Simplified Negative Pressure Wound Therapy in Pediatric Hand Wounds

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Abstract Negative pressure wound therapy (NPWT) is commonly used as a bolster for skin grafts. The technique offers the benefit of negative pressure as well as reduced dressing changes. Skin grafting of the hand provides a unique challenge, and currently, the only commercially available NPWT hand dressings are adult-sized, precluding their use in small children. We present our custom NPWT “mitten” technique for use with skin grafts on the pediatric hand.

Keywords Vacuum-assisted closure (VAC®) · Pediatric hand · Skin graft · Negative pressure wound therapy (NPWT) · Bolster

Introduction

The classic method of skin graft immobilization involves placement of a tie-over bolster dressing onto the graft surface. An increasingly common practice is the use of negative pressure wound therapy (NPWT) to both prevent accumulation of fluid under the graft and to serve as a bolster to minimize shear, a major cause of graft loss. This technique is especially useful in areas with irregular contours, including the heel, perineum, axilla, and hand. The use of NPWT devices on skin grafts has been previously described[1–4], most commonly in adults. Examples of the use of NPWT devices on skin grafts in the pediatric population have been reported, but skin grafting of the hand poses a unique challenge in children

because of small size, the associated painful dressing changes, and difficulty with immobilization to ensure secured graft sites[5]. Although prepackaged NPWT hand dressings are available (VAC GranuFoam® Hand Dressing, Kinetic Concepts Inc., San Antonio, TX, USA), they are large and are only available in one adult size, precluding their use in small children. We present our use of a custom NPWT “mitten” technique to help improve skin graft take on the pediatric hand. Representative cases are illustrated below and listed in Table 1.

Case 1

A 1-year-old boy presented with bilateral deep partial thickness burns to the volar surfaces of his hands after placing his palms on a wood-burning stove. He initially underwent conservative management with dressing changes and splinting of both extremities, but at 3 weeks post-injury, his burns had progressed to full-thickness burns involving the entirety of the palms bilaterally. He underwent full-thickness debridement of both palms. Four days later, the patient returned to the operating room for further debridement and split-thickness skin grafting (STSG) to both palms. The NPWT mitten was then assembled by cutting out four triangular pieces of GranuFoam® per hand and placing them in each web space in order to keep the fingers in abduction (Fig. 1). A larger piece of foam was placed on the volar aspect of each hand over the STSGs, and nonadherent gauze along with the manufacturer's adhesive VAC® drape was applied to each hand to the level of the wrist. The device was set to -75 mmHg of continuous suction. The NPWT mittens remained in place for 7 days. The patient had no short-term complications and the graft had 99% take (Fig. 2).

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Table 1 Listing of patients operated upon by the senior author in which the NPWT mitten was used over a hand skin graft.

Patient	Age	Etiology	Area	NPWT duration (days)	% take of graft
AD	15 months	Severe contact burn to dorsal and volar right hand from flat iron	<2% BSA	7	90
CA	1.5 years	Contact burn, left hand	1% BSA	6	90
CG	1 year	Bilateral burns to volar hands from wood stove	2%BSA	7	~99
EM	14 months	Scald burn to bilateral upper and lower extremities	11% BSA	7	100
OL	12 years	Bilateral hand burns from boiling oil	3% BSA	7	95–100
TC	12 years	Epidermolysis bullosa	1% BSA	7	90
JG ^a	9 years	Go-kart degloving injury, dorsum of right hand	<1% BSA	3 (before coverage)	N/A

None of the patients suffered any complications

BSA body surface area, NPWT negative pressure wound therapy

^a Patient had NPWT mitten placed in preparation for free latissimus dorsi flap coverage of wound with STSG. The patient had no complications

Case 2

A 12-year-old boy with a history of autosomal recessive dystrophic epidermolysis bullosa presented for release of severe contractures involving all digits of the left hand (Fig. 3). He underwent operative release of the contractures. In order to maintain abduction and facilitate skin grafting, longitudinal Kirschner wires were placed through all phalanges. A custom methylmethacrylate external fixator was used to secure the fingers in full abduction and extension. The STSG was harvested, meshed, and sewn to the wound (Fig. 4). Antibiotic ointment and nonadherent gauze were applied and the “mitten” was then placed as described in case 1. Because of the skin's tendency to slough in this patient, a combination of stoma paste and a light compressive wrap were used to secure the device effectively at the wrist. As with all our patients receiving the NPWT mitten, a volar splint was used to immobilize the wrist. This is sufficient to prevent the dressings from becoming loose. The mitten remained in place for 7 days and the graft had nearly 90% take (Fig. 5).

Discussion

A variety of methods to bolster skin grafts have been described in an attempt to improve graft take, ranging from traditional cotton bolsters to silastic foam dressings, silicone rubber dressings, and honey[6–9]. NPWT is thought to hasten the onset of granulation tissue and accelerate wound epithelialization and may lead to shorter recovery times from burn wounds [10–14]. Another benefit of NPWT is increased tissue perfusion which is thought to result from removal of edematous fluid from the wound site, decreasing impedance to blood flow in the tissue bed and reducing infection [15]. According to a 2008 Cochrane review, however, the literature on NPWT to date is limited

Figure 1 Case 1: **a** Preoperative view of bilateral partial thickness burns. **b** Intraoperative image showing the NPWT mitten set up to maintain fingers in abduction and to minimize graft movement. Gauze and an adhesive drape are later placed over the foam.

Figure 2 Case 1: Two months postoperatively, with grafts healed. Left (a) and right (b) palms.

and further clinical trials are required to fully characterize and prove the extent of these advantages [16]. The use of a NPWT device also eliminates the need for painful, resource-intensive dressing changes in the first week, which

Figure 3 Case 2: Extremely fragile skin and recurrent blisters from epidermolysis bullosa led to severe contractures involving the entire hand.

Figure 4 Case 2: Kirschner wires and methylmethacrylate are used to achieve abduction and extension. A STSG from the left anterolateral thigh is shown in place. The NPWT mitten was later placed as illustrated in Fig. 1.

is especially beneficial in the pediatric population. Appropriate patients can be discharged with ambulatory NPWT, usually with equally good results. Conscious sedation is used only for final removal of the NPWT mitten. This not only reduces pain and discomfort but also increases safety by reducing the need for conscious sedation and its concomitant risks. Unlike traditional bolsters, the NPWT mitten removes fluid that can create an environment for infection. Furthermore, the materials needed for the custom pediatric NPWT mitten are readily available.

Conclusion

The NPWT mitten can be considered in any pediatric case requiring skin grafting to the hand. This technique circum-

Figure 5 Case 2: The STSG 2 months postoperatively.

vents the lack of a commercially available pediatric-sized hand NPWT device, allowing for the advantages of negative pressure therapy as well as providing an effective bolster for immobilization of skin grafts.

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