Arthroscopically Detected Intra-Articular Lesions Associated with Acute Ankle Fractures

By Nikoletta Leontaritis, DO, Lauren Hinojosa, BS, and Vinod K. Panchbhavi, MD, FRCS

Investigation performed at the Division of Foot and Ankle Surgery and Infections, Department of Orthopaedic Surgery and Rehabilitation, The University of Texas Medical Branch, Galveston, Texas

Background: Anatomic surgical realignment of ankle fractures may still be associated with poor clinical outcomes, possibly as a result of occult intra-articular injury. The aim of this study was to determine if the severity of an acute ankle fracture is correlated with an increased number of arthroscopically detected intra-articular chondral lesions.

Methods: We conducted a retrospective review of the medical charts on 283 ankle fractures that had been treated with open reduction and internal fixation and for which ankle arthroscopy had been routinely performed. The severity of the ankle fractures was categorized, with use of the arthroscopic findings derived from the operative reports as well as the findings on preoperative radiographs, according to the Lauge-Hansen criteria.

Results: Of the 283 patients, eighty-four (forty-four female and forty male) met our inclusion criteria. Chondral lesions were found in sixty-one patients (73%). Of seventeen fractures graded as pronation-external rotation or supination-external rotation type I according to the Lauge-Hansen classification, fifteen were associated with one or no chondral lesion and two, with two or more chondral lesions. Of ten fractures graded as pronation-external rotation or supination-external rotation type II, nine were associated with one or no chondral lesion and one, with two or more chondral lesions. Of fifty-six fractures graded as pronation-external rotation or supination-external rotation type IV, twenty-seven were associated with one or no chondral lesion and twenty-nine, with two or more chondral lesions. Type-IV pronation-external rotation and supination-external rotation ankle fractures were more likely to be associated with two or more chondral lesions than type-I fractures (odds ratio = 8.1, 95% confidence interval = 1.7 to 38.6; p = 0.0044) or type-II fractures (odds ratio = 9.7, 95% confidence interval = 1.1 to 81.5; p = 0.0172).

Conclusions: Chondral lesions are commonly found after an acute ankle fracture. This retrospective study demonstrated that the number of intra-articular chondral lesions associated with the more severe ankle fracture patterns (pronation-external rotation and supination-external rotation type-IV fractures) was greater than the number associated with the less severe ankle fracture patterns.

Level of Evidence: Prognostic Level II. See Instructions to Authors for a complete description of levels of evidence.

Anatomic surgical realignment of ankle fractures may still be associated with poor clinical outcomes[1-4]. Although the reasons for this remain unclear, many have postulated that occult intra-articular injury is a possible cause[5-14]. Intra-articular chondral lesions are frequently found in association with acute ankle fractures, yet the clinical relevance of such lesions remains unknown.

The frequency or severity of chondral injury has not been correlated with the severity of ankle fracture as classified with the Lauge-Hansen criteria in previous studies[15-17]. Loren and Ferkel conducted a prospective study of forty-eight fractures classified with use of the Lauge-Hansen and AO-Danis-Weber criteria, with the inclusion of plafond-variant fractures, and found chondral lesions in 63% of the ankles; they determined that patients with an ankle fracture have a high prevalence of concomitant intra-articular pathology[15]. However, they did not further subclassify or stage the fractures with use of the Lauge-Hansen criteria; as a result no correlation could be made between the severity of the fracture pattern and the severity of intra-articular injury. Hintermann et al. found that

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the frequency and severity of chondral lesions increased from type-B to type-C ankle fractures, as classified with use of the AO-Danis-Weber criteria, but they found no difference between type-A and type-B fractures with regard to the frequency and severity of chondral lesions[17]. Ono et al. prospectively reviewed the arthroscopic findings and surgical outcomes for 105 "fresh" malleolar fractures that had been classified with use of the Lauge-Hansen system[16]. Chondral lesions were found in twenty-one patients, and the authors concluded that these lesions could occur regardless of the fracture stage or type. No correlation was found between the fracture type and the site of the chondral lesion or between the mechanism of injury and the severity of the chondral damage.

We conducted a retrospective chart review to determine if the severity of an acute ankle fracture, as classified with the Lauge-Hansen criteria, correlates with the severity of arthroscopically detected intra-articular chondral lesions. We hypothesized that more severe ankle fractures would be associated with an increased number of intra-articular chondral lesions.

Materials and Methods

Following approval from our institutional review board, data were obtained from the medical charts of patients with an ankle fracture who had undergone arthroscopy and open reduction and internal fixation between 2000 and 2006. Data were obtained from the patient records of two surgeons at our institution who routinely performed ankle arthroscopy before open reduction and internal fixation of an ankle fracture. The data that we obtained from the medical records included the patient's age and sex, date of injury, date of surgery, Lauge-Hansen classification[18] of the ankle fracture, locations of chondral lesions, presence or absence of concurrent synovitis, and treatment plan. The criteria for inclusion in the present study were (1) a patient age between seventeen and sixty-five years old, (2) a fracture that was neither a pilon or a plafond-variant injury, (3) a date of injury less than three weeks before the date of surgery, and (4) no associated injuries or fractures at the time of the clinical presentation. Of 283 cases examined, 199 did not meet the inclusion criteria, resulting in a study population of eighty-four cases. The exclusion criteria, which included potential confounding factors that could independently influence the extent of osteochondral injuries, were a pilon or a plafond-variant fracture, presentation more than three weeks following the initial injury, multiple injuries in the extremity, and an age of more than sixty-five or less than seventeen years. The majority of patients who did not meet the inclusion criteria were those presenting more than three weeks after the injury, those with multiple fractures, and those with a pilon or a plafond-variant fracture. Each qualifying case was assigned a Lauge-Hansen classification on the basis of preoperative radiographs and/or the operative report and arthroscopy photographs because this classification continues to be used as a guide in the diagnosis and management of ankle fractures[19].

The location of each chondral lesion was categorized as a chondral loose body, the medial malleolus, the lateral malleolus, the anterolateral aspect of the talus, the posterolateral aspect of the talus, the anteromedial aspect of the talus, the posteromedial aspect of the talus, the anterior aspect of the talus, the posterior aspect of the talus, the medial aspect of the talus, the lateral aspect of the talus, or the tibial plafond. In order to determine the frequency and distribution of the chondral lesions in the series, fractures of the same Lauge-Hansen type were grouped together and statistical analysis was performed to compare these groups. Specifically, pronation-external rotation type-I fractures were combined with supination-external rotation type-I fractures, pronation-external rotation type-II fractures were combined with supination-external rotation type-II fractures, and pronation-external rotation type-IV fractures were combined with supination-external rotation type-IV fractures. There were no type-III fractures in our study population.

Statistical Methods

The distribution of clinicopathologic characteristics was compared among the groups (pronation-external rotation/supination-external rotation types I, II, and IV) with use of nonparametric categorical data analysis. An α value of <0.05 was used as a marker of significance.

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There was no outside source of funding for this study.

Results

Baseline Patient Characteristics

Of the eighty-four patients who were evaluated, forty were male and forty-four were female. Most (80%) of the male patients were between twenty-one and forty-nine years of age, whereas most (89%) of the female patients were between thirty and fifty-nine years of age. The distribution of fracture types was similar between the two sexes, and therefore male and female patients were analyzed together. Thirteen fractures (15%) were pronation-external rotation type I, one (1%) was pronation-external rotation type II, seventeen (20%) were pronation-external rotation type IV, one (1%) was a supination-adduction fracture, four (5%) were supination-external rotation type I, nine (11%) were supination-external rotation type II, and thirty-nine (46%) were supination-external rotation type IV.

Chondral Lesions

Overall, chondral lesions were found in association with sixty-one (73%) of the eighty-four ankle fractures. Fifty-one ankles (61%) had lesions involving the talar dome, five (6%) had lesions involving the tibial plafond, and ten (12%) had lesions of the articular surface of the medial and/or lateral malleolus. In addition, there was associated synovitis in twenty-three cases (27%). Although synovitis was considered to be a separate category of articular damage in our data analysis, it was not counted as an episode of chondral injury during our statistical analysis. Figure 1 illustrates the distribution of the chondral lesions in terms of their locations in the ankle and

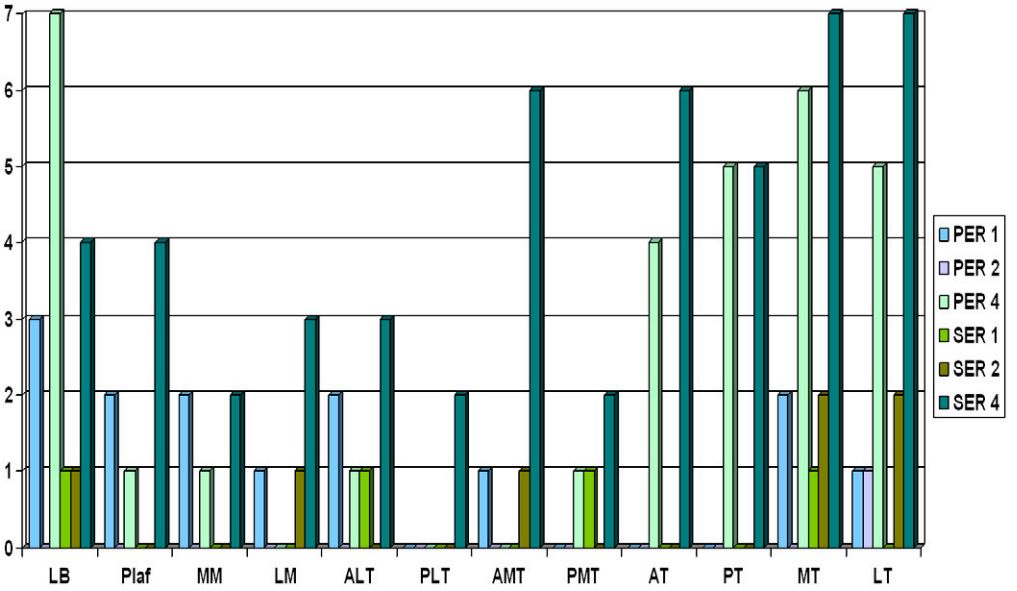

Fig. 1

The distribution of chondral lesions relative to their location and the Lauge-Hansen classification of the fracture. Type-IV fractures were associated with the highest frequency of loose bodies (LB) as well as chondral lesions in the anterior (AT), posterior (PT), lateral (LT), and medial (MT) talar locations. Plaf = plafond; MM = medial malleolus; LM = lateral malleolus; ALT = anterolateral aspect of the talus; PLT = posterolateral aspect of the talus; AMT = anteromedial aspect of the talus; PMT = posteromedial aspect of the talus; and PER 1, PER 2, and PER 4 = pronation-external rotation type I, type II, and type IV, and SER 1, SER 2, and SER 4 = supination-external rotation type I, type II, and type IV.

among the fracture-severity subgroups. The figure shows the variation in the number of chondral lesions among the fracture patterns at each location. Figures 2 and 3 show the percentages of all chondral lesions at each location in the ankle, and Figures 4 and 5 illustrate the percentages of the chondral lesions associated with each Lauge-Hansen fracture type at each ankle location. Type-IV fractures were associated with the highest frequency of loose bodies and the highest frequency of chon-

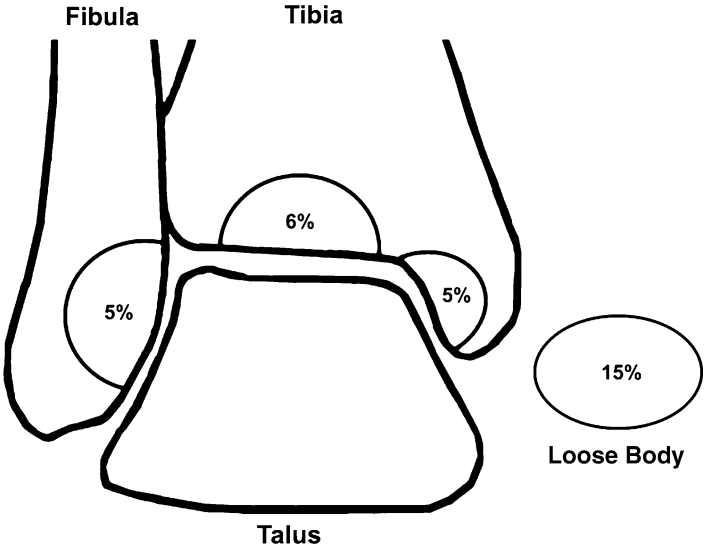

Fig. 2

Overall distribution of chondral lesions on the tibial plafond, medial malleolus, lateral malleolus, and the loose bodies.

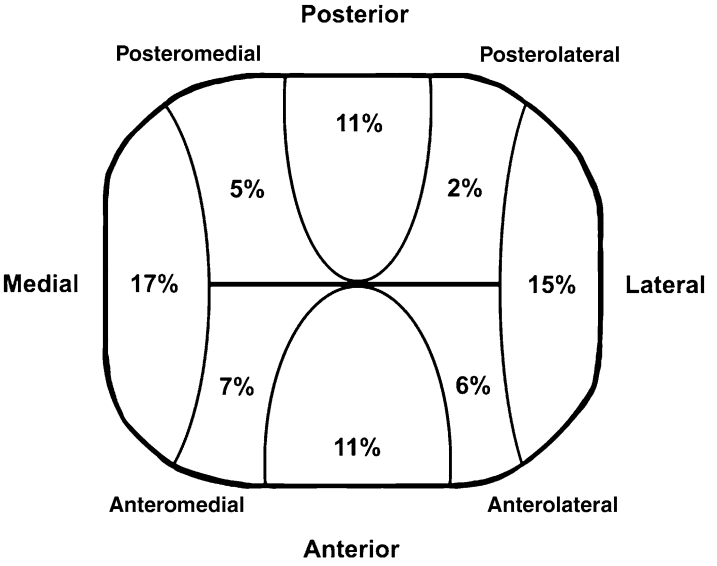

Fig. 3
Overall distribution of chondral lesions on the talus.

dral lesions in the anterior, posterior, lateral, and medial aspects of the talar dome.

Categorical Statistics (Fig. 6)
We used a prespecified cutoff value of two chondral lesions or more to distinguish between severe and mild-to-moderate overall chondral injury associated with ankle fracture. Of seventeen pronation-external rotation or supination-external rotation type-I fractures, fifteen were associated with one or no chondral lesion and two were associated with two chondral lesions or more. Of ten fractures graded as pronation external-rotation or supination-external rotation type II, nine were associated with one or no chondral lesion and one was associated with two chondral lesions or more. Of fifty-six fractures graded as pronation-external rotation or supination-external rotation type IV, twenty-seven were associated with one or no chondral lesion and twenty-nine, with two chondral lesions or more.

A Fisher exact test revealed that, overall, pronation-external rotation and supination-external rotation type-IV ankle

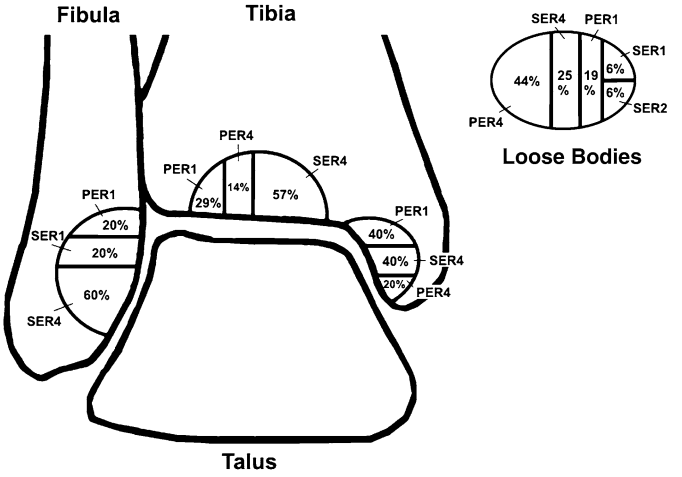

Fig. 4
Overall distribution of chondral lesions on the tibial plafond, the medial malleolus, the lateral malleolus, and loose bodies in terms of the fracture-severity subgroup. PER1, PER2, and PER4 = pronation-external rotation type I, type II, and type IV, and SER1, SER2, and SER4 = supination-external rotation type I, type II, and type IV.

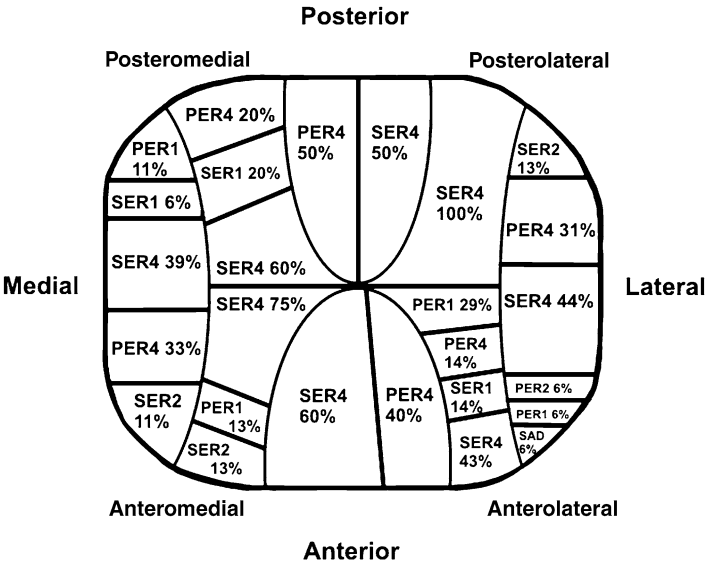

Fig. 5

Overall distribution of chondral lesions on the talus in terms of the fracture-severity subgroup. PER1, PER2, and PER4 = pronation-external rotation type I, type II, and type IV, and SER1, SER2, and SER4 = supination-external rotation type I, type II, and type IV.

fractures were 8.1 times more likely than pronation-external rotation and supination-external rotation type-I fractures to be associated with two chondral lesions or more (odds ratio = 8.1, 95% confidence interval = 1.7 to 38.6; p = 0.0044). In addition, a type-IV ankle fracture was 9.7 times more likely than a type-II ankle fracture to be associated with two chondral lesions or more (odds ratio = 9.7, 95% confidence interval = 1.1 to 81.5; p = 0.0172). With the numbers studied, there was no significant difference in this risk parameter between type-I and type-II ankle fractures.

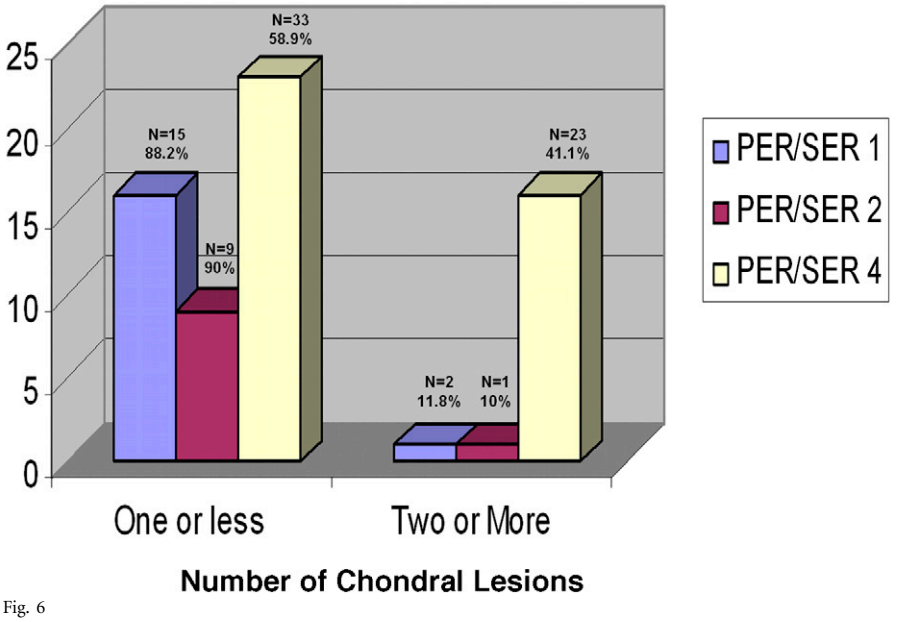

Fig. 6

A prespecified cutoff value of two chondral lesions or more was used to distinguish between severe and mild-to-moderate chondral injury associated with the ankle fracture. PER/SER 1, PER/SER 2, and PER/SER 4 = pronation-external rotation or supination-external rotation type I, type II, and type IV.

Discussion

To our knowledge, this study is the first to correlate intra-articular chondral injury associated with an acute ankle fracture with the stage of the fracture according to the Lauge-Hansen classification. Arthroscopic findings at the time of the surgical treatment of the fracture revealed that chondral lesions are commonly found after acute ankle fractures: the prevalence in our study was 73% (sixty-one of eighty-four ankle fractures). We believe that this is the first study to demonstrate that the severity of the acute ankle fractures, as classified with the Lauge-Hansen criteria, is associated with an increased number of chondral lesions in the ankle. This study showed that a type-IV ankle fracture is 8.1 and 9.7 times more likely than a type-I or a type-II ankle fracture, respectively, to be associated with two chondral lesions or more.

Previous studies of adults with ankle fractures have shown poor results in some patients despite anatomic realignment and even after removal of hardware. Brown et al. assessed late pain associated with hardware placed in the distal part of the tibia and fibula and found that, despite improvement after hardware removal, nearly half of the patients continued to experience pain[1]. We suggest that such ongoing pain may result from intra-articular injury sustained at the time of the fracture. This seems plausible given that meta-analysis has shown that more severe fracture patterns result in worse long-term outcomes as demonstrated by a higher prevalence of posttraumatic arthrosis[19]. Specifically, the prevalence of secondary arthritis was 2.6% with supination-external rotation type-II injuries and 23.6% with supination-external rotation type-IV injuries[19]. While the results of the current study do not directly validate intra-articular injury as the cause of continued pain after anatomical reduction of ankle fractures, they do provide evidence to warrant further investigation.

The most common fracture patterns were represented in our study. Our data did not include pronation-external rotation type-III, pronation-abduction, or supination-external rotation type-III fracture patterns, and they included only one supination-adduction fracture. This reflects the findings of others that such fracture patterns are less common. The literature has shown that up to 72% of ankle fractures can be classified as supination-external rotation injuries, with the majority of studies revealing that <10% of all fractures are other than pronation-external rotation or supination-external rotation injuries[20-23,18]. Thus, we believe that our study group, despite our exclusion of a large number of potential subjects, is representative of the adult population with ankle fractures.

Limitations of this study include its retrospective nature, and, because two different surgeons performed the arthroscopic procedures, interobserver variability in detecting and defining intra-articular lesions may have occurred. Also, not all operative notes quantified the size and depth of the lesions.

While our analysis revealed that the severity of the fracture is associated with an increased number of chondral lesions, we are not aware of any published studies showing that treating these lesions or preferentially assessing patients with supination-external rotation or pronation-external rotation type-IV fractures with arthroscopy improves outcomes. Prospective studies with more detailed analysis of the intra-articular chondral lesions associated with ankle fractures (e.g., analysis of the location and quantity of the lesions and of qualifying factors) are necessary before treatment strategies and prognostic relevance can be established. A prospective randomized trial is under way at our institution to address these variables. ■

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Nikoletta Leontaritis, DO
Lauren Hinojosa, BS
Vinod K. Panchbhavi, MD, FRCS
Division of Foot and Ankle Surgery and Infections,
Department of Orthopaedic Surgery and Rehabilitation,
The University of Texas Medical Branch,
Galveston,
TX 77555-0165.
E-mail address for V.K. Panchbhavi: vkpanchb@utmb.edu

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