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The Effectiveness of Plastic Surgery of Post-Burn Scarring of the Face and Neck with the Use of A Free Skin Graft

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KEYWORDS

plastic surgery; post-burn scarring; free skin graft; autodermoplasty.

Abstract.

The relevance of the problem. The issue of plasty of extensive post-burn defects of the soft tissues of the head and neck is still open. Microsurgical flaps cannot be used in cases where there are no recipient vessels for revascularization of the graft. At the same time, microsurgical autotransplantation of tissues requires special equipment and tools, a trained microsurgical team. In light of the above, further research is needed to improve the known and develop new methods of surgical correction of the consequences of burns of the head and neck. **Objective:** to improve the results of surgical rehabilitation of patients with post-burn scar deformity of the face and neck by applying plastic surgery with a full-layer free skin graft. **Materials and methods:** according to the applied plastic surgery methods, 216 patients were divided into two groups. In the main group – 103 patients, the proposed method of eliminating post–burn scar deformity of the face and neck was performed; in the comparison group - 113 patients, plastic surgery with a free skin graft or its combination with plastic surgery with local tissues was performed according to traditional methods. **Results:** an improved method of plasty with a full-layer free skin graft and local tissues in post-burn scarring of the face and neck, characterized by an improvement in the quality of the removed graft, by reducing the degree of its retraction, as well as stimulation of vascularization, reducing the risk of formation of subcutaneous fluid accumulations, excluding prolonged wearing of a pressure bandage, which generally contributes to a more physiological engraftment of transplanted tissues.

Relevance of the problem. According to WHO, burns rank third among all injuries [1]. Every year, more than 300,000 people die from burns worldwide and approximately 11 million people require medical care [2, 3]. Based on the location of thermal injuries, facial burns account for 18-20% of all injuries [4, 5].

Prevention and treatment of post-burn contractures and deformities remains an urgent problem. Today, there are many different treatment methods, but the standard is to perform reconstructive operations only after the scar tissue has completely formed, that is, 8-12 or more months after the injury [6, 7, 8].

Given that there are many methods for eliminating post-burn scar deformity in the face and (or) neck, the surgeon must absolutely understand what features and risks each of them has. Complex microsurgical methods

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of operations require special equipment and certain skills, which are often unavailable at the regional and, especially, district levels of healthcare. Against this background, plastic methods that are characterized by ease of implementation and the possibility of wide application become highly relevant [9, 10]. These methods include various options for using a free full-thickness skin graft taken from the donor area of the patient himself [11, 12, 13].

Provided that all tactical and technical features are observed, the likelihood of achieving a good aesthetic and functional result with plastic surgery using these methods will be quite high, which makes their use highly in demand. For plastic surgery, an improved method of free skin grafting has been proposed, the evaluation of the results of which served as the basis for this study.

Materials and methods of research. The study included 216 patients with post-burn scar deformity in the face and neck. In the main group, 103 patients underwent the proposed method of eliminating post-burn scar deformity of the face and neck using a free skin graft (FSG); in the comparison group - 113 patients, various options for using FSG were performed using traditional methods (table 1).

Table 1 Distribution of patients into study groups

Type of operation	Comparison group					
	Face		Neck		Total	
	abs.	%	abs.	%	abs.	%
Free skin grafting with a full-thickness graft	25	22,1%	36	31,9%	61	54,0%
Combined plastic surgery of the FSG and local tissues	22	19,5%	30	26,5%	52	46,0%
Total	47	41,6%	66	58,4%	113	100,0%
	Main group					
Free skin grafting with a full-thickness graft	21	20,4%	33	32,0%	54	52,4%
Combined plastic surgery of the FSG and local tissues	21	20,4%	28	27,2%	49	47,6%
Total	42	40,8%	61	59,2%	103	100,0%

Both groups were dominated by women. About half of the patients were aged between 20 and 44 years, and about a third were between 45 and 59 years old. The duration of burns ranged from 1 year to 5 years. In all cases, only completely formed scar deformities without elements of the inflammatory process were subjected to plastic surgery. Taking into account the fact that in this work we consider the results of only one stage of plastic surgery, the sizes of scar defects among patients were different, while the analysis included only patients with an average area of defects that were in the range of 50-120 cm², as well as large defects that exceeded an area of 120 cm².

In the comparison group, there were 67 (59.3%) patients with moderate defects, of which in the area of the upper third face – 14 (12.4%), middle third face – 2 (1.8%), lower third face – 10 (8.8%), defects involving 2 or 3 areas of the face - 7 (6.2%), on the neck - 34 (30.1%). There were 46 (40.7%) patients with large defects in this group: in the area of the upper third face - 6 (5.3%), middle third face - 1 (0.9%), lower third face - 4 (3, 5%), defects involving 2 or 3 areas of the face - 3 (2.7%), on the neck - 32 (28.3%). In the main group of patients with moderate defects there were 55 (53.4%), of which in the area of the upper third face – 10 (9.7), middle third face – 1 (1%), lower third face – 5 (4.9 %), defects involving 2 or 3 areas of the face - 6 (5.8%), on the neck - 33 (32%). There were 48 (46.6%) patients with large defects in this group: upper third face – 7 (6.8%), middle third face – 1 (1%), lower third face – 6 (5.8%), defects involving 2 or 3 areas of the face - 6 (5.8%), on the neck - 28 (27.2%).

The method of surgical treatment of post-burn scar deformity of the face or neck with a full-thickness skin flap included a linear horizontal incision with excision

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of scar tissue, head redressing, removal of constricting scars along the lateral surface of the neck with additional incisions, treatment of the wound surface (recipient area), excision/harvesting of a free skin flap for autodermoplasty, performing autodermoplasty, fixing a freely moved skin flap to the soft tissues of the recipient area, standard fixation of the head, the wound surface of the recipient area is treated by applying the powdered composition "HEMOBEN", in an amount of 60 mg for every 4 cm^2 of the treated surface, and after 5-10 minutes autoplasma diluted with saline in a ratio of 1:1 is applied with a syringe in an amount of 10 ml per 10 cm^2 of surface, before taking a free skin flap from the groin area, acute dermotension is performed by implanting a latex rectangular expander under the skin with a base volume of 40.5 cm^2, into which inject 300-400 ml of sterile saline solution, after which the potential skin flap is irradiated with a laser device "Impulse-100" (Uzbekistan) in the infrared spectrum (with a wavelength of 900 nm) with a frequency of 100 Hz, a pulse power of 80-100 W/per pulse, for 10 minutes at a distance of 3 cm from the surface of the skin flap in scanning mode over its entire surface, excision of a full-thickness skin flap is carried out along the edges of the expander stretch and it is perforated with an injection needle, one puncture for every 1 cm^2, autodermoplasty is performed with the application of fixing interrupted sutures along the edges of the wound at a distance of 1.0 cm from each other with atraumatic monofilament non-absorbable suture material 4/0, after which the freely moved skin flap is additionally fixed to the soft tissues of the neck with similar sutures in a checkerboard pattern without applying a pressure bandage, 1 suture for every 2.0 cm^2, in the early postoperative period, irradiation is carried out through the bandage of the plastic zone with a laser device "Sogdiana" (Uzbekistan) in the infrared spectrum (with a wavelength of 890 nm) with a frequency of 1300 Hz, a pulse power of 5-7 W/per pulse, for 2 minutes by applying to the bandage in scanning mode (over the entire surface of the flap), 2 times a day for 7-10 days (Fig. 1).

Appearance before surgery

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Acute expander dermotension

Application of Hemoben powder to the wound surface after excision of scar tissue on the neck

View after plastic surgery

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Irradiation of the plastic zone with the Sogdiana laser device

Fig. 1. Patient Zh. Post-burn mid-lateral bilateral scar deformity of the neck. Stage III neck contracture. Pronounced cosmetic defect. Plastic surgery with a free skin graft.

For this method, an invention patent was received from the Ministry of Justice of the Republic of Uzbekistan No. IAP 07436 dated May 31, 2023 ("Method of surgical treatment of post-burn scar deformity of the head and neck with a full-thickness skin flap").

In cases of large defects, free skin plasty can be supplemented with local tissue plasty options (combined plasty) (Fig. 2-3).

Status before surgery

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Stages of plastic surgery

Long-term result

Fig. 2. Patient X. Consequence of a deep, extensive chemical burn. Cicatricial eversion of the upper and lower eyelids on the right. Correction of ectropion of the upper and lower eyelids with a full-thickness skin graft and local tissue

Status before surgery

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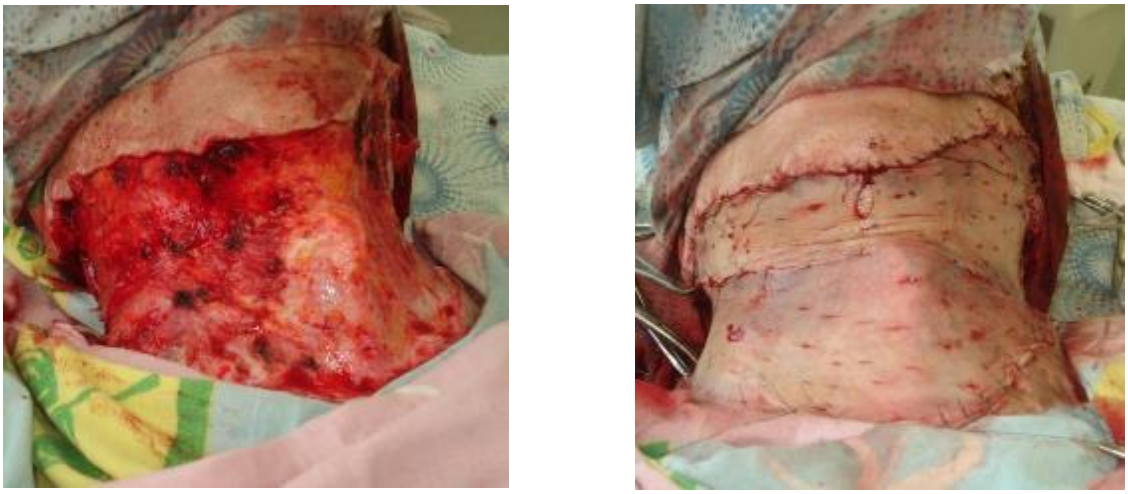


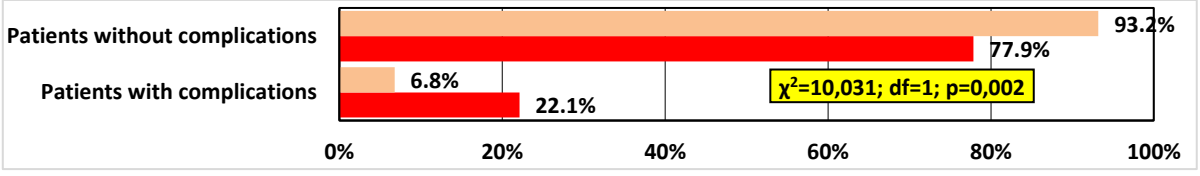
View after excision of scar deformity and plastic surgery

Fig. 3. Patient Sh. Post-burn mid-lateral bilateral scar deformity of the neck. Stage III neck contracture. Combined plastic surgery with a free skin graft and local tissues

All patients in both groups underwent a standard set of preoperative examinations. In the postoperative period, all variants of local complications were taken into account, both in the immediate and long-term periods.

Research results. The duration of wearing the bandage during isolated or combined use of free skin grafting did not differ in the main group; in the comparison group they were also virtually identical. On average, after plastic surgery in the face in the comparison group, primary dressing was performed after 5.3±0.5 days, while in the main group after 3.3±0.5 days ($t=19.66$; $p<0.05$), after plastic surgery in the neck area, these indicators were 5.2±0.5 days versus 3.1±0.3 days ($t=28.18$; $p<0.05$). Accordingly, in general, in all patients, the average time of wearing the bandage was 5.2±0.5 days versus 3.2±0.4 days ($t=33.80$; $p<0.05$).

Among all postoperative complications for all patients, partial graft necrosis developed in 10 (8.8%) patients in the comparison group; in the main group, such a complication was noted in 3 (2.9%) patients. Suture dehiscence in the tension zone of the flap was observed in 9 (8.0%) patients in the comparison group and in 4 (3.9%) patients in the main group. Sub flap suppuration developed in 4 (3.5%) patients in the comparison group. The formation of a subflap hematoma in the comparison group was observed in 14 (12.4%) patients. In the main group, due to the use of a hemostatic agent, no such complications were noted. In total, in the comparison group after plastic surgery of facial defects with a free skin graft, various complications were noted in 25 (22.1%) patients, while in the main group in 7 (6.8%). Accordingly, the postoperative period proceeded without complications in 88 (77.9%) and 96 (93.2%) patients ($\chi 2 = 10.031$; $df = 1$; $p = 0.002$) (Fig. 4).



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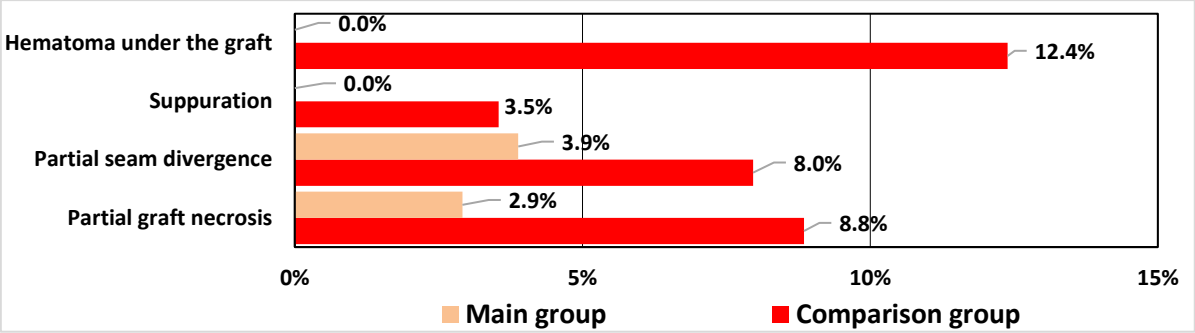

Fig. 4. The frequency of immediate complications after plastic surgery of all defects using a free skin graft

To eliminate complications, the following manipulations were required. Secondary sutures were applied in 9 (8.0%) patients in the comparison group and in 4 (3.9%) patients in the main group. Excision of necrotic tissue was performed in 10 (8.8%) and 3 (2.9%) patients, respectively. Percutaneous puncture of the hematoma under ultrasound guidance was performed in 14 (12.4%) patients in the comparison group. A total of 33 (29.2%) additional interventions were performed in 25 patients in the comparison group, and 7 (6.8%) in the main group ($\chi2$= 17.930; df=1; p<0.001) (Table 2).

Table 2 Treatment options for immediate complications after free skin graft surgery

Type of treatment for complications	Comparison group		Main group	
	abs.	%	abs.	%
Application of secondary sutures	9	8,0%	4	3,9%
Excision of the necrotic part of the graft with (or without) secondary sutures	10	8,8%	3	2,9%
Hematoma puncture*	14	12,4%	0	0,0%
Total	33	29,2%	7	6,8%
$\chi2$ between groups	17,930; df=1; p<0,001			

The development of various complications also affected the average length of the hospital period after surgery. Thus, in the comparison group, this indicator for all patients after isolated or combined free skin grafting was 11.4±1.4 days, while in the main group - 8.5±1.7 days (t=13.62; p< 0.05).

Long-term results were monitored in all operated patients. In both groups, after free skin grafting in the facial area, the most common complication was hypo- or hyperpigmentation of the graft, the frequency of which was 29.2% in the comparison group (33 of 113 patients) and 18.4% in the main group (19 of 103 patients). Hypertrophic scars, which usually formed in the area of suture dehiscence, were identified in 16 (14.2%) and 3 (2.9%), respectively. The most serious complication - wrinkling of the graft with recurrence of scar deformity - was noted in 10 (8.8%) cases in the comparison group and in 3 (2.9%) cases in the main group. In total, there were 59 (52.2%) different complications in the comparison group, and 25 (24.3%) in the main group ($\chi2$= 17.701; df=1; p<0.001) (Fig. 5).

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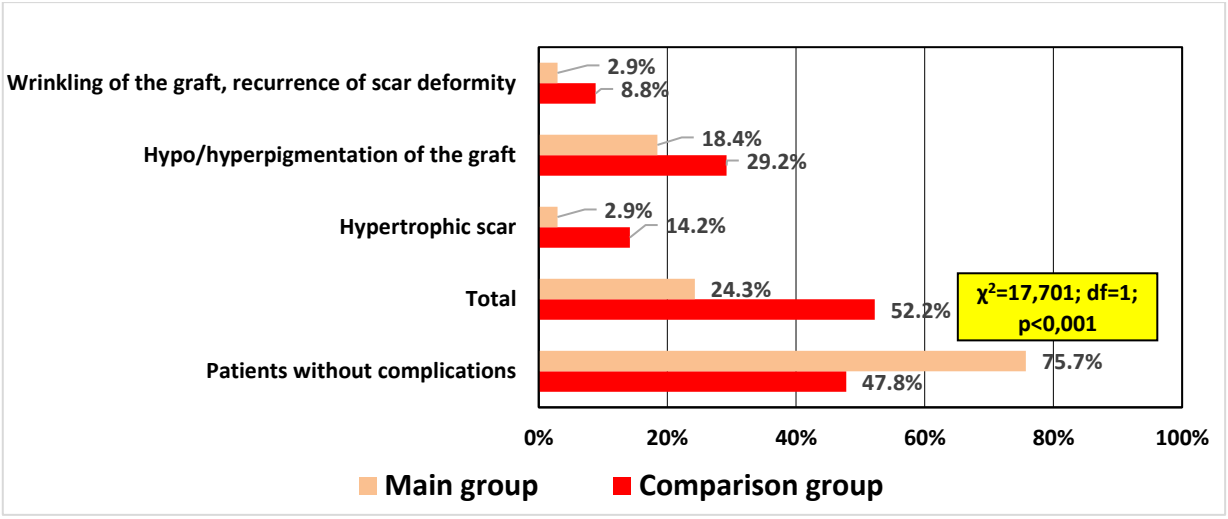

Fig. 5. Frequency of long-term complications after plastic surgery of all defects using a free skin graft

Repeated plastic surgery due to the development of recurrent scar deformity was performed in 10 (8.8%) cases in the comparison group and in 3 (2.9%) patients in the main group. Excision of hypertrophic scars was performed in 4 (3.5%) and 3 (2.9%) patients, respectively; secondary corrective surgery due to partial scar deformation of the graft using local plastic surgery was performed in 6 (5.3%) patients in the comparison group.

Accordingly, in general, 20 (17.7%) patients in the comparison group and 6 (5.8%) in the main group required surgical elimination of complications after plastic surgery of scar defects of the face and neck using various variants of free skin grafting. Hardware cosmetology was used in 39 (34.5%) patients in the comparison group and 19 (18.4%) in the main group. Accordingly, there were 54 (47.8%) and 78 (75.7%) patients without complications ($\chi 2$ 18.375; df=2; $p<0.001$).

Long-term results were assessed using the following criteria.

Excellent result – all cases of flap engraftment without the development of immediate (affecting the quality of engraftment) and long-term complications.

A good result is cases where there was the development of aesthetic complications, which were subjected to various options for hardware cosmetological treatment.

Satisfactory results are cases where patients with long-term complications in the form of partial scar deformity required surgical removal in the form of scar excision or secondary corrective interventions.

An unsatisfactory result is a situation where, after plastic surgery, there is a recurrence of scar deformity in the face or neck, requiring a full re-operation to eliminate the defect.

A study of long-term results on the quality of plastic surgery of post-burn scar deformity in the face and neck showed that excellent results were obtained in 54 (47.8%) patients in the comparison group and 78 (75.7%) patients in the main group. Good results were found in 39 (34.5%) and 19 (18.4%) patients, respectively, satisfactory in 10 (8.8%) and 3 (2.9%) patients. An unsatisfactory result requiring repeated full plastic surgery was noted in 10 (8.8%) patients in the comparison group and 3 (2.9%) in the main group ($\chi 2=18.375$; df=3; $p<0.001$) (Fig. 6).

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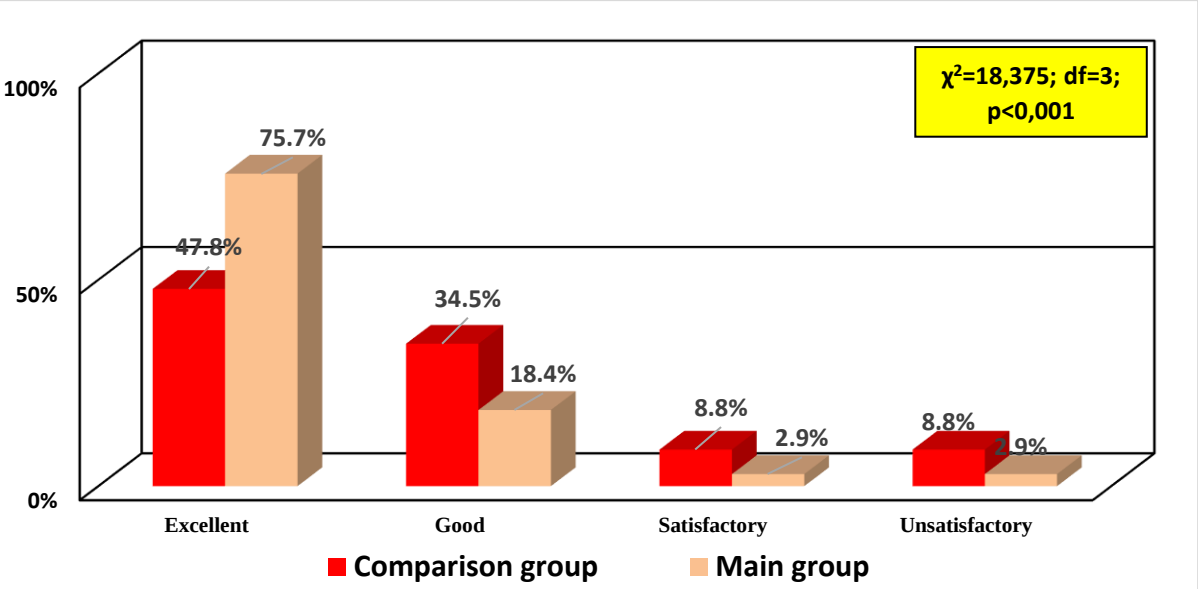

Fig. 6. Summary of long-term functional and aesthetic results of plastic surgery of facial and neck defects using a free skin graft

Thus, an improved method of surgical treatment of post-burn scar deformity of the face and neck with a free full-thickness skin flap is characterized by improving the quality of the harvested graft by reducing the degree of its retraction, as well as stimulating vascularization, reducing the risk of the formation of subflap fluid accumulations, eliminating the long-term wearing of a pressure bandage, which in general, it promotes a more physiological engraftment of transplanted tissues.

Conclusion. The introduction of various options for the use of a free full-thickness skin graft isolated or combined with plastic surgery with local tissues using an improved technique made it possible to reduce the period of wearing a flap-fixing bandage from 5.2 ± 0.5 to 3.2 ± 0.4 days (t = 33.80; p <0.05), reduce the frequency of immediate postoperative complications from 22.1% to 6.8% ($\chi 2$ = 10.031; df = 1; p = 0.002), respectively, reduce the need for invasive methods to eliminate immediate complications from 29.2% to 6.8% ($\chi 2$= 17.930; df=1; p<0.001) and reduce the duration of the hospital stage after surgery from 11.4±1.4 to 8.5±1.7 days (t=13.62; p <0.05).

Improving the quality of engraftment of a free skin graft ensured a reduction in the incidence of long-term complications from 52.2% to 24.3% ($\chi 2$= 17.701; df=1; p<0.001), the elimination of which required the use of hardware cosmetology in 34.5% and 18 .4% of patients, respectively, while the need for repeated surgery decreased from 177% to 5.8% ($\chi 2$= 18.375; df=2; p<0.001).

According to the reduction in the frequency of development of immediate and long-term results in the main group, it was possible to increase the proportion of excellent results of plastic surgery from 47.8% to 75.7% and reduce the frequency of unsatisfactory surgical outcomes from 8.8% to 2.9% ($\chi 2$=18.375; df=3; p<0.001).

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