Modified Unna Boot: Treating Dehisced Incisions After Below-Knee Amputations

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In the United States, over 150,000 people undergo lower-extremity amputations each year; of these, below-knee amputations (BKAs) are the most common. These rates are directly related to incidences of peripheral arterial occlusive disease, neuropathy, and sepsis.[1] Diabetes mellitus is associated with 82% of all vascular-associated amputations, and patients with diabetes mellitus have a 30 times higher rate of amputation than the general public.[2] Similarly, lower-extremity trauma with severe wound infection or major tissue loss can also lead to amputation.[3]

A frequent complication of BKA is incision site dehiscence of the residual limb. The incidence of BKA wound dehiscence ranges between 9% and 57.9% in various studies.[4,5] In ambulatory individuals, the calf muscles of the lower leg act as a pump to return body fluids back to the heart. In cases of BKA, the pump has been removed. Calf muscle pump failure and dependent residual limb position can lead to chronic venous insufficiency, causing venous hypertension.[6] When untreated, venous insufficiency overwhelms the lymphatic system and the residual limb can develop dynamic phlebolymphedema.

Unlike postoperative edema, which is the phenomenon that occurs during the inflammatory stages of healing in the early days after surgery, phlebolymphedema is a later phenomenon. It happens weeks to months postsurgery in residual limbs that develop edema due to absent pump action from calf muscles and dependent positioning of the residual limb. Some of the edema may be attributable to mechanical obstruction and lymphatic vessel injury during amputation. It also occurs when the residual limb is not supported by the prosthesis socket or if tight proximal dressings are applied. As a result, patients can develop a combined lymphedema with components of both dynamic and mechanical lymphatic insufficiency.

In addition, one of the late skin complications of residual limbs is verrucous hyperplasia, seen in patients with lymphedema.[7] Together, venous insufficiency from lack of a mechanical "pump" and lymphatic obstruction from surgical injury increases interstitial fluid accumulation, which can also ultimately result in incision site dehiscence. Wound dehiscence leads to stalled healing, prolonged wound care or a higher-level amputation, delay of patient eligibility for prosthesis, and continued immobility.

Patients are typically ready for prosthesis fitting during the immediate postacute hospital stage (4–8 weeks postoperatively) only after ending early rehabilitation and wound healing. Thus, treating wound dehiscence is critical for patients to move onto the intermediate recovery stage wherein the patient transitions to the first prosthetic device.[8]

Negative-pressure wound therapy (NPWT) in the form of an incisional wound vacuum-assisted closure can stabilize the wound environment, improve tissue perfusion, reduce edema, and keep the incision closed for the first week after amputation.[9] However, in patients with phlebolymphedema and increasing residual limb and wound size, NPWT alone may not stabilize and decrease the actual size of the wound. To combat residual limb edema, providers must add compression to the affected area. Although manual lymphatic drainage is advisable, BKA-related phlebolymphedema typically readily responds to compression alone. Compression of the residual limb forces the interstitial fluid back into the lymphatics, ultimately reducing edema. Accordingly, compression is vital to shrinking the residual limb and treating wound dehiscence.

Unlike the cylindric shape of the normal lower leg, the BKA residual limb is more bullet or pear-shaped, making it difficult to sustain the compression needed to facilitate dehisced wound healing. Studies have examined the various compression modalities to treat venous leg ulcers, but only a handful of case studies have looked at compression modalities after BKA.[10] The Unna boot is one such compression method that provides high-pressure compression during muscle contraction/activity and low-pressure compression at rest.

The Unna boot consists of a gauze bandage containing 10% zinc oxide paste, gelatin, glycerin, water. A self-adherent wrap provides elastic compression.[11] Not only does the Unna boot maintain the necessary amount of compression needed to reduce extremity edema, but it also promotes rapid development of granulation tissue and wound healing.[12,13] The application of an Unna boot can be modified to correctly

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fit the unique shape of the BKA residual limb to create the compression needed to control phlebolymphedema and dehisced wounds. Accordingly, the authors describe herein the following approach to treat dehisced BKA incision sites: a modified Unna boot.

MODIFIED UNNA BOOT APPLICATION

To begin, providers visually inspect for any signs of soft-tissue infection. If a deeper-seated wound infection is suspected, a deep wound culture is collected. Providers order X-rays or computed tomography scans to evaluate

Figure 1. MODIFIED UNNA BOOT PROCEDURE

A, Zinc-impregnated Unna boot strips are placed vertically, beginning and ending below the knee bend on either side of the knee. B, More zinc-impregnated Unna boot strips overlapping each other are placed in the same fashion. C, Circular horizontal wrap placed 2 to 3 cm below the knee bend in a figure eight pattern, angled to accommodate distal residual limb. D, A long-stretch compression bandage is placed over the zinc primer.

for possible osteomyelitis and initiate compression therapy only after the evaluation for infection is complete.

Sharp debridement to promote tissue healing at the incisional wound is usually the first step. Debridement converts the chronic wound to an acute wound, removes biofilm, and restarts the healing cascade. Because most chronic wounds are in the inflammatory stage, these providers often apply collagen dressings in the next step to remove metalloproteases that degrade the extracellular matrix and destroy growth factors.

Next, the patient receives a modified Unna boot to provide the needed compression. It can be difficult to keep any compression wraps on the BKA residual limb due to the round/oval shape of the residual limb. Providers cut zinc-impregnated Unna boot strips into approximately foot-long pieces (zinc inhibits bacterial growth and enhances re-epithelialization of full thickness wounds[14]). A Vaseline-based ointment is applied to the residual limb and Unna boot strips are placed starting below the knee down to the tip of the distal residual limb, where they then go proximally on the other side of the residual limb (Figure 1, A and B). A circular wrap is then applied starting 2 to 3 cm below the knee bend in a figure eight and is angulated by either creating a triangle on the side or making a fold to accommodate the distal residual limb (Figure 1, C). Providers then apply a long-stretch compression bandage over the zinc primer and trim any leftover Unna boot strips (Figure 1, D). The long-stretch compression bandage is not included with the Unna boot and is a separate component. Providers take care throughout the entire process to avoid any potential pressure injury at the fibular head.

After the initial application, the modified Unna boot remains on the residual limb for 2 to 3 days before the edema subsides and the compression wrap is ready to fall off. Providers then re-wrap the residual limb using the same technique to maintain adequate compression. After the initial edema subsides, wraps can be applied once or twice weekly depending on the choice of primary dressing. Providers continue the modified Unna boot until 2 weeks after wound closure, at which point the patient is transitioned to a stump shrinker.

The only contraindications include severe PAD (in which patients may tolerate compression) and zinc allergies. This technique is not used on patients with significant infection requiring frequent monitoring. A stockinette is used in such cases to allow for daily wound evaluations. The proposed technique is more challenging for shorter, above-knee amputation residual limbs because the wrap is more likely to slide down.

CONCLUSIONS

The modified Unna boot application is a useful modality in treating dehisced residual limb incisions after BKA. In the authors' experience, this technique enhances moist wound healing, helps to reshape the residual limb, and even allows for an easier fit for a stump shrinker. The supplies needed are readily available and the treatment is cost effective. Further research on other compression modalities for edematous residual limbs is needed. ●

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