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Single Oblique Posterolateral Approach for Open Reduction and Internal Fixation of Posterior Malleolar Fractures With an Associated Lateral Malleolar Fracture

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ABSTRACT

The purpose of the present retrospective study was to describe the single oblique posterolateral approach for open reduction and internal fixation of large, displaced, posterior malleolar fractures with an associated lateral malleolar fracture. A single oblique posterolateral approach was used for osteosynthesis of the posterior and lateral malleolus in 50 consecutive patients (23 females [46%], 27 males [54%]; mean age, 47.44 ± 16.13 years; mean follow-up duration, 26.32 ± 5.15 months). The mean interval to surgery was 4.3 ± 1.9 days after the inciting trauma. During the follow-up period, the surgery was complicated by skin necrosis around the incision in 2 (4%) patients and sural nerve damage in 2 (4%) patients. We found that the single oblique posterolateral approach to large, displaced, posterior malleolar fractures with an associated lateral malleolar fracture provided easy exposure of the posterior and lateral malleoli and had the potential to decrease the incidence of sural nerve injury because of the smaller incision size.

Reduction of a posterior malleolar fracture with an associated lateral malleolar fracture can be achieved using either an indirect or a percutaneous method (1). The indirect method can be used because the fracture fragment is connected to the fibula by the posterior inferior tibiofibular ligament. However, reduction of the posterior malleolar fracture using ligamentotaxis is not always possible. Also, the relationship between inappropriate reduction and postoperative pain when the fracture has been severely comminuted or the fragment has impacted into the joint has led to a new surgical approach for direct exposure and better visualization.

In previous studies, the posteromedial and the straight longitudinal posterolateral approaches to open reduction and internal fixation of malleolar fractures were introduced (1–4). However, these approaches have disadvantages, including limited visualization of the posterior malleolar fracture fragment, a sizable postoperative scar from the large incision, and damage to the sural nerve.

The purpose of the present study was to describe the use of a single oblique posterolateral approach for open reduction and internal fixation of large displaced posterior malleolar fractures with an associated lateral malleolar fracture, emphasizing the associated reduction in the risk of sural nerve damage by the smaller incision required compared with the established posterolateral approach.

Patients and Methods

Patient Selection

The medical records of 50 patients (23 females [46%], 27 males [54%]; mean age, 47.5 [range 25 to 75] years) who had been treated in our surgical unit from January 2010 to September 2012, for ankle fractures involving the posterior and lateral malleolus were retrospectively reviewed. None of the patients had experienced bilateral ankle fractures. Our institution's ethical review committee approved the study. Patients were included if a minimum of 12 months of follow-up data were available. Consecutive patients from the senior author's (J.S.S.) practice were included in the cohort if they had undergone open reduction and internal fixation of a malleolar fracture using the single oblique posterolateral incisional approach. Patients with accompanying injury of the ipsilateral limb that could have affected the outcome score, patients with an open fracture, and pediatric fractures were excluded from the present study.

The most frequent cause of injury was slipping (n = 40 [80%]), followed by sports injuries (n = 6 [12%]) and traffic accidents (n = 4 [8%]), which are known as high-energy trauma. The fractures were classified using the AO Foundation and Orthopaedic Trauma Association (5), Lauge-Hansen (6), and Danis-Weber (7,8) classifications. Using the AO Foundation and Orthopaedic Trauma Association classification, type 44B3 was the most common (n = 38 [76%]) followed by type 44C2 (n = 10 [20%]) and type 44C1 (n = 2 [4%]). Using the Lauge-Hansen classification, the pronation-external rotation type and supination-external rotation type accounted for 35 (70%) and 15 (30%) cases, respectively. The study included 34 (68%) trimalleolar fractures and 16 (32%) bimalleolar (posterior and lateral malleolus) fractures.

Radiographs and computed tomography (CT) scans were obtained to assess the severity and nature of the posterior malleolar fracture. The ratio of the posterior

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Fig. 1. Course of the sural nerve. An imaginary yellow line shows the course of the sural nerve. The blue line indicates the incision line for an oblique single posterolateral approach.

malleolar fragment to the articular surface using the most confirmable sagittal CT scan image was measured by a single, trained orthopedic surgeon (J.Y.C.). The mean area of the posterior malleolar fragment on the CT images and radiographs was 31.7% and 27.9%, respectively. The severity of the posterior malleolar fracture on the CT scans was classified as posterolateral oblique (type I), medial extension (type II), or small shell (type III) using Haraguchi's classification (9). In our study, 21 cases (42%) were classified as type I and 29 (58%) as type II. None of the patients had type III. All the cases were classified by a single, trained orthopedic surgeon (J.Y.C.).

The indications for surgical fixation using a single oblique posterolateral extensile exposure included involvement of <25% of the articular surface of the posterior malleolus or evidence of posterior subluxation of the posterior ankle. Carr (10) reported that the large displaced fragment of the posterior tibial plafond involving >25% of the articular surface required surgical reduction and stabilization. Surgery was performed as early as possible, taking into consideration the amount of edema and the condition of the skin. The mean interval to surgery was 4.3 (range 2 to 7) days after trauma. The patients were placed in a Cryo/Cuff® (OA, Portland, ME) to maintain the elevation of the affected limb, with intermittent squeezing and cooling while awaiting surgery.

Surgical Approach

Radiographs and 3-dimensional CT scans were obtained to closely evaluate the location and nature of the fracture fragment. The surgical approach was determined according to the accompanying medial and lateral malleolar fractures. A single oblique incision was chosen, especially if a comminuted or impacted posterior malleolar fracture was present that was thought would be difficult to stabilize with the commonly used percutaneous anteroposterior screw fixation technique. The procedure was performed with the patient in the prone position, except for 4 patients (8%), for whom the lateral position was necessary because of comorbidity such as flail chest or the presence of pre-existing external fixators, which made the prone position impossible. A pneumatic tourniquet was applied to prevent bleeding. The procedure was performed with the patient under general anesthesia in 32 patients (64%) and spinal anesthesia in 18 (36%).

A single oblique posterolateral incision for Danis-Weber type B fractures was made over the posterior fibular margin. The incision curved obliquely at the point of the fracture site, resulting in a 10-cm curved incision that reached the Achilles tendon (Fig. 1). The incision was elongated by 5 cm proximally to expose the proximal fracture site for a Danis-Weber type C fracture. Careful dissection was performed near the Achilles tendon attachment site until the sural nerve was found. The peroneal tendon was lifted off posteriorly, and the fragment of the fibula was exposed. The fragment was then reduced and fixed with a plate and screws or screws alone. The lateral malleolar fixation could be removed temporarily if it impeded reduction of the posterior malleolar fragment. The lateral malleolus was then refixed after posterior malleolar fixation had been performed. Dissection was performed between the peroneal tendon and the flexor hallucis longus after fasciotomy (Fig. 2*A*). If the perforating artery from the periosteum to the flexor hallucis longus was encountered, it was ligated, if necessary. The posterior malleolus was exposed by moving the flexor hallucis longus and Achilles tendons medially (Fig. 2*B*). Periosteum dissection was limited to the amount necessary to identify the fracture site. The fractured fragment was reduced using the posterior inferior tibiofibular ligament as a hinge to rotate and elevate the fragment, such that the interposed hematoma could be removed. A one-third tubular plate and screws, locking compression distal fibular plate (DePuy Synthes, Warsaw, IN), and single lag screw were used to fix the lateral malleolar fractures in 35 (70%), 13 (26%), and 2 (4%) patients, respectively. Fixation of the posterior malleolus was performed using a cannulated screw in 34 patients (68%), followed by a cannulated screw and Kirschner wire in 13 (26%) and a buttress plate in 3 (6%). A plate was used in cases of severe comminution that required a buttress effect or in cases in which proximal slippage of the posterior malleolar fragment had occurred, causing an excessively large tibial joint angle on the lateral view (Fig. 3).

After examining the reduction using a C-arm, the wound was irrigated and repaired in the usual manner. Next, the simple fracture on the medial malleolus was fixed using a screw and Kirschner wire, while the assistant internally rotated the lower limb after placing a pillow under the knee at 70° of flexion. The patient was changed to the supine position when the medial malleolar fracture was highly comminuted or displaced. All patients received below-the-knee immobilization with a cast for 4 to 6 weeks. Partial weightbearing was allowed on the basis of the need for syndesmotic fixation, the size of the posterior malleolar fracture fragment, and the degree of comminution. Full weightbearing was allowed at 3 months postoperatively after confirmation of bone union on the radiographs.

Surgical Outcome

Of the 50 patients, 34 (68%) had an accompanying medial malleolar fracture. Of these, 2 patients (4%) had to be repositioned supine during the procedure because of a severe comminuted medial malleolar fracture. The mean operative time was 54 (range 43 to 58) minutes for bimalleolar fractures and 68 (range 62 to 75) minutes for trimalleolar fractures, except for the 2 patients (4%) who had required repositioning on the surgical table. Of the 50 posterior malleolar fractures, 48 (96%) had an accurate reduction (<1 mm of displacement) of the tibial joint surface on the follow-up radiographs (Fig. 4). The mean time to achieve bony union was 12.3 (range 12 to 18) weeks.

The functional outcome was evaluated using the American Orthopaedic Foot and Ankle Society ankle-hindfoot score (11), which includes the foot and ankle core (20 items), pain (9 items), function (6 items), stiffness (3 items), giving way (3 items), and shoe comfort (5 items) scales. The standardized mean was calculated as a score of 0 to 100, with 100 representing the best possible outcome. The Olerud and Molander score (12) was also used to assess the clinical outcome. With the Olerud and Molander score, >95 points represents the best outcome, >90 points a fair outcome, >80 points normal, and <80 points a bad outcome. Complications related to surgery during the follow-up period were also surveyed and are included in the Results section.

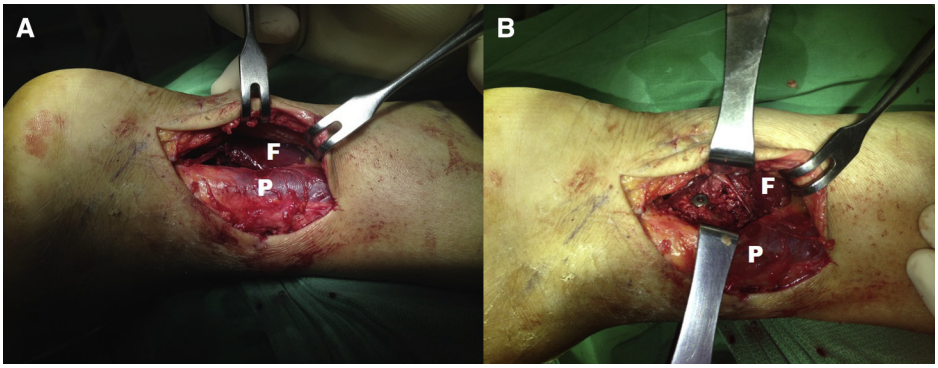

Fig. 2. Intraoperative photographs showing dissection and exposure of the posterior malleolus. (*A*) Dissection between the peroneal tendon and flexor hallucis longus. (*B*) The posterior malleolus was exposed by moving the flexor hallucis longus and Achilles tendon medially and was then fixed using a cannulated screw. F, flexor hallucis longus; P, peroneal tendon.