

THE USE OF TISSUE EXPANSION IN THE TREATMENT OF BURN SEQUELAS – OUR EXPERIENCE

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REZUMAT

Introducere: Reconstrucția cicatricilor postcombustionale cu tegument integru reprezintă actualmente tratamentul standard pentru acest tip de patologie. Expansiunea tisulară reprezintă o tehnică universal acceptată, prin faptul că utilizează lambouri tegumentare extinse, a căror culoare și textură este identică cu cea a tegumentului din zona cicatriceală, rezultatul estetic final fiind optimal. **Obiective:** Scopul acestui studiu este de a prezenta experiența Clinicii noastre în tratamentul sechelelor postcombustionale, prin expansiune tisulară. **Material și metodă:** Într-o perioadă de 5 ani (2001-2005) am tratat 106 pacienți (139 implantări de expander tisular), cu cicatrici postcombustionale localizate la nivelul scalpului, regiunii cervicale, membrului superior, inferior și la nivelul trunchiului. **Rezultate:** Excizia totală a cicatricilor a fost realizată la 88 pacienți (83,01%). Datorită suprafețelor mari de țesut cicatriceal, la 18 pacienți (16,99%), s-a efectuat excizia/reconstrucția seriată pe zone, aceștia fiind încă sub tratament. Complicațiile au fost minore (hematom – 4; serom – 1; dehiscente de plagă – 16; necroze minore tegumentare – 7; expunere de valvă - 2). Complicațiile majore, care au necesitat explantarea expander-ului, au fost: infecția - 8 cazuri și defectarea expanderului (perforarea camerei cu lichid) - 2 cazuri. **Concluzii:** Expansiunea tisulară pentru reconstrucția sechelelor cicatriceale postcombustionale reprezintă o tehnică utilă, cu o curbă de învățare rapidă și cu rezultate estetice optime. Dezavantajele acestei tehnici sunt cele financiare (prețul expander-ului), durata lungă de timp a tratamentului, intervențiile chirurgicale multiple, precum și diformitatea temporară realizată de aplicarea expander-ului.

Cuvinte cheie: cicatrice postcombustională, expansiune tisulară, reconstrucție funcțională, reconstrucție estetică

ABSTRACT

Introduction: Replacement of postburn scars with good quality skin represents, nowadays, the standard of treatment for this pathology. Tissue expansion is a straightforward technique, providing large skin flaps whose color and texture matches the area to be reconstructed, achieving optimal final aesthetic result. **Objectives:** The purpose of this study is to present our results for treatment of postburn sequelae using tissue expansion. **Material and methods:** During a period of five years (2001-2005) we employed tissue expansion for 106 patients (139 expander insertions), located on the scalp, neck, upper limb, lower limb and trunk. **Results:** Total scar replacement was achieved in 88 patients (83.01%), using staged surgery. Due to wide scar involvement, 18 patients (16.99%), are still under treatment. Complications were minor (haematoma – 4; seroma – 1; wound dehiscence – 16; minor skin necrosis – 7; filling valve exposure - 2). Complications requiring expander removal were: infection in 8 cases and expander leakage in 2 cases. **Conclusions:** The use of tissue expanders in order to reconstruct postburn sequelae is a valuable and easy technique, leading to superior aesthetic results. Disadvantages are the price of the expanders, long duration of treatment and multiple procedures and temporary deformity during balloon inflation.

Key Words: postburn scars, tissue expansion, functional, aesthetic reconstruction

INTRODUCTION

Progresses achieved in the treatment of burn injuries, led to increased survival and a higher number of people with extensive postburn scar sequelae; thus, in our medical practice we encounter more and more patients with hypertrophic scars that cover 30-40% of body surface. These scars, according to their

location, determine major functional and aesthetic deficits. At the beginning, the reconstruction of postburn scarred areas was achieved using simple techniques like skin grafts and local transposition flaps. Later on, more sophisticated methods, like free tissue transfer, were employed. The disadvantages of these methods (graft retraction, donor side morbidity, graft loss, suboptimal aesthetic results) favored the development of another reconstructive method, the tissue expansion. From 1957, this procedure was used more and more often as a reconstructive technique.^{1,2}

Because tissue expansion became such a popular reconstructive technique in extensive postburn sequelae, there is a constant need to analyse it comparatively to other procedures, to identify details of indications and/or technical procedures allowing us to improve the final result. Based on a large clinical database, the purpose of this study is to present our

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results in tissue expansion for postburn sequelae and to compare it with similar data in the literature.

MATERIAL AND METHODS

During a five years period (2001-2005), in the Department of Plastic and Reconstructive Surgery of the Clinical Emergency County Hospital Timisoara we have treated 170 patients with scar sequelae of various etiologies, using tissue expansion technique. From these, 106 were admitted with postburn sequelae. Most often, patients were burned by fire. (Fig. 1). The patients' age was between 4 and 45 years and we observed a higher rate of female patients (70 females versus 36 males, respectively 66.03% versus 33.96%). (Figs. 2, 3) There were one or more affected areas per patient, namely 130 locations: scalp in 25/130 locations (19.23%); nose, ear and face in 11/130 locations (8.46%); neck in 26/130 locations (20%), upper limb in 19/130 locations (14.61%), lower limb in 15/130 locations (11.54%), anterior trunk in 17/130 locations (13.08 %), and posterior trunk in 17/130 locations (13.08%), some of the patients presenting multiple locations or requiring multiple or serial expansions of the same body region. (Fig. 4)

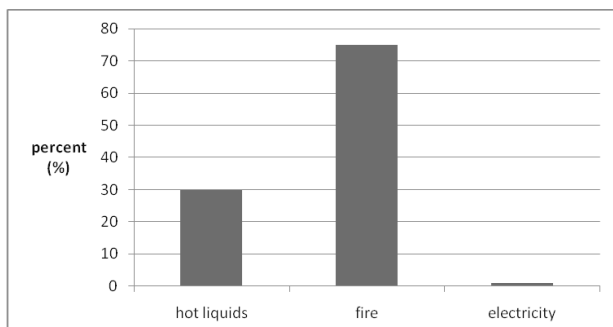


Figure 1. The etiology of postburn scarring.

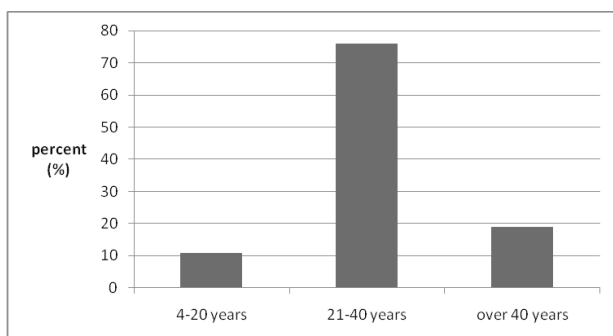


Figure 2. Age repartition within the patient group taken into this study.

Expanders produced by Mentor[®], Allergan[®], McGhan[®], Eurosilicone[®], Silimed[®], of various shapes and sizes were used (rectangular for the scalp, neck, trunk, upper and lower limb; round expander mostly

used for the trunk and kidney-shaped expanders used mostly for scalp and neck region).

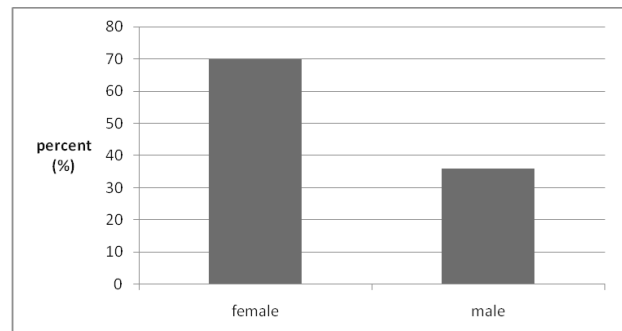


Figure 3. Male/female repartition within patient group taken into this study.

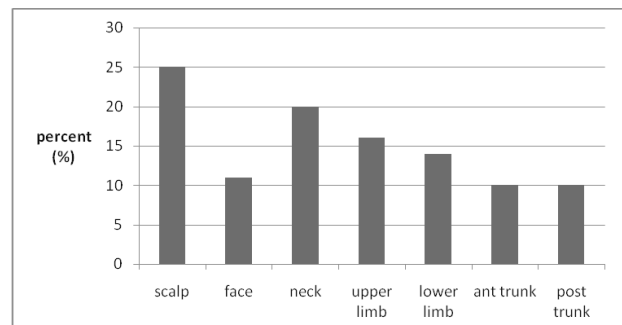


Figure 4. Localization of the postburn contracture.

When performing the data analysis, we encountered a variety of clinical situations: (i) patients having serial expansion in same/different body areas; patients with simultaneous expansion of several regions; (ii) cases in which, in one operative session, the same expander was removed from an area and inserted into another location; (iii) patients that have the expander inserted but not removed (in course of inflation); (iv) patients that underwent surgery for complications of tissue expansion.

In regard with these findings, there is a need to clarify some notions:

1. Expander-related surgery is the central procedure of this method, and refers to expander insertion or removal after complete tissue expansion; it is considered as a separate procedure even if it was accompanied by other procedures during the same operation.

2. There were 139 expander insertions and 121 expander removals, a total of 260 expander-related procedures. Other interventions were considered collection evacuation, secondary suture, expander removal before completion of tissue expansion (43 procedures).

3. A number of 18/106 patients underwent expander insertion and are now in course of inflation.

The expander size was chosen according to the dimensions of the defect to be reconstructed and to the characteristics of the affected zone (smaller in the scalp, neck, face, nose and upper limb and larger for trunk and lower limb (thigh and upper 1/3 of calf). The volumes of the expanders volumes varied between 70-400cc. (Table 1) Preoperatively we checked up again the measurements taken before ordering the expanders and do the markings.

Table 1. The size and types of the expanders used in the study, in relation with the affected body areas.

Region Expanders size and type	Scalp	Face/ Nose/ Ear	Neck region	Upper and lower limb	Anterior and posterior trunk
Rectangular (100-400 cc)	17	11	20	34	30
Croissant (70-150cc)	8	-	6	-	-
Round (160-180cc)	-	-	-	-	4

Operative technique

Under general anesthesia, an incision was made in the vicinity of the defect (0.5 cm); its length was correlated with the affected area and the expander's size, the orientation was perpendicular on the long axis of the defect in 98/139 cases and parallel to it in 41/139 cases. Dissection was continued until the suprafascial plane - anterior and/or posterior trunk/upper and lower limb, or under the galea at scalp level. Two pockets were dissected, one for the expander and one for the filling valve. After placing the expanders and the drainage tubes, the wound was sutured in two layers. At the end of the procedure, the expander was filled with saline (about 10-20% of expander's volume).

Postoperatively, antibiotics were administered for 5-7 days and analgetics for 2-3 days, as needed. In most of the cases, tissue expansion started after two weeks. In 10/139 cases expander inflation was delayed for several days, until the wound was totally healed.

The expander inflations were made as outpatient procedures. The amount of saline to be introduced in each session depends upon the anatomical region, expander's capacity and patient's tolerance. The average time of tissue expansion was 3 months, at a frequency of one inflation/week. In 92/139 cases (66.19%) the overinflation of the expanders with 20% excess of the total volume was achieved.

RESULTS

The second stage of the surgical procedure (expander removal and scar replacement: 121 cases) was performed at 3 months after the first intervention in 85 cases (70.25%) that evolved without any complication.

Complications of tissue expansion were encountered in 40/139 cases (28.78%). Minor complications were considered those that allowed continuation of tissue expansion, while major complications required expander removal before completion of treatment. In the first category we encountered haematoma, seroma, wound dehiscence and fill valve exposure - in 30/139 cases (21.58%). From these, 26 were noticed in patients that completed treatment and 4 in the lot of 18 patients still under treatment. The second category comprised severe infection and expander leakage due to manufacture defect - in 10/139 cases (7.19%). (Table 2) In the 26 cases that presented minor complications, but finished tissue expansion, the second procedure was delayed for 3 weeks, waiting for complete wound healing after necrectomy or evacuation of collections. Wound dehiscence was encountered mostly in cases of reconstruction in scalp and neck region. The infection (8/139 cases, 5.76%) was secondary to wound dehiscence and skin necrosis. In these cases the expanders had to be removed within a timeframe of 3 weeks to 3 months from the implantation and the surgical procedure was repeated after the total healing of the wound.

Table 2. Complications encountered within the patient group.

Type of complication	Number of cases	Percentage (%)
Haematomas	4	3.77
Seromas	1	0.94
Wound dehiscence	16	15.09
Necrosis	7	6.60
Infections	8	7.54
Valve exposure	2	1.88
Expander leakage	2	1.88

After expander removal and scar excision, the resulting defect was covered with the expanded tissue, which had similar characteristics of color and texture with the nearby skin. Complete excision of the scars was achieved in 88/106 patients (83.01%), and it was done in 1-4 expansion stages. In 70/106 patients total

scar removal was done in a single stage of expansion, in 13/106 patients there were necessary 2 stages, 3/106 patients needed 3 stages, and 2/106 patients needed 4 stages of tissue expansion. There are 18/106 patients (16.98%) still in treatment. Some patients were treated by using 2 expanders simultaneously; in one patient we used 4 expanders in the same time (one for cervical area, one for the anterior trunk and 2 for the lower limb). (Table 3)

Table 3. Number of patients with definitive scar excision and reconstruction versus those still in course of treatment, according to the expansion stage.

Total number of patients in the study: 106 patients	Patients with complete scar removal	1 st stage of expansion	70 patients
		2 nd stage of expansion	13 patients
		3 rd stage of expansion	3 patients
		4 th stage of expansion	2 patients
Patients in course of treatment		1 st stage of expansion	12 patients
		2 nd stage of expansion	4 patients
		3 rd stage of expansion	2 patients
18 patients (16,98%)			

DISCUSSIONS

Spontaneous healing of intermediate deep burns and skin graft coverage of deep burns leaves behind areas of postcombustional scars that raise other issues: they tend to shrink during their evolution and frequently become unstable, thus having a high risk of ulceration, leaving behind functional impairment and unpleasant appearance.

In the past, the treatment of large area postburn sequelae consisted mainly in incision/excision followed by skin grafts or transposition of local skin flaps. Frequently encountered problems were skin graft retraction with functional deficit and unpleasant cosmetic aspects, or insufficient local resources for covering the remaining skin defects after scar excision.

Use of free tissue transfer is a tedious procedure, with more or less donor site availability and morbidity and higher risk of flap necrosis. In the last years, tissue expansion technique has improved the postoperative results in these cases.

One of the main advantages of tissue expansion is that it allows full use of the tegument of any region.⁴



Figure 5. Male patient, 35 y.o., post-burn alopecia (140 cm²), treated by tissue expansion using one croissant-shaped and one rectangular-shaped expanders: (A) preoperative planning of scar excision; (B) six months after definitive reconstruction.

The rate of major infections in our series (requiring expander removal before completion of tissue expansion) was 5.76% (8/139 cases), slightly increased compared to similar data reported in literature, 3.1%.⁵⁻⁸ We also encountered two cases of expander malfunction with consequent leakage, leading to expander removal and replacement.

The rate of occurrence of minor complications in our series was 21.58% (30/139 cases), very close to data in the medical literature quoting a rate of minor complications of 20%.⁹ We consider that the relatively low rate of complications is due to the increased experience accumulated over time and to proper patient selection.

Special issues have appeared in the reconstruction of the neck, where the tegument is very thin, has great elasticity and there is no “real” solid plane underneath the expander. In large defects, the expansion was done in two stages using increasing expander volumes, in order to achieve finally defect coverage. At this level, most frequently, we encountered, marginal flap necrosis and wound dehiscence, and this was the reason for delaying the treatment about three weeks.



Figure 6. Female patient, 27 y.o., post-burn scars (230 cm²) affecting the right thigh, treated by tissue expansion using 2 rectangular tissue expanders: (A) preoperative planning; (B) at 2 weeks after definitive reconstruction.

Similar data from the literature emphasize that most frequent complications appear during tissue expansion in the cervical region.¹⁰ At this level it is indicated to use free tissue transfer or expanded supraclavicular flaps, especially when the scars are extended to the anterior chest area or in the supraclavicular region.¹¹

On the scalp an additional challenge is to reconstruct the hairline and the hair-bearing skin. After deep burns, the destruction of the hair bulbs leads to postburn alopecia. Skin grafts used in the emergency treatment of scalp burns leaves behind a sequelar alopecia which frequently becomes unstable. In those cases where the skin defect is over 50cm², tissue expansion seems to be the only surgical solution.^{12,13} Tissue expansion at this level was achieved successfully in our series in 25 out of 106 patients, using rectangular and reniform tissue expanders; in 2 cases the procedure was accompanied by the reconstruction of underlying excised bone using titanium plates. The complications encountered in this area were wound dehiscence and minimal marginal necrosis of the expanded flaps. This is most probably due to atrophic or scarred tissue.^{14,15}

CONCLUSIONS

Tissue expansion is a useful method for reconstruction of any region where we have at least tegument integrity. The best results depend on the selection of patients, their ability to understand the procedure and on surgeon's experience.



Figure 7. Female patient, 30 y.o., post-burn scars (450 cm²) affecting the hip region, treated by using two tissue rectangular tissue expanders: (A) preoperative appearance; (B) final tissue expansion at 3 months; (C) one week after definitive reconstruction.

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