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The Upstream Challenge

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Delayed Primary Closure Using the DermaClose™ RC Tissue Expander.

This device has proven effective for treating diabetic foot wounds.

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Closure of large wounds has been a challenge in podiatric surgery, especially after large defects created by ulcer debridement, metatarsal resection and amputation. The DermaClose™ RC tissue expander allows for closure of large defects without the need for traditional complex skin closure, tissue grafting or creation of skin and tissue flaps. Skin anchors made of surgical steel clips are used with a tension controller to allow for gentle skin stretching on the subcutaneous planes of the wound or defect. It also has special application in the closure of chronic wounds. Two case reports are presented to describe this technique.

Mechanically-assisted delayed primary closure of large foot wounds following emergency or ablative surgery will result in faster healing and assist in enhanced closure of a large tissue defect.

When a wound is created, healing is either by primary closure if enough tissue is available or by secondary intention healing. Many times in podiatry, large wounds and defects are created after ulcer debridement, metatarsal or bone resection and amputation. Secondary intention wound healing can be facilitated by a variety of modalities including local wound care, negative pressure vacuum therapy, hyperbaric therapy, tissue growth factors and application of bioengineered tissue equivalents. However, secondary-intention healing of the defect often takes weeks or months, adding to the cost of wound and palliative care.

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Mechanically-assisted delayed primary closure of large foot wounds following emergency or ablative surgery will result in faster healing and assist in enhanced closure of a large tissue defect.

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Case #1
A 59 year old Caucasian male presents to our clinic with a chronic three-year wound after a hallux and 2nd digital amputation. The patient has a long history of diabetes mellitus and has undergone kidney transplantation. Application of the DermaClose™ device was initiated and required about three months to completely close the wound. The patient was taking immunosuppressive medication during this time, which may explain the prolonged closure rate.

The surgical site is thoroughly cleansed before application of the tissue anchors. A suture loop is then placed through the anchors and tension is applied by the device. In this case, a figure-8 suture was used to apply uniform tension perpendicular to the skin edges. (Figures 1 a,b,c)

Case #2
A 42 year old African-American male presents to our clinic after stepping on a bottle cap in March 2007. The patient is a poorly controlled diabetic with serum glucose running between 250 and 350 mg/dL. His medications include oral hypoglycemics, injectable insulin and cholesterol-lowering drugs. Unfortunately, he developed infection and underwent incision and drainage of deep space abscess with second partial metatarsal resection and digital amputation.

Prior to delayed closure and use of the DermaClose™ device, the patient underwent a series of wound care treatments; negative pressure wound VAC and application of Graft Jacket. After several months, the amputation site failed to close and a large, granulating defect remained (Figure 2).

In order to promote final closure, the DermaClose™ tissue-expanding device was applied. Preparation of the wound consists of surgical debridement of all non-viable tissue. The wound edges are undermined about 2 cm. from the wound edge. (Figure 3 a and b)

During the tension phase, the patient remained in a CAM boot and underwent daily dressing changes. Final closure of the defect was accomplished within just a few days of application. (Figures 4 and 5)

Application
The device described (DermaClose™, Wound Care Technologies, Chanhassen, MN, USA) consists of

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skin anchors made of 316L surgical stainless steel and placed circumferential to the wound 1-1.5 cm. from the wound edge. The anchors penetrate the skin and into the subcutaneous tissue. Each anchor is held in place with two skin staples. A monofilament, high-strength suture is then woven around each anchor. The suture is then tightened to approximately 1.3 kg. of force, bringing the wound edges closer together.

Once the dynamic tension is reached, additional tightening is not needed. Patients should be seen every three to five days for evaluation of the device and the tissue movement. Care should be noted that the anchors do not envelop or imprint into the skin.

The DermaClose™ tension-controller is attached around each skin anchor and the knob of the tension device is rotated until a clutch mechanism provides an audible indication that full tension has been achieved. The device now maintains the proper amount of tension to gently stretch the skin on the subcutaneous planes around the wound until the edges of the wound are brought close enough together for final suturing and closure.

Discussion

In both cases, the wounds are considered chronic, diabetic wounds. The rate of closure varied in case #1 due to immunosuppressive therapy. In general, the DermaClose™ device will provide rapid closure of an otherwise chronic or stagnant wound.

In one of the first studies to evaluate rates of mechanically-assisted closure, Armstrong and Lavery reported that closure can be assisted approximately 40% faster than by secondary intention healing alone.

Optimal results were obtained by strict off-loading of the foot during the tension phase of treatment, debridement with meticulous and frequent wound care. Armstrong and Lavery also identified the average healing time of a standard wound was similar to total contact casting.

Both cases represent a cross-sectional example of a small, chronic wound and a larger defect after amputation. Both responded favorably to mechanical tensioning.
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chanically-induced delayed primary closure.

Conclusion
As one advances from the simple to the complex wound, the theoretical risk for complications increases. Therefore, specialists working in this area should always try to expand armamentarium to assist in wound simplification and closure. Skin stretching devices are among these tools. At the Center for Lower Extremity Ambulatory Research (CLEAR), we are experiencing success in utilizing such devices to augment the closure of wounds. Members of CLEAR were among the first to evaluate this technique in the lower extremity more than a decade ago. We believe that the quality and breadth of these devices are improving. This can only benefit us as we move forward.

References

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