Use of Cross-Leg Flap for Wound Complications Resulting From Open Pilon Fracture

Amit Sood, MD, Babak Khamsi, MD, Ramazi Datiashvili, MD, PhD, and Wayne S. Berberian, MD, MBA

Abstract

Pilon fractures and associated soft-tissue complications present treatment challenges for orthopedic surgeons. Open fractures may require additional soft-tissue coverage. When local soft tissues do not allow for viable coverage, a cross-leg flap is available as a salvage procedure with successful outcomes. To our knowledge, there have been no previous reports of using cross-leg flaps for wound complications in high-energy pilon fractures.

Soft-tissue complications are a known problem in the treatment of pilon fractures of the distal end of the tibia. These fractures typically occur as the result of a high-energy mechanism, and axial load and shear forces often lead to a severe soft-tissue injury. In many cases, these injuries may require additional procedures to provide adequate soft-tissue coverage. These procedures can include use of either a rotational muscle flap or a free flap transfer. In some cases, however, these flaps are not possible secondary to vascular compromise.

In this article, we report the case of a pilon fracture combined with severe soft-tissue injury and vascular compromise of the leg. A cross-leg fasciocutaneous flap was performed as a salvage procedure for coverage of the soft-tissue defect. The patient provided written informed consent for print and electronic publication of this case report.

Case Report

A 23-year-old man sustained a left grade III open pilon fracture after a fall off a cherry picker. He was initially treated with irrigation and débridement of the open anteromedial wound, wound closure, application of external fixation, and open reduction and internal fixation (ORIF) of the concomitant comminuted fibular fracture. Operative fixation of the pilon was performed 3 weeks after injury, once skin and soft tissues were in acceptable condition (**Figure 1**). Skin closure was performed with 2-0 Vicryl sutures (Ethicon, Inc, Somerville, New Jersey) followed by 3-0 nylon skin sutures and No. 2 nylon retention sutures to reduce tension at the incision.

On postoperative day 17, the patient was found to have skin necrosis with exposed hardware over the medial laceration that had resulted from the open fracture (**Figure 2**). The wound measured 7×6 cm. The plastic surgery team was consulted, and

Figure 1. (A) Anteroposterior and (B) lateral radiographs immediately after open reduction and internal fixation of pilon fracture.

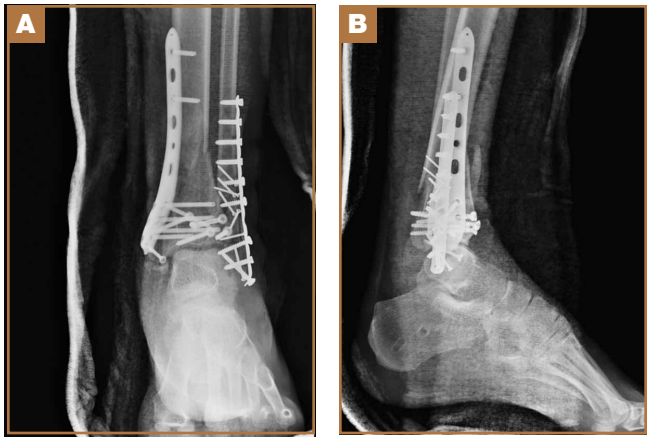

Figure 2. Wound necrosis. Majority of wound is occupied by plate.

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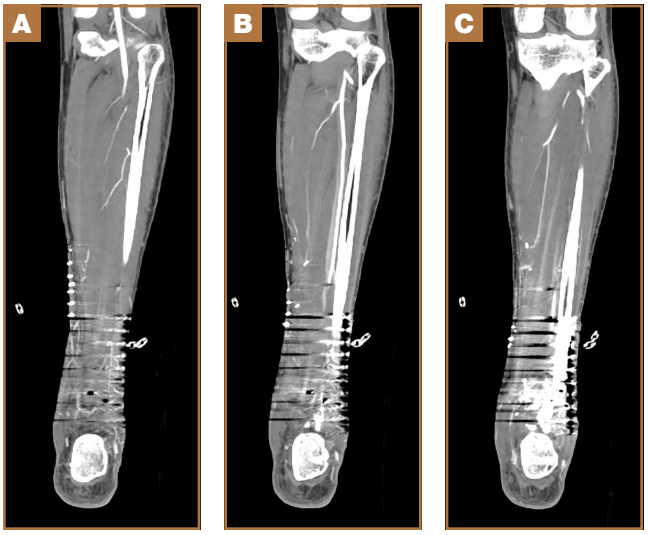

Figure 3. Computed tomography (CT) angiogram shows 1 vessel run off of peroneal artery in distal leg. (A–C) Sequential coronal CT angiogram sequences.

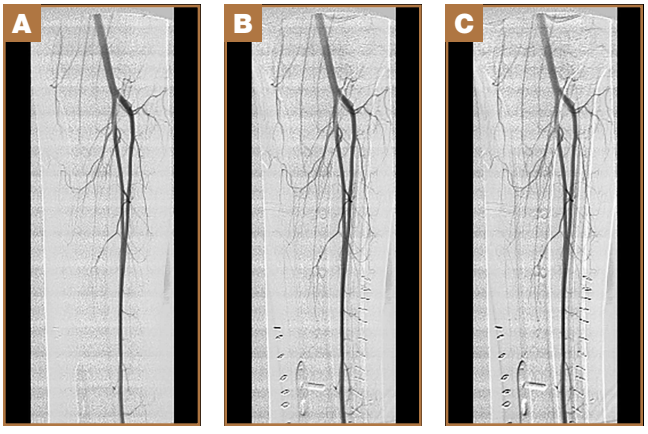

Figure 4. Angiogram confirms 1-vessel run off in distal leg. (A–C) Time-sequenced radiographs after administration of contrast.

Figure 5. Wound after several weeks of vacuum-assisted closure treatment, immediately before surgery for cross-leg flap.

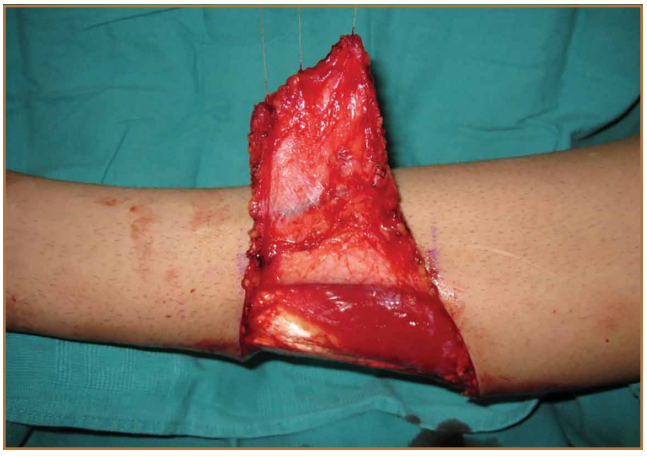

Figure 6. Flap raised from contralateral leg.

a soft-tissue flap was recommended. Preoperative computed tomography angiogram (**Figure 3**) revealed 1 vessel runoff in the leg, constituting the peroneal artery, and a conventional angiogram confirmed this finding (**Figure 4**). Despite these findings, the patient was taken to the operating room 4 weeks after initial injury to try to find a vessel compatible with anastomosis. Intraoperative wound exploration confirmed no patent blood supply for local soft-tissue flap coverage. Therefore, the wound was irrigated and débrided, and a vacuum-assisted closure (VAC) dressing was applied despite exposed hardware and bone. A decision was then made to attempt a cross-leg flap as a salvage procedure, and VAC dressing therapy was continued for several weeks to prepare the recipient site (**Figure 5**).

Seven weeks after injury, the patient was taken to the operating room by the orthopedic surgery and plastic surgery teams. After débridement, a fasciocutaneous flap was raised from the middle third of the contralateral leg (**Figure 6**) based on a posterior tibial artery perforator. The flap, which measured 7×7 cm (sufficient to cover the defect), was raised from lateral to medial from the posterior aspect of the leg with the pedicle located on the medial aspect of the right leg. Flap placement was facilitated by flexing the left knee to 80°. The flap was sutured into place with 4-0 Vicryl deep sutures followed by 4-0 nylon and superficial sutures in an interrupted fashion (**Figure 7**). Rigid external fixation was then applied to both extremities, bridging them together in optimal position (**Figure 8**). This construct included 2 short bars that would elevate the patient's heels off the bed to reduce the chance of heel decubiti. Although including the feet in the external fixator construct may help prevent equinus contracture, we splinted the ankles in neutral position immediately after surgery so that we could begin early range-of-motion (ROM) exercises of the ankles to prevent stiffness. Ankle ROM exercises were started once the flap incorporated, 3 weeks after placement of the external fixator. Lacking medical insurance coverage, the patient could not be admitted to a rehabilitation facility or receive home care. He lived independently and had no help at home, so he had to remain hospitalized after

placement of the external fixator. While hospitalized, the surgical site was treated with frequent dressing changes, including use of bacitracin and nonadherent dressing.

After flap coverage and 4 weeks of bed rest, a base clamping test confirmed the flap was incorporated into the recipient bed. The patient was then returned to the operating room for removal of the external fixator and skin grafting of the donor site. After surgery, he was started on physical therapy, including exercises for bilateral hip, knee, and ankle ROM and strengthening of the lower extremities. Four months after initial injury, the fracture was healed, based on bone consolidation, seen on radiographs, that is consistent with other pilon fractures treated at our institution. Six months after external fixator removal, the patient was able to ambulate independently with minimal discomfort (**Figure 9**). Passive and active ankle ROM was 20° of dorsiflexion and 25° of plantarflexion, compared with 25° of dorsiflexion and 45° of plantarflexion on the contralateral extremity. Subtalar motion had some stiffness with a 10° arc, compared with a 25° arc on the contralateral extremity. On simple manual testing, the patient had 5/5 motor strength with dorsiflexion, plantarflexion, inversion, and eversion. He returned to full duty as a landscaper about 1 year after initial injury and had no recurrence of wound complications or infection.

Figure 7. Photograph of cross-leg flap completed by plastic surgery team was followed by application of external fixator by orthopedic surgery team.

Figure 8. Photograph of external fixation applied to bilateral legs. Two short bars at distal end of construct are designed to keep heels off bed to prevent ulcer development.

Figure 9. Six months after surgery, flap is fully healed, and patient has regained strength and range of motion.

Discussion

Fractures of the distal tibia are commonly known as *pilon* or *plafond* fractures. They represent up to 10% of all tibial fractures. The injury consists of an intra-articular fracture of the tibiotalar joint with varying degrees of proximal extension into the tibial metaphysis. The etiology is an axial load on the tibia with or without a rotational force.[1] Treatment is challenging. The literature includes many reports of wound and soft-tissue complications after ORIF. In 1969, Rüedi and Allgöwer[2] published recommendations that have become the standard for treatment of pilon fractures. Twelve percent of the 84 fractures included in their study were associated with wound complications. In 2004, Sirkin and colleagues[3] suggested that wound problems associated with ORIF of pilon fractures may be caused by attempts at immediate fixation through swollen soft tissue. They postulated that staging the procedure and waiting for decreased soft-tissue swelling may reduce the incidence of wound complications. In their series, only 2.9% of closed pilon fractures and only 9.1% of open fractures had any wound complications, and none of their patients required skin grafts, rotation flaps, or free tissue transfers.

However, soft-tissue complications still remain a significant threat in the treatment of pilon fracture, and cases that require additional procedures for soft-tissue coverage are common. In some cases, wound necrosis may lead to below-knee amputation.[4] There are several coverage options, including local rotational flaps using the soleus muscle[5,6] as well as free flaps using the latissimus dorsi, gracilis, or rectus abdominis muscles.[7] These options require a sufficient blood supply to the region.

Many high-energy pilon fractures may be associated with vascular injury, and therefore flap survival may be compromised. We have reported such a case in the present article. Our patient's preoperative angiogram indicated he had 1-vessel runoff to the distal leg—a situation incompatible with free tissue transfer. It is not clear whether this finding is secondary to trauma to the leg or is caused by an anatomical anomaly. Nevertheless, the poor vascularity posed a challenge to providing soft-tissue coverage. Cross-finger[8] and cross-foot[9] flaps have been described in upper and lower extremity injuries. In 2006, Zhao and colleagues[10] reported on 5 patients with tibia and/or hardware exposure after operative fixation of tibia fractures.

These patients had poor local soft tissue around the wound and therefore underwent cross-leg flap for coverage. It is not clear where the soft-tissue defects were located and whether any studies were performed to assess the local blood flow.

From our patient's case, we learned that multiple factors should be considered when assessing such high-energy injuries. First, respecting the soft tissues is of paramount importance. Our initial management on presentation consisted of irrigation and débridement of the wound, fixation of the fibula, and application of an external fixator to allow for soft-tissue healing before definitive fixation of the pilon. Although ultimately the patient required soft-tissue coverage, soft-tissue healing and viability are important in preventing unnecessary soft-tissue procedures, and therefore we would not have handled our initial treatment differently.

Patient selection is also important. The ideal candidate for a cross-leg flap is a young, healthy person who is compliant and has a strong support system to help with activities of daily living. Unfortunately, because of financial issues and lack of home support, our patient remained hospitalized during his treatment course. For a patient who has support, it is possible to be discharged either home or to a rehabilitation facility once flap viability has been confirmed after surgery.

Another consideration is type of immobilization. Immobilization options include casting, use of Kirschner wires (K-wires), and use of rigid external fixation. For cross-leg flaps, external fixation is superior to casting and K-wires, as it provides a more rigid construct and easier access to the flap for serial evaluation. Further, it is easier for the patient to maintain personal hygiene, and it can provide heel rises to avoid pressure ulcers.

Conclusion

To our knowledge, there have been no reports of using a cross-leg flap for wound complications in high-energy pilon fractures. As already mentioned, many of these fractures may be associated with severe soft-tissue injury and may need flap coverage. A cross-leg flap with external fixation of both legs provides a limb salvage option with satisfactory patient outcomes.

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This paper will be judged for the Resident Writer's Award.