Posterior Malleolar Fractures Associated with Tibial Shaft Fractures and Sequence of Fixation

Harish Kempegowda, MD[1]*; Hemil Maniar, MS, MBBS*[2]*; Raveesh Richard, MD*[1]*; Akhil Tawari, MD*[1]*; Jove Graham, PhD*[3]*; Michael Suk, MD*[2]*; Michael Beebe, MD*[4]*; Chris Han, MD*[5]*; Paul Tornetta III, MD*[5]*; Erik Kubiak, MD*[6]*; James Gotoff, BS*[1]*; Daniel S. Horwitz, MD*[2]

[1]*Geisinger Medical Center, Danville, Pennsylvania, USA;*
[2]*Geisinger Health Systems, Danville, Pennsylvania, USA;*
[3]*Geisinger Center for Health Research, Danville, Pennsylvania, USA;*
[4]*Florida Orthopaedic Institute, Tampa, Florida, USA*
[5]*Boston University Medical Center, Boston, Massachusetts, USA*
[6]*University of Utah Department of Orthopaedics, Salt Lake City, Utah, USA*

Purpose: The purpose of this study was to examine how often posterior malleolar injuries are associated with nailed tibia fractures and to determine the quality of reduction based on the sequence of fixation in associated fracture patterns.

Methods: Retrospective review of the charts at three Level I trauma centers was conducted to identify all skeletally mature patients treated with an intramedullary nail for tibial diaphyseal fracture. The data collected included demographic characteristics, injury characteristics, tibial fracture pattern, associated posterior malleolar fractures, surgical characteristics including sequence of fixation, evident intraoperative displacement of the posterior malleolar fragment on fluoroscopic images, and the quality of reduction. The quality of reduction was considered poor if there was an intra-articular step >1 mm and/or a fracture gap of >1 mm.

Results: A total of 1113 nailed tibia fractures were identified, of which 96 patients (61 males, 35 females) with an average age of 40.3 years (range, 18-66) had associated posterior malleolar fracture (9%). Fracture pattern included 79 (82%) distal spiral type (42-A1, B1), 12 (13%) oblique type (42-A2), and 5 (5%) transverse type (42-A3). Of the 96 patients, 70 posterior malleolus fractures underwent operative management (73%). 54 patients belonged to the malleolus-first group (75%) and 16 patients belonged to the tibia-first group (25%). Of the 54 patients, in the malleolus-first group, based on immediate postoperative radiographs, reduction was graded as anatomic/acceptable in 53 fractures and poor reduction of the posterior malleolar fragment was observed in 1 case (1.8%). Of the 54 patients, 16 were displaced (30%) and 38 were undisplaced (70%), and 25 were contiguous fractures (48%). 53 posterior malleolar fractures were diagnosed preoperatively whereas in one patient the posterior malleolar fragment was evident after the placement of guidewire, the posterior malleolar fragment was stabilized with screws, and then proceeded with tibial nailing to achieve anatomic reduction. Of the 16 patients in the tibia-first group, 11 were diagnosed preoperatively (69%) and 5 were diagnosed intraoperatively (31%). Obvious intraoperative displacement of the posterior malleolar fragment was observed in fluoroscopic images of 5 patients (31%). These five cases of intraoperative displacement were initially undisplaced and two of them were contiguous fractures. Placement of the nail resulted in fracture displacement and in all 5 cases of intraoperatively displaced fractures the reduction of posterior malleolar fragment was attempted by lag-in screw technique with the nail in situ; on

final postoperative radiographs acceptable reduction was noted in 3 cases (66%). Based on immediate postoperative radiographs, the quality of reduction was graded as anatomic/acceptable in 9 cases (56%) and poor reduction of the posterior malleolar fragment was observed in 7 patients (44%) (Table 2). These percentages of patients with intraoperative displacement and poor reduction were statistically significantly different from the malleoli-first fixed group ($P = 0.005$ and $P = 0.001$ respectively) (Table 3).

Conclusion: Many low-energy tibia fracture with a spiral configuration do have an associated posterior malleolus fracture. In order to avoid intraoperative displacement and poor reduction, we recommend fixation of the posterior malleolar fragment prior to nailing of the tibia in associated fracture pattern. This sequence appears to be highly successful in preventing intraoperative displacement when combined with a tibial nail.

See pages 49 - 106 for financial disclosure information.

Table. 1: Prevalence of concomitant tibial shaft fracture and posterior malleolar injury according to tibial fracture patterns and the energy of injury.

Fracture pattern	Low energy	High energy
Spiral types	57 (59%)	22 (23%)
Oblique types	8 (8%)	4 (4%)
Transverse types	1 (1%)	4 (4%)

Table 2. Preoperative and operative variables, compared between the tibia-first and malleolus-first groups.

	Tibia first (n=16)	Malleolus first (n=54)	P-value
Percentage of articular surface involvement, Mean (SD)	36.3 (13.1)	35.2 (10.8)	0.75
Displaced fractures, N (%)	4 (25%)	16 (30%)	0.99
Malleolus diagnosed preoperatively, N (%)	11 (69%)	53 (98%)	**0.002**
Nail size in mm, Mean (SD)	10.0 (0.6)	9.8 (0.9)	0.42
AP lock screws used in distal fragment of tibial nail, N (%)	8 (50%)	20 (37%)	0.39
Clamps used, N (%)	6 (38%)	19 (35%)	0.87
Contiguous fractures between tibial shaft and posterior malleolus, N (%)	6 (38%)	25 (48%)	0.46

Table 3. Intraoperative displacement and quality of reduction, compared between the tibia-first and malleolus-first groups.

	Tibia first (n=16)	Malleolus first (n=54)	Odds Ratio (malleolus vs. tibia first) [95% CI]	P-value
Intraoperative displacement, N (%)	5 (31%)	1 (2%)	0.042 [0.004, 0.391]	**0.005**
Quality of reduction, N (%)				
Anatomic or acceptable	9 (56%)	53 (98%)	--	
Poor	7 (44%)	1 (2%)	0.024 (0.003, 0.221)	**0.001**