Use of Local Sliding Flaps to Manage Deep Localized Burns of the Hand

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Abstract The incidence of hand burns in children is high. In the overall cases of body burns, hand and wrist burns account for about 39%. They may constitute a part of a larger burn of the body, or an isolated injury of the hand and wrist. The choice between early and late escharectomy and skin covering is still a matter of debate. Two cases of deep burns of the hands are presented in this report. The report shows a new way to close the residual wounds of deep burns.

Keywords Hand deep burns · Flap cover

Introduction

The incidence of hand burns in children is relatively high if compared with other age groups. It is possibly due to hyperactivity of children and their curiosity to explore things. Contact burns with hot objects have a high incidence. The common hot objects are hot electric ovens and ironing machines. Hand and wrist burns account for about 39% of all burns [1]. They may be a part of a major burn or an isolated injury of the hand and wrist. Early versus late escharectomy and skin covering is still a matter of debate [2, 3].

The volar type of burn presents a great challenge to the treating surgeons as the function of the hand can be greatly affected. The aim of treatment will consider the function and the shape of the hand. Minimal complications could be accepted if they affect the shape but not the function [4]. The use of skin grafting in burns of the hand comprises mostly a routine of either meshed or non-meshed grafts [5].

The complications with skin grafting are contracture, color changes and hypertrophic scarring. Leibovitch et al. reported many complications after use of full thickness grafts. In our previous experiences we observed many of these complications. Accordingly, we preferred to use local flaps for the full thickness burns of the hand [6].

In this report the author avoided the use of either split thickness or full thickness skin grafting and used local hand flaps around the raw areas.

Case 1

The child was found to have a deep burn of the second and third degrees in the right palm involving the first web space over the adductor muscles (Zone III and IV). Another deep burn was found over the distal palm at the bases of the ring and little fingers (Zone II). Both pulps of distal phalanges of both thumbs were involved.

Most of the contact burns were deep (deep second and third degrees), and needed a time up to 2 weeks to clear up all dead tissues. It took some time to demarcate the burn area with eschar formation.

Methods

Patient was seen one week after the occurrence of the burn. Immediate debridement was done and followed by dressing for 10 days. Patient was then readmitted and operated by moving the sliding flaps to cover the already clean wound (Figs. 3, 4, 9 and 10). The technique is shown in Figs. 18, 19, 20, and 21.

The author saw the patient 1 week after the onset of burns, and immediate debridement and cleaning of the wounds was done under general anesthesia. Wounds were seen to be deep involving all skin layers. Subcutaneous

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tissue was involved and the wound was not ready for skin covering. Tendons were not exposed but were covered with necrotic debris. The patient was discharged with daily dressing in the outpatient plastic surgery clinic for other 10 days, until the wounds became clean. During this period the demolition phase was promoted by promoting the polymorph nuclear leucocytes number and function.

The patient was readmitted and operated on for flap skin covering of the deep raw areas. Under general anesthesia debridement of the wounds was done. In the right hand the raw area on the adductor space was covered by a sliding flap from the near dorsum of the right hand. The flap was designed as in Figs. 3 and 4, and it was sutured using 5/0 nylon. The sliding flap was designed dependent upon the local underlying perforators to be moved from the dorsum of the hand and to be sutured to its original attachment as well as the raw area. The flap is undermined with the deep fascia proximally and distally by one to one and a half centimeters keeping its central attachment to the underlying perforators Figs. 18, 19, 20 and 21. The size of the flap is designed in a way that it can be moved safely to cover the whole defect and be sutured to the same area again.

For the left hand, debridement was done and local random flaps from the lateral aspects of the ring and little fingers were taken down to cover the distal part of the palm. The donor sites were closed primarily. Flaps were fixed with 5/0 nylon sutures to the debrided areas.

Results

The raw areas were completely covered in a nice way. No signs of any contracture. Follow up showed normal function of the hand and all fingers including the right thumb and all fingers in the left hand. Follow up after 15 months show excellent results with no sign for any contracture Figs. 7 and 12.

Case 2

A premature newborn female baby Lyana Humairah, 1 month-old with Down syndrome who suffered from a gangrenous patch of full thickness skin over dorsum of her left hand as in Fig. 13. The gangrenous patch was due to extravasation of drugs which may be considered as a chemical burn, or in case of a vascular problem, could be considered as necrotizing fasciitis.

Methods

Debridement was done on to remove the eschar. After escharectomy the wound was not suitable for skin covering as in Fig. 14 as subcutaneous tissue was non-viable. The author did not remove tissues until the level of tendons. He

preferred to leave a layer of necrotic subcutaneous tissue covering the tendons. The author had to wait for 10 days of dressing to get a clean fresh wound. After 10 days, the wound was clean enough to be covered. The author preferred to use a local flap rather than a skin graft.

A sliding flap was designed to cover the defect as in Fig. 15. The flap was moved from the normal skin lateral to the ulcer (from the radial side) to cover the defect completely and there was no need to move a medial (ulnar) one. Undermining of the medial skin was done.

Post Operative

Results

The wound was covered after treating mild infection which was controlled by antibiotics and the end result is shown in Fig. 16. Figure 17 shows the hand after 1 year, with no contracting scar and the hand has full free movement.

Discussion

Hand and wrist burns have absolute treatment priority. The main principle in deep hand burn treatment is to remove all necrotic tissue and to perform skin cover [7].

Early debridement of deep dermal or full thickness burns in the hand is recommended for early cleaning of the area prior to skin covering. Early cure of the deep burns gives excellent function [3, 4, 7].

As the hand is the most mobile part in the body and every part in the hand has its own function which is integrated with other parts, any burn scarring will leave a bad effect on the whole hand function [8–10]. Basic treatment in every hand burn must assure the recovery of optimal functioning with stable soft tissue cover [10, 11].

Early debridement is needed followed by waiting for a clean surface, in order to achieve a good result from skin covering [7]. To have a rapid clearing of the wound, patients should be treated for any deficiencies and leukocytes production promoted to accelerate the demolition phase. With these actions the period required to clean up the raw surface is reduced. In these two cases fresh blood and or fresh plasma transfusion was done.

The skin of the hand has unique characters, dorsal skin is loose, thin, can be mobilized easily and tendons are superficial, while volar skin is thick, compact, tight, difficult to be mobilized and the tendons are deeper. Regarding motility of the hand, all parts are highly motile and active, if any scarring or contractures occur it will affect the motility. The only fixed parts of the hand are the volar aspect of the hypothenar eminence and distal pulps of fingers, while all other parts of the hand either volar or palmar are highly

Figs. 1–7 Stages of treatment of the right hand

mobile. Dorsal areas seem to be fixed but because of the superficial position of tendons, they always need a flap cover as grafts tend to stick with adhesions and fibrosis limiting tendon mobility.

Complications of skin graft cover include color changes, contractures and development of hypertrophic scars.

Use of full thickness or split thickness is associated with multiple complications. Among these complications are skin color, and variable degrees of contractures.

To avoid these complications in these cases, flaps were employed to give a matching color and avoid any contracture and scarring in the future [4, 6].

The author performed early debridement but there was nonviable subcutaneous tissue. Waiting for a week until the non viable subcutaneous tissue is removed by frequent dressing, allows fresh tissue.

The non viable subcutaneous tissue is removed by promoting the polymorph nuclear leukocytes and treating any blood element deficiencies to enhance the demolition stage of wound healing. The size of the wound was not a problem to the author, but rather the state of cleaning of the wound as any dead tissue makes the healing difficult.

The second case was treated in the same way by debridement and waiting for a time for cleaning of the

Fig 8: Left hand Deep Burn at Zone II over bases of index, middle and ring fingers	Fig 9: After random flaps from sides of fingers.	Fig 10: Post operative with stitch removal

Fig 11: Full extension without contracture or fibrosis	Fig 12: The left hand 15 months after discharge, no sign for any contracture	

Figs. 8–12 Stages of treatment of left hand. End results of surgery in Fig. 12

wound by frequent dressing. Later, the sliding flap was moved to cover the wound. Healing in this patient was relatively slow as the patient has Down's syndrome and she was a premature. Follow up of the two cases showed excellent results without any residual complications such as contractures or movement limitations in Figs. 12 and 17.

In these two patients the author did not use early tangential excision and did not use full thickness grafts. Bondoc et al. [12] described the early management of burned hand in children. Xue-Wei W et al. reported fairly good results in a study of 156 cases with early tangential excision and skin grafting [13].

Fig 13: Gangrenous patch over dorsum of left hand after drug extravasation of drugs or necrotizing fasciitis.	Fig 14: After initial debridement. The subcutaneous tissue is gangrenous and is not suitable for cover.	Fig 15: One week after surgery. Flap was moved from radial side to cover the defect

Figs. 13–15 Case no. 2: Pre and post operative

Figs. 16–17 Case no. 2: (16) one month and (17) one year after surgery

Other Methods of Covering Hand Defects

Jean-Philippe Pradier et al. 2007 reported his way of managing deep extensive burns of the hand using the pocket flap technique. The technique depends upon using a defatted abdominal skin flap and putting the bare hand inside [13].

The author has his own series for management of extensive burns by using flaps as groin pedicle flaps, free vascular flaps, and skin grafting. From records he declines the use of skin (split or full thickness) as it was still possible to encounter complications.

Many methods are used to close any defects which may be small or extensive. Among the recorded methods which are used by the author in other patients, free flaps, abdominal pocket [14], reversed radial artery flaps, flaps based on the dorsal branch of the ulnar artery (Becker's flap) [15], tubed pedicle flap from the groin or supraclavicular region, cross finger flaps, island finger flap based on the digital vascular pedicle, dorso-lateral flaps for finger tip injuries [16], random inter-digital small flaps, Z-plasty, sliding flaps,

osteo-fascio-cutaneous flaps utilizing iliac crest bone and overlying skin and fascia, and other composite flaps. A skin graft could be used if we treat an area away from joints and not affecting the motility like the hypothenar eminence or distal pulps of fingers only. All other areas of the hand are considered critical zones and need early covering by flaps.

Nhat et al. [17] achieved good results only in 33% of a series of 150 patients suffered from severe hand post burn deformities using skin grafting. The idea of sliding flap used in this report is shown in Figs. 18, 19, 20 and 21 [18].

Conclusion

The flap cover is a better alternative for skin graft. The flaps are of different types, and they help significantly in achieving early and full function of the hand if they are done properly and in the correct time. Skin grafting needs to be very limited and restricted in hand covering after burns or trauma.

Figs. 18–21 Diagrams to show how to close the defect using bilateral sliding flaps [17]

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