



Three-square-flip-flap reconstruction for post burn syndactyly[☆]

Oren Lapid*, Amiram Sagi

Hand Surgery Unit, Burn Unit, Department of Plastic and Reconstructive Surgery, Faculty of Health Sciences, Soroka University Medical Center, Ben-Gurion University of the Negev, Beer Sheva, Israel

Received 31 March 2003; accepted 1 April 2005

KEYWORDS

Hand;
Burns;
Contracture;
Syndactyly;
Cicatrix;
Surgical flaps

Summary Introduction: Burns of the hands may result in the formation of web space contractures—post burn syndactyly. We present our experience using the three-square technique originally described by Bando for minor syndactyly.

Method: Tissues of the contracted web are regarded as forming three facets of a cube. If elevated and transposed 90° on their base the facets will fall into place and line the interior of the cube creating a deepened web-space. The first flap is based on the web itself either dorsally or volarly. The second flap is based distally on one of the fingers. The third flap is based laterally on the other finger. Surgery is followed by a splinting regimen.

Results: The design of the flaps is simple and the operation is easy to perform. This technique has achieved good functional and cosmetic results; there have been no flap losses or significant complications.

Conclusion: The three-square-flip-flap is a simple reliable and safe method for the treatment of post burn syndactyly.

© 2005 The British Association of Plastic Surgeons. Published by Elsevier Ltd. All rights reserved.

Syndactyly is an unfavourable sequel of deep burns to the hand. It results from healing by secondary intention or grafting with insufficient attention to dressing and splinting of the web spaces. This

complication is more common in patients who did not receive adequate care or who did not comply with correct dressing and splinting. In its mild form, it presents as hooding of the web space. In severe cases frank syndactyly is present joining the adjacent fingers and reducing the depth of the web space resulting in functional limitation of abduction and of independent finger flexion. Post burn syndactyly resembles simple syndactyly with the difference that the tissue involved is scarred, of low quality and much less pliable.

Many surgical methods have been advocated

[☆]Presented in part at the Tenth Congress of the International Society for Burn Injuries, Jerusalem Israel, November 1-5, 1998 and the F.E.S.S.H sixth congress Bonn Germany, May 26-29, 1999.

* Corresponding author. Address: Department of Plastic Reconstructive and Hand Surgery, Academic Medical Center, Meibergdreef 9, NL-1105 AZ Amsterdam, The Netherlands. Tel.: +31 20 566 9111; fax: +31 20 691 7549.

E-mail address: olapid@yahoo.com (O. Lapid).

often based on methods used to treat congenital syndactyly. Options include the use of skin grafts or a variety of flaps.¹ Flaps suggested include Z-plasties, double Z-plasties, four flap Z-plasties,² variations of the Mustardé dancing man procedure,^{3,4} V-Y flaps,⁵ the Hourglass procedure,⁶ and a three flap web plasty.⁷ Post operative splinting is an integral part of post operative management.⁴

Bandoh originally described the three-square-flap for the treatment of minor syndactyly either congenital or following burns. The interdigital space is regarded as a cube and flaps are designed on each surface of the cube (dorsal side, interdigital surface, and volar side).⁸

We applied this system for the treatment of post burn web space contractures.

Method

The contracted web space is viewed as a cube that has been superimposed onto the normal web space. If this cube were removed a normal web space would remain. Three facets of this cube are exposed; the remaining unexposed facets need to be covered restoring the normal web space. The unexposed facets are covered by elevating the exposed facets as square flaps based on their edge and transposed 90° into place.

The first flap is based on the shortened web itself either dorsally or volarly. The second flap is based distally on one of the adjacent fingers. The third flap is based laterally on the other finger. For each web space, there are four possible configurations of flaps. The flaps are elevated taking care not to damage the neurovascular bundles (Figs. 1-4).

When the post burn syndactyly involves more than half of the proximal phalanx the method may be modified in such a way that only a small skin graft is required to close part of the side of one of the fingers which is not fully covered by the distally based flap. Surgery is followed by a splinting regimen.

Operative results were evaluated by recording the depth of the webs using the anatomical location on the adjacent fingers as reference points.

Results

The three-square-flap technique was used on 14 web spaces for post burn syndactyly. Surgery was performed by the senior author (AS) or by residents under his supervision. Eight of the reconstructed

web spaces were at the level of the proximal interphalangeal joint, six were two thirds of the way from the expected web to the proximal interphalangeal joint. Modification using small skin grafts was required in only three webs. The technique created deep web spaces at the level of the normal web space. There were no complications. On a follow up of at least 1 year, the results were maintained and there was no creep of the web spaces.

Discussion

The normal interdigital web is a dynamic structure which changes its configuration with motion, it is collapsed as a fold when adducted and assumes a square shape when abducted.¹ Post burn syndactyly even when isolated and without flexion contractures, causes impairment to the function of the hand and performance of activities of daily living.

Skin grafting is required in cases of severe post burn contractures with a significant lack of available skin, or when the syndactyly extends beyond the middle of the proximal phalanx.⁸

In less severe cases, local flaps may be used for the reconstruction. The use of flaps is preferable if possible to the use of skin grafts. There is less wound contraction, colour and texture match is better, and there is less donor site morbidity.

Many flaps have been described for the repair of congenital syndactyly,⁹ but not all are suited for use in post burn syndactyly cases.²

The flap design we used introduces a square flap



Figure 1 Post burn contracture of 2nd to 4th web spaces. Design of the flaps. The red flap is based proximal to the contracted web space, the yellow flap is based distally on the fifth finger (the third green flap is based on the side of the fourth finger).



Figure 2 The yellow flap is based distally on the fifth finger, the green flap is based on the side of the fourth finger.

into the base of the reconstructed web space, avoiding scars that will cross it. Similar flaps are introduced in other methods. The three-square-flap is similar to other methods described,^{7,10} which are based on Limberg's original work. In these methods, the donor sites are covered using triangular flaps. This flap is also similar to the design of the Flatt flap,⁷ but the distribution and mobilisation of the tissues is different.

In the three-square-flap technique the flaps are not rotated in a horizontal plane but are folded into



Figure 3 The flaps in place, note the deepening of the treated 2nd and 4th web space as opposed to the non-operated 3rd web space.

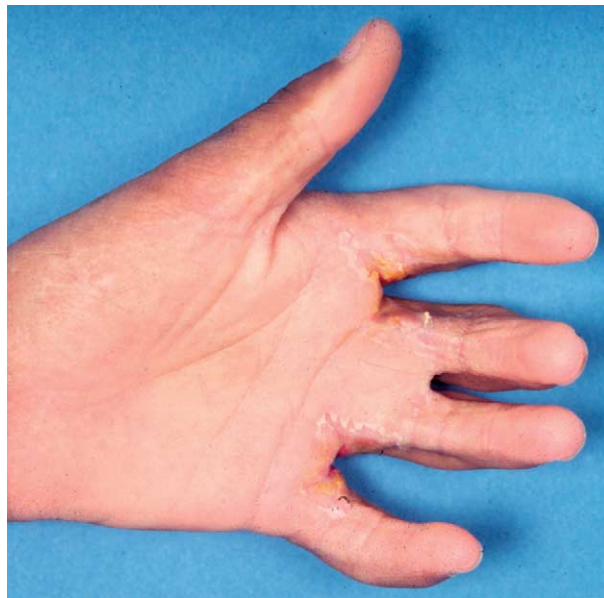


Figure 4 Significant deepening of the treated web spaces achieved as opposed to the non-treated web space.

place upon their base in a manner similar to a hinge flap.⁸ This design requires less elasticity of the mobilised tissue enabling the use of the spared tissue. There is less tension on the flaps reducing the possible compromise of the blood supply of these flaps. The flaps also have an advantageous length to width ratio of about 1:1 and can, therefore, be used on spared, non-pliable skin.

These flaps are best suited for cases of true web space syndactyly but are suitable also for cases of dorsal hooding. In more severe cases, a modification of the flaps is used requiring only a small skin graft to resurface part of lateral aspect of one of the fingers.

References

1. Browne Jr EZ, Teague MA, Snyder CC. Burn syndactyly. *Plast Reconstr Surg* 1978;62:92-5.
2. Krizek TJ, Robson MC, Flagg SV. Management of burn syndactyly. *J Trauma* 1974;14:587-93.
3. Chapman P, Banerjee A, Campbell RC. Extended use of the Mustarde dancing man procedure. *Br J Plast Surg* 1987;40:432-5.
4. Alexander JW, MacMillan BG, Martel L. Correction of postburn syndactyly: an analysis of children with introduction of the VM-plasty and postoperative pressure inserts. *Plast Reconstr Surg* 1982;70:345-54.
5. Savaci N, Hosnuter M, Tosun Z. Use of reverse triangular V-Y flaps to create a web space in syndactyly. *Ann Plast Surg* 1999;42:540-4.
6. Parry SW. Reconstruction of the burned hand. *Clin Plast Surg* 1989;16:577-86.

7. Ostrowski DM, Feagin CA, Gould JS. A three-flap web-plasty for release of short congenital syndactyly and dorsal adduction contracture. *J Hand Surg [Am]* 1991;16:634-41.
8. Bandoh Y, Yanai A, Seno H. The three-square-flap method for reconstruction of minor syndactyly. *J Hand Surg [Am]* 1997;22:680-4.
9. Glicenstein J. What's new in syndactyly? *Ann Chir Plast Esthet* 1998;43:611-6.
10. Hyakusoku H, Fumiiri M. The square flap method. *Br J Plast Surg* 1987;40:40-6.