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Interrupting the seams: The principle of preventive burn reconstruction

Anthony A. Papp [a,*], Aaron E. Berhanu [b], Mark R. Thomas [b], Tam N. Pham [b]

[a] Division of Plastic Surgery, University of British Columbia, Vancouver, Canada
[b] Department of Surgery, University of Washington-Harborview Medical Center, Seattle, WA, USA

Skin grafting has been the mainstay of burn wound reconstruction for decades. Since it was introduced in the burn literature by Reverdin in 1869 and meshed grafts later by Ollier and Thiersch a lot of progress has been made in the fields of harvesting, manipulating, expanding and placing the skin grafts on wounds. Despite the fact that we now can efficiently cover large burn wounds rapidly and save lives, contractures and scarring in general remains an unsolved problem.

Scarring causes a multitude of symptoms that decrease quality of life, including, but not limited to itch, pain, tightness with decreased range of motion and esthetic concerns. After a burn reconstruction with skin grafts all patients have some degree of scarring and hence the reconstruction should be performed in a way that limits or decreases any future problems. This can be obtained by recognizing the most likely anatomical areas that will develop scarring and subsequent problems and plan the surgery accordingly.

Surprisingly, there is very sparse literature on the topic even though the burn team with surgeons and therapists struggle with this problem daily. Vast majority of published literature on skin graft scar contracture prevention completely lacks the acknowledgement of seam placement or surgical technique altogether focusing rather in the pre- and postoperative issues, such as early excision, splinting, early mobilization and postoperative scar management. Additionally, there is a vast amount of literature on how to surgically correct scar contractures rather than how we surgically prevent or minimize them.

One of the most common areas of burn contractures is over the flexor surfaces of joints and in the seams between the skin grafts themselves and between the skin grafts and normal, uninjured skin. Anatomically, the neck, axilla, knees and hands [1] are the most common locations for scar contraction. For instance, scar formation from skin grafted burn wounds is a well-recognized problem in the axilla, with very frequent development of a contracture band in the anterior axillary fold (Fig. 1), given that the natural position of comfort is arm adduction. Application of a skin graft across the axilla also often requires splinting in an abducted position, yet it often does not prevent axillary band formation in the postoperative period.

Long straight lines contract easier than curved or zigzag ones. Greenhalgh and Palmieri [2] presented their zigzag seam between skin grafts to prevent scarring in 2003 but not much has been written since. Isaac et al studied the effect of overlapping seams to decrease scarring but showed no difference at 12 months compared to traditional technique [3].

1. Principles for primary surgical prevention of burn contracture

When primary reconstruction is considered, there are two main principles that need to be considered. The first is to avoid, or interrupt, the linear line of future contracture. The second is the replacement of the injured skin by recruitment of adjacent healthy and supple skin, when available. To avoid a linear contracture along the seam between 2 applied skin grafts, creating a contiguous zigzag along the seam (Fig. 2) is an alternative that has been previously described (ref). This technique mimics the principle of Z-plasty in that a non-linear pattern disrupts the anticipated axis of contraction along the seam. In this scenario, the final Z-plasty limbs are designed to replace central (a.k.a. common) limbs of the original linear design. Transposition of the limbs onto each of the skin grafts creates a final zigzag geometry, which should result in a superior cosmetic appearance with less tension compared to a linear scar. Because acute lengthening is not needed at the time of skin graft placement, the routine use of 60-degree flap angles and 1–2 cm limb lengths are usually adequate to reorient the graft seams.

To avoid a linear seam with adjacent non-burned skin, a local flap can be created at the anticipated location of worst contracture formation. Here, the principle of future scar interruption relies on the fact that the skin adjacent to burn tissue can usually be mobilized. Creating a skin and subdermal fat as a random pedicled flap allows for either lateral motion (transposition or rotation), or forward motion (advancement) into the burn wound defect. The vascular supply to the recruited tissue is within the subdermal plexus. Because of laxity in the unburned skin, the pivot point can be moved slightly so that the donor site can be primarily closed. If the burn wound defect is relatively small and the adjacent skin has sufficient mobility, such as is the case for many axillary burns, a mobilized flap can actually cover the entire central defect (Fig. 3).

* Corresponding author.
E-mail address: anthony.papp@gmail.com (A.A. Papp).

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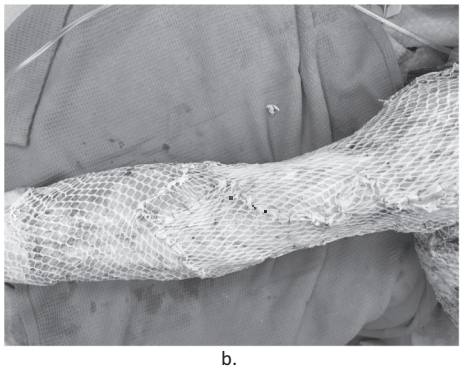
Fig. 1. In the anterior axilla, a typical contracture band will develop along the marked line.

a.



b.

Fig. 2. a) Preventive Z-plasty seam placed between two skin grafts in the volar penile surface. b) Skin graft seams placed in a non-linear fashion to avoid straight lines across elbow joint.

a.

b.

c.

Fig. 3. 4 years old child with full-thickness hot water scald (a). Advancement flap interposed between sheet grafts on the upper arm and shoulder (b). Healed flap and grafts at 2 weeks postoperatively. Child clinically has full range of motion (c).

In transpositions and advancements, the primary interposition with a pedicled skin flap between two skin grafted areas has the advantage of expanding in size as the anticipated skin grafts shrink (Figs. 4–7), expanding the size of the skin flap (Fig. 4).

In summary, we believe that interrupting seams is an important principle in primary burn reconstruction in order to prevent, or at least mitigate future scar band formation. Adding zigzag configuration between applied grafts, recruiting local, vascularized tissue to reconstruct burn defects should help reduce scar contracture and disability, especially over joints and other contracture-prone areas. These principles are easy to follow, and small flaps only add a few minutes to the operating time. This will add up to potential cost savings when later scar release surgeries are being avoided.

Conflicts of interest

The authors warrant that they have no conflicts of interest.

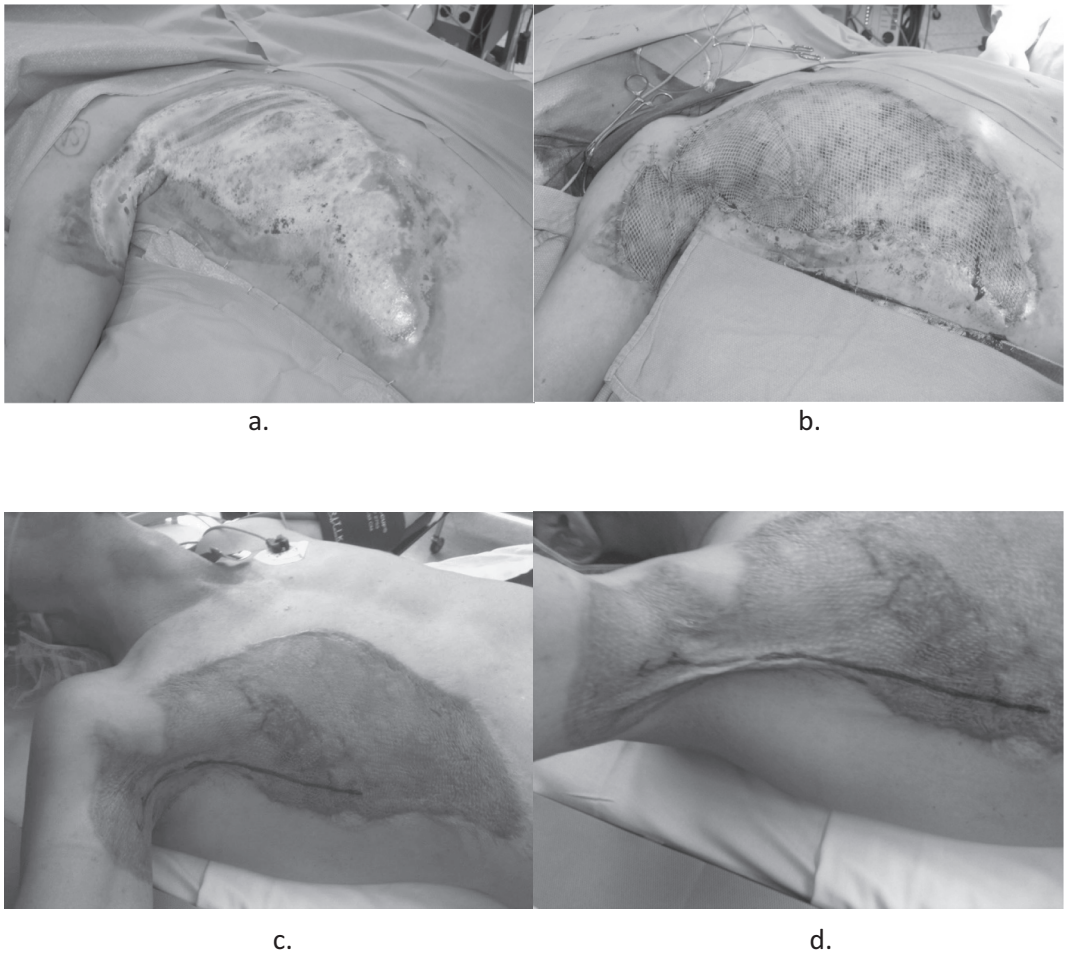


Fig. 4. Full-thickness burn to right chest and axilla on a 50-year-old male (a). Early excision was performed, and defect reconstructed with immediate skin grafting. A small transposition flap was placed in the anterior axillary fold to break the straight line-like scar going across the fold (b). At 1-year follow-up there is no contracture in the anterior axillary fold, but as a sign of the skin graft contracting around it the small flap has become about 3 times wider (c). There is obvious contracture in the posterior axillary fold where no transposition flap was done (d).

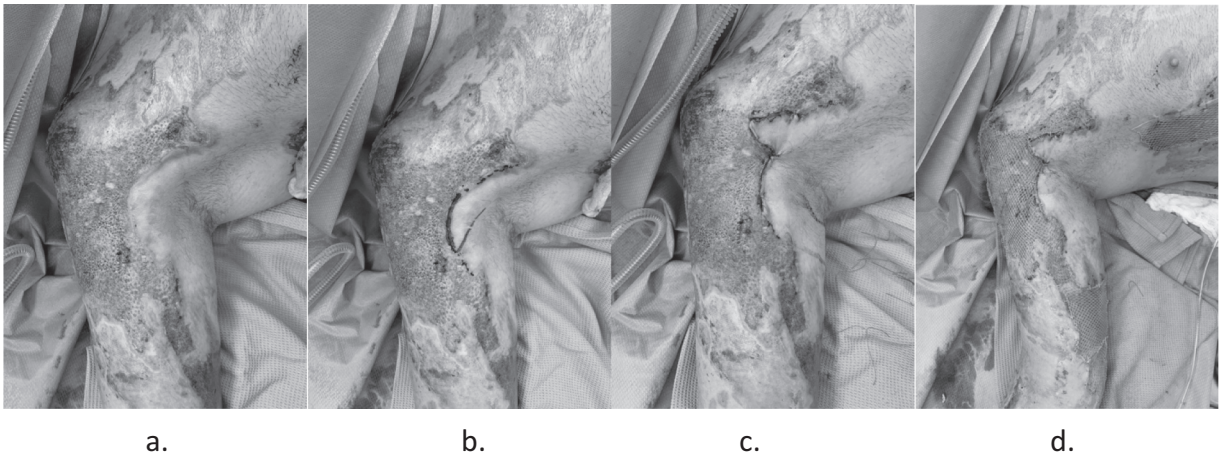


Fig. 5. Anterior shoulder/arm burn extending over the right shoulder joint (a). Transposition flap design (b). Flap in place (c). Skin graft in place (d).

Fig. 6. Full thickness neck and shoulder burn fascially excised. Transposition flap raised and flipped to break linear vertical scar in anterior neck.

Fig. 7. Hand burn extending across the first webspace (a). Transposition flap design (b). Flap in place (c). Skin graft in place (d).

References

[1] Schneider JC, Holavanahalli R, Helm P, Goldstein R, Kowalske K. Contractures in burn injury: defining the problem. J Burn Care Res 2006;27:508–14.

[2] Greenhalgh D, Palmieri T. Zigzag seams for the prevention of scar bands after sheet split-thickness skin grafting. Surgery 2003;133(5):586–7.

[3] Isaac K, Umraw N, Cartotto R. Construction of skin graft seams in burn patients: a prospective randomized double-blind study. J Burn Care Res 2016;37 (6):397–403.