Role of Arthroscopy in Pilon Fractures: How and When do I do It?

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Abstract

Pilon fracture is usually a high-energy trauma involving the soft tissue and bone. Operative treatment of complex intraarticular fractures of the distal tibia was historically fraught with difficulty and high complications rates. The importance of adequate soft tissue management when dealing with these high-energy injuries has became well-recognized as a crucial factor in determining the success of such surgeries. Arthroscopic assisted reduction of the fracture is attractive as it is a minimally invasive approach with less surgical trauma to the soft tissue and provides direct visualization of the articular surfaces, assessment of reduction of the articular fragments and detection of associated chondral injury. However, it is also time-consuming, technically demanding and requires a long learning curve. Its role in the management of pilon fractures appears limited and requires further study.

Keywords: Ankle, Arthroscopy, Fracture, Pilon.

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Introduction

Operative management of complex intraarticular fractures of the distal tibia was historically fraught with difficulty and high complication rates.[1] Over the years, the importance of adequate soft tissue management when dealing with these high-energy injuries has become well-recognized as a crucial factor in determining the success of such surgeries. As a result, two-stage treatment protocols for treating high-energy tibial fractures became popular. Such protocols advocate for the first stage surgery to focus on restoration of fibular length with open reduction and internal fixation of the fibula, as well as external fixation of the distal tibia. The definitive internal fixation of the distal tibia will be arranged as a second-stage procedure once the soft tissue condition has stabilized.[2]

The concept of minimally invasive techniques was also introduced to reduce unnecessary surgical exposure and focus on the management of surrounding soft tissue. This is to better protect the fracture and its surrounding blood supply, leading to improved capacity for bone healing, reduced wound complications and improved functional outcomes.[3]

Authors' Preferred Technique of Arthroscopic Management of Pilon Fracture

Potential applications of arthroscopy in the treatment of pilon fracture include arthroscopic assessment of the quality of fracture reduction, arthroscopic-assisted reduction of the pilon fracture, as well as diagnosis and subsequent management of chondral lesions in the ankle mortise and talar dome.

One of the most suitable indications for arthroscopic management of the tibial pilon is the Tillaux fracture. The application of arthroscopy in the management of such fractures has been reported by various authors in pediatric and adult patients.[4–7] The Tillaux fragment is easily visualized by standard anterior arthroscopy, and fracture reduction can be readily performed *via* instrumentation through the anterolateral portal.[8] The use of arthroscopy in the management of articular triplane fractures has also been reported.[8–10] However, there is a limited indication for arthroscopic-assisted reduction of comminuted tibial pilon fractures. The use of arthroscopy is usually reserved for fractures with mild displacement, without significant articular depression or comminution.[8,11,12] For these cases, minimally invasive fixation, for example, percutaneous screw fixation and external fixation or minimally invasive plate osteosynthesis (MIPO) plating technique, should be feasible before considering arthroscopic assisted fracture reduction.[11,12] In cases where major plating is indicated for stable fracture fixation, open reduction of the fracture supplemented by arthroscopic assessment of fracture reduction is a more appropriate option.

Preoperative X-rays (Fig. 1) and computed tomography images (Fig. 2) of the injured ankle are important for planning the operation. First of all, the fibular fracture, if any, is reduced and fixed in order to restore the fibular length and anatomy. A simple uniplanar external fixator is constructed at the medial aspect of the ankle. The ankle is then distracted, and ankle arthroscopy can be performed *via* the anteromedial and anterolateral portals (Fig. 3). A 2.7 and 4 mm, 30° and 70° arthroscopes should be prepared. The articular surfaces are examined, and the articular fracture pattern is assessed. The most lateral articular fragment of the distal tibia

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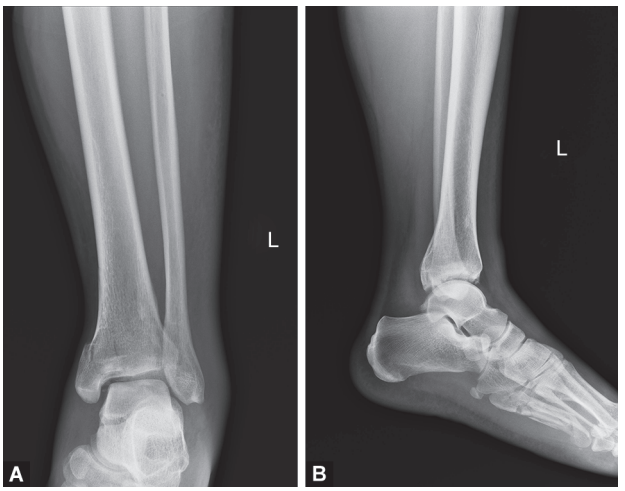
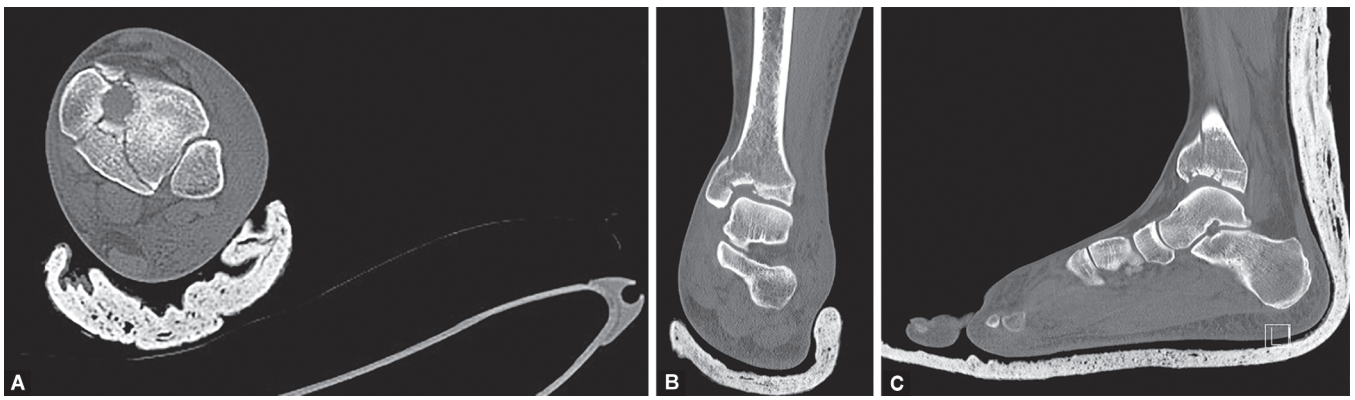
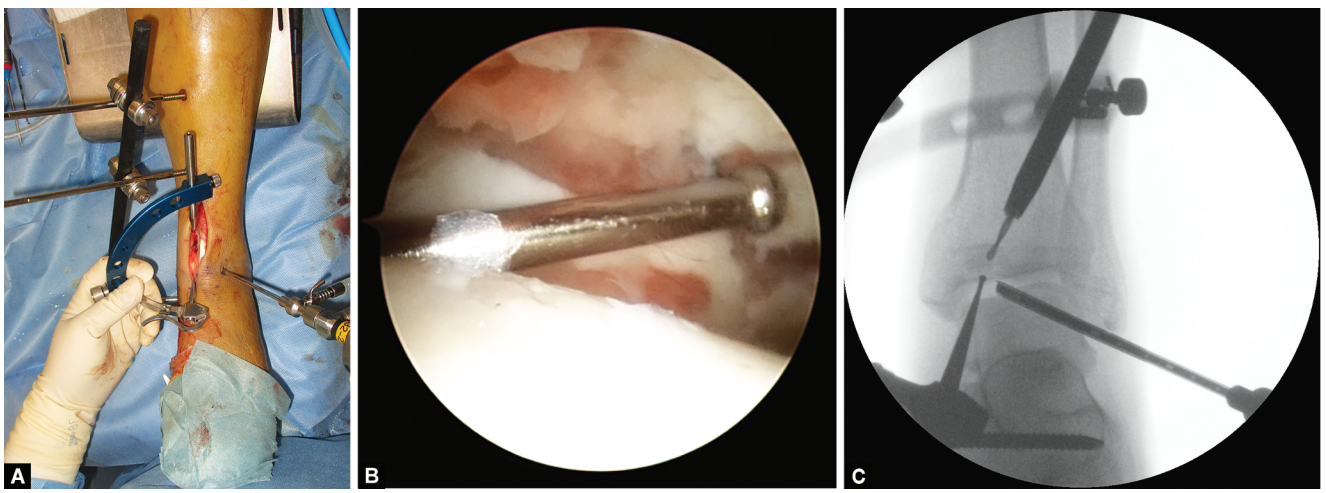


Figs 1A and B: Preoperative X-rays of the illustrated case showed the pilon fracture; (A) Anteroposterior view; (B) Lateral view

Fig. 3: The ankle is distracted with the ex-fix, and ankle arthroscopy is performed *via* the standard anteromedial and anterolateral portals



Figs 2A to C: Preoperative CT images showed the central depression of the pilon fracture; (A) Transverse view; (B) Coronal view; (C) Sagittal view



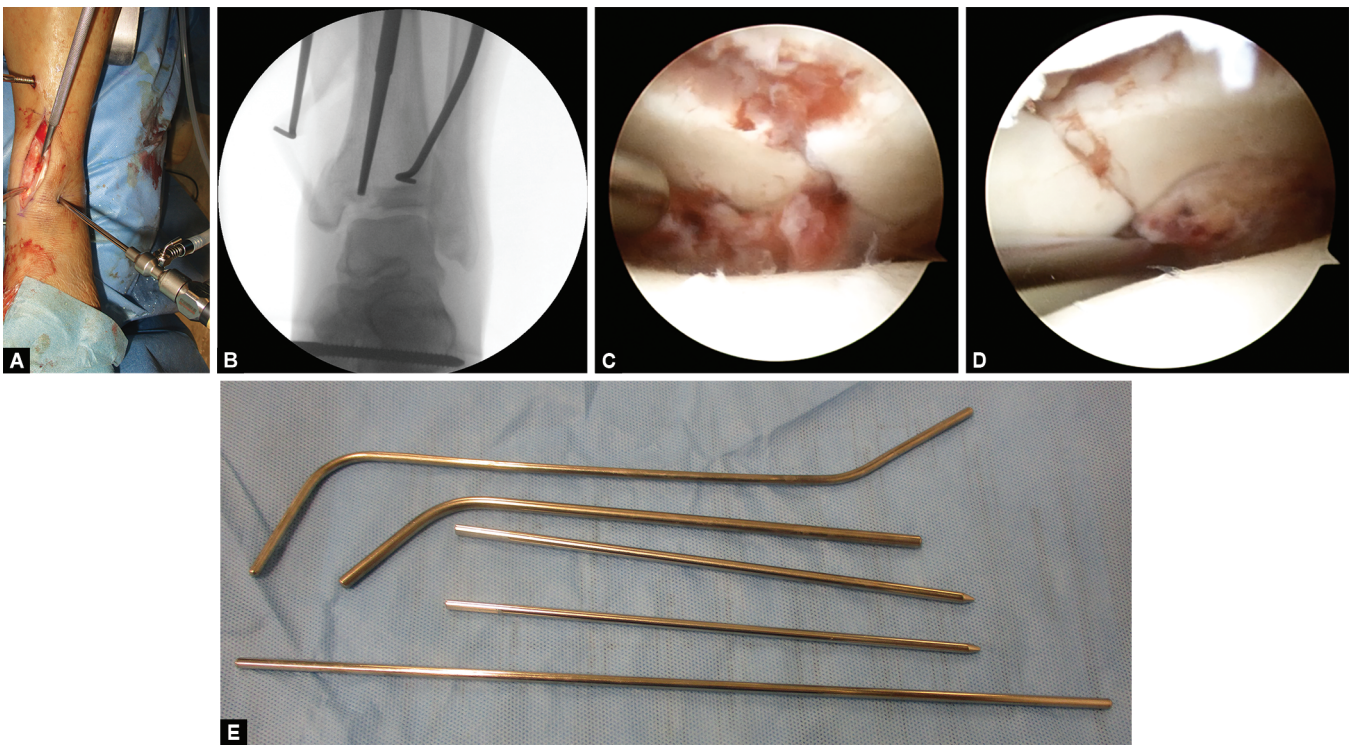
Figs 4A to C: (A) The central depressed fragment can be reduced with the aid of a Micro Vector drill guide (Dyonics); (B) The ball tip is placed at the depressed fragment, and a bone tunnel is created at the anterior tibia toward the fragment; (C) It is important not to drill through the fragment and should leave sufficient thickness of the fragment for subsequent fixation

that is attached to the fibula is the reference for the subsequent reduction of the more medial fragments. The peripheral fragments can be manipulated by K wire as a joystick and temporarily fixed with K wires. The central depressed fragment can be reduced with the aid of a Micro Vector drill guide (Dyonics). The ball tip is placed at the depressed fragment, and a bone tunnel is created at the anterior tibia toward the fragment. It is important not to drill through the fragment and to leave sufficient thickness of the

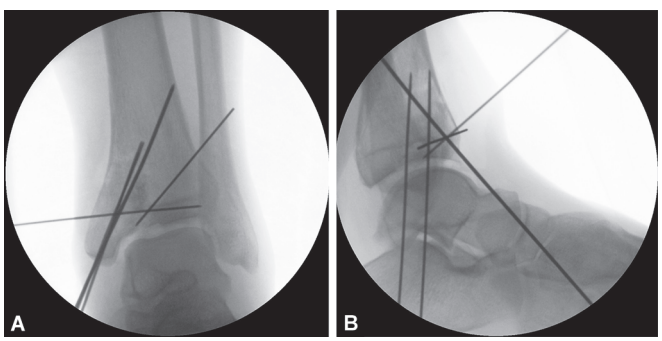
fragment for subsequent fixation (Fig. 4). Then, the depressed fragment is reduced by a punch under an arthroscopic and fluoroscopic guide. Steinmann pins prebent at different angles can also be used for the reduction of the depressed fragments (Fig. 5). The bone void area can be grafted *via* the bone tunnel, and all the fragments are temporarily fixed with K wires (Fig. 6). In this illustrated case, the fracture is fixed with screws and MIPO locking plate (Fig. 7).

Discussion

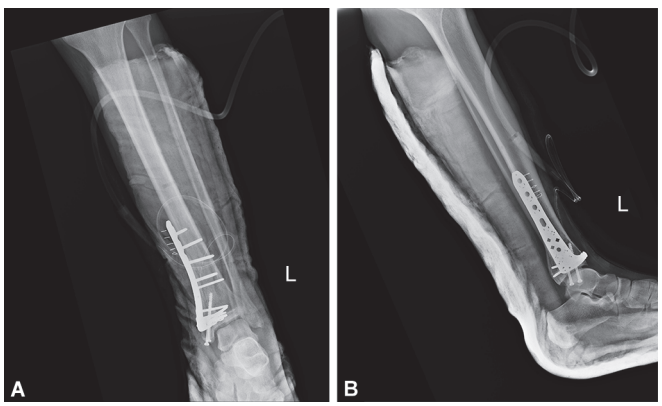
Existing literature and evidence regarding the role of ankle arthroscopy in pilon fractures appear to be scarce. Liu et al. conducted a randomized controlled trial in which 230 Chinese elderly patients with type III pilon fractures were assigned to receive either an external fixation with limited internal fixation or arthroscopic-assisted minimally invasive surgery.[13] They used standard ankle arthroscopy to assess the quality of the articular surface reduction, while another longitudinal incision was made at the distal tibia to allow instruments to be introduced to aid reduction. An external fixator was also applied for initial indirect reduction. The fractures were then fixed with minimally invasive plates and screws. Bone grafts were also used to fill up the metaphyseal defects. They found that patients who had arthroscopic-assisted minimally invasive surgery had better reductions, bone union, Mazur scores and lower prevalence of posttraumatic arthritis compared to those who had an external fixation with limited internal fixation. However, there was no difference in patient satisfaction, implant loosening and infection rates between the two groups.



Figs 5A to E: (A to D) The depressed fragment is reduced by a punch under arthroscopic and fluoroscopic guide; (E) Steinmann pins prebent at different angles can also be used for reduction of the depressed fragments



Figs 6A to B: Fluoroscopic views showed that the bone void area can be grafted *via* the bone tunnel, and all the fragments are temporarily fixed with K wires; (A) Anteroposterior view; (B) Lateral view



Figs 7A and B: The fracture is fixed with screws and MIPO locking plate; (A) Anteroposterior view; (B) Lateral view

Luo et al. described similar surgical techniques applied to 13 tibial pilon fractures.[14] All cases achieved fracture healing with no complications reported. Nine patients had excellent results, two patients had good results, and another two patients had poor results, according to the Mazur score. Those with poor outcomes had posttraumatic arthritis. The satisfaction rate was reported to be 85%.

Cetik et al. described the use of arthroscopy to aid in the reduction of the fracture fragments and restoration of the joint surface in one patient after a unilateral ex-fix had been applied for indirect reduction.[15] The fracture was then fixed with screws. Kralinger et al. described the use of arthroscopic-assisted minimally invasive reduction and percutaneous screw fixation in one elderly patient.[11] The patient was then given a short leg cast for 8 weeks. Both patients were described as having good functional outcomes after the surgeries.

El-Mowafi et al. conducted a randomized controlled trial involving 23 patients with closed pilon fractures fixed with Ilizarov external fixators.[16] The patients were divided into two groups. The first group had concomitant ankle arthroscopy done, while the other group did not. They found that the use of ankle arthroscopy did not lead to any statistically significant improvement in the outcomes.

The use of arthroscopy in intraarticular fracture fixation has the advantage of being minimally invasive and possessing high accuracy, but it is also time-consuming, technically demanding and requires a long learning curve.[17] Its role in the management of pilon fractures appears limited and requires further study.

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