

Posterior Malleolar Fractures

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INTRODUCTION

Posterior malleolar fractures are a common component of ankle fractures. Between 7 and 44% of all ankle fractures involve the posterior malleolus (1). This type of fracture often arises from rotational injury and rarely occurs in isolation. The morphology of the fracture can be variable. A secondary type of posterior malleolar fracture is the posterior pilon variant. This involves a majority of the posterior lip and is usually the result of a combined rotational and axial load injury. Currently there is no consensus regarding the minimum size of the fracture that requires fixation. It is generally accepted that posterior malleolar fractures tend to have worse outcomes. The recent literature has demonstrated improved anatomic reduction with fixation of a posterior malleolar fracture. There is an increasing trend to fixate these fractures when appropriate.

ANATOMY

The posterior malleolus contributes to the congruity of the ankle joint. Ligamentous attachments include the posterior inferior tibiofibular ligament. This ligament provides 42% of the syndesmotic stability (2). An unstable ankle, due to loss of the normal bone or ligament constraints, allows the talus to move in a nonphysiologic manner. The main question is “Does this contribute and how much does it contribute to the development of osteoarthritis?” Multiple studies have demonstrated that increased posterior malleolar fragment size decreases the ankle joint contact area and influences the concentration of loads (3,4). Macko et al demonstrated in a cadaveric study that with a fragment size of 33%, only 87% of contact area remained. With decreased contact area, theoretically there should be an increase in peak stress and an increased rate of arthritis. Peak pressure was not measured in this study. Fitzpatrick et al demonstrated that the size did not influence contact force but changed the distribution (5). The relocation of pressure to a portion of the ankle that does not normally bear such loads could be the source for development of arthritis. Regardless, there is an increased chance of developing osteoarthritis after posterior malleolar fractures, and anatomic reduction is vital for prevention. Anatomic reduction of a lateral malleolus fracture will usually reduce a posterior malleolar fracture through ligamentotaxis of the posterior inferior tibiofibular

ligament. Reduction can be impeded by small fragments of bone or soft tissue interposition. Reduction can also be affected by comminution or a complicated fracture pattern.

CLASSIFICATION

Haraguchi classified posterior malleolar fractures into 3 categories (6). Type I is a posterolateral oblique type (occurs 67%), with a wedge-shaped fragment involving the posterior tibial plafond. Type II is a medial extension type (19%), involving a fracture line extending from the fibular notch to the medial malleolus. Type III is small shell type (14%), an avulsion fragment at the posterior lip of the tibial plafond. This classification system does not identify morphologic patterns. Bartonicek et al created a classification to address the morphology of the fracture types and use this to guide conservative versus surgical intervention (7).

Type I includes an extra-incisural fragment with an intact fibular notch, and is usually treated nonoperatively. Type II involves a posterolateral fragment extending into the fibular notch, and can be treated surgically utilizing a posterolateral approach. Type III is a posteromedial 2-part fragment involving the medial malleolus, and can be treated surgically using a posteromedial approach. Type IV is a large posterolateral triangular fragment, and is always treated surgically, often with a posterolateral approach. Type V includes the remaining fractures that cannot be classified and include irregular fragments.

IMAGING

Radiography is always ordered in cases of ankle fractures. The posterior malleolus fracture can be difficult to assess on standard radiographs. Ebraheim et al (8) described a radiograph with 50 degrees of external rotation coplanar to the fracture to allow for the best visualization. A double contour sign may be present with the posterior pilon variant type fracture if there is a posteromedial fracture fragment (9). Computed tomography (CT) is recommended for all posterior malleolar fractures to better evaluate the size, level of impaction and comminution, and possible disruption of the anterior syndesmosis (10). Ferries et al demonstrated that radiographs poorly assessed fragment size when compared with CT scans (11). Buchler et al studied the reliability of radiologic assessment of posterior malleolar

fractures. They found that the size of the fracture could be estimated but the level of associated impaction or additional impacted fragments was significantly underestimated (12). These fractures are better treated with a posterior approach with direct visualization to aid in reduction of the fracture. Appropriate imaging allows for the practitioner to choose the ideal surgical approach and type of fixation required for a case.

BENEFITS OF FIXATION

Fixation of posterior malleolar ankle fractures restores articular congruity and ankle stability. It prevents posterior talar translation. Fixation of the posterior malleolar fracture restores competence of the posterior inferior tibiofibular ligament. Numerous studies demonstrate that loss of normal bony or ligamentous constraints in the ankle joint can lead to degenerative changes and loss of motion. Miller et al demonstrated that patients with posterior malleolar fractures who underwent surgery had improved restoration of the syndesmosis compared with the nonoperative treatment group (13). Drijfhout van Hooff et al demonstrated that nonanatomic restoration of the joint surface was a significant risk factor for development of osteoarthritis. This study looked at fragments of all sizes and categorized them as small (<5%), medium (5-25%), and large (>25%) (14).

Gardner et al reported malreduction after transyndesmotomic fixation 52% on postoperative CT scans (15). Malreduction can be avoided with attempt at direct or indirect fixation of the posterior malleolar fracture. Another study by Gardner et al demonstrated that posterior malleolar fixation restored 70% of the syndesmotomic stiffness compared with 40% demonstrated with syndesmotomic fixation (16). These 2 studies show fixation of the posterior malleolus as opposed to syndesmotomic fixation, may lead to better anatomic reduction as well as increased strength of the repair. Anatomic reduction with fixation of the posterior malleolus fracture is better at restoring the length of the intact posterior inferior tibiofibular ligament and prevents posterior translation of the fibula.

SIZE

In 1940, Nelson and Jensen published an article that described posterior malleolar fractures in 2 groups. The fractures, based on their size, were called minimal or classical. Minimal fractures were treated nonoperatively with cast immobilization, while classical fractures were treated with open reduction (17). This established that the size of the posterior malleolar fracture on a lateral radiograph would determine the need for fixation or not. This continues to be a driving factor for surgeons deciding on surgical planning for ankle fractures. Many surgeons use the size of

the fracture on a lateral radiograph to dictate the need for fixation, generally 25-30% articular involvement.

Other biomechanic articles discuss the changes in contact area and stability that occur with posterior malleolar fractures (18,19). These articles concluded that the size of the fragment correlates with these changes, and therefore size can be used to delineate surgical management. Many surgeons continue to use the size of the fracture as the deciding factor for fixation. The literature however does not advise only using the size to decide upon surgical intervention.

OTHER FACTORS

Surgical management of posterior malleolar fractures should be based on other factors including fracture dislocation, displacement, articular surface congruity, residual tibiotalar subluxation, fragmentation and comminution, and syndesmotomic stability. Preoperative CT scan allows for visualization of fragmentation, which would require direct fixation for proper reduction.

SURGICAL APPROACHES

The surgical approach is dictated by fracture location and extension. The incision should allow for the easiest access to the posterior malleolar fracture and also allow for fixation of the fibular fracture or medial malleolus fracture if present. The first decision is indirect versus direct approach for the posterior malleolar fracture. Once a direct approach is chosen, the type is decided based on the fracture locations. Most often a posterolateral, or posteromedial approach is used; there are other options such as transfibular or transmalleolar, and combining arthroscopy with open techniques.

Indirect Approach

Most commonly, the fixation for an indirect approach utilizes an anterior to posterior screw placed using fluoroscopy. Screw orientation is crucial for appropriate reduction. Most posterior malleolus fractures are oblique in nature, creating a posterolateral fragment. Another option is to place screws from posterior to anterior. Debate exists about which fracture to fixate first when there is a posterior malleolar fracture and fibular fracture. Fixating the fibula will block the surgeon's view of the posterior malleolar fracture under fluoroscopy, but will help with reduction of the posterior malleolar fracture.

Posterolateral

In a posterolateral approach, the incision is placed along the posterior rim of the distal fibula and dissection is carried down to the interval between the peroneal tendons and

flexor hallucis longus tendon. This approach allows for direct visualization of the fracture. Small fragments of bone that would prevent reduction from an anterior-posterior placed screw can be cleaned out with this approach and allow for appropriate reduction. The fracture can then be fixated with screws or a plate. A posterior plate can be applied to the fibular fracture with this approach as well. Disadvantages include difficulty with assessing joint congruity once the fragment is reduced, and sural nerve injury. One study found the sural nerve present in this approach 83% of the time (20).

Posteromedial

In the posteromedial approach, the incision runs along the posterior rim of the distal tibia to the apex of the medial malleolus. After crural fascia is incised, the posterior tibial tendon and flexor digitorum longus tendon are mobilized and retracted anteriorly. This approach allows for simultaneous fixation of the posterior tibia as well as the medial malleolus in one incision. Disadvantages of the approach include the presence of the neurovascular bundle, and the fact that most fractures have fragments located posterolateral.

REFERENCES

- Jaskulka RA, Ittner G, Schedl R. Fractures of the posterior tibial margin: their role in the prognosis of malleolar fractures. *J Trauma* 1989;29:1565-70.
- Ogilvie-Harris DJ, Reed SC, Hedman TP. Disruption of the ankle syndesmosis: biomechanical study of the ligamentous restraints. *Arthroscopy* 1994;10:558-60.
- Macko VW, Matthews LS, Zwirkoski P, Goldstein SA. The joint-contact area of the ankle: the contribution of the posterior malleolus. *J Bone Joint Surg Am* 1991;73:347-51.
- Hartford JM, Gorczyca JT, McNamara JL, Mayor MB. Tibiotalar contact area: contribution of posterior malleolus and deltoid ligament. *Clin Orthop Relat Res* 1995;320:182-7.
- Fitzpatrick DC, Otto JK, McKinley TO, Marsh JL, Brown TD. Kinematic and contact stress analysis of posterior malleolar fractures of the ankle. *J Orthop Trauma* 2004;18:271-8.
- Haraguchi N, Haruyama H, Toga H, Kato F. Pathoanatomy of posterior malleolar fractures of the ankle. *J Bone Joint Surg Am* 2006;88:1085-92.
- Bartonicek J, Rammelt S, Tucek M, Nanka O. Posterior malleolar fractures of the ankle. *Eur J Trauma Emerg Surg* 2015;41:587-600.
- Ebraheim NA, Mekhail AO, Haman SP. External rotation-lateral view of the ankle in the assessment of the posterior malleolus. *Foot Ankle Int* 1999;9:115-9.
- Weber M. Trimalleolar fractures with impaction of the posteromedial tibial plafond: Implications for talar stability. *Foot Ankle Int* 2004;25:716-27.
- Gardner MJ, Brodsky A, Briggs SM, Nielson JH, Lorich DG. Fixation of posterior malleolar fractures provides greater syndesmotomic stability. *Clin Orthop Relat Res* 2006;447:165-71.
- Ferries JS, DeCoster TA, Firoozbakhsh KK, Garcia JF, Miller RA. Plain radiographic interpretation in tri-malleolar ankle fractures poorly assesses posterior fragment size. *J Orthop Trauma* 1994;8:328-31.
- Buchler L, Tannast M, Bonel HM, Weber M. Reliability of radiologic assessment of the fracture anatomy at the posterior tibial plafond in malleolar fractures. *J Orthop Trauma* 2009;23:208-12.
- Miller AN, Carroll EA, Parker RJ, Helfet DL, Lorich DG. Posterior malleolar stabilization of syndesmotomic injuries is equivalent to screw fixation. *Clin Orthop Relat Res* 2010;468:1129-35.
- Drijfhout van Hooff CC, Verhage SM, Hoogendoorn JM. Influence of fragment size and postoperative joint congruency on long-term outcome of posterior malleolar fractures. *Foot Ankle Int* 2015;36:673-8.
- Gardner MJ, Demetrakopoulos D, Briggs SM, Helfet DL, Lorich DG. Malreduction of the tibiofibular syndesmosis in ankle fractures. *Foot Ankle Int* 2006;27:788-92.
- Gardner MJ, Brodsky A, Briggs SM, Nielson JH, Lorich DG. Fixation of posterior malleolar fractures provides greater syndesmotomic stability. *Clin Orthop Relat Res* 2006;447:165-71.
- Nelson, MC, Jensen, NK. The treatment of trimalleolar fractures of the ankle. *Surg Gynecol Obst* 1940;71:509-14.
- Macko VW, Matthews LS, Zwirkoski P, Goldstein SA. The joint-contact area of the ankle: The contribution of the posterior malleolus. *J Bone Joint Surg Am* 1991;73:347-51.
- Hartford JM, Gorczyca JT, McNamara JL, Mayor MB. Tibiotalar contact area: contribution of posterior malleolus and deltoid ligament. *Clin Orthop Relat Res* 1995;320:182-7.
- Jowett AJ, Sheikh FT, Carare RO, Goodwin MI. Location of the sural nerve during posterolateral approach to the ankle. *Foot Ankle Int* 2010;31:880-3.

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