Introduction

Post-burn neck scar contracture is a major complication that still represents a major challenge for plastic surgeons. It causes cosmetic, functional, and social problems. The skin quality and the multidirectional movement of the neck necessitate special considerations in its reconstruction.

Many methods have been advocated to reconstruct neck contractures, including Z-plasties, split-thickness skin grafts, full-thickness skin grafts, local or pedicled skin flaps with or without tissue expanders, pedicled or free musculocutaneous flaps, and free cutaneous flaps.

Since it was described by Nassif et al., the parascapular flap has been used as a pedicled or island flap for axillary contractures and as a free flap for neck reconstruction. To the best of our knowledge, there are no reports in English describing its use as an island flap for neck reconstruction.

Methods. Nine patients with severe post-burn neck contracture scars were reconstructed with pre-expanded extended island parascapular flaps. All flaps survived completely, providing thin skin coverage of the neck defect with satisfactory natural appearance. The size of the flaps ranged from 32 to 44 cm in length and 11 to 16 cm in width (mean: length 38.2; width, 14.2 cm). No debulking was done but secondary revisions such as Z-plasty and scar revision were performed for all flaps. The donor site was closed primarily in all patients but delayed wound healing was recorded in two. Widening and hypertrophic scar changes developed at the donor site of seven patients.

Conclusions. The utilization of pre-expanded extended island parascapular flap is an effective way for reconstruction of post-burn neck contracture. It provides a large good-quality skin flap that can cover all the aesthetic units of the neck without any microvascular anastomosis. However, the protracted time required for the procedure and the requirement of two operations, plus the repeated follow-up visits, may constitute major disadvantages.

Keywords: Post-burn neck contracture, tissue expansion, parascapular flap

Patients and method

Nine patients were included in this study (6 males, 3 females). Their ages ranged from 17 to 53 yr (mean, 30.89 yr). All presented with severe post-burn neck contracture and three also had bilateral axillary contracture. A pre-expanded extended island parascapular flap was expanded to be used as an island flap for reconstruction of post-burn neck scar contracture in nine patients.

Surgical technique

• First operation

Expander implantation was performed under local anaesthesia in five patients and general anaesthesia in the other four patients. No neck scar release was done for intubation in any patient.

With the patient in the lateral decubitus position, a longitudinal incision was made laterally at the mid-axillary line, controlled by scar tissue distribution. The expander was inserted completely, below the scapula, in the fatty area-
olar tissue plane above the deep fascia of the muscles.

Tissue expanders of various kinds, sizes, and shapes were used, as dictated by the deformity. In all patients we used smaller expanders (the mean size of the expanders was 350 cc, followed by overexpansion) than their declared end volume. All ports of the expanders were placed externally. After sound wound healing (10 to 14 days), we started inflation twice a week up to the required volume. The mean inflation volume was 587 cc (range, 430 to 780 cc).

- Second operation

The second stage was performed one week after the last injection (mean injection time, 52.7 days; range, 47 to 63 days). Marking was done while the patient was standing, and the flap was designed to be wide distally and narrow as it went up. The maximum transverse diameter located on the expander was at the middle of the neck, and the pedicle was protected in the middle of the narrow proximal part of the flap.

No neck scar release was needed for intubation in any patient but fibro-optic assisted nasal intubation was performed in three patients who had received local anaesthesia.

With the patient in the supine position, the neck was placed in an as extended a position as possible, excision of the scar tissue was performed, and the neck was released to the limits of its aesthetic unit. Partial- or full-thickness platysma transection was sometimes needed to obtain full extension. The size and shape of the defect were evaluated and measured.

With the patient in the lateral decubitus position, the expander was removed and the flap was elevated from distal to proximal through the fatty areolar layer above the muscular fascia of the back. No dissection was made deep in the muscular fascia, especially around the pedicle where the fascia surrounds the triangular space. In the patients with axillary contracture, superior extension of the flap was performed to allow better reconstructions of the axilla.

As the pedicle was traced to the triangular space, numerous vascular branches were isolated and ligated. A transverse skin incision in the axilla was made either separately or in continuity with the main incision in order to dissect the subscapular system, delivering the flap through the triangular space into the axilla.

The expander capsule expander was not removed from the flap but fine superficial longitudinal release incisions were made. Many sutures were taken from the deep fascia of the neck to the flap capsule.

After good haemostasis and drain insertion, the donor site was closed directly in all patients after suitable undermining.

**Results**

All the flaps survived completely (flap size: length, 32 to 44 cm; width, 11 to 16 cm; mean length and width, 38.2 and 14.2 cm, respectively). The quality of the harvested skin flap gave good coverage of the neck defect as regards thickness, elasticity, pliability, and colour. This resulted in a satisfactory, natural appearance of the neck, with no bow-stringing deformity. Post-operative neck movement was normal in all directions with no recurrence of the contracture during the follow up period.

The flap was used to reconstruct the anterior fold of the axillary contracture on the same side of the flap in three cases with good post-operative extension of the axilla and without recurrence during the follow-up period.

The data of our patients are presented in Table I, and a representative clinical case is shown in Figs. 1-8.

During the expansion time, two expanders became exposed, forming two small ulcers. One of these healed with conservative management and the other did not interfere with the completion of the expansion.

Wound dehiscence at the recipient site occurred in two patients and healed by local wound care. No debulking was done in any flap but secondary procedures such as Z-plasty and scar revision were performed in all flaps.

The donor site was closed primarily in all patients, sometimes with mild tension over the skin flaps. Delayed wound healing was recorded in only two patients at the donor site. Post-operatively, seven patients developed widening, hypertrophic changes of the donor site scar but this was accepted by all patients.

**Table I - Patient data**

<table>
<thead>
<tr>
<th>Size of flaps (cm)</th>
<th>Days between the two operations</th>
<th>Volume after expansion (ml)</th>
<th>Size of expander (ml)</th>
<th>Previous neck operations</th>
<th>Total burn area (percentage)</th>
<th>Area to be corrected</th>
<th>Age (yr)</th>
<th>Sex</th>
<th>No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>40 x 14</td>
<td>55</td>
<td>650</td>
<td>400</td>
<td>-</td>
<td>53</td>
<td>Neck</td>
<td>17</td>
<td>Male</td>
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<tr>
<td>44 x 15</td>
<td>58</td>
<td>780</td>
<td>500</td>
<td>STSG* twice</td>
<td>31</td>
<td>Neck and axilla</td>
<td>35</td>
<td>Male</td>
<td>2</td>
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<td>41 x 15</td>
<td>52</td>
<td>630</td>
<td>350</td>
<td>-</td>
<td>25</td>
<td>Cervico-mental</td>
<td>26</td>
<td>Male</td>
<td>3</td>
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<tr>
<td>42 x 16</td>
<td>63</td>
<td>680</td>
<td>350</td>
<td>-</td>
<td>27</td>
<td>Neck</td>
<td>47</td>
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<tr>
<td>37 x 15</td>
<td>48</td>
<td>530</td>
<td>300</td>
<td>STSG* once</td>
<td>35</td>
<td>Cervico-mental</td>
<td>23</td>
<td>Female</td>
<td>5</td>
</tr>
<tr>
<td>32 x 11</td>
<td>47</td>
<td>490</td>
<td>300</td>
<td>STSG* twice</td>
<td>21</td>
<td>Neck and axilla</td>
<td>53</td>
<td>Male</td>
<td>6</td>
</tr>
<tr>
<td>37 x 13</td>
<td>50</td>
<td>430</td>
<td>250</td>
<td>STSG* twice</td>
<td>40</td>
<td>Neck</td>
<td>20</td>
<td>Female</td>
<td>7</td>
</tr>
<tr>
<td>34 x 15</td>
<td>52</td>
<td>520</td>
<td>300</td>
<td>-</td>
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<td>33</td>
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<tr>
<td>37 x 14</td>
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<td>570</td>
<td>400</td>
<td>-</td>
<td>23</td>
<td>Neck and axilla</td>
<td>24</td>
<td>Female</td>
<td>9</td>
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</tbody>
</table>

* STSG = Split-thickness skin graft
Fig. 1 - Pre-operative view of patient with post-burn contracture of neck and left axilla.

Fig. 2 - Expander filled with 780 cc saline and fully inserted below scapula with external port.

Fig. 3 - Intra-operative view of flap, which was 44 cm in length and 15 cm in x 15 cm width.

Fig. 4 - Intra-operative view of the flap, its pedicle, and expander capsule.

Fig. 5 - Intra-operative view of the flap covering all the aesthetic unit of the neck and the anterior axillary fold.

Fig. 6 - Early post-operative photos of flap, with complete survival.

Fig. 7 - Post-operative view of flap after Z-plasty.
Discussion

The basic goals of head and neck reconstruction are restoration of appearance (symmetry, contour, and colour, and texture match) and function (mobility, sensation, and facial expression). Many techniques have been advocated for the reconstruction of post-burn neck contracture and all of them have their advantages, disadvantages, and limitations.

Skin grafting can cover a wide area after complete scar excision in a single operative procedure, but recurrence is not uncommon due to secondary skin graft contracture, especially with split-thickness skin grafts.

The use of local tissue, with the advantage of colour and texture match with the injury site, is sometimes difficult or impossible to be achieved in burn patients.

Myocutaneous flaps are a good method for reconstruction of severe mentosternal contracture deformities but their bulkiness, together with cervical sagging and donor site morbidity, limits their use.

Technically challenging as it is, a free flap does not always give a superior outcome. It is time-consuming and costly, and often involves a number of complementary procedures. In relation to head and neck burn reconstruction, a free flap tends to mask facial muscle movement and has the potential of creating unnatural face and neck contours.

The parascapular flap, as it was originally described, was normally never used to reach and reconstruct the anterior aesthetic unit of the neck as an island flap. In this study, we expanded the randomized distal part of the parascapular flap below the scapula, and this expansion produced a delay phenomenon that augmented the blood supply and increased the surface area of skin harvesting, which allowed the flap to reach the contralateral side of the neck.

Also, expansion leads to subcutaneous fat atrophy; this has been attested by many anatomical studies showing thinning of all the soft-tissue layers between the skin and the expander, except for epidermal thickness. This thinning of the flap not only provides a similar appearance to thin neck skin but also increases the flap’s pliability and elasticity, as required by the recipient neck site.

Five expanders were implanted under local anaesthesia to avoid unnecessary release and grafting in the first operation. Although no neck scar release was performed for intubation in any patient, we must be prepared for difficult intubation using full equipment, including fiberoptic intubation techniques and the use of scar release under local anaesthesia.

Tissue expanders of various kinds, sizes, and shapes were used in relation to the distribution of scar tissue. All expander ports were positioned externally, as this was found to be safe and to have many advantages.

In all the patients we used smaller expanders than needed, followed by overexpansion, in order to facilitate their insertion, especially in the case of procedures performed under local anaesthesia (mean overinflation rate, 1.7 times).

The flap was dissected through the fatty areolar tissue plane above the deep fascia of the muscles. We do not recommend dissection of the flap below the fascia of the teres major muscle as described by Roll et al.

Despite the findings of Pallus and Von Heimburg and of Ma et al., the periprosthetic capsule is regarded by a great number of authors as untouchable because of the risk of damaging the vascular network. For that reason we did not remove the expander capsule from the flap but performed fine parallel release incisions (capsulotomies) only along the part of the flap that was to be applied to the neck. These release incisions not only increased the surface area of the flap but also helped to take sutures between the deep fascia of the neck and the flap, preventing bow-string deformity.

No debulking was needed for any flap as the expansion caused atrophy of the subcutaneous fat. Secondary procedures such as Z-plasty and scar revision were performed in all flaps.

All the donor sites were closed directly despite the large dimensions of the flaps. The same result was achieved by Roll et al. in all their patients (20 in number) but we must remember that our flaps were larger.

Seven patients developed widening and hypertrophic changes in the donor site scar, in spite of which the donor site was accepted aesthetically by all patients. It was found better to have direct wound closure, even with some tension, than use skin grafts. Prophylactic post-operative measures were used early to prevent scarring complications.

The main disadvantages of this technique are its long duration, with the requirement for two operations, and the repeated follow-up visits. Moreover, hypertrophic scars may develop on the margin of flaps and donor sites.

Conclusion

The utilization of the pre-expanded extended island parascapular flap is an effective way of reconstructing post-burn neck contracture. It provides a large good-quality skin flap that can cover all the aesthetic unit of the neck without microvascular anastomosis. The expansion of the flap will augment its blood supply, improve its skin quality, increase its size, and ameliorate the resultant donor site scar.
RÉSUMÉ. Données générales: Depuis qu’il a été décrit par Nassif et al. en 1982, le lambeau parascapulaire a été utilisé comme lambeau pédiculé où il est pour les contractures axillaires et comme lambeau libre pour la reconstruction du cou. Au meilleur de notre connaissance, il n’existe pas de rapports dans la littérature en anglais qui décrivent son utilisation comme lambeau pour la reconstruction du cou. Méthodes. Neuf patients brûlés atteints de contracture du cou ont été reconstruits moyennant la méthode du lambeau en îlot parascapulaire étendu pré-expansé. Résultats. Tous les lambeaux ont maintenu leur viabilité, en fournissant une couverture de peau fine pour le défaut et un aspect naturel et satisfaisant. La dimension des lambeaux variait entre 32 à 44 cm de longueur et 11 à 16 cm de largeur (valeurs moyennes, respectivement 38,2 et 14,2 cm). Aucune réduction n’a été faite mais des procédures secondaires, comme par exemple la plastie en Z et la révision des cicatrices, ont été effectuées pour tous les lambeaux. Le site donneur a été fermé en manière primaire chez tous les patients, mais un retard de cicatrisation s’est produit en deux cas. Sept patients ont présenté un élargissement et des modifications cicatricielles hypertrophiques dans le site donneur. Conclusions. L’utilisation du lambeau en îlot parascapulaire étendu pré-expansé constitue un moyen efficace pour la reconstruction de la contracture du cou post-brûlure. Cette méthode fournit un grand lambeau cutané de bonne qualité qui couvre tout l’ensemble des unités esthétiques du cou sans anastomose microvasculaire. Cependant, les temps très longs de la procédure, la nécessité de deux opérations et les visites répétées de bureau peuvent se démontrer des désavantages importants.

Mots clés: contracture post-brûlure, expansion tissulaire, lambeau parascapulaire

BIBLIOGRAPHY