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Circumferential Negative Pressure Wound Therapy for Lower Extremity Fractures: A New Technique

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Introduction

Soft tissue edema resulting from trauma is a major obstacle in expeditious and successful care of lower extremity fractures. Techniques that can alleviate or mitigate post-injury and postoperative edema are of great use in the care of lower extremity fractures. Since the development of negative pressure wound therapy (NPWT), the nature of traumatic wound management has significantly changed. We propose that circumferential NPWT can help decrease time to definitive fixation and prevent the number of postoperative wound complications in lower extremity fractures.

Previous methods used to accelerate resolution of edema incorporate passive techniques that can lead to a prolonged and unpredictable course, ultimately delaying definitive treatment. Early reports on intermittent pulsed compression devices have not yielded significant improvements compared to more conventional techniques.[1] While early fracture care is preferred, premature intervention can lead to compromised soft tissue envelopes. Staged protocols have been shown to be beneficial in the management of these injuries,[2] however, only passive techniques have been employed to deal with both post-injury and postoperative edema.

NPWT has been shown to be beneficial in the management of soft tissue injuries after significant trauma.[3] It has been successfully utilized over operative incisions in the acute postoperative period of operatively treated fractures.[4,5,6] In this article, we describe a new technique, which actively employs circumferential NPWT applied to the zone of injury or postoperative extremity, to help reduce both the time to definitive fixation and postoperative wound complications.

Materials and methods

This technique consists of using circumferential NPWT over the entirety of the distal tibia, ankle, and foot to prevent excessive post operative edema as well as accelerate its resolution. The application requires basic NWPT dressings including an open pore sponge, semi occlusive dressing (petroleum gauze), airtight adhesive dressings (such as iodophor impregnated adhesives), and a negative pressure source. All of these are readily available at most hospitals and are simple to apply and operate. Additionally, they can be maintained under splints, around external fixators, and over both open and closed wounds.

For preoperative application, the zone of injury is dressed with non-adherent petroleum laden gauze. The entirety of the skin is covered so that none of the sponge directly contacts the skin. The sponge is then applied in a circumferential fashion around the distal extremity taking great care so that no area of skin is directly exposed to the sponge. A larger sponge can be cut so that it folds around the ankle, hindfoot, and forefoot in one continuous sleeve or multiple sponges can be combined within one semi-occlusive dressing. When placing one large sponge around the entire distal extremity, slits should be cut two thirds of the way down the long axis of the sponge, each one third of the total width of the sponge. This can then be placed on the posterior aspect of the leg with the slits at the level of the ankle and the distal third of the sponge on the plantar aspect of the foot. A corresponding sponge can then be placed on the anterior aspect of the distal leg with a fold at the ankle and distal third of the sponge on the dorsal aspect of the foot. The NPWT system is then set to 125mm Hg continuous therapy in conjunction with strict elevation and non-weight bearing precautions.

Postoperatively, the entirety of the surgical site should be covered. Our practice is to keep the dressings in place for at least 5 days.

Results

Between August of 2012 and September of 2014 this technique was utilized successfully in four patients during the acute postoperative period. Of those four, three were fractures of the talus that underwent open reduction and internal fixation through dual medial and lateral approaches and one was a trimalleolar ankle fracture treated acutely with open reduction and internal fixation.

None of the four patients had serious wound complications that necessitated reoperation and none required an extended course of antibiotic therapy. One incision had mild drainage after discontinuation of circumferential NPWT that resolved with superficial wound care. No patient had any wound complication related to

the resumption of range of motion or weight bearing and no deep infections occurred.

Discussion

Even with advanced staged protocols and progressive soft tissue management, postoperative wound complications remain a significant problem in high energy lower extremity. To date many series have shown wound complications rates upwards of thirty percent, especially in high energy injuries and complex fracture patterns.

Tibial plafond fractures have been shown to have wound complications and delayed wound healing anywhere from 5% to 36%.[7,8,9] Ankle fractures tend to have a significantly lower wound complication rate. SooHoo *et al.* reported an overall wound infection rate of 1.44% out of a total sample size of 57,183 in operatively treated ankle fractures.[10]

Although talar neck fractures undergoing open treatment also have a less wound issues than tibial plafond fractures, rates of complications still remain high. Vallier *et al.* reported a wound complication and infection rate of nearly 9% (3.3% superficial wound, 3.3% wound dehiscence, 5% deep infection).[11]

In operatively treated calcaneal fractures, Folk *et al.* found an overall wound complication of 25%.[12] Howard *et al.* performed a RCT comparing nonoperative versus operative management of displaced intraarticular calcaneal fractures and found that 16% had superficial wound slough with 4.4% going on to deep infection early and 0.4% going on to deep infection late.[13]

Conclusion

Circumferential NPWT for pre and postoperative edema control is a simple, noninvasive method to accelerate edema resolution preoperatively and mitigate high rates of wound complications in lower extremity fractures.

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