTHETIC BED

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### Abstract

A comparative study of the effect of hard and two-layer (with soft lining) bases of complete removable dentures on the tissues of the prosthetic bed was carried out using the method of laser Doppler flowmetry in 40 patients with complete secondary adentia. It has been established that the use of complete removable dentures affects the intensity of blood circulation in the microcirculatory bed of the mucosa of the prosthetic bed. Changes that occur in the blood supply of tissues under prostheses with rigid bases are reversible and return to their original values after at least 6 months, or even blood supply increases adaptively, however, on the other hand, it significantly and irreversibly impairs the blood supply to the tissues of the prosthetic bed, which in the long term can cause a dystrophic decrease in the volume of the bone base, and under a prosthesis with a rigid base, the changes are reversible and after 6 months the blood filling adaptively increases.

**Keywords:** complete removable denture, laser Doppler flowmetry.

One of the most important conditions for the successful restoration of defects in the dentition of edentulous jaws with complete removable dentures with a predictable long-term result is the prevention of atrophy of the alveolar process [1]. The latter is especially important for the lower jaw, where prosthetic conditions are unfavorable for severe bone atrophy.

The bed practically makes it impossible to adequately fix the prosthesis. Over time, when the prosthesis is re-manufactured, the situation only worsens due to a decrease in the area for its support [2]. It is known that for the manufacture of bases for complete removable dentures, acrylic plastics are used in 98% of cases. Such removable dentures are combined irritants of the tissues of the prosthetic bed. In addition to the therapeutic effect, their rigid bases lead to the development of atrophic processes in the mucous and bone tissue of the jaws. Bone atrophy in the region of the apex of the alveolar process is also due to involutional changes in the body, but is mainly associated with uneven distribution of the chewing load under the basis of the prosthesis on subordinate tissues and compression of the mucosa, which leads to ischemia. Under mechanical pressure, partial or complete occlusion of small blood and lymphatic vessels, and this cannot but affect the metabolism and trophism of tissues [3]. To avoid the harmful effect of a hard base, numerous manufacturers offer a variety of liners (soft plastics) for laboratory and clinical use, acrylic-based and silicones, which are recommended as a shock-absorbing substrate in complete removable dentures. It is assumed that the distribution of the load on the mucosa occurs in such a way that it excludes areas of concentration of occlusal pressure. The manufacturer claims that a prosthesis with an inner

surface made of soft material will less aggressively affect the tissues of the prosthetic bed. In this regard, we considered it expedient to compare the effect of rigid and double bases of complete removable dentures on the tissues of the prosthetic bed, in particular, to study changes in the state of the capillary bed of the mucosa in the immediate and remote periods of use of structures. In this work, we used laser Doppler flowmetry as a modern diagnostic method the state of blood circulation at the capillary level, a direct effect on metabolic processes in tissues, plays a significant role in the course of inflammatory, reparative and dystrophic destructive processes. The method is based on measuring the Doppler components in the spectrum of the reflected laser signal scattered by particles moving in the tissues. The method provides a unique opportunity to assess the value of tissue perfusion, i.e. the volume of mobile blood per unit time through a unit mass of tissues and allows for dynamic non-invasive determination of capillary circulation in the surface layers [4]. Irradiation from the device does not harm a person, and the probe itself can be positioned in specified areas of the oral cavity using individual acrylic plates to obtain objective and repeatable indicators [5].

The aim of the work was to study changes in blood microcirculation in the tissues of the prosthetic bed when using complete removable dentures for the lower jaw, which have a hard and double (with a soft lining) bases in the next period of observation.

### Materials and research methods.

Complete removable dentures for the lower jaw were made for 40 persons with complete secondary adentia, equally for men and women of middle age - Period 55-65 years. The selection criteria for the observation groups were as follows:

1) a stable state of health, in particular, the absence of a history of cardiovascular pathology;

2) the absence of injuries and inflammatory processes in oral cavity;

3) moderate atrophy of the alveolar processes (first class according to Schroeder and Keller);

4) history - no smoking.

The experimental patients were divided into two groups, equal in age and sex and clinical picture. In the first group, complete removable dentures had a single-layer hard base, in the second - a two-layer one with a soft liner.

All prostheses were made in a similar way, according to generally accepted technology. Functional prints were obtained using individual trays and masses. Artificial teeth exhibited on prostheses according to the bilateral balanced occlusal scheme. Hot polymerization plastic was used as a rigid material for the basis of prostheses. The soft substrate was formed in a laboratory way. The prostheses were produced by compression molding. At the stage of delivery of prostheses, special attention was paid to occlusal correction. In subsequent visits, if necessary, inaccuracies of the basis, which injured the mucosa, were eliminated.

To study blood microcirculation, rigid plates were made, the boundaries of which were the same as those of the corresponding lower removable dentures (Fig. 1). The plates were made on copies of master models of edentulous jaws beyond the boundaries drawn with an indelible pencil; they had four holes in the projection of the canines and first molars for laser Doppler flowmetry.

Blood microcirculation in the mucous and submucosal layers of tissues was studied in each patient before the application of complete removable dentures after a week, after 1, 3 and 6 months of use. 15 minutes before the measurements, which took place between 10.00 and 12.00 am, the prostheses were removed from the oral cavity. After that, the plates were placed in the oral cavity, and the probe of the device was inserted into the prepared holes and measurements were made.

The obtained data were processed by the methods of variational

Research results and discussion.

In the first group, where patients used prostheses with rigid bases, the intensity of blood circulation in all areas is lower compared to the values before prosthetics ( $p < 0.05$ ). It is characteristic that the value of the microcirculation index in the canine zone returned to its original values only after six months, and in the molars zone during this period, according to the measurement results, the blood circulation became even more intense. The data obtained indicate that the imposition of complete removable dentures with rigid bases makes it difficult for normal blood microcirculation in the subprosthetic tissues. However, these changes are reversed, and after 6 months, the blood circulation indicators not only return to normal, but may also exceed the initial values, which indicates an increase in the intensity of blood supply to the mucosa of the prosthetic bed. The results, in our opinion, can be explained by the fact that a rigid basis under occlusal load, it injures subordinate tissues

in a certain way, which leads to inflammatory processes, accompanied by intensification of blood circulation. Excessive mechanical pressure probably prevents the gingivomuscular reflex, which thus plays a protective and adaptive role. In favor of this is the fact that it is in the zone of the molars, and this, of course, is the area of high concentration of mechanical loads, that the most intensive blood circulation is observed. However, further studies are needed to confirm these findings. The intensity of blood circulation in the tissues of the prosthetic bed of patients who used prostheses with soft liner, similar to the previous group also significantly decreased within a week after their imposition ( $p < 0.05$ ). However, studies have shown that even after 6 months, blood circulation indicators have not returned to their original values.

The data obtained convincingly indicate that blood supply disorders in the tissues under a removable prosthesis with soft lining are preserved. Moreover, in contrast to the previous group, where the state of blood circulation at least returned to normal in the long-term follow-up period, such changes are clearly irreversible. It is interesting that in [6] it is noted that when using prostheses with a soft lining layer facing the mucosa, the jaw compression force increases by a third, and this, accordingly, improves chewing efficiency by a quarter. In this case, the mechanical load on the soft tissues decreases, but the pressure on the bone resistance increases within 3 seconds. After the start [7]. Summing up, we note that the soft liner, when using a double basis, works as a mechanical load distributor. At the same time, through the blunting of the gingivomuscular reflex on the tissues of the prosthetic bed, a more powerful chewing force is carried out and, accordingly, chewing efficiency increases, which makes such prostheses more acceptable to use for patients. However, as the study showed, with all these advantages, the use of a soft substrate as part of the basis causes an irreversible deterioration in blood microcirculation in the subprosthetic tissues, and this, no doubt, will accelerate atrophic changes. Moreover, there is evidence that a short-term strong load affects the tissues of the prosthetic bed less than a weak, but prolonged one [5]. In the future, metabolites that accumulate in soft tissues during prolonged ischemia are able to induce the activity of osteoclasts, thereby acting destructively directly on the bone base of the prosthetic bed [8].

#### Conclusion.

Using laser Doppler flowmetry, we studied the effect of the bases of complete removable dentures on the tissues of the prosthetic bed, which allowed us to draw the appropriate conclusions.

1. The use of complete removable dentures affects the intensity of blood circulation in the microvasculature of the tissues of the prosthetic bed.

2. Changes that occur in the blood supply of tissues under prostheses with rigid bases are reversed and return to their original values at least after 6 months, or even blood supply is adaptively enhanced.

3. Integration of a soft liner into the basis of a removable prosthesis allows for a more even distribution of the chewing load, however, it significantly and irreversibly impairs the blood supply to the tissues of the

prosthetic bed, which in the long term can cause a dystrophic decrease in the volume of the bone base.

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