Strategies for Surgical Approaches in Open Reduction Internal Fixation of Pilon Fractures

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Summary: Pilon or tibial plafond fractures usually result from high-energy injuries with rotation and/or axial compression. They occur in an area of relatively poor soft tissue coverage and frequently present a surgical challenge in deciding which incisions will be best for performing open reduction internal fixation. A variety of anterior and posterior approaches have been described based on the ease of fracture reduction and internal fixation with plates. Some of the incisions are fracture specific, that is, planned for a limited approach to the pilon. But in more complex cases, a wider exposure is indicated and thus more extensile approaches, both anterior and posterior, can be valuable. This review article will describe the different surgical approaches, focusing on their indication and technique.

Key Words: pilon, tibial plafond, distal tibia, surgical approaches, intra-articular distal tibia, anterolateral approach, extensile approach, anteromedial approach, posteromedial approach, posterolateral approach, modified posteromedial approach, open reduction internal fixation

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INTRODUCTION

Intra-articular fractures of the distal tibia, known as pilon or plafond fractures, frequently result from high-energy injuries with rotation and/or axial compression. They occur in an anatomic region where there is particularly poor soft tissue coverage, and thus, the first concern should be for the soft tissues and do no further harm (Fig. 1). The principle of delay between injury and definitive fixation, well described more than a decade ago,1–3 has substantially decreased soft tissue complications. An ankle-spanning external fixator, with pins placed in the tibia far proximally from the fracture, applied at the time of injury has become the standard of care (Fig. 2), with no attempt to directly approach the pilon fracture. Fixation of the fibula at the time of application of the external fixator, once thought to be essential,4,5 has become not so popular over time and less frequently advocated.6,7 Others8 are of the opinion that fixation of the fibula should be performed as the first step at the time of open reduction internal fixation (ORIF) of the pilon fracture. Surgical treatment should assure an anatomic reduction of the articular surface while respecting the soft tissue environment, and the osteosynthesis should be sufficiently stable to permit early mobilization. Preoperative planning with precise radiologic interpretation of the fracture is essential in managing these injuries. The complexity of the fracture demands evaluation by computed tomography (Fig. 3). The development of anatomically contoured plates with angular stability and the possibility of mini-invasive osteosynthesis for certain fractures have also contributed to improved outcome.

Pilon fractures are located in the distal segment of the tibia, from the flare of the metaphysis at the transition from diaphysis to metaphysis and extending into the ankle joint. They are classified as (Arbeitsgemeinschaft für Osteosynthesefragen) AO/OTA9 partial or complete fractures, 43-B and 43-C, respectively (Fig. 4). Types 43-A are also in this anatomic area but are extra-articular and therefore not considered as pilon fractures. From a surgical point of view, it is helpful to divide the distal tibia and plafond into 3 basic columns: medial, lateral, and posterior.10 In Figure 5, in orange, we see the medial column, which is the continuation of the medial side of the triangular diaphysis of the tibia. This column ends in the large subcutaneous medial malleolus, which is in continuity with horizontal articular surface of the tibial plafond. In blue is the lateral column, the prolongation of the anterolateral side of the triangular tibial diaphysis, which contains the notch for the fibula and ends in the tubercle of Tillaux–Chaput forming the anterolateral articular surface of the plafond. And in green is the posterior column, which is the continuation of the posterior triangle of the diaphysis of the tibia, ending in the large posterior malleolus, which descends further than the anterior margin of the articular surface.

The surgical approach to the pilon fracture is dictated by the location of the articular injury (column) and the mechanically appropriate fixation. The coronal plane deformity as a result of the fracture provides clues regarding areas of tension and compression failure. Three basic fracture patterns are seen, including (1) axial failure of the tibia with an intact fibula, (2) varus angulation of the tibia with tension failure laterally and compression on the medial side, and (3) valgus angulation of the tibia with compression laterally. Although more complex fractures with greater articular injury may require an approach that allows for visualization of the medial and lateral columns (the entire plafond), primary fixation will require plate fixation on the compression or...
concave side of the deformity. The plate in this position acts as a buttress. This review article will describe the different surgical approaches, focusing on their indication and technique. Although a wide variety of approaches have been suggested, we will concentrate on those that offer the best access for each particular fracture. Critically, as has been mentioned by others, one must be aware of the potential for damage to the vascular supply to bone and soft tissue from each of the proposed approaches.

SURGICAL APPROACHES

The Anterior Approaches

Minimally Invasive Approaches

The minimally invasive approaches (minimally invasive plate osteosynthesis, MIPO) are indicated primarily for extra-articular fractures (AO/OTA 43-A, which are not pilon fractures) or distal tibia fractures with a simple split into the articular surface (AO/OTA 43-C1). They play very little role in fractures with any greater degree of articular involvement. The general objective with a less invasive approach is not to expose the metaphyseal component of the fracture so as to avoid disturbing soft tissue and bone vascularity. The stability goal for this portion of the fracture is relative, allowing for limited motion at the fracture leading to callus formation, and not absolute with rigid fixation. However, the articular component of the fracture demands an anatomic reduction and absolute stability. The 2 basic minimally invasive approaches are medial and lateral, but the latter is fraught with increased danger to neurovascular structures.

Medial

The patient is placed supine on a radiolucent operating table. Typically, one can reduce the fracture by manual traction and proceed directly to fixing the tibia. In cases where the fibula is fractured and relatively noncomminuted, one can consider first performing ORIF of the fibula to help realign and stabilize the tibia before MIPO. For the fibula, an incision is made at the level of the fracture and fixation is achieved with a one-third tubular plate. For the tibia, an oblique 30-mm long incision is made at the tip of the medial malleolus extending from proximal anterior to distal posterior (Fig. 6A). The obliquity permits the incision to be prolonged toward the anterior metaphyseal area and articular surface to allow for direct reduction of any simple intra-articular split in this plane. A medial to lateral lag screw can thus be inserted to achieve compression at the joint before sliding the plate up the tibia. If necessary, a second limited incision can be made directly over the fracture if the split is in another plane. Careful dissection through the subcutaneous tissue reveals a thin layer of fibrous tissue. It is just under this layer, and above...
the periosteum, that a scissor should be inserted and slid proximally. A drill guide is attached to the most distal hole of the plate to act as a handle for plate insertion. The plate is placed into the layer created by the scissor and slid proximally on top of the periosteum (Fig. 6B). The position of the plate along the subcutaneous border of the tibia is determined by palpation. One must resist the strong tendency for the plate to slide posteriorly. The first step is to accurately determine the position of the distal end of the plate, which should extend approximately halfway along the medial malleolus but not as far as the tip. Once this is correctly determined with the help of the C-arm, a temporary Kirschner wire (K-wire) is introduced into the drill guide that is already in place. The goal is to secure the plate in the distal metaphysis. The next step is to assess the sagittal position of the plate proximally. This is easily done by making a small incision at the proximal end of the plate that can be easily palpated or seen with the C-arm. At this point, one must be sure that the fracture is reduced, specifically with regard to length and rotation, and then temporarily fix the plate proximally with another provisional K-wire. Once the plate is secured to the bone at both ends, one must control for any flexion or extension deformity occurring at the fracture. If there is an extension deformity, one helpful maneuver is to place a rolled sheet beneath the leg just proximal to the fracture. Conversely, if there is a flexion deformity, the rolled sheet is placed posteriorly just distal to the fracture site.

At this point, one needs to use the C-arm to evaluate frontal plane alignment. If the alignment is satisfactory, then one must be careful in using the nonlocked screws in situations where the plate is not firmly against the bone. Otherwise, the standard screw will pull the bone to the plate and may create a varus or valgus deformity. On the other hand, if there is mild frontal plane malalignment, a standard nonlocked screw should be inserted first as a “reduction screw” to correct the alignment via indirect reduction (Fig. 6C). At this point, locked screws are inserted proximal and distal to the fracture in an alternating fashion. The entire length of the plate holes at the level of the fracture is left empty (Fig. 6D). In those cases where a reduction screw was used, it should be removed so as not to have any screws too close to the fracture. Again, this is to support the concept of relative stability. In those cases where the reduction cannot be achieved in this minimally invasive fashion, one can

FIGURE 3. Computed tomography scan of complex pilon fracture with the articular surface in more than 2 pieces. Top is frontal, middle is sagittal, and bottom is axial.
extend the proximal limb of the oblique incision and perform a limited open reduction. The wound is closed in standard fashion (Fig. 6E).

**Anterolateral**

For single-plate osteosynthesis using a minimally invasive approach, it is preferable to use the medial approach as described above. A cadaveric study was performed to determine the potential for injury to the superficial peroneal nerve and the pedicle containing the deep peroneal nerve and anterior tibial artery and vein using an anterolateral MIPO approach. The results showed that the superficial peroneal nerve was not at risk, but the deep peroneal nerve and anterior tibial vessels were clearly so. It was possible to trap the neurovascular bundle beneath the plate if it was not kept just on top of the periosteum and also injure these structures by inserting screws in a “stab wound” fashion. Thus, MIPO for the distal tibia is best performed medially, and the anterolateral plate placement should be performed as a limited open procedure visualizing the neurovascular structures (see below).

**Anteromedial Approach**

The anteromedial approach was popularized by the AO. The indication for the anteromedial approach is typically for the fracture of the medial column of the distal tibia. It provides access to the medial malleolus and to the medial and middle thirds of the anterior tibiotalar joint. The anterior marginal fractures are also addressed through this approach.

It does not provide an easy access to the lateral column, and therefore, it is not an approach of choice for those fractures because of the fact that it requires excessive traction on the fragile soft tissues to adequately visualize and reduce the Chaput fragment and perform lateral plating. Such fractures may require an approach to both sides of the articular surface using 2 incisions, and the AO approach may provide the medial exposure. The patient is placed supine on a radiolucent operating table. The incision begins 15 mm distal to the tip of the medial malleolus and gently curves anteromedial crossing the tibiotalar joint in its middle third and extends proximally along the subcutaneous border of the tibia (Fig. 7A). The branches of the saphenous nerve and the saphenous vein are found in the subcutaneous tissue and spared if possible. The developed fasciocutaneous flap is mobilized en bloc. The extensor retinaculum is visualized and incised vertically medial to the tibialis anterior tendon, and care should be taken not to open the sheath of this tendon (Fig. 7B). The ankle joint is opened anteriorly. The fracture fragments are identified and reduced in standard fashion. Those characterized by a simple split should be treated with compression lag screws perpendicular to the fracture line(s) and application of a neutralization plate. This can frequently be a small fragment antiglide plate that can be placed anterior to prevent the proximal gliding of the articular fragment. In cases of articular impaction, the subchondral bone and articular fragments are disimpacted, anatomically reduced, and temporarily stabilized with K-wires. The reduced articular surface is supported by autologous graft taken from the proximal tibia or iliac crest. Intraoperative C-arm control is mandatory to ensure anatomic reduction of the articular surface. If possible, independent...
lag screws are used to rigidly fix articular fragments. An anatomic medial metaphyseal plate with locking screws is applied to the medial column. This 2-plate fixation of the medial column is seen in Figure 7C. The retinaculum and subcutaneous tissue are closed with 2-0 resorbable sutures, and the skin is carefully closed with interrupted nylon sutures after the method of Allgöwer.

**Anterolateral Approach**

The anterolateral approach is indicated for pilon fractures that involve the lateral column. It may be indicated in anterior and anterolateral type B fractures, in type C fractures with articular damage laterally, and in those cases with a valgus deformity thus requiring a lateral buttress plate. It provides access to the lateral and middle thirds of the anterior tibiotalar joint but does not provide access to the medial column. Thus, it is not suitable in fractures with medial comminution, medial crush with impaction at the medial corner of the joint, or varus deformity where a medial buttress is required. These situations may require an approach to both sides of the articular surface, either with 2 incisions or an extensile approach as described below. When the lateral column fracture is associated with a fibular fracture, ORIF of both fractures can be done through a single incision. Other authors have suggested 2 separate incisions, one posterolateral for the fibula and the other anterolateral for the pilon. If this is done, one must be careful about the skin bridge between the 2
incisions and thus we favor a single anterolateral approach for both fractures.

The patient is placed in the supine position. An incision is begun 4 cm distal to the ankle joint and extended proximally along the anterior border of the fibula to a point above the most proximal extent of the tibia fracture (Fig. 8A). The incision is carried down to the anterior border of the fibula, taking care to protect the superficial peroneal nerve. It is preferable not to fix the fibula first so that the fractures can be displaced to improve visualization and reduction of the tibia. Next, careful blunt dissection over the anterior border of the fibula is carried out to the interosseous membrane and the plane between the interosseous membrane and the overlying contents of the anterior compartment is developed with a large elevator or finger; thus, the muscles of the anterior compartment are retracted medially (Fig. 8B). This will protect the neurovascular bundle that moves together with the anterior compartment muscles. At the joint level, the anterior syndesmotic ligament is identified on the fibula and followed medially to the anterolateral Tillaux–Chaput fragment (Fig. 8C). This (usually large) fragment is hinged laterally to allow visualization and reduction of the posterior articular surface and posterior column. The articular surface is disimpacted and anatomically reduced, often progressing from posterior to anterior and lateral to medial. Temporary K-wires are placed to maintain the reduction, and cancellous autologous bone may be used to support the reduced articular surface. Posterior or lateral column reduction requires further visualization proximal to the joint that can be achieved by elevating the contents of the anterior compartment. At this point, the fibula can be reduced and stabilized with a small fragment plate (Fig. 8D). An anatomic anterolateral metaphyseal plate with locking screws (3.5, 4.0, 5.0 mm) is carefully positioned just proximal to the distal tibia articular margin and passed submuscularly up the lateral surface of the tibia. Finally, the soft tissues are carefully closed in routine fashion (Fig. 8E).

Lateral Approach

The indications and contraindications for the lateral approach as described by Grose et al are the same as that of the anterolateral approach. Although the incision and initial dissection differ, the deep portion of the lateral approach arrives at the same location as the anterolateral one. An incision is made along the anterior border of the fibula from above the most proximal extent of the fracture (tibia or fibula) and extending distally 3 cm below the ankle joint. Anteriorly, one must take care to avoid injuring the superficial peroneal nerve. The fibula can be reduced and fixed at this point, if desired. The plane between the interosseous membrane and the overlying anterior compartment is developed bluntly with use of a periosteal elevator. Dissection is continued anteriorly, medially, and distally exposing the anterior tibia and the ankle joint, as with the anterolateral approach. The anterior inferior tibiofibular ligament is identified and followed medially to the fragment of Tillaux–Chaput. Manipulation of this fragment will allow for improved visualization of the tibial plafond. The remainder of the procedure follows the one described above for the anterolateral approach.

Extensile Approach

The extensile approach is indicated for the group of fractures that result in a complete separation of the 3 columns of the tibia from the metaphysis or diaphysis. No portion of the articular surface remains in contact with the shaft, and there is usually extensive joint comminution. Up until recently, there was no single incision described that permitted simultaneous exposure of the medial and lateral columns. The AO anteromedial approach in its original description offers excellent visualization of the medial column but does not provide for good access to the lateral column and fracture of Tillaux–Chaput. The anterolateral approach, while offering very good exposure to the lateral column, does not allow for excellent visualization of the medial column. The extensile


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approach provides complete access to both medial and lateral columns through a single incision and offers the advantage of plate placement medial, lateral, and/or anterior. For those fractures with proximal extension, the plates can be passed subcutaneously from distal to proximal through the open joint incision. It is a useful surgical approach in those fractures involving more than one column; however, it is not necessary for fractures of one column (type 43-B) or those that are extra-articular (type 43-A).

The incision is begun 10 mm below the tip of the medial malleolus and proceeds transversely across the ankle to a point just lateral to the midline and then turns at a 110-degree angle (and not more acute), proceeding proximally 10 mm lateral to the tibial crest (Fig. 9A). Thus, the incision lies lateral to the tibialis anterior tendon. The vertical limb of the incision can be extended as proximally as desired. In situations with more extensive injury to the lateral column of the distal tibia, the point of the turn can be moved a bit more laterally. The incision is carried down through the subcutaneous tissue, and a full-thickness flap is elevated. The incision continues onto the extensor retinaculum exposing the underlying tibialis anterior tendon. The retinaculum is incised, with an attempt to leave the tibialis anterior tendon undisturbed in its sheath (Fig. 9B). The full-thickness flap is retracted medially, whereas the tendon of the tibialis anterior is retracted laterally (Fig. 9C). At the level of the ankle joint, the articular capsule is opened longitudinally, exposing the talus. Subperiosteal dissection exposes the ankle joint and fracture site, and retraction of the tissues laterally exposes the entire lateral articular fragment of Tillaux–Chaput (Fig. 9D).

The articular surface is reconstituted progressively, frequently beginning with any displaced lateral column fragments (Tillaux–Chaput). The reduction proceeds from posterior to anterior and lateral to medial, and the articular fragments are provisionally stabilized with K-wires. Once the articular block has been reconstituted, it is joined to the proximal fragment. Specific plate placement is determined by the nature of the fracture, but frequently 2 plates are used, one anterolateral and the other medial. For proximal extension of the fracture, the plates are introduced through the open incision and slid proximally in a subcutaneous fashion (Fig. 9E). It is important that one plate be placed on the compression (concave) side of the fracture to act as a buttress. The holes in the plate can be easily palpated and screws inserted through small incisions. To fill the metaphyseal defect and support the reconstructed articular surface, autologous bone graft may be added. If desired after fixation of the pilon, the fibula can be fixed with a small fragment plate.

Closure of the wound begins with the extensor retinaculum, the subcutaneous tissue, and then the skin with interrupted 3-0 nylon sutures using the technique of Allgöwer (Fig. 9F).

The Posterior Approaches

A variety of posterior approaches to the ankle have been described. These were generally for trimalleolar fractures (Danis–Weber type B or C) with a large posterolateral fragment, the so-called Volkmann’s triangle. More often, the posterior fragment is lateral and was termed a “posterior pilon” fracture by Hansen. Fractures of the posteromedial corner have been well reported. These fractures have been approached through posterolateral or posteromedial approaches. But for the true pilon fracture and not the trimalleolar fracture, the first question to answer is why go posterior in ORIF of pilon fractures? Generally, reduction and fixation of the posterior column is performed from the front. In most cases, the standard anterior incisions allow for reduction of the posterior pilon either directly or indirectly. However, we see as the primary indication for going posterior at the outset of reconstruction is when there is extensive comminution of the posterior column (metaphyseal/diaphyseal) with shortening and malalignment. In such cases, it is

![FIGURE 9. Extensile approach. A, Outline of incision from 10 mm below the tip of the medial malleolus transversely across the ankle just lateral to the midline and then turns to continue proximally 10 mm lateral to the tibial crest. B, Retinaculum is incised with an attempt to leave the tibialis anterior tendon undisturbed in its sheath. C, Full-thickness flap is retracted medially, whereas the tendon of the tibialis anterior is retracted laterally. D, Retraction of the tissues laterally exposes the entire lateral articular fragment of Tillaux–Chaput (arrow). E, Plates are introduced through the open incision and slid proximally in a subcutaneous fashion. F, Skin closure using the technique of Allgöwer.](image-url)
necessary to reestablish the correct length and axial and rotational alignment so the posterior column can serve as the template to reduce the anterior pilon. A number of posterior approaches have been described, including posterolateral, posteromedial, and modified posteromedial.

**Posteromedial Approach**

The posteromedial approach is not commonly required for the fixation of pilon fractures. Occasionally, it can be useful for posterior pilon fractures with an intact anterior plafond or those pilon fractures with a large posteromedial fragment. The patient can be placed supine with a bump under the contralateral buttock to externally rotate the limb, or prone. The basic incision is centered at the ankle joint between the tendo Achilles (TA) and the posteromedial border of the distal tibia (Fig. 10A). Proximally, the incision parallels the posteromedial border of the tibia, and distally, it parallels the path of the posterior tibial tendon (PTT). Deepening the incision through the subcutaneous fat and fascia reveals the deep fascia (Fig. 10B) over the PTT and flexor digitorum longus, the posterior tibial neurovascular bundle, and the flexor hallucis longus (FHL) tendon. For access to the posteromedial quadrant of the distal tibia, it is necessary to carefully incise the deep fascia proximally, protecting the neurovascular bundle (Fig. 10C). The interval used for deep dissection is dependent on the location of the major fracture fragments. In some cases, it is between the posterior border of the tibia and the PTT. This is useful for proximal exposure only because the distal PTT and its retinaculum should be left undisturbed from the posterior tibia. It may also be between the PTT and the flexor digitorum communis. And a third possibility is between the flexor digitorum longus and FHL, which requires direct exposure and protection of the neurovascular bundle along its length as it is retracted posterolaterally (Fig. 10D). The neurovascular bundle can be retracted anteromedially or posterolaterally. A posteromedial plate can be placed to buttress a posteromedial fragment. The posteromedial approaches do not provide good access, visualization, and plate placement for those posterior fractures that extend laterally. In addition, the fibula cannot be fixed through this incision.

**Posterolateral Approach**

The posterolateral approach has been well described.\textsuperscript{20,25} It is usually performed with the patient prone. For simpler posterior fragments that are really part of a malleolar fracture pattern and not a true pilon fracture, the patient can be placed supine with a bolster beneath the ipsilateral buttock to roll the affected limb into internal rotation. The approach allows for only indirect reduction of the posterior articular surface by reduction of cortical fragments of the posterolateral metaphysis and diaphysis. However, when there are major fracture fragments posterior, this approach allows for direct reduction of diaphysis and metaphysis to regain length and rotation. This allows for the posterior pilon to provide a template for reduction of the anterior pilon to an intact posterior plafond. The incision (Fig. 11A) is begun midway between the lateral border of the TA and the posterolateral border of the fibula, extending as far proximally as required to reduce the posterior column with regard to reestablishing correct length. Care must be taken not to injure the sural nerve. The deep fascia is opened, and blunt dissection is carried out between the peroneal tendons and the FHL (Fig. 11B). The peroneus brevis and the longus are retracted anterolaterally as the plane is developed medial to the peroneal tendons and lateral to the FHL. An incision (Fig. 11C) is made through the lateral fibers of the FHL to elevate it off back of the fibula, interosseous membrane, and posterior tibia. Thus, the lateral portion of the posterior aspect of the tibia, posterior column, and plafond are visible (Fig. 11D). Fixation of more medial fragments through this incision will be difficult and require more forceful soft tissue retraction. In such cases, a separate medial incision will be necessary.\textsuperscript{11} Proximally, the muscles are dissected off the interosseous membrane. Reduction of the posterior column as regards length and alignment can be performed directly with fixation by plates directly on the posterior column. At

![FIGURE 10. A, The incision is centered at the ankle joint between the TA and posteromedial border of the tibia. B, Exposure of the deep fascia over the PTT and flexor digitorum longus, posterior neurovascular bundle, and FHL. C, Following incision of the deep fascia the neurovascular bundle is visible and must be protected. D, Posterolateral retraction of the neurovascular bundle.](image-url)
the level of the joint, large posterolateral fragments can be rotated on their intact ligamentous hinge to visualize the articular surface and reduce impacted fragments. Fixation of this posterior fragment can be performed with antiglide plates and lag screws. The fibula can be fixed directly through this approach by retracting the peroneal muscles posteromedially.

**Modified Posteromedial Approach**

An option to expose the entire posterior pilon is to perform a modified posteromedial approach. This provides visualization from medial to lateral without extensive soft tissue retraction. The cross-sectional anatomy of the pilon shows the surgical approach medial to the TA and FHL (Fig. 12, green arrow). The incision (Fig. 13A) is begun just proximal to the insertion of the TA on the calcaneus, 1 cm medial to its border, and extended proximally for a distance of 12 cm. The superficial fascia is opened exposing the TA and the distal portion of the soleus muscle. The TA is retracted laterally with care taken to preserve the sheath of the tendon. At this level, muscular fibers of the soleus may be encountered attached to the deepest part of the TA and are retracted along with the tendon. The bulk of the PTT is retracted medially. We have not exposed the posterior column more proximally than the junction of the middle and distal thirds of the tibia. Blunt dissection is carried down to the transverse intermuscular septum that constitutes the floor of the superficial posterior compartment (Fig. 13B). This septum separates the posterior superficial compartment from the deep posterior compartment. The septum is cut longitudinally in the midline providing access to the deep posterior compartment, and the tendon and muscle belly of the FHL are seen. The tibial nerve is visible at this point along the medial border of the FHL (Fig. 13C). The interval is developed between the medial border of the FHL and the tibial nerve. The FHL is retracted laterally. With further retraction of the FHL, the entire metaphyseal region of the posterior tibia is visualized, along with the posterior ankle capsule, the posterior syndesmosis, and the posterior aspect of the medial and lateral malleoli (Fig. 13D). Plates can be applied directly on the posterior aspect of the plafond and column and also the more proximal (meta-diaphyseal) tibia (Fig. 13E). If desired for reduction and fixation of an associated fibula fracture, the...
FHL can be retracted medially and the peroneal tendons laterally exposing the desired length of fibula (Fig. 13F). There is good visualization and exposure to allow screw placement from multiple angles. Continuing the dissection proximally in the same interval exposes the posterior meta-diaphyseal tibia and the posterior column further proximally as necessary (Fig. 13G). This approach goes through intermuscular planes and is not an internervous approach.

Reduction of the displaced and shortened posterior fragments is accomplished by direct visualization, assisted by the presence of the external fixator providing traction and alignment. The objective is to recreate the posterior anatomy of the tibia, with particular importance paid to achieving proper length. We usually stabilize the posterior column with a long small fragment locking T-plate but have also used a 2.7-mm reconstruction plate. The plate should be long enough to secure bicortical screw purchase on the intact proximal tibia. The distal screws at the level of the pilon should be relatively short so as not to interfere with anterior reduction and fixation. After we are satisfied with the reduction and fixation posteriorly, the wound is closed in routine fashion. Skin sutures are placed with the Allgöwer\textsuperscript{13} modification of the Donati technique that allows for close approximation of the wound edges without undue tension.
DISCUSSION

The aim of this review is to describe the different surgical approaches for reduction and fixation of pilon fractures. It should be clear to the reader that there are a number of factors to consider, never forgetting the importance of the soft tissues. Surgeon experience and hence surgeon preference will also play a substantial role in the decision-making process. We have endeavored to outline those surgical approaches that would be of the most important clinical relevance. At times, a combination of these approaches may be necessary, such as in those situations where one is required to go both posterior and anterior as well described in the current literature.12,20 A solid understanding of the bony and soft tissue anatomy, the nature of the fracture as established by computed tomography scan, thorough preoperative planning with drawings, and sound knowledge of the different surgical approaches will help to ensure a satisfactory outcome even in the most difficult cases.

REFERENCES