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CHANGES OF PERIODONTAL BLOOD SUPPLY IN PATIENTS WITH MAXILLOMANDIBULAR ANOMALIES AND DISORDERS OF THE ARCHITECTONICS OF THE VESTIBULE OF THE MOUTH

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We studied rheological changes in periodontal tissues in 60 patients 12–15 years old with maxillomandibular anomalies, deformities before treatment and after surgical correction. In comparison group where were 15 persons without maxillofacial anomalies, deformities, oral habits and periodontal status. The results showed the presence of blood circulation deficit and reduce the trophic tissue, which was indicated by the increase in vascular tone index, venous outflow index, peripheral resistance index and reduce of extensive blood flow index and rheographic index ($p < 0.05$). Positive dynamics of rheographic indices were observed in all groups, however, a significant difference with the indices in the comparison group in most indices was observed in the 2B group ($p < 0.05$). All patients have pronounced stagnation in the periodontal tissues, insufficient blood circulation, and impaired venous outflow. Carrying out surgical correction allogeneic transplantation using palatal graft ensures normalization and stabilization of rheographic indexes in the early and long-term follow-up.

Key words: vestibule of the mouth; periodontium; oral mucosa; allogeneic transplantation; blood supply.

Н.П. Махлинець, З.Р. Ожоган, М.М. Рожко, Г.Б. Проць, М.М. Ільків ЗМІНИ КРОВОПОСТАЧАННЯ В ЯСНАХ ТКАНИН ПАРОДОНТА У ПАЦІЄНТІВ ІЗ ЗУБОЩЕЛЕПОВИМИ АНОМАЛІЯМИ ТА ПОРУШЕННЯМИ БУДОВИ ПРИСІНКА РОТА

Проведене вивчення реологічних змін у тканинах пародонта у 60 пацієнтів із набутими зубощелепними аномаліями, деформаціями до лікування та після хірургічної корекції. Вікова група пацієнтів – 12–15 років. Групу порівняння склали 15 осіб. Результати дослідження показали наявність дефіциту кровообігу та зниження трофіки тканин, про що свідчило підвищення показника тону судин, показника венозного відтоку, показника периферичного опору, зниження індексу обсяжного кровотоку та реографічного індекса ($p < 0,05$). Після проведеного лікування у всіх групах спостерігали позитивну динаміку реографічних показників, однак достовірну різницю з показниками у групі порівняння за більшістю показників спостерігали у 2Б групі ($p < 0,05$). Визначення реографічних показників є одним з важливих методів у діагностиці порушень кровопостачання тканин пародонта. У хворих із зубощелепними аномаліями з порушеннями архітектоники присінка рота є виражені застійні явища у тканинах пародонта, недостатність кровообігу, утруднений венозний відтік. Проведення хірургічної корекції з використанням піднебінних мукозних трансплантатів забезпечує нормалізацію та стабілізацію реографічних показників у ранні та віддалені терміни спостереження.

Ключові слова: присінок рота; пародонт; слизова оболонка ротової порожнини; аллогенний трансплантат; кровопостачання.

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Disorders of the architectonics of the vestibule of the mouth are one of etiological factors in the development of a number of diseases, including the detection of gingival blood flow disorders of the periodontium [1, 3, 13]. A number of scientific studies indicate that disturbances in the architecture of the vestibule affect the course of the orthodontic treatment stage, complicating it and leading to gum recession, which is caused by muscle and mucous strands of labial, mental, buccal, facial muscles and restoration of blood supply in order to prevent a number of diseases [1, 5, 12]. Various methods are used for studying regional blood supply and gingival blood flow [1, 5, 10]. Knowing about the problem areas of blood supply, the doctor selects the tactics of managing the patient using surgical correction and the drug therapy.

In modern surgical practice, there are various methods of correcting violations of the architecture of the oral cavity: frenulum plasticity and normalization of the depth of the vestibule of the mouth. The main complication after any chosen method of surgical correction of the architecture of the oral cavity is cicatricial changes of the mucous membrane of the vestibule of the mouth (in 10 %–30.5 % of patients) [4, 6]. That is why it is important to pay special attention to the management of the postoperative period. An important stage of surgical treatment is the method of wound healing and drug therapy in the postoperative period. A number of scientists emphasize that wound healing is accelerated when using preparations based on hyaluronic acid (HA) or vitamin drugs to prevent formation of hypertrophic scars [2, 4, 6, 7, 8, 11, 14].

The purpose of the study was to establish the state of regional blood supply in patients with maxillomandibular anomalies and disorders of the architectonics of the vestibule of the mouth aged 12–15 years before treatment and at the stages of complex treatment.

Materials and methods. We studied rheological changes in periodontal tissues in 60 patients with maxillomandibular anomalies (MMA) and disorders of the architectonics of the vestibule of the mouth aged 12–15 years before treatment and after surgical correction (1 month, 6 months, 12 months). All patients were divided into 2 groups and 4 subgroups. The first group consisted of 30 patients who had plastic surgery of connective strands by the classical method, where the wound was healed by secondary tension. In group 1A (15 people) in the postoperative period, chlorhexidine-denta was prescribed, in group 1B (15 people) – chlorhexidine-denta and gengigel. In the second group (30 patients), plastic surgery of connective strands were performed using our proposed method, where the wound heals by primary tension. The operation consists in taking a mucosal allogeneic transplantation using palatal graft and fixing it in the area of the surgical wound in the area of the connective tissue strands (buccal frenulum). In group 2A (15 people) in the postoperative period, chlorhexidine-denta was prescribed, in group 2B (15 people) – chlorhexidine-denta and gengigel. In comparison group where were 15 persons deformities, oral habits and periodontal status. All patients underwent rheography of the vestibule of the mouth with the help of the following devices and programs: Rheograph “DX”, “DX-Complex Regina 2002”. Rheoelectroencephalograph was a recording device. Rheographic curves were evaluated on the basis of qualitative and quantitative analyses. They recorded the rheogram and its first derivative – the differential rheogram, with the help of which quantitative indices were calculated: vascular tone index (VTI), venous outflow index (VOI), peripheral resistance index (PRI) and reduce of extensive blood flow index (EBFI) and rheographic index (RI) [11]. Statistical processing of the results was performed using a personal computer using the software package Statistica 12.0. Data distribution was assessed using the Kolmogorov-Smirnov test of normality. Mean values and standard errors were calculated for continuous variables. Correlation between parameters was analyzed using Spearman’s correlation coefficient and tested for significance. Significance was set at $p < 0.05$ [9].

Results of the study and their discussion. The results of investigation of regional circulation of the tissues of the vestibule of the mouth showed the presence of blood circulation deficit and reduce the trophic tissue, which was indicated by the increase VTI, VOI, PRI and reduce of EBFI and RI ($p < 0.05$). Qualitative characteristics of rheograms were correlated with quantitative characteristics. A direct dependence of the configuration of the anacrotic phase of the rheographic curve on the VTI and the displacement of the dicrotic tooth to the apex from the PRI, was established. In the process of statistical processing of the obtained results of the rheological study, a correlation dependence was established between VTI and PRI ($r = 0.42 \pm 0.27$; $p < 0.05$). The results of EBFI in patients with maxillomandibular anomalies and disorders of the architectonics of the vestibule of the mouth were significantly different from this index in healthy individuals ($p < 0.05$). It was established that all indices (VTI, PRI, VOI, EBFI) are interdependent (correlation between VTI and PRI ($r = 0.42 \pm 0.27$; $p < 0.05$); between VTI and VOI ($r = 0.29 \pm 0.18$; $p < 0.05$); between VTI and EBFI ($r = -0.24 \pm 0.16$; $p < 0.05$); between PRI and VOI ($r = 0.43 \pm 0.21$; $p < 0.05$); between PRI and EBFI ($r = -0.36 \pm 0.21$; $p < 0.05$); between VOI and EBFI ($r = -0.29 \pm 0.17$; $p < 0.05$). A significant difference in RI compared to the results in the comparison group was observed in patients maxillomandibular anomalies and disorders of the architectonics of the vestibule of the mouth ($p < 0.05$). A significant difference in RI compared to the results in the comparison group was observed in patients with maxillomandibular anomalies and disorders of the architectonics of the vestibule of the mouth ($p < 0.05$). The results of our research are consistent with the indices obtained by other authors [2, 6].

After 1 month, the improvement of verification signs of rheograms was noted in patients of 1A group. The rheographic curves had a period of rapid filling, a gentle ascending part, a rather gentle top and the same descending part. We found positive dynamics of rheological indexes, but it was insignificant. EBFI and RI were increased. Indexes VTI, PRI and VOI were decreased. EBFI was significantly different from the indicator before treatment ($p < 0.05$). After 6 months, a significant increase of RI and decrease of VTI were diagnosed in comparison with similar indices before treatment ($p < 0.05$). The qualitative characteristics of the rheograms indicated positive dynamics of blood supply restoration, but were insignificant compared to the indices in the control group, and were characterized by gentle ascending and descending parts of the geographic curve. An additional dicrotic wave was present at the end of the curve. It indicates a violation of venous outflow, which is confirmed by VOI ($p < 0.05$). 12 months later EBFI, RI were significantly different from the indicator before treatment ($p < 0.05$). Qualitative characteristics of the rheograms indicated the presence of a gentle ascending and descending part, a bifurcated peak was often followed, and the descending part had an additional dicrotic wave (Table 1).

Table 1

Analysis of the results of rheographic examination in patients of 1 group aged 12–15 years (M±m)

Group	Index	Control group, n=15	Follow-up period			
			before reatment, n=15	after treatment, n=15 (months)		
				1	6	12
1A	VTI, %	13.58±1.28	20.17±1.25*	17.81±1.35*	16.31±1.45	18.02±1.15*
	PRI, %	71.05±3.17	84.15±4.04*	74.92±2.36	72.17±2.63●	75.16±2.52
	VOI, %	11.26±0.54	17.63±1.44*	14.78±1.56*	14.91±1.35*	14.33±1.43*
	EBFI, Om/sec	0.121±0.005	0.081±0.005*	0.098±0.005*●	0.105±0.006*	0.101±0.006*●
	RI, conditional units	0.74±0.05	0.36±0.04*	0.52±0.05*	0.61±0.06●	0.56±0.06*●
1B	VTI, %	13.58±1.28	20.41±1.24*	16.41±1.14●	16.32±1.34●	15.81±1.32●
	PRI, %	71.05±3.17	83.93±4.05*	73.25±3.25●	72.04±4.02●	71.96±4.41●
	VOI, %	11.26±0.54	18.03±1.46*	14.64±1.38*	14.12±1.29*	14.22±1.54
	EBFI, Om/sec	0.121±0.005	0.076±0.005*	0.103±0.006*●	0.111±0.005●	0.106±0.006●
	RI, conditional units	0.74±0.05	0.34±0.04*	0.57±0.05*●	0.64±0.04●	0.61±0.05●

Notes: * – statistical significant difference with control group, $p<0.05$; ● – statistical significant difference before and after treatment, $p<0.05$.

The results of the rheographic study in patients of the 1B group 1 month after the operation indicated an improvement in the verification signs of rheograms: rapid filling, normalization of the top of the rheographic curve, the presence of a dicrotic tooth. Quantitative indices of rheograms indicated an improvement in blood supply, which was manifested by an increase of EBFI and RI ($p<0.05$) and a decrease of VTI, VOI, PRI ($p<0.05$). 6 months after mucogingival correction of disorders of the architectonics of the vestibule of the mouth was diagnosed the dynamics until the improvement of the studied rheographic indices, which was manifested by a significant increase of EBFI, RI and a decrease of PRI compared to the indices before treatment ($p<0.05$) (Table 1). On rheograms, the curve had sloping ascending and descending parts, the top of the rheographic curve had dynamics until normalization. After 12 months, the indices of the rheograms had dynamics to deterioration in terms of quantitative and qualitative characteristics, but they were significantly different from the indices before treatment. The rheographic curve had a gentle ascending part with a bifurcated top in the form of a “rooster's crest”, a gentle descending part with an additional wave.

In the comparative characteristics of regional blood circulation in patients of groups 1A and 1B, a statistical significant difference between indexes, which is associated with the use of a preparation based on hyaluronic acid in the postoperative period ($p<0.05$). We believe that such changes in rheograms are caused by the way the wound heals after surgical correction of disorders of the architectonics of the vestibule of the mouth. Other scientists also emphasize on the positive wound-healing properties of HA [7, 14].

1 month after the surgical correction, rheographic indices in patients of the 2A group indicated the dynamics until the normalization of the rheogram amplitude. The rheograms had a gentle ascending part with a rather sharp top and a gentle descending part. After 6 months, the qualitative and quantitative (VTI, PRI, VOI, EBFI, RI) characteristics of the rheographic study indicated an improvement in blood circulation in the operated area ($p<0.05$) (Table 2).

Table 2

Analysis of the results of rheographic examination in patients of 2 group aged 12-15 years (M±m)

Group	Index	Control group, n=15	Follow-up period			
			before reatment, n=15	after treatment, n=15 (months)		
				1	6	12
2A	VTI, %	13.58±1.28	20.51±1.26*	16.45±1.24	14.70±1.69●	15.51±1.46●
	PRI, %	71.05±3.17	84.08±4.06*	74.56±2.25	71.05±1.35●	71.31±1.41●
	VOI, %	11.26±0.54	17.49±1.45*	14.81±0.97*●	12.42±1.52●	13.31±1.05●
	EBFI, Om/sec	0.121±0.005	0.082±0.005*	0.107±0.005●	0.113±0.004●	0.110±0.004●
	RI, conditional units	0.74±0.05	0.37±0.04*	0.56±0.05*●	0.63±0.05●	0.68±0.05●
2B	VTI, %	13.58±1.28	20.32±1.25*	16.02±1.04●	14.12±1.34●	14.20±1.23●
	PRI, %	71.05±3.17	84.26±4.04*	74.21±3.25	70.05±1.55●	70.22±2.45●
	VOI, %	11.26±0.54	17.31±1.43*	13.08±0.97●	11.81±1.12●	11.95±1.05●
	EBFI, Om/sec	0.121±0.005	0.075±0.005*	0.106±0.005*●	0.115±0.004●	0.119±0.004●
	RI, conditional units	0.74±0.05	0.33±0.04*	0.53±0.05*●	0.68±0.04●	0.70±0.05●

Notes: * – statistical significant difference with control group, $p<0.05$; ● – statistical significant difference before and after treatment, $p<0.05$.

After 6 months, VTI, PRI, VOI, RI did not significantly differ from similar indices in the control group ($p>0.05$). A rapid increase in the amplitude of the rheographic curve, a rise of the anacrotic curve to the top, and a sharpening of the top of the wave were observed. A dicrotic wave was diagnosed, which was located closer to the middle third of the dicrotic phase of the wave. After 12 months, the rheographic indices showed a trend towards deterioration compared to the indices after 6 months, but they were significantly different from the results before treatment ($p<0.05$).

The characteristics of rheograms in patients of the 2B group 1 month after mucogingival correction, by our proposed method and supplemented in the postoperative period with gengigel (HA), showed the dynamics until the normalization of all qualitative and quantitative indices. On the rheograms, we observed a gradual increase in the amplitude of the rheographic curves, a sharp peak and a gentle descending part appeared. Qualitative characteristics were correlated with quantitative characteristics. The indices of VTI and VOI, PRI decreased compared to the indices before surgical correction ($p<0.05$), and EBF1 and RI increased ($p<0.05$).

We believe that the restoration of blood supply in the early days after surgery and its dynamics until normalization are due to both the method of wound healing and the drug used in the postoperative period. Other scientists also emphasize the advantages and features of drugs based on HA. It affects receptors that play a role in cell migration, angiogenesis, and inflammation, and has the ability to affect all parts of the periodontium [8, 9]. HA affects the inflow and outflow of nutrients, waste products of cells. HA plays a crucial role in cell signaling and hemostasis, and also controls the cell matrix and cell exchange. This wound-healing property of HA is also used in various methods of treating periodontal diseases, taking into account all the positive properties of the medium and the possibility of use in children [7, 14]. That is why the drug of choice was gengigel, Italy. The results obtained by us show a mutual dependence between the condition of the postoperative area and the quality of blood supply in this area.

6 months after the treatment, the normalization of the qualitative characteristics of the rheograms was diagnosed. The rheographic curves had a pointed top of the wave, the anacrotic curve rose to the top faster, and the dicrotic wave was more pronounced and was located closer to the middle third of the dicrotic wave phase. 6 months after the treatment, we observe the normalization of all indices of the quantitative assessment of rheograms in comparison with those before the treatment ($p<0.05$). Quantitative characteristics of the rheographic study 6 months after were unreliably different from the results of the study in the control group, which indicated the normalization of blood supply in the periodontal tissues ($p>0.05$).

Normalization of the wave was observed on the rheograms 12 months after the treatment. It had a steep ascending part with a peak that had a sharp or pointed shape, and the descending part was gentle with a well-defined dicrotic wave in the middle part of the rheogram. The values of VTI, PRI, VOI, EBF1, RI practically did not differ from the average values of indices in the control group ($p>0.05$). We observed a significant difference between the obtained results and identical indices before surgical intervention on the tissues of the vestibule of the mouth ($p<0.05$), which indicates the superiority of the proposed method of treatment.

Our proposed scheme of complex treatment of patients with maxillomandibular anomalies and disorders of the architectonics of the vestibule of the mouth ensures the normalization of blood supply in the tissues of the vestibule of the mouth in terms of quantitative and qualitative indices not only in the early and late periods after treatment, which indicates a steady improvement of regional blood circulation in the tissues of the periodontium and oral mucosa, in particular, and a significant difference 6 and 12 months after treatment in patients of the 2B group according to the results of VTI, VOI, EBF1, RI ($p<0.05$). The results obtained by us are confirmed by other works, which emphasize the need for a comprehensive approach to the treatment of such patients [1, 4].

Conclusions

1. Our research has shown that determination of rheographic indices is one of the important methods in the diagnosis of disorders of the blood supply of periodontal tissues.
2. The results of the rheographic study, based on quantitative and qualitative characteristics, showed that patients with maxillomandibular anomalies on the background of disorders of the architectonics of the vestibule of the mouth, have pronounced stagnation in the periodontal tissues, insufficient blood circulation, and impaired venous outflow, which was evidenced by an increase of VTI, VOI, PRI, a decrease of EBF1 and RI ($p<0.05$). Qualitative indices of rheograms were correlated with quantitative characteristics.

3. Carrying out surgical correction using our proposed method allogeneic transplantation using palatal graft and HA in postoperative period ensures normalization and stabilization of rheographic indexes in the early and long-term follow-up. It indicates a steady improvement of regional blood circulation in the tissues of the periodontium and the vestibule of the mouth, in particular, and a significant difference of the results in patients of the 2B group ($p < 0.05$).

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