DOI: https://doi.org/10.30795/jfootankle.2022.v16.1645

Technical Tips

Open tibial pilon fracture with an extensive osteochondral defect: Staged reconstruction

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Abstract

The surgical treatment of large post-traumatic osteochondral defects related to open tibial pilon fractures is challenging. Staged treatment with soft tissue damage control and bone reconstruction in the second half is often the best therapeutic option. We present a technical tip using osteochondral allograft to reconstruct an area with extensive bone loss in the distal tibial epiphysis after a gunshot wound, describing the treatment stages and good clinical results.

Level of Evidence V; Therapeutic Studies; Expert Opinion.

Keywords: Trauma; Allograft; Tibial fractures.

Introduction

The treatment of multi-fragmented open tibial pilon fractures associated with bone loss due to gunshot wounds is a challenging and rare situation outside the war/armed conflict environment. Special care should be taken with firearms-related injuries, especially due to skin loss, contamination, and significant osteochondral loss.

There are a few reports in the literature due to the low incidence of this situation[(1,2)]. In the final stage of treatment, reconstruction and repair of the articular surface using autograft, allograft, or fresh osteochondral allograft are reported[(3,4)]. However, most patients with open tibial pilon fractures and bone defects are treated with tibiotarsal arthrodesis[(5)].

We present a technical tip using osteochondral allograft to reconstruct an area with extensive bone loss in the distal tibial epiphysis after a gunshot wound, describing the treatment stages and good clinical results.

Clinical symptoms and radiological findings

A 35-year-old male victim of an open tibial pilon fracture to a gunshot wound (Figure 1A-B) submitted to initial emergency treatment at another institution.

Four days after the first procedure, the patient requested discharge and was transferred to our hospital. On physical examination, the surgical wound on the lateral face of the ankle presented edges under tension and blisters on the anterior face associated with local hyperemia, negative expression, and hypoesthesia on peroneal nerve area (Figure 1C-E).

The imaging investigation in our institution, radiographs, and ankle computed tomography shows the shortening of the tibial fracture, remnant of the intra-articular firearm projectile, and bone loss of the anterolateral aspect of the distal tibia (Figure 2A-K).

Technical tip

Given the complexity of the bone and soft tissue injuries, we opted for the 3-staged treatment.

First stage

- Removal of the external fixator.
- Open reduction and internal fixation of the tibial shaft through combined anteromedial and medial access to reestablish the tibia length using compression screw and neutralization plate (Figure 3A, 3D-E).

Study performed at the Hospital Israelita Albert Einstein, São Paulo, SP, Brazil.

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Conflicts of interest: none. **Source of funding:** none. **Date received:** July 24, 2022. **Date accepted:** July 26, 2022. **Online:** August 31, 2022.

How to cite this article: El Fatah SA, Pires EA, Oliveira FM, Oliveira LSR, Fonseca FC, Godoy-Santos AL. Open tibial pilon fracture with an extensive osteochondral defect: Staged reconstruction. J Foot Ankle. 2022;16(2):183-7.

- External tube to tube fixation – 2 Schanz wires in the proximal tibia, 1 Schanz wire in the medial calcaneus, and 1 Schanz wire at the base of the first metatarsal (Figure 3B).
- Collection of samples for culture and antibiogram.
- Incisional negative pressure wound therapy for soft tissue injury (Figure 3C).

Five days after the first stage and negative culture results, a good clinical appearance of the lateral soft tissue was observed, with no clinical signs of local infection.

Second stage

- Removal of the external fixador (Figure 4A).
- Open reduction and internal fixation of posterior malleolus (anti-shear plate + compression screw through the plate) and lateral malleolus (plate with 2.8mm locked screws). (Figure 4B-D, 4G-H).
- Incisional negative pressure wound therapy for soft tissue injury.

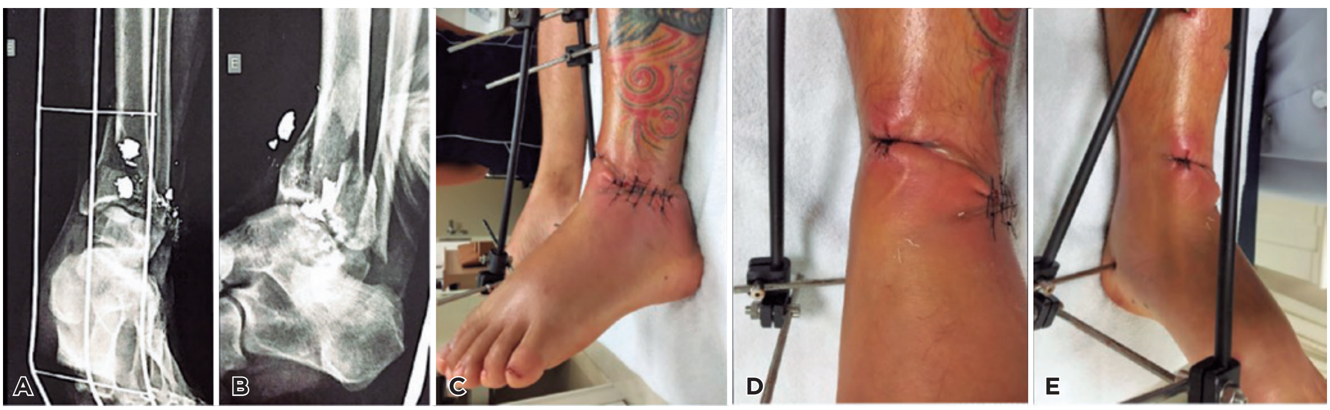

Figure 1. Patient admission. A and B) Radiographic images of the ankle in anteroposterior and lateral views taken upon admission to another hospital. C-E) Photographic images of the patient's leg on admission to our institution showing external fixation and local hyperemia.

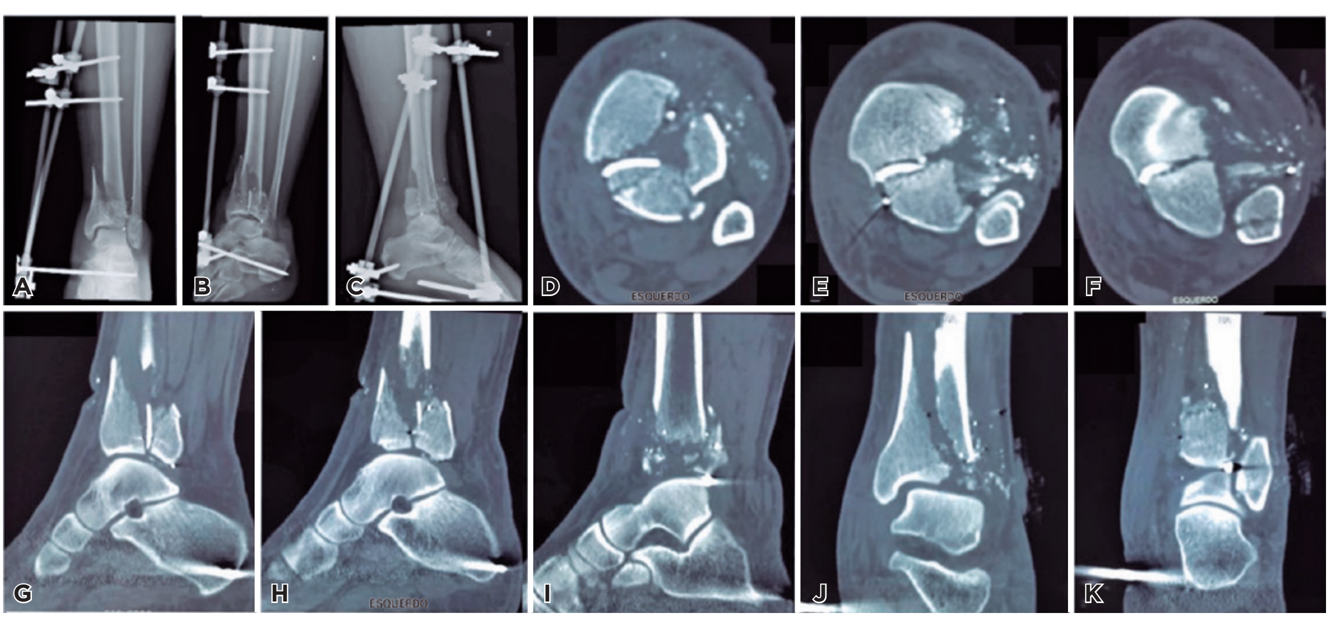

Figure 2. Radiological examinations performed upon admission to our institution. A-C) Radiographic images demonstrating a simple fracture trace of the fibula and comminuted distal tibia fracture. D-K) Computed tomography showing multi-fragmented open tibial pilon fractures with articular trace and extensive bone defect in the anterolateral aspect of the distal tibia.

Four weeks after the second stage, the appearance of the soft tissue was excellent. The patient was already undergoing physiotherapy gaining range of motion, muscle strengthening, and progressive partial load training. Therefore, we considered the opportune time to address bone loss in the anterolateral aspect of the distal tibia.

Third stage

- Reconstruction of the osteochondral failure through the anterolateral access route and use of a distal tibial allograft modeled in the shape of the osteochondral lesion and fixation with a compression plate and screws (Figure 5A-E).

Figure 3. First stage. A) Photographic image of the posteromedial and anteromedial pathway for anteromedial fragment reduction and fixation. B) Photographic image of the open wound after cleaning and debridement. C) Photographic image after new external fixation and incisional negative pressure wound therapy on the lateral wound. D-E) Postoperative fluoroscopic images demonstrating the larger fragment fixation, thus maintaining the length of the medial column restoration.

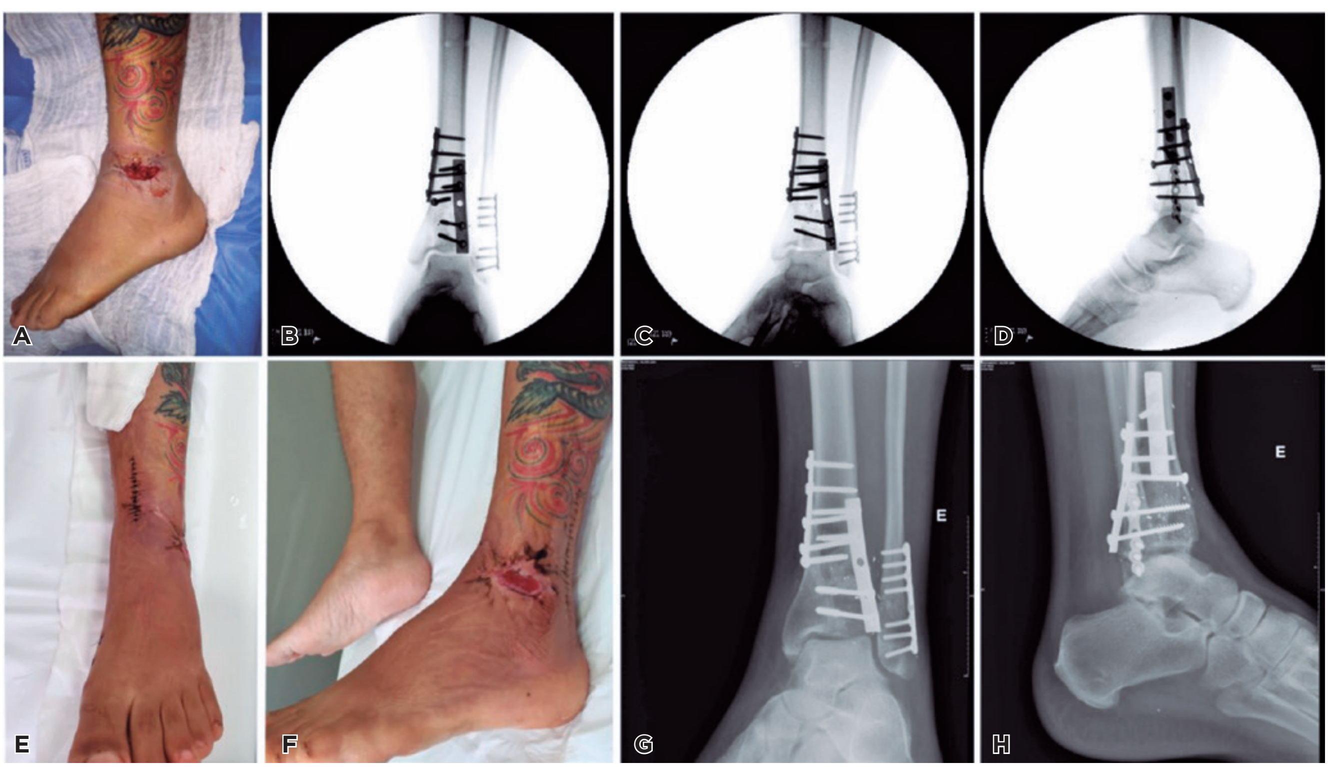

Figure 4. Second stage. A) Photographic image with an improvement of the lateral wound after removal of the external fixator. B-D) Fluoroscopic images in the anteroposterior, mortise, and lateral views of the ankle observing the fixation method of the posterolateral fragment of the tibia and fibula through a posterolateral ankle approach. E-F) Photographic images at two weeks after surgery showing wounds without inflammation with progressive improvement of the edema. G-H) Radiographic images in mortise and lateral views of the ankle at four weeks after surgery demonstrating bone healing with anterolateral osteochondral failure.

- Incisional negative pressure wound therapy for soft tissue injury.

The patient resumed physiotherapy gaining range of motion, muscle strengthening, and progressive partial load training until reaching full load without help six weeks after surgery. (Figure 6A-F).

Image control shows consolidation of the allograft and tibiotarsal joint congruence.

Discussion

Multi-fragmented open tibial pilon fractures associated with bone loss to gunshot wounds are typically related to high energy mechanisms and significant soft tissue injuries[1]. Therefore, the main objective of treating these complex fractures is to avoid soft tissue necrosis, minimize postoperative infection, and preserve the joint surface[6].

There are many techniques for this type of injuries such as open reduction and internal fixation in a single or staged time, primary ankle arthrodesis, joint surface reconstruction using autologous graft, allograft, or even fresh osteochondral allograft, and ankle arthroplasty[3,4].

Primary arthrodesis shows a good functional prognosis but increases the risk of degeneration in adjacent joints and may cause limb shortening[7].

In 1969, Rüedi and Allgöwer combined four key principles for treating tibial pilon fractures: restoration of length, reconstruction of the articular surface, bone graft to fill metaphyseal defects, and internal fixation with plate and screws[8]. However, the allograft is indicated when the fracture is associated with a joint defect greater than 3cm[9].

The incisive reduction and external fixation and the open reduction and internal fixation present a comparable functional prognosis. However, the external fixation tends to have a higher risk of postoperative complications, including infection, osteoarthritis, and pseudarthrosis[4].

The donor areas of autologous osteochondral bone graft are restricted; therefore, for major defects, the allograft represents an option for the tibiotarsal joint with large osteochondral lesions of the talus[10]. Few articles describe this technique for tibial defects[11].

When there is a bone defect greater than 5cm, the allograft is an option to be considered for arthrodesis because the

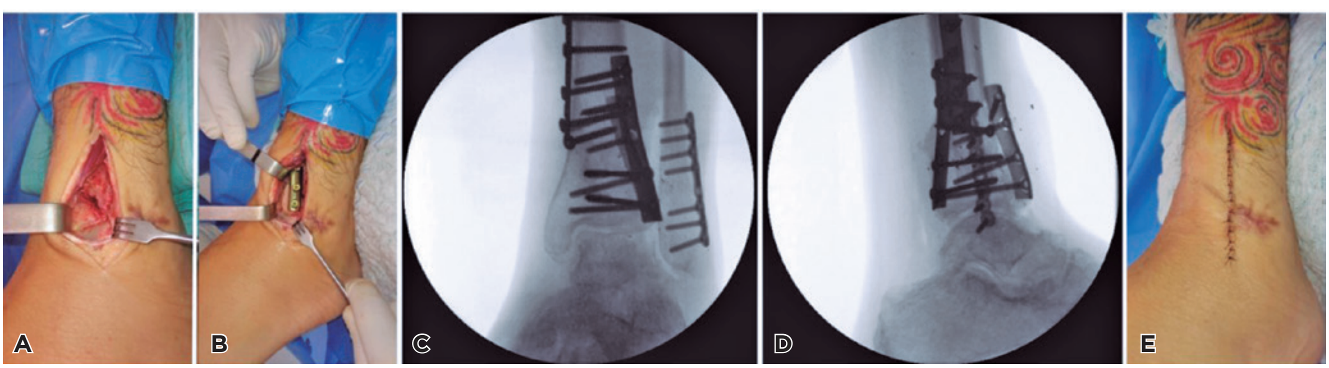

Figure 5. Third stage. A-B) Photographic images of the anterolateral view of the ankle with allograft positioned in the region of the osteochondral defect and method of allograft fixation. C-D) Fluoroscopic images in anteroposterior and lateral views of the ankle demonstrated allograft positioning and fixation method. E) Photographic image after suturing the anterolateral approach.

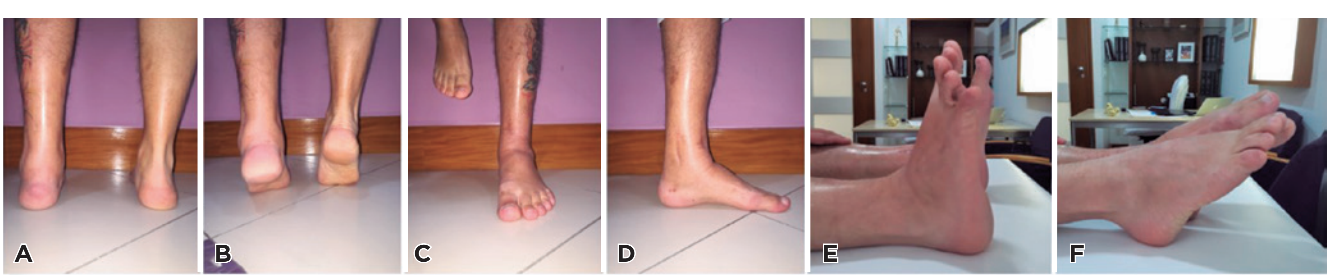

Figure 6. Six weeks after filling the osteochondral defect. A-F) Photographic images demonstrating patient with full weight-bearing without help and good ankle range of motion.

joint function can be preserved. Only two successful studies of this alternative in the literature were found[12,13]. Some complications inherent to this procedure, such as graft failure, arthrofibrosis, advanced osteoarthritis, and partial or complete osteonecrosis, are reported in the literature[10].

We describe a joint reconstruction technique using bone allograft with excellent postoperative recovery. Injuries of this type are rare, treatment experiences are not comprehensive and systematic, and treating these injuries is difficult, given the limited published literature available to guide surgeons.

Author's contributions: Each author contributed individually and significantly to the development of this article: SAEF *(https://orcid.org/0000-0002-3555-1334) Data collection, wrote the article; EAP *(https://orcid.org/0000-0001-6008-8671) Conceived and planned the activities that led to the study, approved the final version; FMO *(https://orcid.org/0000-0002-7961-7585) Interpreted the results of the study, approved the final version; LSRO *(https://orcid.org/0000-0002-0815-7999) Interpreted the results of the study, wrote the article; FCF *(https://orcid.org/0000-0002-8907-0472) Participated in the review process, approved the final version; ALGS *(https://orcid.org/0000-0002-6672-1869) Participated in the review process, approved the final version. All authors read and approved the final manuscript. *ORCID (Open Researcher and Contributor ID) iD.

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