Original Article

# Identifying Intra-Articular Pathology With Arthroscopy Prior to Open Ankle Fracture Fixation

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**Purpose:** To assess the prevalence of intra-articular findings with ankle arthroscopy in patients undergoing operative fixation for ankle fractures. **Methods:** This is a retrospective review of ankle fractures that were treated with arthroscopy and open reduction and internal fixation by a single surgeon. Between August 2016 and July 2018, operative reports, office notes, and images were reviewed to identify intra-articular pathology and fracture type. An analysis was performed with regard to fracture type, presence and location of osteochondral lesions, loose-bodies, syndesmotic injury, and deltoid injury. **Results:** Fifty-seven ankle fractures were identified that met inclusion criteria. In total, 84.2% of the fractures had intra-articular pathology, most commonly a syndesmotic injury followed by presence of intra-articular loose bodies and osteochondral defects. **Conclusions:** In our study, use of arthroscopy before open ankle fracture fixation identified intra-articular pathology in 84.2% of subjects. The most common pathology was syndesmotic injury. The addition of an arthroscopic assessment in patients with operatively treated ankle fractures may help improve treatment provided to patients during ankle fracture surgery. **Level of Evidence:** Level 4 Therapeutic Case Series.

The purpose of this study is to assess the prevalence of intra-articular findings with ankle arthroscopy in patients undergoing operative fixation for ankle fractures. Ankle fractures make up one-half of the fractures of the foot and ankle.[1-4] The incidence of ankle fractures is estimated to be between 71 and 187 per 100,000 person years, and projections show this measure will continue to increase.[5] A meta-analysis study looking at 1822 ankle fractures demonstrated that even when anatomical alignment is achieved and maintained from surgery, less than 80% of patients reported good/excellent outcomes, with the main complaint in the remaining group being continued pain and/or functional limitation.[2]

In previous studies in which arthroscopy was performed at the time of ankle fracture surgery, a variety of intra-articular pathology has been documented, including chondral lesions, loose bodies, and ligamentous damage. Several studies cite the incidence of associated chondral injury as high as 50% to 70%, and chondral lesions have been shown to be an independent predictor for the development of post-traumatic osteoarthritis.[3,6-11] Another potential cause of chronic pain after ankle fractures is ligamentous instability, the diagnosis of which has been shown to be difficult both preoperatively and intraoperatively.[8] Studies have shown standard radiographs and biomechanical intraoperative tests may be inadequate for diagnosing syndesmotic injury.[1] Others have suggested that ankle arthroscopy can provide additional information to help guide diagnosis and treatment.[12]

The purpose of this study is to assess the prevalence of intra-articular pathology identified through arthroscopy in patients undergoing operative fixation for ankle fractures. Our hypothesis is that there would be a high incidence of ligamentous and intra-articular pathology definable by arthroscopy that would be neglected if a surgeon was to only perform open reduction and internal fixation (ORIF) of the ankle fracture.

## Methods

Between August 2016 and July 2018, the senior author's (T.W.) patient database was searched using

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Current Procedural Terminology codes 27766-27823 to identify all patients treated surgically for ankle fractures. Patient inclusion criteria for this review were as follows: any patient older the age of 18 years with the diagnosis of an acute ankle fracture who had preoperative diagnostic radiographs available for review and who underwent surgical treatment. Patients were excluded from the analysis if they had missing data from their medical record (operative reports, radiographs, follow-up records, etc.) or if they were undergoing surgery for a nonunion or malunion of a nonacute fracture.

The senior author who performed all of the surgeries included ankle arthroscopy as a standard protocol in treating all ankle fractures during the study period. At the time of surgery for fixation of the ankle fracture, preoperative stress radiographs would be taken using fluoroscopy to evaluate the integrity of the syndesmosis. The patient was then prepped for ankle arthroscopy using standard anterolateral and anteromedial portals with standard arthroscopic equipment, including the use of a traction device and gravity fluid flow. Intra-articular assessment of the cartilage surface of the tibial plafond and the talar dome, as well as the gross integrity of the syndesmotic and deltoid ligaments, were performed. Syndesmotic injuries were diagnosed using previously published techniques: direct visualization of an avulsed/torn anterior inferior tibiofibular ligament or posterior inferior tibiofibular ligament, the "drive-through sign" (the ability to pass a 2.8-mm shaver into the medial gutter) as described by Schairer et al.,[13] and widening of the distal tibiofibular joint >2 mm with internal/external rotation of the ankle as measured with an arthroscopic probe, as described by Takao et al.[14]

Any intra-articular pathology noted at the time of arthroscopy was treated using standard techniques (microfracture, debridement, drilling, removal of loose body, etc.) before the traction was removed and the fracture was addressed with ORIF. The results of intraoperative stress radiographs along with the arthroscopic findings were compared and used in the decision-making for syndesmotic fixation.

Each chart was reviewed for date of injury, date of surgery, patient sex and age at the time of fracture, and Lauge−Hansen classification of fracture pattern. Each ankle fracture was independently reviewed by 2 independent orthopaedic surgeons (K.S., S.H.). The reviewers disagreed on fracture classification in 6 patients, and the final determination in these cases was made by the senior author.[15] The patients' operative reports and arthroscopy images were analyzed to record the presence of intra-articular pathology noted on arthroscopy, sorted as chondral lesions (tibial or talar), loose bodies, and syndesmotic or deltoid ligament injuries. The aforementioned findings were compiled for all patients in a spreadsheet, and the prevalence of intra-articular injuries was calculated.

**Table 1.** Breakdown of Fracture Types

| Fracture Types | No. Fractures | Percentage |
|---|---|---|
| SAD | 6 | 10.5% |
| SER | 43 | 75.4% |
| PAD | 3 | 5.3% |
| PER | 5 | 8.8% |
| Total | 57 | |

NOTE. Shown is the breakdown of number and percentage of each fracture type based on the Lauge−Hansen classification.

PAD, pronation−abduction; PER, pronation−external rotation; SAD, supination−adduction; SER, supination−external rotation.

## Results

Database review for of the Current Procedural Terminology codes identified 76 ankle fractures that underwent an ORIF with an ankle arthroscopy. In total, 18 patients were excluded due to missing information, and 1 patient was excluded because the arthroscopy was performed at the time a nonunited fracture was being treated, rather than an acute fracture. Thus, 57 unilateral ankle fractures were included in the study for analysis. Table 1 demonstrates distribution of fracture types with supination−external rotation (SER), accounting for 75.4% of the fractures.

Overall, intra-articular pathology was seen in 84.2% of the ankle fractures. The most common pathology seen was a syndesmotic injury in 59.6% of patients followed by 52.6% having an intra-articular loose body (defined as any free-floating fragment of cartilage, bone, or osteochondral fragment) and 38.6% having an osteochondral defect of either the talus of tibial plafond (Table 2). There were no deltoid injuries in the supination−adduction or pronation−abduction groups; however, the rates of deltoid injury in SER and pronation−external rotation (PER) patterns were 30% and 80%, respectively. PER fracture patterns had the greatest rate of intra-articular findings at 100% (Table 3). Supination−adduction and pronation−abduction both had 66.7% intra-articular pathology, and SER had 86% (Table 3).

Patients were followed for an average of 6.3 months (range 3-13 months). In our series, there were no arthroscopy-related complications. There were 12 repeat surgeries in our cohort, 10 were for removal of hardware, and 2 were for incision and drainage of a superficial wound infection unrelated to the arthroscopic procedure.

## Discussion

As surgeons continue to seek to improve outcomes in ankle fracture surgery, increased attention is paid to

**Table 2.** Breakdown of Intra-Articular Findings

| Total | Total = 57 | Percentage |
|---|---|---|
| Loose body | 30 | 52.6% |
| Talar OCD | 13 | 22.8% |
| Tibial OCD | 9 | 15.8% |
| Any OCD | 22 | 38.6% |
| Syndesmotic injury | 34 | 59.6% |
| Deltoid injury | 17 | 29.8% |
| None | 9 | 15.8% |

NOTE. Demonstrates breakdown of intra-articular findings of all fracture types.

OCD, osteochondritis dissecans.

subtle instability of the syndesmosis and other intra-articular pathology.[4] We found 84.2% of ankles fractures had intra-articular pathology, most commonly a syndesmotic injury.[4,16] These findings support the recent growing body of evidence that there is a high prevalence of intra-articular cartilaginous and syndesmotic injury associated with ankle fractures. The information gained through arthroscopic evaluation may be helpful in discussions with the patient and in managing expectations for the postoperative course. The secondary purpose of this study was to assess which ankle fracture pattern is associated with additional pathology.

A systematic review of ankle fractures evaluated with arthroscopy by Chen et al.[6] showed 63.3% of patients had chondral lesions. Leontaritis et al.[6] showed increasing chondral injury with increasing severity of ankle fractures such as supination external rotation type IV fractures. Several other recent studies showed rates of chondral injury ranging from 69% to 73.2%.[7,8] Our study showed less-frequent chondral injury with a 38.6% overall incidence, with 15.8% tibial and 22.8% talar OCDs specifically. When we evaluated chondral injury among fractures in our study, we found there was an increase in chondral injury with greater energy injuries such as PER fractures. Level II evidence shows initial cartilage damage at the time of arthroscopy and ORIF to be predictive of patient outcomes.[9] This information may be valuable in counseling patients and helping set expectations.

The incidence of ankle fractures has been reported at 13 per 10,000 person years, and recent studies have shown the incidence of syndesmotic injury to be in the range of 2.09 syndesmotic injuries per 100,000 person-years.[17]

Several methods for assessing syndesmotic integrity both preoperatively and intraoperatively have been reported. Techniques include standard ankle radiographs and stress films.[18] In particular, there is level II evidence suggesting that there is no association between tibiofibular clear space on anteroposterior (AP) radiographs with the presence of ligamentous pathology on magnetic resonance imaging.[18]

Several techniques for intraoperative assessment of syndesmotic stability exist, including the Cotton test and intraoperative external rotation stress films. Further, there are multiple described methods of performing each test, with no consensus on cut-off values for positive examinations. For example, the Cotton test has been described as an AP radiograph with simultaneous direct lateral translation of the fibula with use of a pointed clamp or bone hook as well as a lateral intraoperative radiograph while applying anterior force in the sagittal plane.[19] Intraoperative external rotation also has been performed with varying degrees of dorsiflexion and with varying amounts of force. Recent level I studies have shown that Cotton and external rotation stress tests lack sensitivity.[19] Sensitivity of the Cotton test has been reported as low as 0.25 and external rotation stress test as low as 0.58, calling into question the reliability of these tests to accurately demonstrate syndesmotic instability.[20]

In a case series of 38 patients with Weber B fractures, Takao et al.[8] compared the use of plain film radiographs and arthroscopy for the diagnosis of syndesmotic injury. One surgeon analyzed AP radiographs, another analyzed mortise films, and the third used arthroscopy to evaluate syndesmotic disruption. Criteria of greater than 5 mm tibiofibular clear space and less than 10 mm tibiofibular overlap were used for AP films. Talocrural angle with greater than 2-mm talar tilt and 4-mm medial clear space were used on the mortise films. Lastly, arthroscopy evaluated the anterior, posterior, and transverse tibiofibular ligaments by direct visualization but not the interosseous ligament. Their results show identification of 42% of syndesmotic injuries by use of AP films, 55% by use of mortise, and all syndesmotic injuries were identified arthroscopically.[6]

With regard to incidence of syndesmotic instability in the setting of ankle fracture, Yassin[7] et al. and Chen et al.[6] showed 78% and 77% syndesmosis injury,

**Table 3.** Percentage of Arthroscopic Pathologic Findings in Each Fracture Type

| Summary | SAD | SER | PAD | PER |
|---|---|---|---|---|
| Total number | 6 | 43 | 3 | 5 |
| Loose body | 33.3% | 51.2% | 66.7% | 80.0% |
| Talar OCD | 33.3% | 18.6% | 33.3% | 40.0% |
| Tibial OCD | 16.7% | 16.3% | 33.3% | 0.0% |
| Any OCD | 50.0% | 34.9% | 66.7% | 40.0% |
| Syndesmotic injury | 16.7% | 62.8% | 33.3% | 100.0% |
| Deltoid injury | 0.0% | 30.2% | 0.0% | 80.0% |
| None | 33.3% | 14.0% | 33.3% | 0.0% |

NOTE. Shown is the percentage of each arthroscopic pathologic finding seen in each fracture pattern.

OCD, osteochondritis dissecans; PAD, pronation—abduction; PER, pronation—external rotation; SAD, supination—adduction; SER, supination—external rotation.

respectively. While Yassin's study was a case series with 2 year follow-up, the incidence of syndesmotic instability was very similar to the meta-analysis by Chen et al.[6,7] Our findings showed slightly less syndesmotic instability at 60%. This may be due to an unequal distribution of high and low energy injuries among studies.

Magnetic resonance imaging findings alone are not sufficient for the diagnosis of ligamentous injury and may miss deep deltoid injuries.[21] Cadaveric studies have shown that radiographs with the ankle positioned in dorsiflexion and external rotation are the most reliable combination for prediction of deep deltoid injury.[22] However, there is currently no consensus for recommendation on the objective amount of medial clear space widening, with some suggesting 4 to 6 mm as cutoff for a positive examination.[23] Our study showed a moderate degree of deltoid injury in the SER fractures and a high degree of deltoid injury in the PER fractures at 30% and 80%, respectively.

Thordarson et al.[24] showed 55% loose bodies whereas Yassin et al.[7] found a loose body in 36% of fractures. Our study showed a comparatively greater number of loose bodies, at 53% of our series of ankle fractures. Leontaritis et al.[3] had a lower occurrence of loose bodies during arthroscopy for ankle fracture at 15% and noted them to be most associated with pronation external rotation IV fractures. The range in occurrence of loose bodies among studies investigating arthroscopic findings at the time of ankle ORIF is likely a function of the distribution of fracture types within these studies.

In addition to potentially increasing the diagnostic ability of associated pathology with ankle fractures, ankle arthroscopy at the time of ORIF provides lavage of the joint, which may potentially alter the intra-articular environment and reduce the inflammatory burden, allow quicker return of range of motion, improve pain, and decrease formation of post-traumatic arthritis.[25] In a prospective randomized trial of 72 ankle fractures treated with arthroscopy at the time of ORIF, clinical results show improved American Orthopedic Foot and Ankle Scores for those patients with combined intra-articular pathology, particularly addressing occult syndesmotic injury, which was treated at the time of ORIF rather than ORIF alone.[8]

Future directions may include randomized prospective studies to evaluate response to treatment of intra-articular pathology encountered at the time of arthroscopy and to further delineate the clinical significance of these findings. Studies regarding the cost and value of ankle arthroscopy at the time of ORIF may then be addressed. Our study corroborates with other studies showing ankle arthroscopy at the time of ORIF provides unparalleled intra-articular evaluation, particularly with regard to syndesmotic instability. Further, it provides lavage to the joint and allows removal of loose bodies while being reproducible and efficient.

### Limitations

There are several limitations of this study. Due to the retrospective nature of the study, the data able to be gathered regarding the intra-articular pathologies are limited to arthroscopic images and descriptions in operative reports. Therefore, depth and size of cartilage lesions, magnitude of widening of the syndesmosis on stress testing, and other similar valuable data points were not available for analysis. In total, 18 of 76 fractures also were excluded from the study due to lack of information in the chart, which may have induced transfer bias and altered the true prevalence of intra-articular injury. In addition, in this study we evaluated only the prevalence of the intra-articular findings at the time of surgery; it is not known whether some of the findings existed before the ankle fracture. In addition, although all syndesmotic injuries were treated and cartilage injuries were addressed at the time of surgery, any clinical benefit to the addition of these treatments is assumed, as there was no control group and no outcome measures were recorded postoperatively. Lastly, the follow-up period was short. Although no arthroscopy-related complications were observed in our study, there may be complications that occurred after the follow-up period.

## Conclusions

In our study, use of arthroscopy before open ankle fracture fixation identified intra-articular pathology in 84.2% of subjects. The most common pathology was syndesmotic injury. The addition of an arthroscopic assessment in patients with operatively treated ankle fractures may help improve treatment provided to patients during ankle fracture surgery.

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