

# TISSUE EXPANSION FOR BURN SEQUELAE: JEITAWE BURN CENTER, LEBANON

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**SUMMARY.** Burn sequelae used to be treated with skin grafts and local or distant flaps with a high morbidity on the donor site. The purpose of treatment today by skin expansion is to achieve aesthetic amelioration, as the advantage of this technique is that it becomes possible to obtain local flaps with the same characteristics of colour, texture, hair, and sensitivity as normal skin. This is a review of 14 cases of burn patients treated between 2006 and 2010 at our burn centre at Jeitawe Hospital, Lebanon. The patients' ages ranged from 6 to 50 yr. The regions expanded were the scalp, forehead, neck, trunk, and the upper and lower limbs. The implants were positioned on the fascial layer; antibiotics and drainage were routinely used. The inflation of the expander began two weeks after surgery and continued for an average time of three months. Complications were rare. Results were good with an improvement of scars and minimal morbidity. Fifty per cent of our patients underwent another expansion.

**Keywords:** tissue expansion, burn sequelae, surgical technique

## Introduction

Tissue expansion relies on the ability of skin and soft tissue to generate in response to tension. Tension is generated by implanting a subcutaneous balloon (expander) that is inflated over a period of weeks; new tissue is generated in response to the constant stretching caused by the progressive inflation of this expander.<sup>1</sup> This tissue can be used to reconstruct defects such as those encountered after burn excision. The sequelae of most burn wounds involve cosmetic and functional deformity, even after skin grafting is used. The concept of the increase in skin surface area after expansion is due to the generation of new tissue with increased vascularity rather than stretching of the existing skin. This new skin enables us to close the donor site in case distant flaps are planned. As a general rule, the diameter of the expanded flap should be two to three times the diameter of the skin that is to be excised.<sup>1</sup> With experience, the complication rates following the procedure drop dramatically. The disadvantage of the technique is the temporary cosmetic deformity during the expansion phase and the multiple procedures frequently needed.

## Methods

Fourteen patients with burn sequelae were reviewed

between 2006 and 2010 at our burn centre, during which period we fitted 22 expanders.

The female-to-male ratio was 9 to 5 (64% to 36%). The age range was from 6 to 50 years, with a mean age at the time of the surgery of 27 yr.

Twenty-four expanders were used, of different sizes but mostly of three shapes: rectangular, elliptical, and crescent-shaped (*Table I*). The maximum volume filled varied between 100 and 800 cc, depending on the location and the development of complications.

**Table I** - Number of expanders per area

Head and neck	Scalp: 2	Forehead: 3	Neck: 3	Total: 8
Trunk	Supraclavicular area: 2	Upper chest: 2	Abdomen: 2	Total: 6
Upper limb				Total: 5
Lower limb				Total: 5

Two expanders were used simultaneously in six patients (two in the head and neck, two in the upper limb, and two in the lower limbs).

## Surgical technique

The physical examination during the first consulta-

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tion was very thorough: we had to check the location and the shape of the burn scar to be treated and to look out for available surfaces for the placement of prostheses, the choice of which is fundamental: they have to be as large as possible, they have to be numerous, and they must not leave any unexpanded normal skin on the borders of the scar.<sup>2</sup> Thus, at the end of the consultation, we knew the approximate amount of skin to be grafted. Counselling of the patients is essential, as they have to be aware of the cosmetic deformity and mild discomfort during the expansion phase. They also have to be warned that, with large lesions, a second expansion will be necessary.

#### Insertion

At our burn centre the system we use consists of an injection valve port that is connected to the device by silicone tubing of customized length.<sup>3</sup> The valve is placed at distance in a subcutaneous plane, preferably over a firm supportive tissue (mostly bony) to prevent overturn or migration.

The choice of the incision is extremely important. This is placed over cicatricial tissue, preferably perpendicularly to the defect. It should be as small as possible, fitting the diameter of the valve (3 to 4 cm), and placed at a distance from the area to be expanded in order to prevent any tension on it during the filling process.

The previously planned pocket is dissected bluntly, using smooth-ended scissors in a subcutaneous, supra-aponeurotic plane - in size it must be slightly larger than the device itself. We inject saline inside it to remove all fatty debris and we create a narrow tunnel for the valve. After ensuring good haemostasis, using electrocautery (which we do not perform in the scalp in order to avoid burning the hair follicles), we position our device after removing the air content, push the valve into its tunnel, and - if there is any possibility it may migrate from its tunnel - fix it with sutures.<sup>3</sup> We test our system by injecting 30 cc of saline through the valve. We then close the incision using two planes of vicryl 3-0 and nylon 4-0 or 5-0 over a suction drainage system that is removed in 24 h before discharging the patient, who is given prophylactic antibiotherapy for five days.

Serial expansion is started two weeks post-insertion provided that the skin flaps are in excellent condition. The injection must not be painful, and the skin should not be discoloured. The best criterion is the patient's own appreciation - we should stop filling when the patient feels a stretching sensation because the skin expansion must always be comfortable.<sup>2</sup> If there is any sign of hyperpressure, don't hesitate to remove some liquid. The filling process continues at a rate of one or two sessions per week until enough soft tissue is obtained (after approximately three months).

#### Reconstruction

Under general anaesthesia, we perform an overfilling by introducing a large amount of liquid inside the prosthesis. This will discolour and distend the skin, thereby increasing the periprosthetic dissection.<sup>2</sup> In this way, in a few seconds we gain some more centimetres of skin. The incision is placed over the previous one, we dissect using electrocautery until we reach the device. This we remove, and we then cut its connecting tube. The valve is removed by a cross-incision over it.

The expanded tissue is doubled by a well-vascularized periprosthetic collagenic capsule.<sup>2</sup> We do not perform one capsulectomy but several capsulotomies (*Fig. 1*) in order to facilitate the advancement of the flap. The flap is then redesigned and the defect is excised in accordance with the available tissue. The incision is closed using two planes of vicryl 3-0 and nylon 5-0 (in the scalp we use one plane of nylon 3-0) over a suction drainage system that is removed after 24 h.



Fig. 1 - Capsulotomies.

#### Results

Twenty-two expanders were used, with complications in just three cases (13%). In two cases a major complica-



Fig. 2 - Implant exposure.



**Fig. 3** - Internal valve extrusion

tion developed, leading to removal of the expander. The first was a neck expander where there was seroma formation two weeks after expansion, and the second was a scalp expander in which there was implant exposure through the incision one month after expansion (*Fig. 2*). One patient developed a minor complication in an upper chest expander where extrusion of the internal valve occurred because it had been misplaced under burned tissue. However, we continued the expansion as if it were an external valve system, taking maximum hygiene measures (*Fig. 3*).

Most of the patients reported a good degree of satisfaction; 50% needed re-expansion.

Some representative clinical cases are shown in *Figs. 4-8*.

### Discussion

Tissue expansion is a reliable method of providing additional cutaneous tissue, thereby optimizing contour and colour match. The effects of expansion on skin, which include increased surface area and vascularity, allow coverage of a variety of burn wounds, thus ameliorating cosmetic and functional deformities.<sup>3</sup>

However, we still have to face many problems.

Sometimes the amount of tissue calculated turns out to be less than sufficient, owing to skin flap retraction after removal of the implant. This happened in some of our cases, especially at the level of the limbs. However, by performing an overfilling just before the reconstruction procedure, we were still be able to gain some more skin.

The use of small incisions, placed perpendicularly to the lesion and away from the pocket, decreases the risk of wound dehiscence .

In paediatric patients, the use of a local cream anaesthetic, EMLA, 15 min before each filling, decreases the pain related to the injection, making the use of an internal valve possible.



**Fig. 4a** - Thermal burn in the chest treated with skin grafting.



**Fig. 4b** - One supraclavicular and one abdominal expander inflated over a period three months.



**Fig. 4c** - Re-expansion using a larger abdominal prosthesis one year after first surgery.



**Fig. 4d** - Peri-operative view: incision placed over previous incision used to place the implant, and removal of the system.



**Fig. 4e** - Advancement of the flap and excision of appropriate burned tissue.



**Fig. 4f** - Closure of the wound over a Penrose draining system.

In cases of chest burns in young girls, when we plan an abdominal expander to remove burn tissue from the breast area, we have to take care to perform a simple de-epidermization of the burn scar in order to avoid excision of breast tissue.

The complication rate in our centre was low. In all

our cases, the results were good and the patients were satisfied. This is therefore an extremely important technique that gives superior cosmetic and functional results compared to traditional skin grafting. However, most of the patients needing another expansion could not afford it as it was not covered by their medical insurance.

*Case 1*

This 6-yr-old girl suffered a thermal burn in the left hemi chest and left upper limb, treated previously with split-thickness skin grafting; her parents were seeking cosmetic amelioration. We planned two expanders: one elliptical expander, placed over the left supraclavicular area, the other an abdominal rectangular expander, to be inflated over a period of three months. There were no complications but satisfaction was low. One year later, the patient underwent another re-expansion, this time with a larger abdominal expander, and the results were excellent (Figs. 4a-f).

*Case 2*

A 30-yr-old man suffered chemical burns in the left cheek caused by acid, also treated with skin grafting but with mediocre aesthetic results. We proposed an elliptical rectangular neck expander that was inflated for three months. The patient suffered the result of the cosmetic deformity during the expansion phase but following removal of the system and adjustment of the flaps the result was excellent and he was completely satisfied. There were no complications (Figs. 5a,b).



**Fig. 5a** - Patient three months after inflation of an elliptical rectangular expander.



**Fig. 5b** - Removal of the expander and advancement of the flap.

*Case 3*

A 40-yr-old man suffered a bilateral thermal burn injury to his cheeks, and he needed his beard back. We proposed a large rectangular scalp expander that remained inflated for three months. At the time of reconstruction we created a bitemporal pedicled flap that was rotated to replace the burn scar. Three weeks later he had a second operation, and a third was needed to sever the flap pedicle.

The unused portions were rotated back to their original place. No complications were observed and the aesthetic results were excellent (Figs. 6a,b,c,d).



**Fig. 6a**- Thermal burn to the cheeks.



**Fig. 6b** - Rectangular scalp expander inflated for three months.



**Fig. 6c** - Peri-operative view: bi-pedicled temporal flap.



**Fig. 6d** - Two months post-op.

*Case 4*

The patient was a 20-yr-old girl who survived an explosion. She presented with loss of muscular mass from the lateral thigh area and was treated with several skin grafts. After two years we proposed the use of two rectangular thigh expanders, kept inflated for three months. Following removal and advancement of the flaps, the patient's degree of satisfaction was acceptable. We advised her to undergo another re-expansion (Figs. 7a,b,c).

*Case 5*

When this 35-yr-old man presented with left upper limb burn, we first proposed a rectangular arm expander. After three months it was possible to remove 40% of the arm scar. Currently the patient is undergoing another re-expansion with two expanders: one crescent-shaped for the axilla and the other rectangular for the forearm (Figs. 8a,b,c).



**Fig. 7a** - Thermal burn in the thigh treated with multiple skin grafting.



**Fig. 7b** - Two rectangular expanders inflated for three months.



**Fig. 7c** - Removal of the prostheses and advancement of the flaps.



**Fig. 8a** - Left upper limb burn: planning of rectangular expander and Z-plasty for axillary contracture.



**Fig. 8b** - Three months post-inflation of the prosthesis.



**Fig. 8c** - Re-expansion with two current prostheses one year after removal of first implant.

**L'EXPANSION TISSULAIRE DANS LES SÉQUELLES DE BRÛLURES: LE CENTRE DES BRÛLÉS DE JEITAWE, LIBAN. RÉSUMÉ.** Les séquelles de brûlures traitées avec des greffes cutanées et des lambeaux locaux ou à distance ont été caractérisés dans le passé par un taux élevé de morbidité du site donneur. Le traitement par expansion cutanée mire aujourd'hui à réaliser des résultats esthétiquement supérieurs, puisqu'il offre la possibilité de créer des lambeaux locaux qui présentent les mêmes caractéristiques de couleur, de structure, de cheveux et de sensibilité que la peau normale. Dans cette recherche nous nous sommes proposés de réexaminer 14 cas de patients brûlés traités entre 2006 et 2010 dans notre centre des brûlés à l'hôpital Jeitawe, au Liban. L'âge des patients variait de 6 à 50 ans. Les régions traitées avec la technique de l'expansion étaient les suivantes: le cuir chevelu, le front, le cou, le tronc et les membres supérieurs et inférieurs. Les greffes ont été placées sur la couche fasciale et nous avons employé les antibiotiques et le drainage comme routine. Nous avons commencé à gonfler l'extenseur deux semaines après l'intervention chirurgicale et nous avons continué pour une période moyenne de trois mois. Les complications ont été rares. Les résultats ont été bons et ont démontré une amélioration des cicatrices et une morbidité minimale. Ensuite 50% de nos patients ont subi une pratiqué une seconde expansion.

**Mots-clés:** expansion tissulaire, séquelles des brûlures, technique chirurgicale

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