SAS Journal of Surgery
Abbreviated Key Title: SAS J Surg
ISSN 2454-5104
Journal homepage: https://www.saspublishers.com

OPEN ACCESS

Surgery

Screw Fixation of an AO/OTA 43-C1 Tibial Pilon Fracture Through Two Minimally Invasive Approaches in a Young Adult: A Case Report

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DOI: https://doi.org/10.36347/sasjs.2026.v12i08.011 | **Received:** 17.06.2026 | **Accepted:** 10.08.2026 | **Published:** 25.08.2026

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Abstract **Case Report**

Background: Tibial pilon fractures are articular injuries of the distal tibia whose management must balance restoration of articular congruity, mechanical stability, and preservation of the soft-tissue envelope. We report an AO/OTA 43-C1 fracture treated with targeted fixation of the main fragments using five cancellous screws through two minimally invasive approaches. ***Case presentation:*** An otherwise healthy 18-year-old man sustained a high-energy motorcycle–car collision. On admission, his Glasgow Coma Scale score was 15/15. Examination showed complete functional impairment of the right lower limb, ankle deformity, and an approximately 1-cm superficial medial wound that did not communicate with the fracture site. Distal pulses were palpable. Radiographs and computed tomography demonstrated an AO/OTA 43-C1 fracture of the right tibial pilon with complete separation of the distal epiphyseal block, a large anteromedial fragment incorporating the medial malleolus, and an anterolateral Chaput fragment; there was no metaphyseal comminution, and the fibula was intact. On hospital day 1, after wound review, the fracture was reduced and fixed with two medial screws, two anteroposterior screws, and one independent screw for the Chaput fragment. The postoperative course was uncomplicated. At 3.5 months, bone union was satisfactory, with disappearance of the fracture lines on follow-up radiographs. Functional recovery was excellent; walking was pain-free, with only a mild reduction in plantar flexion compared with the uninjured side. ***Conclusion:*** In a selected patient with an AO/OTA 43-C1 fracture composed of clearly defined major fragments and a soft-tissue envelope suitable for early fixation, fragment-specific screw fixation through two limited approaches may achieve satisfactory reduction while minimising additional soft-tissue injury. Longer follow-up remains necessary to assess the definitive articular outcome.

Keywords: tibial pilon fracture; AO/OTA 43-C1; Chaput fragment; screw fixation; osteosynthesis; case report.

INTRODUCTION

Tibial pilon fractures involve the weight-bearing articular surface of the distal tibia and commonly result from high-energy axial loading. Management is challenging because these injuries combine articular disruption, metaphyseal injury, and variable compromise of the soft-tissue envelope [1–3]. Rüedi and Allgöwer were the first to describe a systematic approach to these injuries and established principles of articular reconstruction that continue to underpin current practice [4].

According to the AO/OTA classification, a 43-C1 injury is a complete articular fracture with a simple articular pattern and a simple metaphyseal component [5]. Computed tomography enables identification of the main fragments, definition of fracture-line orientation, and selection of the appropriate surgical approaches and fixation strategy [6,7]. Systematic fracture mapping has shown that these injuries follow reproducible patterns, allowing each approach to be planned according to the fragments it is intended to control [8,9].

Our department previously reported a series of 28 comminuted tibial pilon fractures treated by minimally invasive plate osteosynthesis, based on the principle that preserving the soft-tissue envelope and fracture haematoma reduces postoperative complications [10]. The present case explores another point on this spectrum: a simple articular pattern with two well-defined major fragments in which reduction could be achieved and maintained without a plate.

We report a closed AO/OTA 43-C1 fracture of the right tibial pilon associated with a separate superficial

non-communicating wound, treated early with multi-screw fixation through a medial approach and a limited anterolateral approach. This case report was prepared in accordance with the CARE guidelines [11].

Case Presentation

An otherwise healthy 18-year-old man was admitted to the emergency department after a high-energy road-traffic collision involving a motorcycle and a car. The reported impact sites were the head, right shoulder, and right lower limb, with an initial loss of consciousness of unspecified duration.

On admission, the patient was alert, with a Glasgow Coma Scale score of 15/15 and no focal neurological deficit. Musculoskeletal examination showed partial functional impairment of the right upper limb and complete functional impairment of the right lower limb, with visible ankle deformity. Distal neurovascular status was intact: distal pulses were present and well palpable, with no sensory or motor deficit.

Skin examination revealed an approximately 1-cm superficial wound on the medial aspect of the foot, with surrounding abrasions. Copious irrigation with normal saline followed by primary skin closure was performed immediately on admission. Exploration showed no communication with the fracture site; the fracture was therefore classified as closed. Tetanus immunisation was up to date. Amoxicillin–clavulanate 2 g was administered in the emergency department and repeated at induction of anaesthesia as surgical antibiotic prophylaxis.

Figure 1: Clinical appearance of the medial wound of the right foot in the original photographs. A: appearance on admission before local care. B: appearance after copious irrigation with normal saline and primary skin closure. Exploration showed no communication with the fracture site

Diagnostic assessment

The cranial and right-shoulder trauma work-up was unremarkable. Standard radiographs of the right ankle, followed by multiplanar computed tomography with three-dimensional reconstructions, demonstrated a complete articular fracture of the right tibial pilon, classified as AO/OTA 43-C1.

The entire distal epiphyseal block was separated from the metaphysis. The fracture consisted mainly of a large anteromedial fragment incorporating the medial malleolus and an anterolateral fragment corresponding to the Chaput tubercle. There was no metaphyseal comminution, and the fibula was intact. Computed-tomography-based fracture mapping guided the selection of complementary medial and limited anterolateral approaches.

Figure 2: Preoperative imaging. A and B: standard anteroposterior and lateral radiographs showing the articular fracture of the right tibial pilon. C and D: sagittal and coronal computed-tomography images defining the fracture morphology

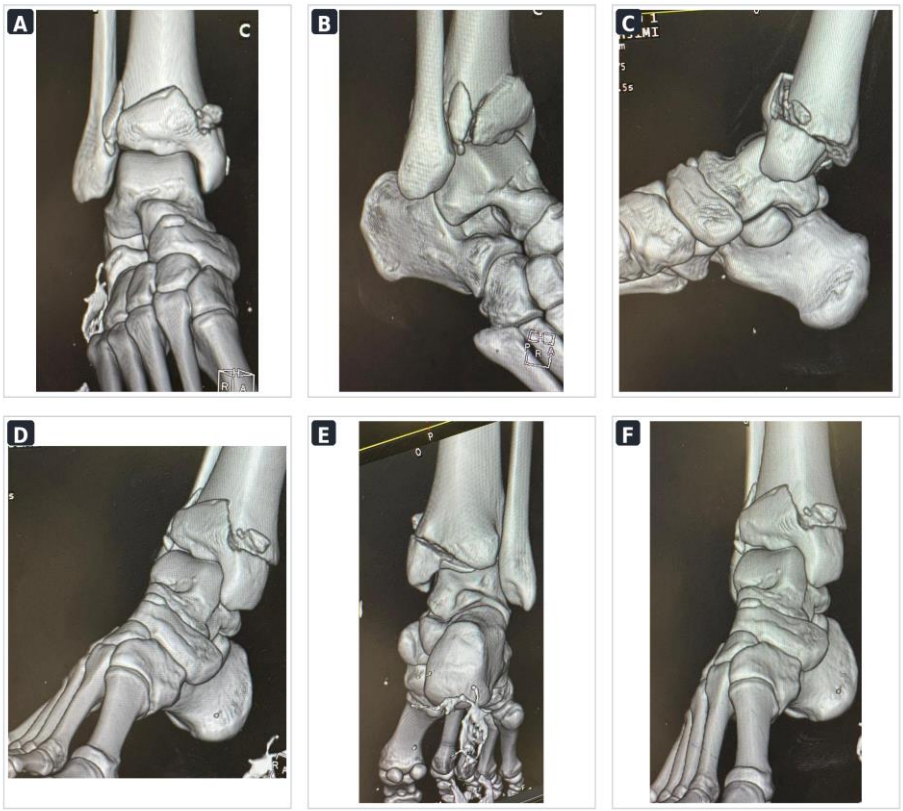

Figure 3: Preoperative three-dimensional computed-tomography reconstructions (A–F) showing the main articular fragments, particularly the large anteromedial fragment incorporating the medial malleolus and the anterolateral Chaput fragment

Surgical Technique

Definitive fixation was performed on hospital day 1. The patient was positioned supine with a pneumatic thigh tourniquet, under image-intensifier guidance. Operative time was 50 minutes. The superficial wound was first reviewed and debrided, confirming the absence of communication with the fracture site.

A 5-cm medial approach centred over the medial malleolus allowed reduction of the large anteromedial fragment incorporating the medial malleolus. The fragment was stabilised with two cancellous screws. A limited anterolateral approach was then used to insert two cancellous screws in an anteroposterior direction. The Chaput fragment was reduced and secured with a separate cancellous screw.

The final construct therefore comprised five cancellous screws: two for the medial fragment, two anteroposterior screws, and one dedicated Chaput screw. Immediate postoperative radiographs showed satisfactory reduction, restoration of articular congruity on the available views, and appropriate implant positioning.

Figure 4: Immediate postoperative radiographs. A: anteroposterior view. B: lateral view. The construct comprises five cancellous screws, with satisfactory maintenance of reduction and appropriate implant positioning

Postoperative course and follow-up

The immediate postoperative course was uncomplicated, with no cutaneous, infectious, vascular, or neurological complication. The patient was discharged on postoperative day 2 with analgesia and thromboprophylaxis using enoxaparin 4,000 anti-Xa IU subcutaneously once daily for six weeks. Dressings were changed every other day, and sutures were removed on postoperative day 21.

The right lower limb was kept non-weight-bearing for six weeks. At the 1-month follow-up visit, skin healing was satisfactory, with no local inflammatory signs. Radiographs showed maintained reduction and construct stability, without evident secondary displacement. Rehabilitation was initiated at this stage with passive ankle mobilisation.

Progressive weight-bearing was allowed from postoperative day 45. At 10 weeks, radiographs confirmed maintained alignment and no implant migration. At 3.5 months, the patient walked without pain. Clinical examination showed satisfactory dorsiflexion and a mild reduction in plantar flexion compared with the contralateral side.

Figure 5: Radiographic assessment at 1 month, showing maintained reduction and construct stability without evident secondary displacement

Figure 6: Radiographic assessment at 10 weeks, showing maintained alignment and no implant migration

Figure 7: Functional assessment at 3.5 months using the original photographs. A: dorsiflexion. B: plantar flexion, mildly reduced on the operated side compared with the uninjured side. C: return to pain-free walking

Timeline

Table 1: Clinical, therapeutic, and radiological timeline

Time	Clinical/radiological findings	Management	Outcome
Day of injury	Motorcycle–car collision; head, right-shoulder, and right-lower-limb impacts; initial loss of consciousness	Initial trauma assessment	GCS 15/15 on admission
Admission	Ankle deformity; superficial medial wound; distal pulses preserved	Copious irrigation, primary skin closure, antibiotic prophylaxis; trauma work-up	Non-communicating wound; cranial and shoulder work-up unremarkable
Initial imaging	AO/OTA 43-C1 fracture of the right tibial pilon	Radiographs, multiplanar computed tomography, and 3D reconstructions	Identification of the anteromedial and Chaput fragments
Hospital day 1	Closed fracture; soft tissues suitable for fixation	Wound debridement/review and fixation with five cancellous screws	Satisfactory radiographic reduction
Postoperative day 2	Uncomplicated postoperative course	Discharge; analgesia; enoxaparin 4,000 anti-Xa IU daily for six weeks; non-weight-bearing	No immediate complication
1 month	Satisfactory healing; no inflammatory signs	Passive ankle mobilisation initiated	Stable construct without secondary displacement
Postoperative day 45–10 weeks	Progressive weight-bearing followed by radiographic assessment	Progressive weight-bearing and continued rehabilitation	Alignment and implants maintained
3.5 months	Pain-free walking; mild limitation of plantar flexion	Functional rehabilitation	Satisfactory functional recovery

DISCUSSION

The AO/OTA 43-C1 pattern differs from C2 and C3 injuries by having less articular and metaphyseal comminution, which may allow reconstruction based on a limited number of major fragments [5]. In the present case, computed tomography identified a dominant anteromedial fragment and a Chaput fragment and enabled a fragment-specific fixation plan. The value of computed tomography in pilon fracture planning was highlighted by Tornetta and Gorup, who found that it changed the operative plan in 64% of cases, and by the anatomical work of Topliss et al., who demonstrated the reproducibility of the main fragment patterns [6,7].

Soft-tissue management remains decisive. In high-energy fractures with marked swelling, fracture blisters, or severe cutaneous compromise, staged management remains a reference strategy for reducing complications associated with definitive fixation [1,3,12]. Nevertheless, early primary fixation may be considered in carefully selected patients when the soft-tissue envelope is favourable and reduction can be achieved without extensive dissection [13–15]. In the largest series of early primary fixation of type-C fractures, the rate of deep infection or wound dehiscence was 2.7% among closed fractures [13]. In this case, the simple fracture pattern, absence of an open fracture, and locally acceptable soft-tissue condition supported definitive fixation on hospital day 1.

The two limited approaches were selected according to fragment location: the medial approach provided control of the fragment incorporating the medial malleolus, whereas the limited anterolateral approach facilitated anteroposterior screw placement and independent fixation of the Chaput fragment. Selection of surgical approaches for pilon fractures is now guided by fracture mapping rather than a predetermined template [9], and the combination used here reflects this principle. This strategy avoided plate fixation in this particular case. It should be considered in the context of our department's previous experience: in a series of 28 comminuted pilon fractures, minimally invasive plate osteosynthesis yielded good clinical and radiological outcomes while preserving the soft-tissue envelope [10]. The present case does not contradict that approach but rather represents the less complex end of the spectrum: when the articular pattern is simple and the major fragments can be reduced individually, the soft-tissue benefit of limited exposure may be achieved with screw fixation alone. However, a single case cannot establish the superiority of screw fixation over plate osteosynthesis or staged management; treatment must remain individualised according to fracture morphology, achieved stability, and soft-tissue condition.

The Chaput fragment carries the tibial insertion of the anterior inferior tibiofibular ligament [7]. Its independent reduction and fixation therefore serve both syndesmotic and articular purposes: restoration of the

fragment restores the ligament's bony attachment, and syndesmotic stability was achieved in this case. This consideration was one reason for preferring the anterolateral approach to indirect reduction of the lateral column.

The initial medial wound did not communicate with either the fracture site or the fracture haematoma. It therefore did not meet the criteria for Gustilo–Anderson classification, and the injury was described as a closed fracture associated with a separate superficial skin wound. This distinction is practical as well as terminological: had the fracture been open, the rationale for immediate definitive fixation would have been substantially weaker, because deep infection and wound dehiscence are several times more frequent after open injury, including in series supporting early fixation [13,14].

The early functional outcome was favourable; however, pilon fractures may lead to stiffness, persistent pain, and post-traumatic osteoarthritis despite satisfactory reduction [3,14,16]. In the series with the longest follow-up, the mean Foot and Ankle Outcome Score at approximately six years was 76.2 of 100, and 72% of patients reported satisfaction, underscoring that a good 3-month outcome does not predict the 6-year result [14].

The main limitations of this report are the short follow-up, the absence of postoperative computed tomography to quantify residual articular step-off or gap, and the lack of long-term radiographic assessment. Reduction is therefore described as satisfactory on the available views rather than anatomical, as no postoperative computed-tomography measurement was obtained. Longer follow-up is required to assess construct durability and the evolution of the tibiotalar joint.

Conclusion

This report describes a closed AO/OTA 43-C1 tibial pilon fracture in an 18-year-old patient, characterised by a large anteromedial fragment incorporating the medial malleolus and an anterolateral Chaput fragment. Fixation with five cancellous screws through a medial and a limited anterolateral approach resulted in satisfactory postoperative reduction and favourable early functional recovery.

This case highlights the value of computed-tomography-based fracture mapping, fixation tailored to each fragment, and careful selection of patients who may benefit from early fixation through limited approaches. The 3.5-month follow-up remains insufficient to assess the definitive articular outcome.

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