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Research Article

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A Cost-Effective Technique: Glove-Assisted Negative Pressure Wound Therapy (NPWT) for Enhancing Skin Graft Take on the Toes

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ABSTRACT

Achieving stable graft take in raw areas over the toes and web spaces is challenging due to anatomical complexity, movement, and moisture. Negative Pressure Wound Therapy (NPWT) has been shown to enhance graft adherence, but its application in such areas can be technically demanding and costly. We report a case where a latex glove finger was used to apply NPWT to secure split-thickness skin grafts in a patient with an electrical burn-associated raw area over the toe and first web space. A 12-year-old male child sustained high-voltage electrical burns involving both feet, resulting in raw areas over the left fourth toe and fourth webspace. After debridement and granulation, the area was covered with a split-thickness skin graft. However, the graft failed to take, and a regraft was required. We used a sterile surgical glove to deliver glove-assisted NPWT postoperatively. The dressing maintained an airtight seal, and subsequent examination on the 5th post-operative day showed complete graft uptake. Glove-assisted NPWT is an innovative, low-cost method that can effectively enhance graft survival in anatomically complex and high-risk areas like the toes and web spaces.

Keywords: NPWT, Skin Graft, Electrical Burns, Toe Raw Area, Glove-assisted NPWT, Burn Reconstruction, Negative Pressure Dressing.

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Introduction

Electrical burns often result in deep tissue injury with raw areas requiring grafting after adequate debridement and granulation. Grafting over the toes and web spaces poses specific challenges due to complex contours, mobility, and the risk of fluid accumulation beneath the graft. NPWT helps stabilise the graft, remove serous collections, and improve neovascularisation, enhancing graft take. The application of NPWT on the distal extremities, especially the toes, offers a practical challenge, as it is difficult to obtain an airtight seal using conventional techniques while avoiding skin complications such as maceration or erosion to the surrounding normal tissue. Preventing such complications requires isolating the involved toe in an airtight dressing, which may not be feasible with standard methods.

In addition, applying commercial NPWT kits can be impractical in resource-limited settings. Glove-assisted NPWT, which uses a sterile surgical glove as a conforming sealing material, offers a cost-effective and anatomically adaptable alternative. This case illustrates its successful use to support graft adherence in post-burn toe and web space reconstruction.

Materials and Methods

The study was carried out in the Department of Plastic Surgery of a tertiary care centre following approval from the Departmental Ethics Committee. Informed consent was obtained from the patient's legal guardian before the procedure. The patient was a 12-year-old boy who sustained high-voltage electrical burns involving mixed second-degree injuries to the face, neck, and with exit wounds on both lower limbs, affecting approximately 15% of his total body surface area. He was admitted to our tertiary burns unit, where he received fluid resuscitation according to stan-

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dard protocols, along with broad-spectrum antibiotics and supportive management.

Surgical intervention involved early tangential excision of the burn eschar on both feet under general anaesthesia. The resulting raw area was covered with a split-thickness skin graft harvested from the left thigh. The grafted area was managed postoperatively with standard measures including a tie-over dressing, splinting, and immobilisation. On the fifth postoperative day, graft inspection revealed more than near-complete graft loss over the lateral aspect of the 4th toe and 4th webspace, corresponding to the exit wound (Figure 1). The residual raw area of 3 x 1 cm was regrafted with a small split skin graft (Figure 2), and a glove-finger assisted NPWT was applied to maintain graft adherence after confirming that the patient had no history of latex allergy.

Figure 1: Raw Area Following Skin Graft Loss

The graft was secured using absorbable sutures and covered with a layer of non-adherent dressing and thin gauze padding. An 8 Fr Infant Feeding Tube (IFT) tip was placed within the dressing layers, avoiding direct contact with the graft (Figure 3). The glove finger of a size eight sterile latex glove was pulled over the toe to cover the dressing completely, and the proximal end of the glove was taped to the foot at the level of the metatarsophalangeal joint using transparent adhesive tape to secure an airtight seal (Figure 4). A window was made at the distal end by a cut on the glove tip and covered with transparent film to monitor the toe tip. The IFT was then connected to a wall-mounted suction apparatus, and a continuous negative pressure of -75 mmHg was applied. Adequacy of seal was confirmed by shrinkage of the dressing. The dressings were changed on the third and fifth postoperative days, and NPWT was continued for 7 days.

Figure 2: Regrafting with Small Split Skin Graft

Figure 3: Graft Site Covered with Non-adherent Dressing and IFT Placed

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Figure 4: Glove Finger Assisted NPWT Applied

Results

Examination on the 5th post-operative day showed complete graft take with no evidence of hematoma, seroma, or infection. There was no maceration or erosion of the adjacent skin (Figure 5). At 2 weeks' follow-up, the graft was well integrated and fully taken. No adverse events were noted during the treatment period.

Figure 5: Complete Graft take on 5th Postoperative Day

Discussion

Tie-over bolster dressing is the gold standard for skin graft immobilization [1]. However, this may not always be possible when the grafted area is in a difficult anatomical position, such as the toes or web spaces. NPWT is an attractive alternative to maintain graft adherence. The application of NPWT over raw areas involving the distal foot is complex. It demands meticulous technique, owing to the contour irregularities of the toes and web spaces that hinder obtaining an airtight seal. Standard practice often requires covering the entire distal foot, sometimes extending up to the ankle and including all toes, to ensure an airtight seal during NPWT application. This frequently causes maceration and skin excoriation of the adjacent uninvolved digits and web spaces.

Various techniques have been described in the literature for applying NPWT to the distal extremity. Yoshida et al described the use of foam cut into the shape of a hand and placed dorsally and ventrally over the hand for NPWT application following skin grafting on the hand [1].

Niimi et al described a “sandwich technique” for fixing a skin graft to the thumb, where they used two adhesive sheets placed on the dorsal and pulp sides of the thumb after applying the NPWT device [2]. In a modification of their technique, Niimi et al also described an “Elephant Trunk technique” for critical limb ischemia of the toe, which consisted of a sponge dressing shaped similar to an elephant trunk that covered the affected toe, with the device being sandwiched between two adhesive drape sheets [3]. This resulted in the entire forefoot being covered by the NPWT dressing.

The use of sterile surgical glove-assisted NPWT was explored in a few studies for extremity wounds. Gopal and Solomon used sterile gloves, a Foley’s catheter and an autoclavable sponge to apply NPWT [4]. Sreelesh and Bhandari also used sterile gloves for NPWT when applied on the foot, adding a wound contact layer of collagen powder [5]. However, both their techniques result in the complete coverage of the toes.

Kamolz and Lumenta used a similar technique in grafted upper and lower extremity burns, but they cut holes at the glove tips to allow observation of the tips of the toes [6].

Mashiko et al used surgical glove fingers alone without NPWT as dressing aids to help graft adherence in the fingers [7].

In our case, using a gloved finger in NPWT helped maintain graft-to-bed contact without shear, manage exudate in the web space, keep the graft environment dry, and ensure a uniform pressure environment even over an irregular surface. As the adjacent toes and feet remained outside the dressing, maceration was prevented, and local hygiene could be maintained. The distal window allowed monitoring of tip vascularity, as distal ischemia secondary to constriction by the glove is a theoretical complication of the technique. This technique is especially valuable where commercial NPWT devices are unavailable or impractical due to cost or anatomy.

Conclusion

Glove finger assisted NPWT is a practical, low-cost innovation that enhances split-thickness skin graft take over difficult areas like the toes and web spaces, without causing damage to adjacent normal tissue. It should be considered a useful adjunct in the reconstructive armamentarium, particularly in burn care and resource-limited settings.

Conflicts of Interest: None declared

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