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Reconstruction of thoracic burn sequelae by scar release and flap resurfacing

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ABSTRACT

Introduction: In the USA, 450,000 thermal burns receive medical treatment annually. Burn scars are commonly excised and covered with skin grafts. Long-term, these treatments commonly leave patients with discomfort, reduced total lung capacity and forced vital capacity, and restriction of thoracic expansion and shoulder joint mobility. In this article, we present our experience with using scar release and immediate flap reconstruction to treat thoracic restriction due to burn sequelae.

Methods: From 1998 to 2014, we enrolled 16 patients with anterior thoracic burn sequelae that had previously been treated conservatively or with skin grafts that eventually recidivated. Preoperatively, we measured thoracic circumference in expiration and inspiration, %FVC, %FEV1, and shoulder mobility. All patients underwent anterior thoracic scar release and immediate flap resurfacing.

Results: At 2 weeks to 3 months postoperatively (mean, 2.6 months), mean thoracic circumference upon inspiration increased from 83.6 cm ± 5.7 to 86.5 cm ± 5.8 ($p < 0.0000000001$). Mean %FVC improved from 76.0% ± 2.64% to 88.2% ± 4.69% ($p < 0.0000001$). Mean %FEV1 improved from 79.2% ± 3.85 to 87.8% ± 2.98 ($p < 0.000001$). All 14 patients who had restricted shoulder mobility preoperatively no longer had restricted shoulder mobility postoperatively. The mean patient-reported satisfaction was 4.6/5 (range, 3–5). At a mean follow up of 2.5 years, none of the contractures recidivated. Complications included 2 cases of tissue necrosis of the distal end of the flap. In one case, the flap was restored; in the other case, the patient eventually had to receive a new flap. Additional complications included two local infections that were successfully treated with oral and local antibiotics and two hematomas that were drained and eventually healed without tissue loss.

Conclusions: Scar releases and flaps provide a safe and effective method for the correction of restricted thoracic expansion, respiratory restriction, decreased range of shoulder motion, and discomfort from thoracic burn sequelae.

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1. Introduction

In the USA alone, 450,000 thermal burns receive medical treatment every year [1]. Survival from burns has greatly improved over the last 70 years [2]. This has increased the need to adequately treat the long-term effects of burns. Burn survivors commonly have significant restrictive respiratory defects, which can be due to internal respiratory tract damage and/or thoracic scars that physically restrict thoracic expansion [3–5]. However, as far as we are aware, thoracic burn sequelae-induced respiratory restriction and restricted thoracic expansion has not been discussed in the literature since 1998 [5].

Burn scars are commonly initially treated with early excision and covered with skin grafts [6]. Unfortunately, in many cases, the general status of the patient does not allow immediate coverage with flaps. Despite intensive therapy, thoracic burn scars treated with early excisional therapy commonly leave patients with discomfort, long-term reduced total lung capacity (TLC) and forced vital capacity (FVC) [5], and restriction of thoracic expansion and shoulder joint mobility. Chronic burn sequelae are effectively released with PALFs (Percutaneous Aponeurotomy & Lipo-Filling) [7] or incised and covered with flaps [8,9]. However, as far as we are aware, these treatments have not been used to correct the respiratory restriction or discomfort associated with burn sequelae-induced thoracic expansion restriction.

While scar release cannot correct internal respiratory tract damage, it should improve thoracic expansion, and thus, relieve respiratory restriction. It should also improve shoulder mobility and relieve discomfort. In this article, we present our single-center, 17-year experience with using scar release and immediate flap reconstruction to treat 16 patients who suffered thoracic restriction due to burn sequelae. The flap selection was done according to availability of donor areas, patient desire, and operating room capabilities. The evaluation was performed by measuring thoracic cage expansion and spirometry pre- and postoperatively.

2. Materials and methods

At various surgical centers in Argentina, we retrospectively enrolled 16 patients (7 females, 9 males) with anterior thoracic wall burn seuqelae from 1998 to 2014. All cases had previously been treated with skin grafts or conservative treatment of the intermediate burn and eventually recidivated. All patients had self-reported restricted thoracic expansion, and 14 had decreased ability to retract the shoulder. We do not have records of initial burn severity in all cases. Patient ages ranged from 8 to 51 (mean, 30), and BMI ranged from 24 to 31 (mean, 26). Eight patients were smokers. All patients underwent anterior thoracic scar release and immediate flap resurfacing. One patient required two flaps, but all others were each treated with one flap. The flaps utilized were: anterolateral thigh (ALT) (6), deep inferior epigastric perforators (DIEP) (3), superficial inferior epigastric artery (SIEA) (2), dorsal scapular island (2), internal mammary artery perforator (IMAP) (2), adductor perforator (1), and submammary–superficial superior epigastric (1).

2.1. *Surgical technique*

The patients were placed in the dorsal decubitus position under general anesthesia, and the area was prepared with betadine and sterile technique. We longitudinally sectioned the scar through the midline and retracted the surrounding tissues, creating an immediate 4–5 cm gap. The defect produced by the scar release was not directly related to the increase of thoracic circumference. The central defect was surfaced with a specific flap depending on several factors. In facilities lacking microscopes or adequate anesthesia (3 patients), we were forced to use vicinity or local flaps. In these cases, we used the dorsal scapular island flap, which is a reliable alternative to free-tissue transfer for reconstruction of anterior chest defects [10]. The dorsal scapular island flap is difficult to harvest, but it is reliable and safe. IMAP flaps and submammary flaps (based on the superficial branch of the IMA) are other options for central defect reconstruction. In adequately equipped facilities, we prefer ALT flaps for men and SIEA or DIEP flaps for women because they have good tissue matching with the recipient area and acceptable donor morbidity. Additionally, a second surgical team can harvest these flaps simultaneously. In one case without traditional donor site availability, an adductor perforator flap was used.

The recipient vessels were usually the IMA in the third intercostal space. We routinely resect the distal end of the rib to obtain better exposure of the vessels. For SIEA flaps, the vessels match well with the IMAPs of the second intercostal space without the need for rib resection. In two cases, we used the transverse cervical artery and vein as the recipient vessels at the inferior sternocleidomastoid muscle level.

2.2. *Measurements*

Preoperatively, we measured the thoracic circumference at the level of the nipples during maximum inspiration and maximum expiration with a measuring tape. We tested the mobility of each of the patients' shoulders by asking them to stand with their backs against a wall and retract both shoulders to the wall simultaneously. We also used spirometry to measure FVC and forced 1-second expiratory volume (FEV1). Using the Morris calculation [11], we predicted FVC and FEV1 for each patient and used their recorded spirometry values to determine the percent of their predicted value retained. We also asked patients to rate their discomfort on a scale of 1–5 (1 = severe discomfort, 5 = no discomfort). At 2 weeks to 3 months postoperatively, we repeated the above tests and asked patients to rate their satisfaction with the procedure on a scale of 1–5 (1 = completely unsatisfied; 5 = completely satisfied). These scales are not validated questionnaires. Only one patient had to be evaluated at 2 weeks; all others were evaluated at 2–3 months. We also repeated the above tests at 2, 5, and 7 years postoperatively. We followed all patients for complications for up to 14 years.

2.3. *Statistical analysis*

Using a paired two-tailed *t*-test, we compared the mean preoperative and post-operative maximum exhalation thoracic