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Posterior Inferior Tibiofibular Ligament Release to Achieve Anatomic Reduction of Posterior Malleolar Fractures

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ABSTRACT

We assessed the clinical and radiographic outcomes of posterior inferior tibiofibular ligament (PITFL) release to achieve anatomic reduction of posterior malleolar fractures (PMFs). Nineteen PMFs (>25% of tibial plafond) that could not be reduced after anatomic reduction of distal fibula fractures were managed by PITFL release. The syndesmosis was stressed intraoperatively and by 2 surgeons unaware of the postoperative measurements to increase reliability. The pre- and postoperative fracture gaps and articular step-offs were measured on lateral radiographs of all patients and computed tomography (CT) scans of 12. Tibiofibular clear space and overlap measures at the final follow-up visit were used to evaluate postoperative syndesmotic stability. Postoperative function was assessed using the American Orthopaedic Foot and Ankle Society (AOFAS) scale score. The mean pre- and postoperative fracture gap and step-off of the PMFs was 4.9 mm and 0.4 mm and 2.8 mm and 0.4 mm, respectively. On CT scan, the mean pre- and postoperative fracture gap and step-off was 5.2 mm and 0.5 mm and 3.3 mm and 0.6 mm, respectively. The preoperative and final follow-up tibiofibular clear space and overlap did not differ significantly. The mean follow-up period was 26.7 months, and the mean AOFAS scale score was 90.6 points at the final follow-up. Direct visualization and reduction of PMFs through PITFL release led to satisfactory clinical and radiographic outcomes without causing ankle instability.

Posterior malleolar fractures (PMFs) account for 7% to 44% of all ankle fractures and typically result from rotational ankle injury and rarely occur in isolation (1–3). Ankle fractures involving posterior malleolar fracture fragments (PMFFs) have worse clinical outcomes than uni- or bimalleolar fractures (2,4). The large size of PMFFs decreases the joint contact area and increases the peak joint stress, which can lead to osteoarthritis (OA) (5,6). Based on the results from biomechanical studies, the size of the PMF has historically been a major determinant of the treatment method. Surgical treatment is usually considered necessary when the fragments constitute >25% to 33% of the tibial plafond on ankle lateral radiographs (4,7).

In most cases of PMF, the posterior inferior tibiofibular ligament (PITFL) maintains its integrity and remains attached to the PMF (8,9). Thus, the posterior malleolus can be reduced by ligamentotaxis of the PITFL, and reduction and fixation of PMFFs can be performed with anatomic fibular reduction to help restore syndesmotic stability without the need for transsyndesmotic fixation (9–11). In addition, direct reduction through a posterolateral approach is possible under direct visualization using the PITFL as a hinge and accessing the fracture site using an open-book method (9,12,13). However, even after anatomic reduction of the distal fibula, sometimes the PMF cannot be reduced using the posterolateral approach owing to rotation of the PMF or the presence of incarcerated fracture fragments.

In ankle fractures that did not result in precise reduction of the PMF after anatomic reduction of the distal fibula, we performed release of the PITFL to expose the articular surface and achieve anatomic reduction of the fragments. The purpose of the present study was to assess the clinical and radiographic outcomes and complications of this treatment option.

Patients and Methods

The present study included patients who required open reduction and internal fixation for a PMF. The internal review board of Kyung Hee University Hospital at Gangdong approved the present study. All the patients provided written informed consent. The indications for surgery were bimalleolar or trimalleolar fractures that had violated >25% of the articular surface and had a >2-mm step-off or fracture gap of the ankle joint line on the preoperative lateral radiographs.

A total of 52 patients (52 ankles) underwent surgery for displaced PMFFs from March 2010 to February 2013. The mean interval from the date of injury to surgery was 8 (range

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Table
Demographic patient data

Variable	n (%)
Age (y)	
Mean	45.1
Range	13 to 68
Gender	
Male	7 (36.8)
Female	12 (63.2)
Diagnosis	
Bimalleolar	4 (21.1)
Trimalleolar	15 (78.9)
Fracture classification	
Lauge-Hansen	
PER	4 (21.1)
SER	15 (78.9)
Dennis-Weber	
A	2 (10.5)
B	13 (68.4)
C	4 (21.1)
AO	
A3	3 (15.7)
B1	1 (5.3)
B2	1 (5.3)
B3	10 (52.6)
C1	3 (15.8)
C2	1 (5.3)
Haraguchi	
1	13 (68.4)
2	6 (31.6)
Malleolar fixation	
Lateral	
Reconstruction	1 (5.3)
One-third tubular plate	18 (94.7)
Medial	
Cancellous	5 (45.5)
Tension band	6 (54.5)
Posterior (lag screw)	
Cannulated	2 (10.5)
Cancellous	5 (26.3)
Cortical	12 (63.2)
Posterior malleolar fracture fragment	
Articular involvement	
Mean	36
Range	27 to 50
Incarceration	8 (42.1)
Rotation	11 (57.9)
Follow-up period (mo)	
Mean	26.7
Range	24 to 38
AOFAS scale score (points)	
Mean	90.6
Range	61 to 100

Abbreviations: AOFAS, American Orthopaedic Foot and Ankle Society; PER, pronation external rotation; SER, supination external rotation.

4 to 12) days. In 19 of the 52 patients, reduction of the PMFFs could not be obtained after anatomic reduction of the distal fibula and manual reduction of the PMFFs. We performed release of the PITFL through a posterolateral approach for reduction and fixation of the posterior malleolus in these 19 patients.

The baseline clinical characteristics of the patients are summarized in the Table. Of 19 patients, 7 were male and 12 were female, and their mean age was 45.1 (range 13 to 68) years. No patient had OA or bony abnormalities on the preoperative radiographs. All surgeries were performed by the same surgeon (J.H.L.). In 8 patients, the PITFL was dissected for anatomic reduction of the fracture surface, because incarcerated fragments prevented reduction. In the remaining 11 patients, the PMFFs were so large and rotated that the PITFL was cut to achieve accurate reduction of the PMF (Fig. 1).

Surgical Technique

With the patient placed in a lateral position, a longitudinal incision was performed between the anterior border of the Achilles tendon and the fibula. The sural nerve was identified and protected. The lateral malleolar fragments were reduced first and fixed temporarily with a reduction clamp. These were not fixed with the plate because the fixed plate disturbed visualization of the articular surface under fluoroscopy. Reduction of the PMF was evaluated using fluoroscopy. If anatomic reduction had not occurred, the fracture site was exposed, and manual reduction of the posterior fragments was attempted. When reduction failed, the PITFL was released to mobilize the posterior fragments (Fig. 2). In cases in which the incarcerated fragments remained rotated or inserted in the articular surface, the free fragments were handled directly to obtain reduction, using the articular surface of the talus as a reduction template. Subsequently, the PMFFs were reduced. C-arm imaging was used to confirm reduction. The posterior malleolar fragment was fixed with lag screws. The PITFL was not reattached after fixation of the PMF. Next, plate fixation was performed for the temporarily fixed lateral malleolar fractures (Fig. 3). When medial malleolar fractures were also present, the patient was placed in the supine position and fixation performed. After fracture fixation, the external rotation test and Cotton test using a bone clamp were performed to evaluate syndesmotic stability.

Postoperative Management

For 2 weeks after surgery, short leg splint immobilization was provided. Next, the patients wore a semirigid ankle brace for 6 weeks. After 2 weeks, ankle range of motion exercises were performed intermittently without the brace. Partial weightbearing and crutch ambulation were started when radiographic evidence of bony union was seen after 6 weeks. Full weightbearing and free ambulation were allowed after radiographic and clinical observation of full bony union.

Radiographic Measurements

Radiographic measurements were performed using a picture archiving and communication system (PiView STAR; Infinitt Healthcare, Seoul, Korea) by 2 orthopedic surgeons (Y.J.K., J.H.L.), and the mean of the 2 independent values was analyzed. Both surgeons were unaware of the other's measurements, and they reviewed the measurement protocol before the study.

Preoperatively, plain ankle radiographs, including anteroposterior (AP), lateral, and mortise views, and 3-dimensional (3D) computed tomography (CT) (Brilliance 64; secondary capture device software version; Philips, Best, The Netherlands) images were obtained for all patients. Fractures were categorized using the Lauge-Hansen and Dennis-Weber classification systems on the basis of the radiographic findings and the Haraguchi classification system using the 3D-CT images (14) (Table). In all cases, the lateral view

Fig. 1. A trimalleolar fracture accompanying a large, displaced posterior malleolar fracture was diagnosed in a 33-year-old female patient. *(A)* Anteroposterior and lateral radiographic views. *(B)* Incarcerated fragments between the posterior malleolar fractures and posterior talar subluxation were observed.