

Original Article

Repair of severe cicatrical contracture in neck regions using expanded humeral back flap with double pedicles

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Received October 25, 2015; Accepted July 26, 2016; Epub October 15, 2016; Published October 30, 2016

Abstract: Due to the insufficient tissue to resurface the large defect after local flap transfer as well as the poor functional and cosmetic after traditional methods such as skin grafting, it is challenging that reconstruction of neck contracture deformities after severe burns. We observed the results of repairing deformity due to cicatrical contracture in neck regions using expanded humeral back flap with double pedicles. In this study, eight patients with severe cicatrical contracture in neck regions were hospitalized from October 2010 to October 2013. We used pre-expansion humeral back flap with double pedicles. The skin expanders were placed in the deep fascia on the surface of the trapezius muscle. Using the musculocutaneous perforator of transverse cervical artery as a rotated pedicle, the circumflex scapular artery as a free pedicle. The free circumflex scapular artery was anastomosed to the other side facial artery under the microscope. All flaps survived in 8 cases with satisfactory results. Six patients were followed up for 6 to 24 months. It was found that the color and texture of skin flaps were good. Appearance and function were obviously improved. In conclusion, pre-expansion humeral back flap with double pedicles can provide a large area flap; it is a better choice to repair severe neck scar contracture.

Keywords: Burns, neck, cicatrix, surgical flaps, dilatation

Introduction

Burns and fires result in more than 300,000 deaths and almost 11 million people each year require burn-related medical attention all over the world [1]. Major improvements in burn care in the 20th century brought in a shift in attention from mortality towards reduction of morbidity [2, 3]. Post-burn complex scar contractures cause functional impairment of the extremities, shoulder and neck, persistent tightness or limitations of range of motion or even prolong rehabilitation [4, 5]. The burn scar contracture has been classified into dynamic (early phase) and static (late phase) by Yenidunya [6]. However, early reconstruction of dynamic scar contractures could decrease rehabilitation time and improve life quality, before proceeding to static complex scar contractures.

The goals of treatment for neck contractures are to release the contractures thoroughly; to regain the natural profile, contour, and color

match; and to restore the normal mobility. Recently, numerous methods for releasing the complex scar contracture have been developed; the most common procedure being scar excision and coverage with split- or full-thickness skin grafts [7, 8]. Disadvantages of this simple technique include contracture recurrence, the need for prolonged immobilization, unstable skin and concerns regarding insufficient donor tissue [9].

Although skin grafting is a commonly used treatment, its major disadvantages are hyperpigmentation and contracture [10]. Local flaps such as the deltopectoral flap [11] and transverse cervical artery perforator flap [12] can be advanced into burn defects. These local flaps are able to obtain contour and color match with the nearby tissue. Complex scar contractures are also resolved with multiple Z-plastics and local or pedicled cutaneous flaps; however, there are often limitations of local injured donor tissue [5].

Free scapular fasciocutaneous flaps can be used to resurface defects in the neck [13]. However, the bulkiness and size limitation of the flaps hinder their further application. Several second-stage debulking procedures are usually needed to obtain a better appearance. Furthermore, the usage of a skin graft at the donor site is usually unavoidable. The use of pre-expanded scapular free is a viable option to improve the final aesthetic appearance and functional result and to reduce donor-site morbidity. Therefore, free fasciocutaneous flaps are playing an increasing role in the reconstruction of complex scar contracture [14].

In this article, we present a series of 8 patients who underwent neck reconstruction using pre-expanded humeral back flap with double pedicles. The indications, methods, and outcomes for these cases are provided, and the advantages and drawbacks of this technique are discussed.

Material and methods

Patients

Between October 2010 and October 2013, eight consecutive patients who were the phase IV neck scar contracture deformity, underwent skin graft healing in local hospital after boiled water scald. Six men and two women who ranged from 14 to 28 years old were recruited for the study. The approximate age at time of injury ranging from 5 to 10 years were 3 cases and over 10 years were 5 cases.

The age and defect size were recorded for each case. The assessments of outcomes with at least 2-year follow-up included flap failures, infections, partial necrosis, donor-site complications, and the need for future revisions. This study was approved by the medical ethical board of the Xiangya Hospital of Central South University (protocol 2010/12).

Surgical technique

First operation: Before operation, the upper trapezius muscle intramuscular perforator of transverse cervical artery and circumflex scapular artery was positioning by Continuous Wave Doppler. The expander was local between the two flaps. The selection of expander type and volume is based on the need of the repairing.

The expansion time was ranged from 8 to 10 months. The region of the expander implantation and the surgical incision were marked by methylene blue. With the patient in the lateral decubitus position, a longitudinal incision (approximate 10 cm) was made at the back line. The wet saline gauze was used for oppression hemostasis fully. The expander with expansion water sac was inserted up the deep fat layer and the injection valve was implanted below the subcutaneous. After injected 20 mL volume, one negative pressure drainage tube was left and the surgical incision was sutured layered. When the wound healing, the expander was filled twice a week until the targeted volumes were achieved. Annuliform pressure bandages were used (encircling entire body) at the inferior border of the expander to prevent gravitation-induced descent during expansion.

Second operation: The second operation was performance about 1 month after the end of water injection. Before operation, the perforator vessel was checked using the Continuous Wave Doppler. The patient was initially placed supine with the neck and shoulder hyperextended. Thorough release of the contracture was achieved by incising scar tissues in the subcutaneous, platysmal, and subplatysmal layers according to the depth of scarring. The shape of the incision along the neck should be perpendicular and curvilinear to avoid future contracture. The size and shape of the defect were evaluated and measured.

For flap elevation, patients were placed in the lateral decubitus position with the ipsilateral arm free. Using the template of the neck wound made after release, marking in the expanded region was carried out based on the size and shape of the defect and on the location of the recipient blood vessels. The expander was then removed and the flap was elevated from the distal to the proximal end. After effective hemostasis and insertion of the drain tube, the donor site was closed directly in most patients after suitable undermining. Microsurgical vessel anastomosis was performed in an end-to-end fashion, between the circumflex scapular artery and the facial artery and between the circumflex scapular vein and the facial vein. The flaps were then positioned and inset between the edges of the skin in the remaining defect. The average operative time was about 6.5 h.



Figure 1. In case 1, the shape of flap and the neck function cured well six months after the initial reconstruction. A. The lateral view before the second stage of the reconstruction (serious scar contracture, passive bucking of the neck); B. The frontal view before the second stage of the reconstruction; C. The lateral view after the second stage of the reconstruction; D. The frontal view after the second stage of the reconstruction.

Results

Case reports

The skin flaps of the total three patients survived. With the return visit continued from 6 to 24 months, the color of skin flaps, the flexibility of skin flaps, were well. The necks of patients were back freely. The back incision had a few scar and the shoulder joint activity was normal.

Case 1: A 20-year-old boy sustained a neck scar contracture over 17 years. He was presented to our clinic with extensive scar hyperplasia, skin grafting changing, extruded the leather facing about 0.5 cm that caused a decrease in the cervicomental angle and functional limitation of neck movements after a neck and chest skin grafting 14 years. In the first stage of the reconstruction, a 600 mL elliptical tissue expander was inserted through a 7 cm horizontal incision at the upper of right anti-

cline quadratus and deep lateral carotid artery branch of intramuscular perforators. A serial expansion on a twice-weekly basis was performed for 8 months up to about 1200 mL. In the second stage of the reconstruction, the expander was moved on August 2013 and the pre-expanded scapular flap was harvested. With the neck in full extension, the size of the defect was determined to be 45 cm×15 cm. After microsurgical vessel anastomosis, the flap was positioned and insert between the edges of the wound. The flap donor site was closed directly. The early postoperative course was uneventful. Six months after the initial reconstruction, the shape of flap and the neck function cured well (**Figure 1**).

Case 2: A 16-year-old girl sustained a neck scar contracture 13 years resulted from boiled water scald. She was presented to our clinic with neck and chest hyperplasia, skin grafting changing, scar extruded the leather facing about 15×8 cm² with red color and no ulcer-

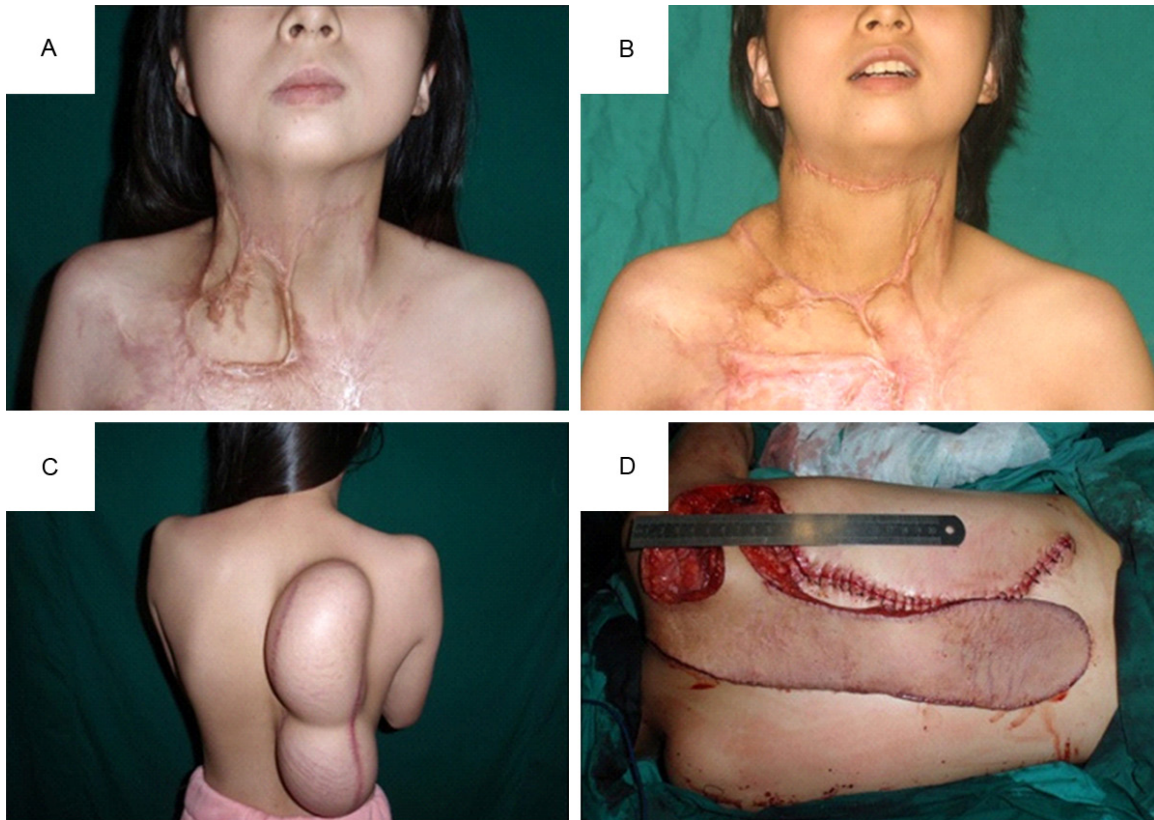


Figure 2. In case 2, the shape of flap and the neck function cured well six months after the initial reconstruction. A. Limited neck back before the reconstruction; B. Freely neck back after the reconstruction; C. Two aqueous capsules were inserted at the first stage of the reconstruction; D. The area of the flap was up to 35 cm×12 cm at the second stage of the reconstruction.

ation and pressing pain that caused a decrease in the cervicomenal angle and obviously functional limitation of neck movements. In the first stage of the reconstruction, an 600 mL elliptical tissue expander was inserted through a 7 cm horizontal incision at the deep lateral carotid artery branch of intramuscular perforators through the deep fascia layer below and scapular circumflex artery through the below, respectively. A serial expansion on a twice-weekly basis was performed for 7 months up to about 1200 mL. In the second stage of the reconstruction, the expander was moved on November 2012 and the pre-expanded scapular flap was harvested. With the neck in full extension, the size of the defect was determined to be 35 cm×12 cm. After microsurgical vessel anastomosis, the flap was positioned and insert between the edges of the wound. The flap donor site was closed directly. The early postoperative flap survived well. After six months re-examination, the shape of flap and the neck function cured well (Figure 2).

Case 3: A 12-year-old boy sustained a neck scar contracture over 1 year resulted from high-voltage shock. He was presented to our clinic with scars on the body, including the jaw and neck scar, the left shoulder scar, the left chest scar. The jaw and neck scar was hyperplastic contracture and becoming a deformity that caused a functional limitation of neck movements and oral deformity. In the first stage of the reconstruction, a tissue expander was inserted through a 7 cm horizontal incision at the right back rhombic myocutaneous flap area. In the second stage of the reconstruction, the expander was moved on May 2013 and the pre-expanded scapulaar flap was harvested. With the neck in full extension, the size of the defect was determined to be 20 cm×14 cm. After microsurgical vessel anastomosis, the flap was positioned and insert between the edges of the wound. The flap donor site was closed directly. The early postoperative flap survived well. After six months re-examination, the shape of flap and the neck function cured well (Figure 3).

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Figure 3. In case 3, the shape of flap and the neck function cured well six months after the initial reconstruction. A. The frontal view before the reconstruction; B. The lateral view before the reconstruction; C. The scapular artery spined by tweezers; D. After flap inserted; E. Return visit after 1 month of the reconstruction; F. Return visit after 6 months of the reconstruction.

Discussion

A disfiguring scar in the head and neck region also affects the function of various parts. The skin in this region is thin and pliable where the contractures can result in abnormalities of lip competence, facial expression and decreased neck movements [15, 16]. The basic goals of neck reconstruction are the restoration of

appearance including symmetry, contour, color, texture match and function, mobility, and sensation in particular. There are several surgical options for resurfacing the neck after the release of contractures, such as skin grafts, pre-expanded axial and random flaps, free tissue transfer from the scapular and deltoid area, groin, forearm, anterolateral thigh, and tensor fascia lata [16]. However, each proce-

ture has its own advantages, disadvantages, and limitations.

Skin grafts are less time consuming and technically demanding. However, contracture and hyperpigmentation are the major drawbacks of skin graft. Another disadvantage of skin grafting is its inability to restore a natural color and contour due to hyperpigmentation and lack of subcutaneous tissue [17]. Tissue expansion of adjacent neck tissue is another method for the correction of neck post-burn contracture [18]. The expanded neck skin is more flexible than the skin in other areas of the body. The increase of surface area in neck expansion is mostly the result of the stretching phenomenon rather than newly regenerated tissue mass. Pre-expanded local flaps such as subclavicular flaps [19], deltopectoral flap [20], and supraclavicular flaps [21] are able to obtain contour and color match to the nearby tissue. However, major disadvantage of these flaps is the morbidity of the donor site that always leads to a hypertrophic scar of the thorax.

Free tissue transfer for neck burn reconstruction is another choice [22]. Studies proved that radial forearm flaps were to be reliable, free groin flaps have the less potential morbidity of the donor site and free anterolateral thigh flaps were reliable and large flaps with long pedicles. However, their disadvantages were the donor site, the variability and shortness of the vascular pedicle, and a significant color and contour mismatch, respectively [5, 23].

There are several advantages of our technique in neck burn reconstruction. Pre-expansion humeral back flap with double pedicles not only makes the flap thinner but also makes the flap more adequate for reconstruction. Expansion causes an increase in the surface area of flap and in the size of the capillary bed, which allows the surgeon to harvest more tissue, even beyond the anatomical boundaries of the known blood supply of the flap. Larger free scapular flaps make it possible to resurface larger neck defects after resection of scars. While a scapular flap is located in a well-concealed area, expansion further minimizes donor-site morbidity. Most donor sites can be closed directly without excessive tension. Patients typically are willing to accept scars in the region of the back where the flap is harvested [24].

Nevertheless, there were several disadvantages with this surgical method including extra-operative procedures, the prolongation of hospital stay, the repeated follow-up visits, and the potential complications during tissue expansion period. Tissue loss may be caused by infection, overexpansion, and inadvertent flap thinning. Moreover, the pre-expansion humeral back flap with double pedicles procedure requires greater surgical skills than traditional microsurgery.

Conclusions

In present study, the usage of the pre-expansion humeral back flap with double pedicles is an obviously effective way of reconstructing post-burn neck contracture. It provides a significant quality skin flap, which can cover the defect after contracture release. We concluded that the pre-expansion humeral back of the flap facilitates blood supply, improves the quality, increases the size of free scapular flap, and minimizes the donor-site morbidity.

Acknowledgements

This study is funded by the Science & Technology Department of Human Province (Project No. 2013WK3032). We are glad to thank the co-workers and members of the microsurgical division and burn unit of department of plastic and reconstruction surgery at Xiangya Hospital of Central South University.

Disclosure of conflict of interest

None.

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