Vacuum-Assisted Closure With External Fixation of the Hand

Kenneth S. Gerszberg, BS; Virak Tan, MD

Since 1995 when vacuum-assisted closure (VAC) became available in the United States, it has become widely accepted as a means to treat many types of wounds. When these wounds are further complicated by underlying fractures, internal fixation is not always an option because of overlying soft tissue defects. External fixation may therefore be the first line of treatment for stabilization of the bone and at times may be definitive. Initially, the use of VAC for soft tissue defect in an external fixator may not seem compatible due to difficulties of placing the dressing around the external fixator pins and frame. Furthermore, when the wound is around the hand, achieving a complete vacuum seal around the digits is almost impossible with the current adhesive drape.

Previous authors have reported how to place the VAC around external fixators. Ozer and Smith used surgical towels to pad the external fixator pins while Ioban drapes (3M Health Care, St. Paul, Minnesota) were used to cover the fixator, towels, and wound construct on the lower extremity. Lemmon et al used pieces of foam to cover hardware prominences instead of using the surgical towels. An additional method is to place the VAC sponge and adhesive drape under the external fixator, when the construct allows. This article demonstrates an easy technique of applying a VAC around an external fixator of the wrist and hand, with the aid of a surgical glove.

MATERIALS AND METHODS

We performed a retrospective review of charts and radiographs of 2 patients who underwent this technique. For both patients, we used the “glove technique” for 2 weeks.

Patient 1

A 52-year-old man experienced a crush, degloving injury to his left hand after a rollover motor vehicle accident. The injuries consisted of multiple carpal bone fractures, carpometacarpal and distal radial ulnar joint dislocations, and road rash on the dorsum of his hand that extended down to the bone.

The patient underwent emergent wound irrigation and debridement and skeletal stabilization with a multiplanar external fixator and K-wire fixation (Figures 1, 2).

Over the course of the next several weeks, the patient had serial irrigation and debridements and the hand wound was treated with non-adherent dressings. Approximately 3 weeks after the index surgery, a VAC dressing was placed to include the external fixator to assist with wound management (Figures 3-5).

At 5 weeks, the external fixator was removed. The extensor tendons were still exposed (Figure 6), therefore the VAC was continued with the “glove technique” (Figure 7). At 10 weeks, granulation tissue was present over the tendons and a split-thickness skin graft was applied to the hand. Figure 8 shows complete soft tissue healing.

Patient 2

A 40-year-old man was struck by a motor vehicle and sustained closed head trauma and bilateral upper extremity open fractures. On the left arm, he had an open trans-styloid perilunate fracture-dislocation of the wrist with exposed tendons and neurovascular structures on the volar side (Figures 9, 10). The open wound was emergently irrigated and
debrided, and the lunate was reduced. Due to his overall medical condition, an external fixator was placed across the wrist to provide provisional stability. The VAC dressing was applied around the external fixator using the “glove technique.”

Two weeks later, the patient was medically stable and the wound had healed sufficiently to allow definitive stabilization of the trans-styloid perilunate fracture-dislocation. At the same time, the VAC was discontinued and a split thickness skin graft was applied to the volar wound.

The external fixator was kept in place for 12 weeks. Figure 11 shows complete healing of the hand wound at approximately 13 weeks after the initial injury.

**Surgical Technique**

The traumatic wound is first irrigated and debrided as per the usual open injury protocol. The construct of the external fixator and percutaneous fixation are determined by the bony and soft tissue injury pattern. After placement of the external fixator, the VAC dressing sponge (Kinetic Concepts Inc, San Antonio, Texas) is cut to fit the wound. Relaxing cuts in the VAC sponge can be made to fit around the external fixator pins (Figure 3). The ends of the pins are padded with extra sponges followed by placement of a large sterile surgical glove over the hand-external fixator-sponge construct. Sponges from the scrub brush are sufficient to pad the ends of the pins. The tips of the glove are cut to allow the fingers to be exposed (Figure 4). No adhesive drape is needed around the fingers. The proximal end of the glove is reinforced and sealed with the standard VAC adhesive drape that wraps circumferentially around the wrist/forearm. The suction tubing is then placed on top of the sponge. The tubing is then connected to the VAC machine, and the suction is set to the desired pressure (Figure 5). Once a vacuum is created, additional adhesive drape can be applied over the glove in the areas of prominence to minimize tears in the glove.

**Results**

In both patients, the soft tissue defect healed after the “glove technique” and a split-thickness skin graft. No complications related to the technique or VAC use were reported.

**Discussion**

Compared with traditional wound care, VAC is believed to work based on its ability to remove edema/exudates, reduce bacteria counts, increase granulation tissue and angiogenesis, and reverse tissue retraction at an open wound. The use of VAC also allows for the increased success of skin grafts, which may need to be performed after a degloving injury. Furthermore, wound management with VAC may be invaluable for patients who are not medically stable to undergo more invasive soft tissue reconstruction procedures.

When the open injury is further compromised by complex fractures or dislocations, an external fixator may be the first line of treatment for the skeleton; however, use of VAC for these wounds can be cumbersome, especially around the wrist and hand because...
it is difficult to create a complete seal around the fixator and fingers.

Our “glove technique” uses a surgical glove to cover the VAC sponge and fixator frame, which is a more effective and facile method than using the adhesive drape that is provided in the kit. The glove can stretch over the fixator pins and conform to the complex geometry, and only the proximal end needs to be sealed with the adhesive drape. The tips of the glove are cut so that the fingers can be examined, making it easy to test the neurovascular status. The cut ends of the glove act as one-way valves to form a seal around the fingers when negative pressure is applied. No adhesive drape is therefore needed around the fingers because of the one-way valves. This is particularly useful because adhesive drape around the fingers rarely provides an airtight seal.

Ng et al\(^6\) has described using a sterile surgical glove to cover the VAC dressing on the hand without the use of an external fixator. Our “glove technique” is a combination of the Lemmon et al\(^2\) and the Ng et al\(^6\) techniques. We made the additional modification of cutting the distal tips of the glove to provide easier access to check vascular status.

Indications for the “glove technique” include injuries of the hand/wrist that require bony stabilization with an external fixator along with an overlying soft tissue defect that would benefit from VAC therapy. Contraindications for the technique are the same as those for VAC therapy in general.\(^7\) The VAC dressing should not be placed directly in contact with exposed blood vessels, anastomotic sites, or nerves. Malignancy in the wound, untreated osteomyelitis, and necrotic tissue with eschar present are also contraindicated.

This article demonstrates that the “glove technique” around an external fixator about the wrist and hand is simple, reliable, cost-effective, and widely available because it does not require anything more than a surgical glove.

**REFERENCES**