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THE EFFECT ANALYSIS OF THE DOUBLE-LAYER BASES IN REMOVABLE DENTURES WITH OCCLUSIVE PART ON THE MICROCIRCULATORY STATE OF THE DENTURE FOUNDATION AREA VESSELS

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The purpose of this work was to determine the effect of double-layer bases in removable dentures with occlusive part on the microcirculatory state of the denture foundation area vessels compared to the effect of dentures made of ordinary base resin. To achieve this purpose, 20 patients with post-traumatic defects of the maxillary bone were examined and orthopedically treated. The method of laser Doppler flowmetry was used to study the characteristics of blood circulation. The generalized analysis of microcirculatory parameters showed the absence of negative effect on the hemodynamic characteristics of the microvasculature in the denture foundation area tissues in the manufacture of removable structures with double-layer bases, which is a major factor in preventing the development of functional and structural changes that occur both from pressure and indirectly through neuroreflex mechanisms.

Key words: microcirculation of vessels, double-layer basis, removable denture, occlusive part, mucous membrane of the oral cavity**.**

The work is a fragment of the research project "Optimization of methods for diagnosis and treatment of basic dental diseases", state registration No. 0119U002899.

From the numerous literature data [3, 8], it is obvious that even the most modern non-removable dentures will not be able to replace removable dentures for a long time. However, they can injure denture foundation area tissues due to the inevitable pressure on the mucous membrane. Analyzing the factors that affect the duration of removable dentures operation, and noting their cumulative nature, we can state the discrepancy of the five-year period of their application with the period of clinical well-being. Recent studies show that repeated and subsequent orthopedic treatment with newly made removable dentures application, change the hemodynamic characteristics of the denture foundation area tissues [4, 9, 10]. These changes can negatively affect the prognosis of effective functioning of the denture. Due to this, double-layer bases of removable dentures become increasingly used. This technique is especially useful in such complex clinical cases as the maxillary bone defects, which are combined with the maxilla and maxillary sinuses, when it is necessary to make a removable denture with an occlusive part. According to M.A. Rebrova, the leading role in the functional and structural changes development in the denture foundation area tissues belongs to vascular disorders that occur both from pressure and indirectly through neuroreflex mechanisms [2, 8, 11].

Currently, a method of computer registration of capillary blood flow in the mucous membrane of the denture foundation area with the preservation of fragments of video in the database is developed in dentistry. The high resolution of the obtained video fragments allows not only to see the state of microvessels, but also to calculate the linear and volumetric rates of capillary blood circulation by canals: arterial, venous and transitional [6, 7].

The purpose of this work was to determine the effect of double-layer bases in removable dentures with occlusive part on the microcirculatory state of the denture foundation area vessels compared to the effect of dentures made of ordinary base resin.

Materials and methods. The study was performed on the basis of the Department of Prosthetic Dentistry of the University Dental Center of Kharkiv National Medical University.

Deontological aspects are resolved within the framework of the current legislation of Ukraine, the Law of Ukraine "On Medicinal Products", 1996, Art. 7, 8, 12, Principles of ICH GCP (2008), Order of the Ministry of Health of Ukraine No. 690 dated 23.09.2009 "On approval of the Rules for performing clinical trials and examination of clinical trial materials and the Standard Regulations on the Ethics Commission" as amended; Declaration of Helsinki of the World Medical Association. The study was performed with minimal psychological losses on the part of patients. Patients were fully informed about the purpose and methods of the study, the potential benefits and risks, as well as possible discomfort during diagnosis and treatment. All ethical requirements are met in accordance with maintaining the confidentiality of information obtained during the study. The work was considered and approved by the Commission on Bioethics of KhNMU of the Ministry of Health of Ukraine.

20 patients, aged 39 to 56 years, with post-traumatic defects of the maxillary bone were examined and orthopedically treated. They were divided into 2 groups: I – control group (n=10, 8 men, 2 women),

patients, whose removable dentures were made with occlusive part of the ordinary base resin; II – main group (n=10, 6 men, 4 women) patients, whose removable dentures were made with occlusive part and two-layer bases.

The method of laser Doppler flowmetry (LDF) using a multifunctional laser diagnostic complex "LAKK-02" was used to study the characteristics of blood circulation. The measurement was performed before dental prosthetics and at different times after the imposition of removable dentures: 1 day, 1 month and 6 months. Operation of the "LAKK-02" complex was performed in the "LDF+spectrophotometry" mode. Before starting the study, the signal was calibrated according to the manufacturer's instructions.

Capillary blood circulation indices were measured in a state of complete physical and mental rest in a room with a temperature of 20-22 °C. During the Doppler imaging, the patient was in a sitting position, the head was fixed on the headrest. Records were performed in the area of the muco-gingival junction at the level of the interdental gingiva from the vestibular surface. The duration of each measurement ranged from 30 to 60 seconds. Each indicator in the subject was determined three times in the same examination area, taking into account biometric and chronometric characteristics, and considering their average value.

The study evaluated the following characteristics: by the method of laser Doppler flowmetry (LDF) – the microvascular flow index (MFI) according to the following formula:

MFI = C × Nrbc × Vav., where:

C – coefficient of proportionality (constant),

Nrbc. – the number of red blood cells in the volume of tissue probing,

Vav. – the average speed of red blood cells.

The MFI parameter determines the dynamic characteristic of blood microcirculation – the change in blood flow per unit of time in the studied volume of tissue of about 1 mm^3 in relative blood perfusion units (BPU). LDF signal has a constant and time-varying components associated with the tone of microvessels.

The database formation based on the results of randomized controlled trials was carried out in Microsoft Excel, 2007. Statistical processing of the study results was performed using the "STATISTICA V. 8.0" software package. We calculated the arithmetic mean value of the quantitative indices presented in the text as (M±m), where M is the sample mean, m is the error of the mean. The results of the qualitative index description (frequency of withdrawal) were expressed in percentage. In all statistical analysis procedures, the achieved significance level (p) was calculated, and the critical significance level in this study was assumed to be 0.05. The hypothesis of equality of general means in the two compared groups was tested using the nonparametric Wilcoxon-Mann-Whitney test for independent samples, and the percentages were performed using the chi-squared test [1].

Table 1

Microcirculatory indices in the mucous membrane of the denture foundation area of patients with post-traumatic defects of the maxillary bone

Indices	Control group, ordinary base resin (n=10)				Main group, double-layer removable dentures (n=10)			
	Treatment stages							
	Before imposition	1 day	1 month	6 months	Before imposition	1 day	1 month	6 months
Microcirculatory index, M, BPU	16.9± 0.32	23.2± 0.4 [a]	21.8± 0.51	20.3± 0.75	17.14±0.54	16.8± 0.19 [a]	17.2± 0.35	17.3± 0.22
Flaxmotion index, FMI	1.51± 0.13	1.05± 0.19 [b]	1.11± 0.09 [c]	1.19± 0.08 [c]	1.4± 0.2	1.42± 0.28 [b]	1.46± 0.13 [c]	1.53± 0.15 [c]
Intravascular resistance, R, %	5.39± 0.31	3.28± 0.42	3.39± 0.29	3.49± 0.38 [d]	5.41± 0.2	5.48± 0.41	5.36± 0.28	5.46± 0.44 [d]
Vascular tone, %	91.6± 3.15	84.3± 2.75 [b]	83.1± 4.16	79.6± 3.84 [d]	94.8± 2.53 [b]	92.9± 3.2	93.6± 2.91	94.3± 4.1 [d]

[a] – significant differences between groups I and II on the first day at the level of $p<0.01$;
[b] – significant differences between groups I and II on the first day at the level of $p<0.05$;
[c] – significant differences between groups I and II after 1 and 6 months at the level of $p<0.05$;
[d] – significant differences between groups I and II after 6 months at the level of $p<0.01$.

Results of the study and their discussion. As a result of our study, we found a reliably significant ($p<0.01$) increase in the microcirculatory index value (Fig. 1, Table 1) in the control group of patients immediately on the first day of denture application from 16.9 BPU up to 23.2 BPU, indicating an increase in vascular perfusion and a decrease in their tone, which further decreased due to the compensatory response of the organism, while in patients of the main group a significant difference in indices at different stages of measurement was not observed.

Determination of the flaxmotion index (FMI) (Fig. 2) showed the variability of perfusion in the control group – on the first day the index significantly (p0,05) decreased from 1.51 to 1.05, later it increased after 1 month only by 0.06 and after 6 months by 0.08, but it did not return to the initial level. For the main group, the flaxmotion index increased slightly with each subsequent measurement, but no significant difference between the stages was found – no variability was observed throughout the study. Comparing the FMI of both groups in 1 and 6 months after dental prosthetics, we recorded a significant ($p<0.05$) difference in results in favor of double-layer removable dentures.

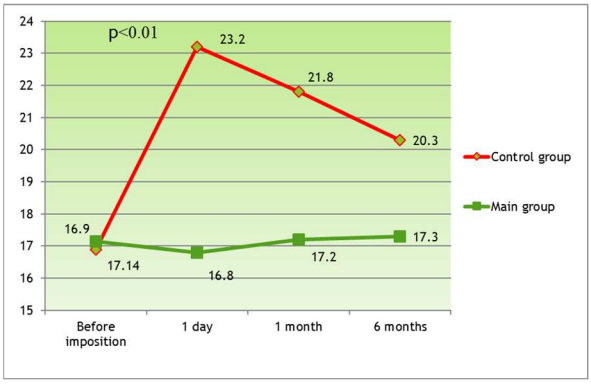

Fig. 1. Microcirculatory index (M), BPU

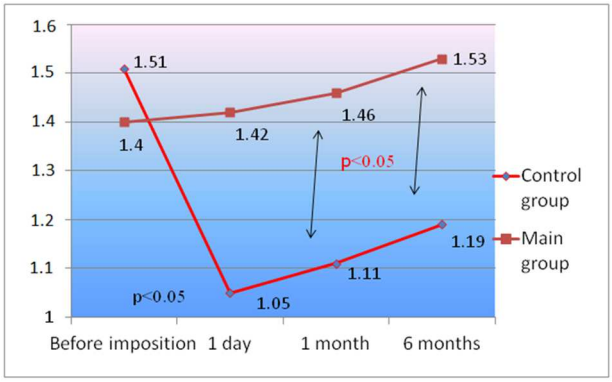

Fig. 2. Flaxmotion index, (FMI)

Indices of intravascular resistance (Fig. 3) ranged from 3.28% to 5.48%. As we had suspected, using double-layer removable dentures, we did not see significant changes from stage to stage and for this parameter, while in the control group there was a significant ($p<0.05$) decrease in the 2nd stage of the study, at the 3rd and 4th stages it increased slightly (possibly due to compensatory reactions), but remained significantly lower than the measurement before dental prosthetics. As a result – a significant ($p<0.01$) difference between the main and control groups 6 months after dental prosthetics.

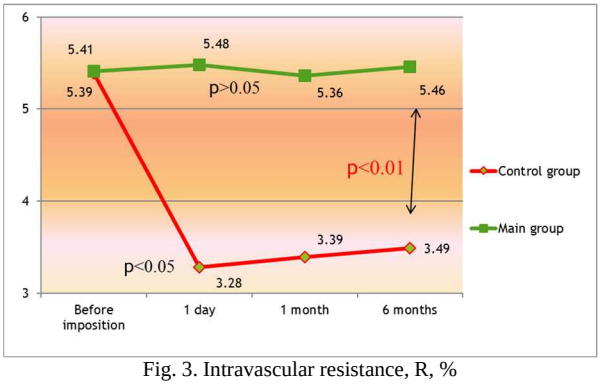

Fig. 3. Intravascular resistance, R, %

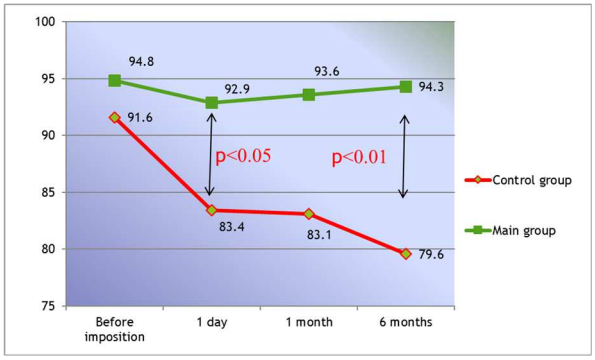

Fig. 4. Vascular tone, VT, %

The next studied parameter was a vascular tone (Fig. 4). From the obtained data we see a significant ($p<0.05$) difference between the groups already at the 2nd stage, and a year later the difference becomes significant at the level of 99.9%.

Thus, we see that a number of previous studies have focused on studying the effect of partial or full removable dentures on the state of the oral mucosa [3, 4]. Other studies were aimed at analyzing the relationship between the microcirculation of oral tissues and general diseases of the organism [6, 7]. We were the first to use the method of laser Doppler flowmetry to control the quality of orthopedic treatment of patients with post-traumatic defects of the maxillary bone using occlusive dentures with a double-layer base.

Therefore, a generalized analysis of the microcirculatory parameters in the mucous membrane of the denture foundation area of patients with post-traumatic defects of the maxillary bone showed that in comparison with standard manufacturing of partial removable dentures with an occlusive part, manufacturing of removable dentures with double-layer bases had a number of essential advantages. In particular, our study proved the lack of negative impact on the hemodynamic characteristics of the microcirculatory flow of the denture foundation area tissues, which is fundamental in the functional and structural changes development that occur both from pressure and indirectly through neuroreflex mechanisms, and this will undoubtedly have a positive effect on the prognosis of the denture functioning.

Conclusions

1. When using double-layer removable dentures with an occlusive part, the microcirculatory index did not change significantly ($p>0.05$).

2. No significant blood perfusion variability was observed when determining the flaxmotion index.

3. A significant ($p<0.01$) difference between the intravascular resistance indices of the main and control groups 6 months after dental prosthetics was determined.

4. After 1 year of dentures application, a significant difference in the "Vascular tone" index was recorded between the studied groups at the level of 99.9%.

The performed study made it possible to clearly demonstrate the effect of two-layer removable dentures with an occlusive part on the microcirculatory state of the denture foundation area vessels and compare it with the effect of dentures made of ordinary base resin. Prospects for further research. Further research will focus on ways to improve the occlusal efficiency of patients with partial maxillary adentia and a defect of the hard palate and alveolar process to improve their quality of life.

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Реферати

АНАЛІЗ ВПЛИВУ ДВОШАРОВИХ БАЗИСІВ ЗНІМНИХ ПРОТЕЗІВ З ОБТУРУЮЧОЮ ЧАСТИНОЮ НА СТАН МІКРОЦИРКУЛЯЦІЇ СУДИН ПРОТЕЗНОГО ЛОЖА

Янішен І.В., Федотова О.Л., Хлистун Н.Л., Ющенко П.Л., Доля А.В.

Метою даної роботи було визначення впливу двошарових базисів знімних протезів з обтуруючою частиною на стан мікроциркуляції судин протезного ложа порівняно з впливом протезів, які виготовлені зі звичайної базисної пластмаси. Для досягнення поставленої мети було обстежено та проведено ортопедичне лікування 20 пацієнтів із посттравматичними дефектами верхньої щелепи. Для вивчення характеристик кровотоку застосовували метод лазерної допплерівської флоуметрії. Узагальнений аналіз параметрів мікроциркуляції показав відсутність негативного впливу на гемодинамічні характеристики мікроциркуляторного русла тканин протезного ложа при виготовленні знімних конструкцій із двошаровими базисами, що є основним фактором профілактики розвитку функціональних і структурних змін, які виникають як від тиску так і опосередковано через нервово-рефлекторні механізми.

Ключові слова: мікроциркуляція судин, двошаровий базис, знімний протез, обтуруюча частина, слизова оболонка порожнини рота.

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АНАЛИЗ ВЛИЯНИЯ ДВУХСЛОЙНЫХ БАЗИСОВ СЪЕМНЫХ ПРОТЕЗОВ С ОБТУРИРУЮЩЕЙ ЧАСТЬЮ НА СОСТОЯНИЕ МИКРОЦИРКУЛЯЦИИ СОСУДОВ ПРОТЕЗНОГО ЛОЖА

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Целью данной работы было определение влияния двухслойных базисов съемных протезов с обтурирующей частью на состояние микроциркуляции сосудов протезного ложа по сравнению с влиянием протезов, изготовленных из обычной базисной пластмассы. Для достижения поставленной цели было обследовано и проведено ортопедическое лечение 20 пациентов с посттравматическими дефектами верхней челюсти. Для изучения характеристик кровотока применяли метод лазерной доплеровской флоуметрии. Обобщенный анализ параметров микроциркуляции показал отсутствие негативного влияния на гемодинамические характеристики микроциркуляторного русла тканей протезного ложа при изготовлении съемных конструкций с двухслойными базисами, что является основным фактором профилактики развития функциональных и структурных изменений, которые возникают как от давления так и опосредованно через нервно рефлекторные механизмы.

Ключевые слова: микроциркуляция сосудов, двухслойный базис, съемный протез, обтурирующая часть, слизистая оболочка полости рта.

Рецензент Аветіков Д.С.