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Posterolateral Approach for Treatment of Posterior Malleolus Fracture of the Ankle

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ABSTRACT

Treatment of the posterior malleolus has been debated among orthopedic surgeons. Most orthopedic surgeons will fix the posterior malleolus if it is larger than 25% to 30% of the distal articular surface. The most common method of fixation of the posterior malleolus is by indirect reduction and anteroposterior screws. In the present study, we describe the technique and results of treatment of the posterior malleolus by direct reduction through the posterolateral approach to the ankle. The decision to fix the posterior malleolus was determined by its size and displacement. A total of 12 consecutive patients underwent the posterolateral approach to reduce the posterior malleolus, and these were fixed by posterior plate. Two patients were lost to follow-up in the early postoperative period (both after 2 months). No deep infection or wound dehiscence occurred. Ten patients had adequate (<2-mm displacement of the articular surface) radiologic reduction at the final follow-up visit. There were 2 cases of 2 mm or more of articular surface displacement at the final follow-up visit (1 patient had 2-mm displacement noted in the immediate postoperative period and 1 patient had adequate reduction in the beginning but was displaced with additional follow-up). The posterolateral approach to the ankle is a useful tool to treat certain cases of posterior malleolus fracture. It allows good visualization and stable fixation of the posterior malleolus.

Posterior malleolar fracture is an important element of some ankle fractures. No consensus has been reached on the treatment of the posterior malleolus fracture. Traditionally, the decision regarding the surgical fixation of the posterior malleolus depended on its size. Small avulsion fractures usually do not need surgical stabilization of the posterior malleolus; however, larger displaced fragments of the posterior tibial plafond involving more than 25% to 30% of the articular surface require surgical reduction and stabilization (1–8).

No universal consensus has been reached on the best method to reduce and stabilize the posterior tibial malleolus. Indirect reduction with stabilization of the posterior malleolus using anteroposterior screws is the most common method of fixation of the posterior malleolus among orthopedic surgeons (8,9). Different approaches have been described for fixation of the posterior malleolus (9–14). Recently, interest has been growing in obtaining direct reduction and fixation of the posterior malleolus from the posterior surface using a posterolateral approach to the ankle (7,14–17). Despite this growing interest, the studies describing the result of this approach are very limited (7,15,18).

Our hypothesis is that the use of the posterolateral approach for the treatment of certain types of posterior malleolus fracture can lead to good results with a low incidence of complications. The purpose of the present study is to describe the technique and our results using the posterolateral approach to reduce and stabilize posterior malleoli in the surgical treatment of ankle fractures.

Patients and Methods

This was a retrospective consecutive case series study. We included all patients who had undergone a posterolateral approach for the treatment of a posterior malleolar fracture from 2003 to 2009. The institutional review board approved the present study. A total of 12 patients were included in our study. The mean patient age was 41 (range 20 to 61) years. Of the 12 patients, 10 were men and 2 were women. Three patients had undergone application of a temporary spanning external fixator shortly after injury until definitive fixation surgery. The indication to reduce and stabilize the posterior malleolus was determined by its size and amount of displacement. Fixation of the posterior malleolus was done if the fragment was more than 30% of the tibial plafond and the posterior malleolus was displaced more than 2 mm after closed reduction of the ankle. No medical comorbidities were considered as an indication or a contraindication to using the posterolateral approach to the ankle. Of these 12 patients, 2 had previous open reduction and internal fixation of the ankle fracture and had presented with posterior subluxation of the ankle in the early postoperative period. Of the 12 patients, 10 were followed up until bone healing, and 2 were lost to follow-up before

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bone healing (both after 2 months). The mean follow-up period was 5.3 (range 2 to 72) months.

We reviewed the medical records and radiographs of the patients. The surgical procedure, reduction of the fracture, early complications, and wound healing were assessed.

Surgical Procedure

The patients were positioned prone with the tourniquet applied over the proximal thigh. A posterolateral approach was used. The skin incision was midway between the lateral border of the Achilles tendon and the fibula. The sural nerve was identified and protected. The sural nerve courses the lateral border of the Achilles tendon (going from medially to laterally) approximately 10 cm proximal to the Achilles tendon insertion. However, the sural nerve anatomy is highly variable, and the surgeon should perform meticulous blunt dissection to avoid injury of the nerve and its branches (16,19,20). Deep dissection proceeded between the flexor hallucis longus medially and the peroneal tendons laterally. The posterior surface of the fibula can be reached by retraction of the peroneal tendons laterally, and the plate should be applied posteriorly. The posterior surface of the tibial can be reached by retraction of the flexor hallucis longus and the deep posterior compartment medially. Reduction can be obtained by direct manipulation of the fracture fragment and by traction on the foot and dorsiflexion of the ankle. The extra-articular fracture line is used to guide the articular reduction. Intraoperative fluoroscopy was used to assess the quality of the reduction. A buttress plate was applied on the posterior surface of the tibia to fix the posterior malleolus.

A separate medial incision was used to treat the medial malleolar fracture. An assistant held the leg with the knee flexed. The medial malleolus was reduced and fixed with partially threaded screws (regular or cannulated).

Postoperatively, the leg was immobilized in a splint or cam boot. The sutures were removed after 2 weeks and the range of motion exercises started. Weight bearing was begun by 10 weeks postoperatively when advancing signs of union were seen on the radiograph (Fig. 1).

Results

All 12 patients had a posterolateral approach to reduce the posterior malleolus. Of the 12 patients, 2 were lost to follow-up in the early postoperative period (both after 2 months). None of the 10 patients (who were followed up for >2 months) developed delayed union or nonunion, and bone healing was obtained in all of them by 4 months after surgery. The wounds in all patients healed satisfactory. No deep wound infection and wound dehiscence developed. The fibular fracture was internally fixed in all cases using a posterior plate. The medial malleolus was fixed by a separate incision in 9 cases. Assessment of the postoperative radiographs at the last follow-up visit showed adequate radiologic reduction in 10 patients with less than 2 mm of displacement of the distal tibial articular surface (Fig. 2). There were 2 cases of 2 mm or more of articular surface displacement at the final follow-up visit. The first of these 2 patients had a 2-mm articular step (noted on the immediate postoperative radiograph). The second of these 2 patients was a diabetic patient with diabetic foot neuropathy who had had ankle fracture dislocation with a posterior malleolus fracture. The patient had anatomic reduction on the immediate postoperative radiographs. However, with continued follow-up, the fracture showed mild posterior subluxation. The patient did not want to undergo revision of the fracture fixation because of her minimal symptoms as a result of her neuropathy.

Discussion

Fixation of the posterior malleolus has been debated among surgeons; however, most orthopedic surgeons will fix the posterior malleolus if it is greater than 25% of the distal articular surface (1–9). Some studies have indicated that surgical fixation of small fragments can have a beneficial effect on the stability of the joint (21). Other studies found that anatomic reduction of the posterior malleolus improves the prognosis of trimalleolar fractures (22,23). Despite that, in a recent meta-analysis, no consensus was found in the published data regarding which fragment sizes of posterior malleolar fractures should be fixed (24).

The method of fixation of the posterior malleolus was traditionally from the anterior aspect by using indirect reduction and an anteroposterior screw, relying on the attachment of the posterior inferior tibiofibular ligament between the fibula and posterior malleolus (8, 9). This type of reduction cannot always ensure adequate articular reduction. Studies have shown that this technique does not achieve the same degree of anatomic reduction of the posterior malleolus as direct reduction (15).

Many surgical approaches to the posterior malleolus have been described. A long medial incision with dislocation of the ankle was used to reach the posterior fragment. This method requires extensive soft tissue stripping of the fracture fragments (10). Kao et al (11) described a posterior-medial-anterior approach to pilon fractures that uses a larger J-type incision that starts posteriorly proximally and then curves around the medial malleolus and distally is located over the dorsomedial foot (11). A posteromedial incision has been described that allows fixation of the posterior and medial malleoli from the same incision (9,14). This approach has limited visualization of the posterior malleolus fragment. Holt (13) described an arthroscopically assisted reduction of the posterior malleolus. Weber (12) described a case series of 9 patients who were treated with a combined posteromedial and posterolateral approach. All the previous approaches either involved excessive dissection or had limited visualization of the posterior malleolus. Recently, interest has been growing in fixing the posterior malleolus using a posterolateral approach (7,14–17). Despite the recent interest in the approach, the studies describing its results have been very few (7,15,18).

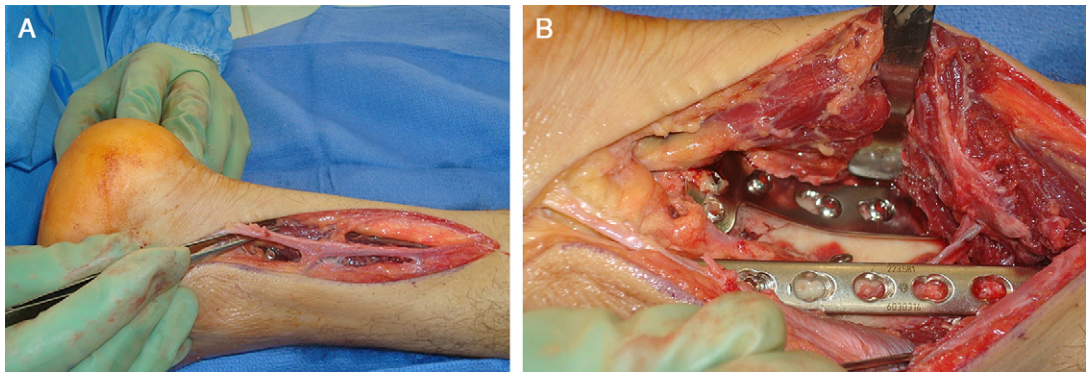

Fig. 1. (*A*) Sural nerve dissected. (*B*) Approaching posterior surface of both tibia and fibula between flexor hallucis longus and peroneal muscles. Posterior plate applied to both tibia and fibula.

Fig. 2. (*A, B*) Lateral and anteroposterior radiograph of trimalleolar fracture. (*C*) Computed tomography scan showing size of posterior malleolus. (*D, E*) Lateral and anteroposterior radiograph 3 months later showing adequate reduction, fixation by posterior plates, and good healing of tibia and fibula.

The posterolateral approach was described originally for bone grafting (25). It has also been described for treatment of pilon fracture (distal tibial axial fractures) with conflicting results (26–28).

Indirect reduction and screw fixation is less invasive than direct reduction using a posterolateral approach; however, the anterior incision does not allow adequate visualization of the fragment and does not allow removal of the interposed periosteum or removal of organized blood clots (if surgery is performed more than a few days after the fracture).

The posterolateral approach provides a real internervous plane between the flexor hallucis longus muscles (supplied by the tibial nerve) and the peroneal muscles (supplied by the superficial peroneal nerve). There will be muscle tissue between the hardware and the skin. This is in contrast to the anterior or medial approach to the tibia or the lateral approach to the fibula in which all the hardware lies immediately under the skin and can cause irritation later on. Wound dehiscence in the posterolateral approach will not lead to the same disastrous complications as with other approaches to the ankle. Thus, in patients with fracture dislocation of the ankle, this approach is safer than other approaches. In the case of major soft tissue contusion, bruising often does not involve the posterior aspect of the leg; thus, the posterolateral approach could be used without increased risk (16). We had no cases of deep wound infection, similar to the results from other

investigators (7,14,15,18). The posterolateral approach also has other advantages. In the case of fracture dislocations, gravity will help with intraoperative reduction, rather than being a deforming force, when the patient is placed in the supine position (16). Another advantage is that the hardware with the posterolateral approach is deep in the ankle, with good soft tissue coverage and no irritation to the patients.

We used the space between the flexor hallucis longus and the peroneal tendons to reach both the posterior surface of the tibia and fibula. Some investigators have described the approach as reaching the posterior surface of the tibia by retracting the flexor hallucis longus laterally (17). However, we believe this will put the tissues in the distal part of the incision under more tension. Also, some investigators (16,17) reflect the peroneal tendons medially to expose the fibula. However, this could cause excess retraction of the lateral structures.

Few peer-reviewed reports of this approach have been published. Miller (29) in 1974 reported on 5 cases of internal fixation of the posterior malleolus using the posterolateral exposure but gave minimal details regarding the technique used or the patient outcomes. Heim (22) reported on 60 trimalleolar fractures treated surgically, 16 of which were treated through this approach. Again, Heim (22) did not give details regarding the technical aspect of the approach or the results of this subset of patients.

Talbot et al (16) provided a detailed description of the technique of the posterolateral approach in a surgical technique report but without presenting their own results. Also, Carmont and Davies (17) in a recent report described the similarity between the posterolateral approach of the ankle and volar approach of the wrist with no presentation of the patients' results. Amorosa et al (14) reported on only 2 cases of posterior malleolus fracture treated with the posterolateral approach. Only a few previous reports have described the results of this approach when treating a relatively large number of patients (7,15,18).

If the medial malleolus is not fractured, the patient can be placed in the lateral position. If the medial malleolus is fractured, the patient should be placed in the prone position. Fixation of the medial malleolus can be difficult using the posterolateral approach. The knee should be flexed, with an assistant holding the leg, and a separate incision performed medially. The position of the fracture fragments will be awkward for the surgeon used to fixing the medial malleolus fracture with the patient in the supine position. This can potentially lead to malreduction of the medial malleolus. We did not have malreduction in any of our patients; however, in the series by Huber et al (15), they reported 3 cases of suboptimal reduction of the medial malleolus. They attributed this to the use of the prone position and the difficulties in reducing the fracture in this position (15). It should be noted that they had changed their practice to the lateral decubitus position in the latter part of their study (15). In the lateral position, they used a combination of flexion and external rotation of the extremity with tilting of the table (15). We believe that putting the patient in the lateral position would make fixation of the medial malleolus much harder than in the prone position. Other investigators (7) have also used the lateral position.

We do not use the posterolateral approach for all our patients with posterior malleolus fractures. We had only 12 cases with the posterolateral approach in more than 5 years (on average, we perform 2 to 3 cases of ankle fracture reduction each week). Our preferred method of fixation for ankle fractures with a posterior malleolus fracture is anatomic reduction and rigid fixation of the lateral malleolus (using the lateral approach). This continues to be our primary method of fixation, used for the vast majority of patients. Fixation of the fibula will allow for indirect reduction of the posterior malleolus by the attachment of the posterior inferior tibiofibular ligament. Fixation of the lateral malleolus using a direct lateral approach (with or without syndesmotic fixation) in the presence of a small posterior malleolus fracture is a safe and effective procedure with minimal risks. In the case of a large (>30%) nondisplaced posterior malleolus fracture, the same approach (fixation of the fibula using the lateral approach) can be used with the addition of percutaneous anteroposterior screws. Most orthopedic surgeons will choose the same approach (8,9). We have reserved the posterolateral approach for displaced large posterior malleolus fracture that continue to be significantly displaced (>2 mm) after closed reduction of the ankle. We found this to be more common in fractures in which surgery had been delayed for a longer period of time. However, with the minimal risk associated with the posterolateral approach, and with surgeons becoming more familiar with the approaches, some investigators have started to expand the indications for the posterolateral approach and fixation of the posterior malleolus from its posterior aspect. Miller et al (18) prospectively followed up 31 patients who had undergone the posterolateral approach to treat an unstable ankle fracture. Of these 31 patients, 9 had a posterior malleolus fracture, 14 had a syndesmotic injury and no posterior malleolus fracture, and 8 had ankle dislocation and a posterior malleolus fracture. All 3 groups of patients underwent surgery and fixation with the posterolateral approach (18). They found that posterior malleolar stabilization of the syndesmotic injuries was equivalent to screw fixation and recommended that when a posterior malleolar fracture is present, regardless of the size of the fracture fragment, an anatomic reconstruction should be performed by fixation of the fragment using a posterolateral approach (18). Forberger et al (7) retrospectively described their results in treating 45 consecutive patients with the posterolateral approach. They used the posterolateral approach to surgically fix the posterior malleolus if it involved more than 25% of the articular surface or in young patients (<50 years old) and those with subluxation of the ankle if more than 10% of the articular surface was involved (7). They concluded that the posterolateral approach allowed good exposure and stable fixation of a displaced posterior malleolar fragment with few local complications.

Amorosa et al (14) described the posterolateral approach to treat what they termed "posterior pilon." They defined this type of injury as a combination of an axial and twisting load. According to their description, these types of injuries result in a large piece of the posterior malleolus and comminution of the articular surface. It could be that this type of fracture will still be referred to as a "trimalleolar fracture" by most orthopedic surgeons. Of the 15 patients described in their study, only 2 were treated with posterolateral approach. The other 13 patients underwent either a posteromedial (9 patients) or a combined posterolateral and posteromedial (4 patients) approach (14). Similarly, Huber et al (15), in 1996, used the expression "trimalleolar pilon" to describe severe lesions with marked posterior instability of the tibiotalar articulation. They noted a zone of impaction of the articular surface of the tibia with loss of the sphericity of the tibial articular surface and cranial migration of the talus. They found that the larger the posterior fragment and the longer the medial extension of the fracture line, the more that these fractures resembled pilon fractures. They recommended that these fracture should not receive the same management as simple malleolar fractures and that these fractures should be treated using the posterolateral approach with internal fixation of the posterior articular fragment of the tibia with a dorsal antiglide plate to obtain better results. They compared the quality of the reduction of the posterior tibial malleolus in 30 consecutive ankle fracture-dislocations with involvement of the posterior malleolus treated by indirect reduction and anteroposterior screws with another group of 30 consecutive similar fracture-dislocations treated with a posterolateral approach, direct open reduction, and dorsal

antiglide plate fixation of the fibula and tibia. The reduction was anatomic in 8 (27%) of 30 patients in first group and 25 (83%) of 30 in the second group (15).

Our results regarding wound healing, fracture reduction, and bone healing are consistent with those from other studies of the posterolateral approach of the ankle that studied a relatively large number of patients (7,15,18). We had no cases of deep wound infection or skin dehiscence. Anatomic reduction was obtained in 11 of the 12 patients, with an additional patient having loosening of the reduction during the follow-up period. One point of weakness of our study was that we were unable to assess the functional results of the patients because most of our patients failed to continue follow-up once their fractures had healed and they were released to full activity. Another weakness was the retrospective nature of our study.

Our results and the results of similar studies (7,15,18) were obtained when this method of treatment was used to treat what most orthopedic surgeon term "trimalleolar fractures," even if some comminution was present at the articular surface. Applying the same approach to high-energy, axial-loading fractures (pilon fractures) might yield a greater incidence of complications than occurred in our patients (27). In addition, visualization of the articular joint with this approach is much less than with the anterior (anterolateral or anteromedial) approach to the ankle. In cases of marked anterior comminution, reduction of the anterior fragment will be nearly impossible from the posterior aspect. Anecdotally, we used the posterolateral approach in 2 cases of pilon fractures, and 1 of these patients developed nonunion and implant failure.

In conclusion, we found that the posterolateral approach is a useful approach to treat fractures of the posterior malleolus with good visualization to achieve good reduction with minimal complications. We believe it should be used only for displaced fractures that involve more than 30% of the distal articular tibial surface and that continue to be displaced more than 2 mm after closed reduction of the ankle. This is because the posterolateral approach still requires more invasive surgery with more dissection than fixing the lateral malleolus using the lateral approach and relying on indirect reduction of the posterior malleolus. Surgeons should be aware that when using this approach, fixation of the medial malleolus might be more difficult than usual because of the patient's position. Also, this approach might give less predictable results if used to treat high-energy pilon fractures.

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