

THE FIRST CLINICAL EXPERIENCE IS INTRAOPERATIVE STRETCHING OF THE SKIN IN THE ELIMINATION OF SCAR DEFORMITIES OF THE UPPER EXTREMITIES

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Abstract

The authors present the first clinical experience of using a new method of plastic surgery to eliminate the effects of burns of the upper extremities. 26 patients were operated on in a new way. The proposed method of upper limb plastic surgery with intraoperatively stretched tissues in 24 (92.3%) patients out of 26 allowed to achieve good functional and aesthetic results.

Keywords: surgical tactics, scar, scar deformation, tissue sprains, plastic and reconstructive surgery.

Actuality of the problem. It is known that rapid intraoperative stretching was first used by Sasaki (1987) and consists of rapid, cyclic stretching of the skin performed during surgery, when mobilization of tissue flaps is performed. Sasaki reported his experience in almost 300 cases where it was found that this technique was able to provide an additional 1–3 cm of flap length [3, 5]. Rapid intraoperative stretching is a controversial technique and is still a matter of debate among researchers: whether true stretching effects are occurring or simply improved undercutting, tissue harvesting, and coverage of the defect. The technique of rapid tissue stretching depending on the area of reconstruction has not been determined [4, 8]. Additional clinical, physiological, and morphological studies will help to better understand the process and delineate applications of rapid intraoperative stretching. Rapid intraoperative stretching is particularly attractive for cases of rapid one-stage repair of soft tissue defects. However, clinical experience with this technique is still insufficient.

In the literature, there are isolated instructions on the technique of using rapid intraoperative tissue stretching using a Foley catheter; a stretching technique and possible parameters for lengthening flaps have been proposed [2, 7]. In this case, after planning the flap, it is cyclically stretched. The balloon is inflated until the tissue turns pale and becomes tense. The balloon remains inflated for 3 minutes; the saline solution is then removed and the tissue is allowed to rest for a few minutes. The cycle is repeated twice more, after which the flap is transferred and the donor site is closed. Some authors believe that with rapid stretching there is a large

immediate rebound contraction of the stretched tissue, which may limit the use of the technique [6]. An experimental study of rapid intraoperative stretching, carried out on laboratory rats using a silicone balloon and monitoring the viability of the flaps, showed the possibility of using this method in the human facial area [1].

Materials and methods: In the department for the consequences of trauma and orthopedics of the multidisciplinary medical center of the Andijan region, 26 patients with soft tissue defects and cicatricial deformities of the upper extremities were operated on. The time from burn wound healing to surgery ranged from 2 to 12 years. Patients with fresh scars were given conservative therapy before and after surgery in order to accelerate the “maturation” of the scar. Along with traditional methods of surgical treatment of scar deformities, new methods of surgical interventions were used to treat them. The choice of operation depended on the area and location of the defect and scar, and the condition of unaffected adjacent tissues.

To close wounds after excision of rough scars, we have developed a method of intraoperative stretching of tissues of adjacent areas.

The technique of intraoperative tissue stretching was as follows: at the border of the scar mass with healthy skin, an incision 1.5-2.0 cm long is made. Through this incision, a subcutaneous pocket is formed using the tip of a forceps, corresponding to the size of the Foley catheter. The cavity is temporarily plugged for 5-10 minutes with napkins moistened with isotonic sodium solution. A Foley catheter is implanted into the formed bed. The wound is temporarily sutured with interrupted sutures. The Foley catheter is filled intraoperatively with sterile saline as much as possible, creating compression on the tissue from the inside. After 530 minutes, the liquid is extracted back and relaxation of the stretched tissue occurs. After a 4-minute interval, the balloon is again filled with liquid for 530 minutes. This procedure is repeated three times. After this, taking into account the available tissue supply, the scars are excised and the resulting wound is closed with intraoperatively stretched tissue. For a cylinder, except for the elbow area, creating a bed in these areas is associated with great technical difficulties. The soft tissue in the elbow area easily peels off from the muscle and stretches well. From these stretched tissues, by “sliding” and forming flaps, the defect can be restored.

Physiological and morphological studies were carried out. The state of microcirculation in stretched and displaced tissues in 26 patients before and after intraoperative balloon stretching was studied using transcutaneous determination of oxygen tension in tissues (R_{tO_2}). For this purpose, the TSM-3/400 system from “Radiometr”, Denmark was used.

To study morphological changes in stretched tissues, biopsies were taken from them during operations for *scanning electron microscopy* (SEM). *For transmission microscopy (TEM)*, skin biopsies of patients immediately after excision were fixed in a 2.5% glutaraldehyde solution in 0.1 M phosphate buffer pH 7.4 for 2-12 hours, washed in phosphate buffer, and further fixed with 1% solution of osmium tetroxide and, after dehydration in alcohol - acetone, poured into a mixture of epon and araldite.

Results and discussions. The work is based on the results of surgical treatment of 26 patients with post-burn scar deformities who were treated in the department of trauma and orthopedics

of the Andijan Regional Medical Center from 2021 to 2023, aged from 18 to 36 years. Of these, 11 (42.3%) patients were male and 15 (67.7%) were female. The main damaging factors were flame burns (16 patients (76.2%)). Patients were admitted to the department at different times (from 1 year to 27 years) after healing of burn wounds.

To increase the skin area in 26 patients, a 30-balloon Foley catheter was used. Their base area ranged from 10 to 38 cm², volume - from 18 to 52 ml.

In 13 patients, balloons were implanted in the forearms, in 13 - in the elbow area.

Before tissue stretching, the average oxygen tension in tissues was 78.6±5.8 mmHg. After introducing the furacillin solution into the expander, the oxygen tension in the tissues above it decreased to a critical level, reaching 8.2±4.3 mmHg. 5 minutes after removing the liquid from the balloon, the tension of the tissues above the balloon decreased and the PtCO₂ level rose to 78.1±10.6 mmHg. This was an indication for the next session of infusion of fluid into the balloon. After plastic surgery, 30 minutes later, the level of PtSO₂ in the displaced tissues was 75.9±9.2 mmHg.

Intraoperative stretching of the skin does not cause disruption of its general architecture. In the epidermis, no integrity violations in the form of tears or cracks are detected. There is a decrease in the number of rows of cells of the spinous layer. At the same time, no phenomena of acantholysis and cytolysis were noted.

Ultrastructural studies using TEM and SEM also did not reveal any disturbances in the architectonics of either the epidermis or the dermis.

The contacts of the epidermis, both with the basement membrane, and the cells of the basal and spinous layers with each other, are completely preserved.

When performing tissue stretching using a Foley catheter around the elbow, we encountered certain difficulties in the form of a slow increase in tissue area and poor tolerance of stretching. At the same time, patients noted pain and paleness of the skin.

Results. In the postoperative period, one (3.8%) patient experienced partial suture dehiscence. In the long-term period from 1 to 2 years, 24 (92.3%) patients showed good and satisfactory results.

Conclusions. In conclusion, it can be emphasized that for the restoration of scarred skin of the upper extremities, the most optimal are unaffected adjacent tissues.

They can be used by wide mobilization or after acute intraoperative balloon tissue distension. The use of the method of intraoperative balloon tissue stretching for small scars (2.5-3.5 cm) allows achieving good functional and cosmetic results in more than 92.3% of patients.

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