



SHORT-TERM AND LONG-TERM RESULTS OF MARGINAL PERIODONTAL TISSUES CORRECTION AT FRONTAL TEETH AREA

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Abstract. *In the article are presented short- and long-term results of correction marginal periodontal tissues after orthodontic treatment at frontal teeth area.*

The results of the study are based on the data of a comprehensive examination and treatment of 178 patients who needed orthopedic treatment of the front group of teeth. All patients were divided into 3 groups: group 1 (112 people) were treated with Ellman Surgitron-DF device, group 2 (34 patients) - with microsurgical scalpel, group 3 – with LIKA-surgeon laser system.

It was proved, that in 7-14 days after the intervention, a less pronounced gingival hyperemia was found in the group of patients treated with the Ellman Surgitron-DF device, compared to patients treated with the usual surgical method and laser. The level of bleeding was also lower in patients who were operated on with the use of a radioscalpel as early as 1 day after the intervention, and the pronounced difference was noted further up to 28 days after the intervention. In these patients, such signs as swelling of the clear margin and even fibrinous plaque were less pronounced.

Long-term results showed that the level of recession of the gingival margin in group 1, after treatment with Ellman Surgitron-DF device, was minimal, its characteristics (indicator of the degree of bleeding of the gingival groove and the final index of recession assessment) were significantly better compared to the corresponding values of the indicators in groups 2 and 3.

Key words: *teeth implants, marginal periodontal tissue, laser correction, short-term results, long-term results. Statement of conflict of interest and financing: the author declare no conflict of interest.*

Introduction.

The number of patients who turn to the clinic of orthopedic dentistry with complaints about the aesthetic inferiority of teeth and dental rows increases every year in connection with the development of the field and dental materials science, as well as with the increase in the cultural level of the population [10].

An important problem for obtaining aesthetic and functional results of dental treatment of the visible part of the front teeth of the upper jaw when talking, smiling is the condition of the gingival papillae and the mucous membrane of the alveolar processes, the symmetry of the zeniths. The effectiveness of orthopedic interventions without preliminary preparation and treatment of the mucous membrane of the gums followed by correction of the marginal edge of the gums can lead to an unsatisfactory result and the occurrence of numerous complications [1]. Perception of the condition of the marginal part of the gums is of great importance for planning orthopedic dental treatment of front teeth with fixed orthopedic prostheses (metal ceramics) [8].

Overview of the researcher.

In recent years, effective laser technologies have been developed for the treatment of various periodontal diseases and correction of the mucous membrane of the gums,



and a large amount of material on the application of these technologies in dentistry has been accumulated. The laser scalpel has become a common and effective tool for dentists, but when using it, it is difficult to predict the result. However, there are other methods that can provide optimal treatment results. One of them is a radio wave scalpel, which works on a completely different basis, the use of which reduces the risk of postoperative complications and improves the result of surgical intervention on periodontal tissues [15].

Buser D. et al. studied the process of gingival recession in adults associated with orthodontic treatment of a deep traumatic occlusion. Plaster models and intraoral photographs were studied. The results of the measurements showed that orthodontic treatment of a deep bite in adults causes gum recession [3].

Researchers show the possibility of restoring the normal volume, contours and architecture of the gums around dental implants. On the other hand, there is no single opinion in the literature regarding the reaction of periodontal tissues to mechanical trauma during correction of the level of the gingival margin [16].

In a number of studies, the authors attempted to assess the dynamics of gum contour formation at various stages of patient rehabilitation using an objective method of assessing changes in the topography of objects in the oral cavity [5], as well as assessing the state of the microcirculatory bed in the field of gum contour formation using functional methods of laser Doppler flowmetry [11]. A comparative assessment of the effectiveness of various methods of surgical correction of the clear margin is becoming more and more relevant, since in recent years there has been an active introduction into clinical practice of special minimally invasive methods of surgical intervention, which include: electrocoagulation, laser exposure, cryodestruction or their combination. The possibilities of using the radioscalpel "Ellman Surgitron-DF" attract the special attention of researchers, since the most important prerequisite for the use of this method is a gentle effect on biological tissues, which is the most important characteristic of the radiosurgical method [12, 14].

In connection with the above, it is relevant to study and expand the possibilities of using different methods of gingival margin correction before and at the stage of orthopedic treatment of the visible front group of teeth to improve the aesthetic results of complex rehabilitation of patients.

The purpose of the work is to improve the aesthetics of the dentition of the upper jaw with the help of surgical correction of soft tissues and the formation of the gingival margin with temporary structures of the dentition.

Research material and methods. The results of the study are based on the data of a comprehensive examination and treatment of 178 patients who needed orthopedic treatment of the front group of teeth of the upper jaw with aesthetic defects of individual teeth, volume, shape of tooth crowns, gum color and asymmetry of the gingival margin. No accompanying pathology was noted. The age of the patients was from 25 to 45 years, the most frequent patients were 30-34 years old - 84 patients (47.2%). Approximately one third (31.4%) were patients aged 25-29 years, 21.4% were patients aged 35 and over. The distribution by gender showed that there were almost twice as many women among the examined patients, their share in the total sample was 64%, the share of men was 36%, respectively.



All patients were divided into 3 groups depending on the method of correction of the gingival edge of the front group of teeth of the upper jaw, fig. 1. The main group (group 1) included 112 patients (62.9%), who were treated with the radio wave method using the Ellman Surgitron-DF device. The second group (group 2) included 34 patients (19.1%) who underwent surgical treatment using a microsurgical scalpel. The third group (group 3) included 32 patients (18.0%), who underwent correction of the gingival margin using the LIKA-surgeon laser system (Photonica Plus Ukraine).

A clinical, laboratory and instrumental examination was carried out, questionnaires developed at the Department of Orthopedic Dentistry were asked to be filled out. Clinical observations in all groups were performed in the early period after the start of treatment on 1, 3, 7, 14, 28 days. The dynamics of regeneration of the gingival margin after the intervention was evaluated using a score scale for the severity of hyperemia, bleeding, edema, cyanosis, fibrinous plaque, and pain. To assess the long-term results of gingival margin correction within one to two years, such criteria as the presence or absence of recession of the gingival margin and the intensity of bleeding of the gingival groove during a probe test were used; The state of periodontal tissue microcirculation was studied using laser Doppler flowmetry (LDF). Microcirculation parameters were assessed before treatment and 1, 3, 7, 14, 28 days, 6 months after surgery.

The study of the hemodynamics of the mucous membrane of the frontal area of the upper and lower jaws was carried out using the method of laser Doppler flowmetry (LDF) using a laser surface blood flow velocity analyzer BLF-21D "TRANSONIC SYSTEM INC" (USA) with a helium-neon laser (LGN 207 B) with a power of laser radiation at the output of the optical cable at least 0.3 mW.

The obtained data were presented as a general assessment of the result of gingival margin correction. A score of 1-4 points corresponded to good correction results, and satisfactory to 4-6 points. The number of points above 6 was considered as an unsatisfactory result of the correction.

The following criteria were used to assess the long-term results of correction within one to two years: 1) presence or absence of recession of the gingival margin; 2) the intensity of bleeding of the gingival groove in the probe sample according to Müller. Using the modified criteria of the American Dental Association (USPHS criteria), the change in color and marginal fit of the prosthesis were determined. The average wearing time of temporary crowns was 28 days.

Statistical processing and analysis of data was carried out by generally accepted methods using the StatSoft Statistica 10 application program package and non-parametric statistics. Methods of descriptive statistics included estimation of the arithmetic mean (M), error of the mean value (t). Qualitative indicators are presented in the form of absolute values (Abs.) and in percentages (%). While multiply comparison we used Kruskal-Wallis one-way analysis of variance. After calculating the H-criterion, the data in the subgroups were matched in pairs using the median test. The critical level of reliability of the null statistical hypothesis was taken to be equal to 0.05.

Research results.

A preliminary survey of three groups of patients requiring orthopedic treatment



of the front group of teeth of the upper jaw showed that the most frequent complaints were disorders of the aesthetics of the gingival margin in the area of the frontal teeth. In addition, patients often complained of bleeding gums, impaired speech, difficulty biting food, tab. 1.

Table 1 - Distribution of patients according to complaints before correction of the gingival margin

Complaints	Ellman Surgitron-DF (n=112)		Microsurgical laser scalpel (n=32)		LIKA-surgeon (n=34)		p
	Abs.	%	Abs.	%	Abs.	%	
Disturbing of aesthetics	109	97,3	32	100,0	33	97,1	0,87
Bleeding gums	43	38,3	12	37,5	13	38,2	0,93
De-cementing of existing prostheses	19	17,0	4	12,5	6	17,7	0,78
Irregular gingival edge of frontal teeth	85	75,9	27	84,4	24	70,6	0,81
Difficulty biting	25	22,3	7	21,9	7	20,6	0,89
Speech (speaking?) disorders	57	50,9	16	50,0	18	52,9	0,89

Note: p - a multiple comparison using the H-Kruskal-Walli's criterion.

As can be seen from the table 1, there were no significant differences in the frequency of complaints between patients of different groups.

The study of the dynamics of regeneration showed that 1 day after the start of treatment, the severity of hyperemia was approximately the same in groups 2 and 3, amounting to 2.3-2.4 points, in group 1 the value of the indicator was slightly lower - 2.0±0.3 points, although no significant differences between groups were found (Fig. 1). After 3 days, the severity of hyperemia decreased to 1.8±0.1 points in the Ellman Surgitron-DF group, this value was significantly ($p<0.05$) lower than in the LIKA-surgeon group - 2.1±0.1 points. The level of the indicator of the Microsurgical laser scalpel group was 2.0±0.3 points, no significant differences from the indicators of other groups were found, fig. 1.

A week after the start of treatment, the severity of hyperemia decreased to the greatest extent in patients in group 1 - to 1.2±0.1 points, while the level of the indicator was significantly ($p<0.05$) lower than in group 2 - 1.9±0.3 and group 3 - 1.5±0.1 points, respectively. After 14 and 28 days, the revealed tendency remained - a decrease in hyperemia was observed in patients of all groups. At the same time, in patients who were treated using the Ellman Surgitron-DF device, the level of assessment of this symptom was 0.7±0.1 and 0.4±0.1 points, respectively, 2 and 4 weeks after the start of treatment, the value of the indicator was reliable ($p<0.05$) lower than in other groups. In the same period, the severity of hyperemia was the maximum in patients treated with the LIKA-surgeon device - 1.6±0.1 and 1.2±0.1 points 14 and 28 days after the



intervention, respectively, in patients of the Microsurgical group laser scalpel indicator values were lower, amounting to 1.2 ± 0.1 and 0.9 ± 0.2 points, respectively, fig. 1.

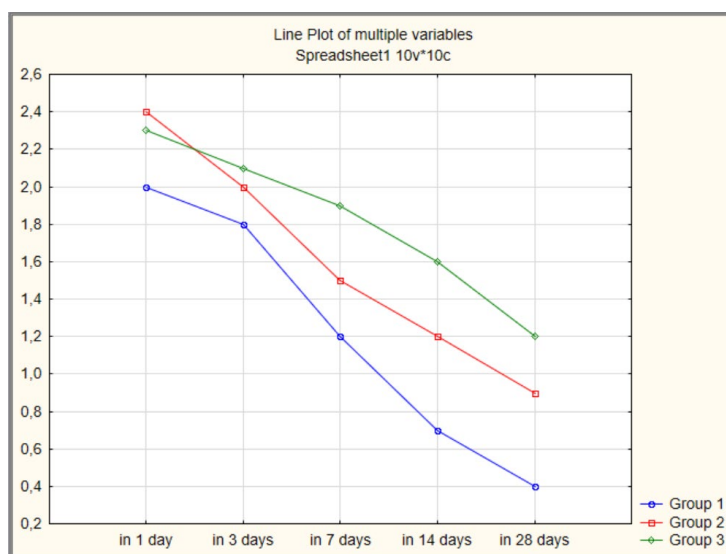


Fig. 1. Dynamics of hyperemia of the gingival margin on a scale of 0-3 points.

Comparison of the severity of bleeding on an 8-point scale 1 day after the start of treatment showed that the value of the indicator was the maximum in patients of group 3, amounting to 5.8 ± 0.6 points, fig. 2. At the same time, in group 1, the level of this parameter was significantly ($p < 0.05$) lower than in other groups. In patients of group 2, the value of the indicator was at an intermediate level and amounted to 5.2 ± 0.3 points. 3 days after the start of treatment, gum bleeding significantly decreased in patients treated with the Ellman Surgitron-DF device - to 3.8 ± 0.4 points, which is 1.7 times lower ($p < 0.05$) than in the group that treated with Microsurgical laser scalpel (6.1 ± 0.4 points), and also significantly ($p < 0.05$) less than in patients treated with LIKA-surgeon device (5.0 ± 0.5 points). It should be noted that the revealed trend was noted after 7 and 14 days. Thus, in group 3, gum bleeding remained at a fairly high level - 5.7 ± 0.2 and 4.9 ± 0.5 points, respectively, fig. 2.

In patients of group 2, the value of this indicator was significantly ($p < 0.05$) lower in both cases and amounted to 4.2 ± 0.1 and 3.3 ± 0.3 points on the 7th and 14th day, respectively. In patients of group 1, the severity of bleeding in these terms was estimated at 3.0 ± 0.1 and 2.1 ± 0.1 points, respectively, which was significantly ($p < 0.05$) less than the values of this indicator in other groups, fig 2.

Finally, on the 28th day, the bleeding gums in group 1 were estimated by us to be only 1.6 ± 0.2 points on average, which was significantly ($p < 0.05$) lower than that of patients in group 2 (2.1 ± 0.2 , 2 points) and 3 (3.5 ± 0.3), fig. 2.

The severity of edema, which was assessed on a 3-point scale, as shown in Fig. 3, was 1 day after the intervention from 2.1 ± 0.3 points in group 1 to 2.7 ± 0.2 points in group 2, however, no significant differences in the values of the indicator were found in all groups. After 3 days, in patients who were treated with the Ellman Surgitron-DF device, swelling decreased to 1.9 ± 0.2 points, while in the Microsurgical laser scalpel and LIKA-surgeon groups, its expressiveness was significant ($p < 0.05$) higher, respectively 2.6 ± 0.3 and 2.3 ± 0.2 points.

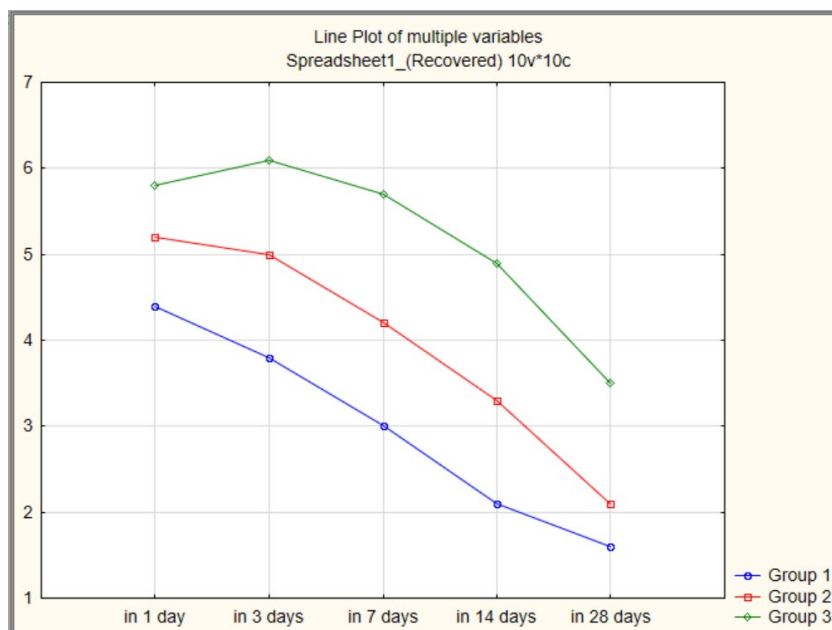


Fig. 2. Dynamics of bleeding gums on a scale of 0-8 points.

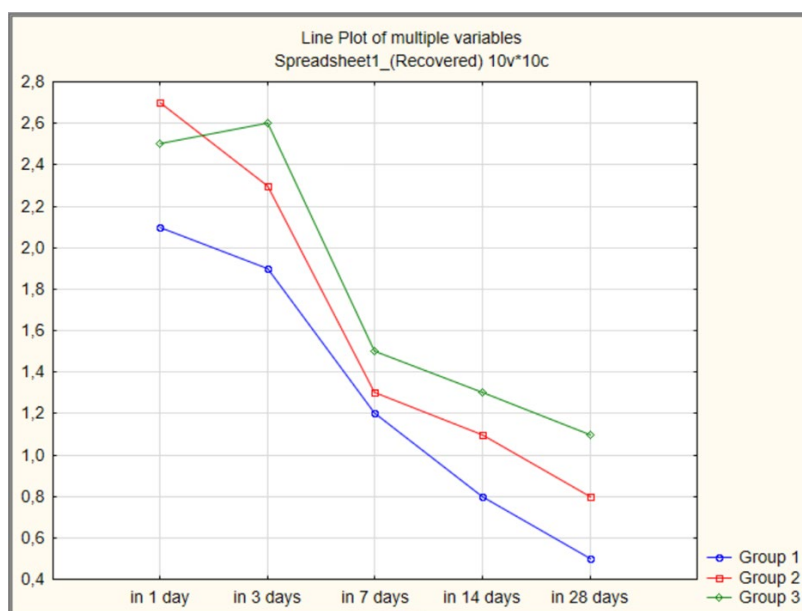


Fig. 3. Dynamics of the severity of edema on a scale of 0-3 points.

A significant decrease in the swelling of the gingival margin was noted on the 7th day after the start of treatment in patients of all groups, while the values in groups 1 and 2 were approximately at the same level - 1.2-1.3 points, in group 3 the swelling was slightly more pronounced and estimated by 1.5 ± 0.1 points. After 14 and 28 days, the expressiveness of edema in group 1 was minimal, amounting to 0.8 ± 0.1 and 0.5 ± 0.1 points, respectively, which in both cases was significantly ($p < 0.05$) less than in patients group 3 - 1.3 ± 0.1 and 1.1 ± 0.2 , respectively. The degree of edema in group 2 during this period of observation was intermediate and amounted to 1.1 ± 0.2 and 0.8 ± 0.1 points on the 14th and 28th days, fig 3.

The fibrinous plaque was evaluated on a 2-point scale, and already 1 day after the start of treatment, its severity was maximal in the group treated with the LIKA-surgeon device - 1.7 ± 0.2 points, fig. 4. In the Microsurgical laser scalpel group, the value of



this indicator was 1.5 ± 0.2 points, and in patients whose treatment was performed using the Ellman Surgitron-DF device, its level was minimal - 1.2 ± 0.2 points. However, it was not possible to detect significant intergroup differences in this indicator both 1 day after the start of treatment and 3 and 7 days later. However, in group 1, this indicator was estimated at 1.1 ± 0.2 and 0.9 ± 0.1 points, respectively, while its maximum value continued to remain in group 2 - 1.4 ± 0.1 and 1.1 ± 0.1 points, respectively, on the 3rd and 7th day from the start of treatment, fig. 4.

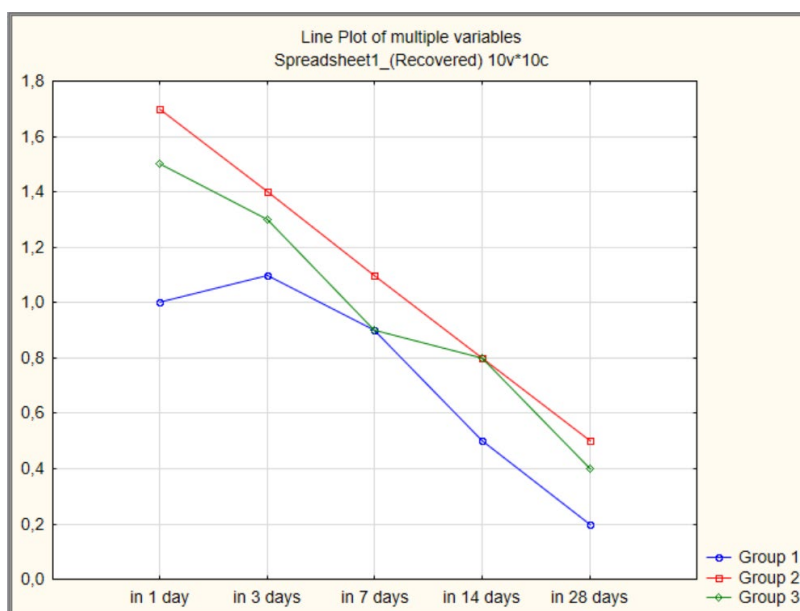


Fig. 4. Dynamics of fibrinous plaque on a scale of 0-2 points.

On the 14th day, the reduction in the expressiveness of the fibrinous plaque was minimal in group 1 - to the level of 0.5 ± 0.1 points, this value was significantly ($p < 0.05$) lower than in patients who were treated using other techniques. After 28 days from the start of treatment, the expressiveness of the fibrinous plaque in group 1 decreased to 0.2 ± 0.1 points, while in groups 2 and 3 the value of the indicator was slightly higher, respectively 0.4 ± 0.1 and 0.5 ± 0.1 points, although there were no significant intergroup differences, fig. 4.

The assessment of pain on a 3-point scale showed that 1 day after the treatment, its level was maximum in group 2 - 2.5 ± 0.3 points, the intensity of pain was lower in group 3 - 2.2 ± 0.1 points, Fig. 5. The minimum value of this indicator in patients of group 1 was 1.8 ± 0.2 points. The value of this parameter was significantly ($p < 0.05$) lower than in the group treated with Microsurgical laser scalpel. The revealed trend was preserved 3 and 7 days after the start of treatment. The intensity of pain was minimal in group 1, amounting to 1.5 ± 0.1 and 1.0 ± 0.1 points, respectively. The value of this indicator was significantly ($p < 0.05$) lower than in patients treated with a Microsurgical laser scalpel. In patients of group 3, the intensity of pain was less, however, several indicators exceeded the value of the average indicator in group 1, where the level of pain was estimated at 1.8 ± 0.8 and 1.4 ± 0.1 points, respectively.

It should be noted that after 14 and 28 days, no significant differences in the values of this indicator were found, the intensity of pain decreased in all groups, while it was minimal in the group treated with the Ellman Surgitron-DF device, estimated at 0.9 ± 0.2



and 0.6 ± 0.1 points. In the group treated with the Microsurgical laser scalpel, the value of this parameter in these terms was 1.2 ± 0.1 and 0.9 ± 0.2 points, in patients treated with the LIKA-surgeon device - 1.1 ± 0.1 and 0.7 ± 0.1 points, respectively, fig. 5. The study of the expressiveness of cyanosis showed that in patients of group 1 at all times of the study the value of the indicator was minimal compared to other groups, gradually decreasing from 1.3 ± 0.2 on 1 day to 0.5 ± 0.1 points after 28 days.

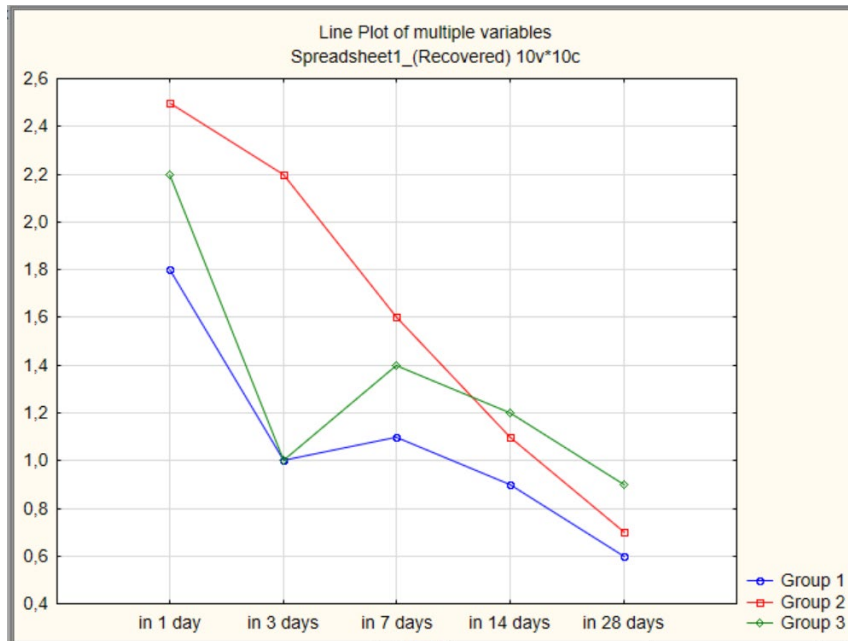


Fig. 5. Dynamics of pain severity on a scale of 0-3 points.

The study of the state of the gingival margin at the time of fixation of the permanent non-removable structure on a 2-point scale showed that the level of restoration of the given shape of the gingival contour after surgical correction in the Ellman Surgitron-DF group was significantly ($p_1 < 0.01$) lower than in patients in the LIKA- group surgeon and Microsurgical laser scalpel, tab. 2.

Table 2 - Evaluation of the result at the moment of fixation of a permanent fixed structure

Research time	Group 1	Group 2	Group 3	p
Retention (Preservation) of the shape of the gingival margin	$0,41 \pm 0,1$	$0,79 \pm 0,2$	$0,91 \pm 0,1$	$p_1 < 0,01$ $p_2 < 0,01$ $p_3 = 0,016$
General evaluation of correction results	$1,92 \pm 0,3$	$2,61 \pm 0,2$	$2,9 \pm 0,2$	$p_1 < 0,01$ $p_2 < 0,01$ $p_3 < 0,01$

Note: p_1 - the probability of the difference in indicators between groups 1 and 2;
 p_2 - the probability of the difference in indicators between groups 2 and 3;
 p_3 - the probability of the difference in indicators between groups 1 and 3.

The overall evaluation of results was also maximal in group 3, which was significantly higher than in other groups ($p_{2-3} < 0.01$). The value of this parameter was



minimal in patients of group 1, which was significantly lower than in other groups ($p < 0.01$).

Long-term evaluation of correction results. Criteria such as the presence or absence of gingival recession and the intensity of bleeding of the gingival groove during the Muller probe test were used to evaluate the long-term results of the correction of the marginal edge of the periodontium within one to two years.

Comparison of the results of treatment in the remote period showed that the level of recession of the gingival margin of the group treated with the Ellman Surgitron-DF device was minimal, table. 3. This value was significantly ($p < 0.001$) lower than the corresponding levels in the Microsurgical laser scalpel and LIKA-surgeon groups.

Table 3 - Assessment of periodontal margin recession and gingival groove bleeding in the remote period

Research time	Group 1	Group 2	Group 3	p
Recession of the marginal edge of the periodontium (1-6 points)	1,89±0,1	2,80±0,4	3,12±0,2	$p_1 < 0,01$ $p_2 < 0,01$ $p_3 < 0,01$
Bleeding of the gingival groove (0-3 points)	0,91±0,2*	1,39±0,3	1,82±0,2	$p_1 < 0,01$ $p_2 < 0,01$ $p_3 < 0,01$

Note: p_1 - the probability of the difference in indicators between groups 1 and 2;
 p_2 - the probability of the difference in indicators between groups 2 and 3;
 p_3 - the probability of the difference in indicators between groups 1 and 3.

The evaluation of gingival groove bleeding in patients treated with the Ellman Surgitron-DF device was twice as low as in the group treated with the Microsurgical laser scalpel and in patients treated with the LIKA-surgeon device, table. 3.

Comparison of treatment results in the remote period showed that the level of recession of the gingival margin in group 1 was minimal, its characteristics (indicator of the degree of bleeding of the gingival groove and the final index of recession assessment) were significantly better compared to the corresponding values of the indicators in groups 2 and 3.

Discussion of research results.

In recent years, many authors, within the framework of various aspects of the gingival margin, pay more attention to the evaluation of the results of surgical treatment with the help of a laser [4, 6]. Limited indications for the use of a laser scalpel in periodontal surgery are due to the powerful effect of laser energy on biological tissues, which in turn depends on the adsorption characteristics of tissues. The main dangerous effect is an increase in temperature in the region affected by the laser: soft tissues heat up from 37° to 60°, coagulation occurs at a temperature of 65-90°, protein denaturation - at 90-100°. Under the influence of the laser beam, there is a rapid increase in temperature and pressure inside the cells, as a result of which they are damaged (ruptured). A number of authors indicate the existing danger of a sharp temperature jump up to 1500 - 2500°C when using a continuous mode of exposure to a laser beam [9].



Until now, there are no unequivocal data confirming a decrease in the intensity of postoperative pain after exposure to a laser on soft tissues [1], very polar opinions of researchers about the acceleration of the wound healing process, the complete elimination of microbial colonies from the surface of the affected tooth root [7], and as well as radical removal of pathological soft tissues from the periodontal pocket area using a laser [5]. The results of our research are to some extent consistent with the dissatisfaction of many researchers with the results of laser application.

According to a number of authors, in most patients the aesthetic defect of the gingiva occurs at a later time, which leads to the need for local plastic surgery with the subsequent formation of the gingival contour by the body of the temporary prosthesis, but there are data on the dynamics of the formation of the gingival contour in the period after the operation and directly at the stage of preparation for no prosthetics. Thus, in the study of Schoenbaum TR. et al. (2008) the most changeable clinical parameters of the gingival contour were quantified. A comparison of these indicators was carried out in the area of front teeth of the upper jaw in 103 young people. The authors concluded that, along with other indicators related to aesthetics, clinical parameters characterizing the gingival contour can be basic, which can contribute to a better prognosis of the aesthetic results of treatment [13].

In a study by Wu et al., the relationship between the axis of the tooth crown and the contour of healthy gums was evaluated. The authors concluded that the ratio between the axis of the crown of the tooth and the contour of the gums is individual, the angular values range from 40 to 110°. In 84.1% of cases, these values were within 70-110°, in 15.9% of cases - from 40 to 70°, which indicated the inclination of natural teeth [17].

It should be noted that the use of the "Ellman Surgitron-DF" radioscalpel was more effective in most evaluation parameters in the early and long-term periods after surgical treatment, as well as taking into account objective and subjective criteria. This was evidenced by a comparative evaluation of the results of surgical correction of the marginal edge of the periodontium, performed early after the intervention.

Closing and conclusions.

Based on the conducted questionnaire of patients who need orthopedic dental treatment of the front group of teeth, in 97.8% of cases, the most common complaints of patients were dissatisfaction with the aesthetics of existing dental prostheses; gum recession and asymmetric location of the gingival margin in the area of the front group of teeth.

Comparative characteristics of the results of correction of the gingival margin when using manual, laser and radio wave methods showed that the radio scalpel "Ellman Surgitron-DF" is the most effective and safe method of correction of the gingival margin, which is confirmed by the overall assessment of the results of correction in the group, which was significantly less, than in the Microsurgical laser scalpel and LIKA-surgeon groups.

Comparison of treatment results in the remote period showed that the level of recession of the gingival margin of the group treated with the Ellman Surgitron-DF device was significantly ($p < 0.001$) lower than the corresponding levels in the Microsurgical laser scalpel and LIKA-surgeon groups.



The evaluation of gingival sulcus bleeding in patients treated with the Ellman Surgitron-DF device was twice as low as in the comparison groups.

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