DOI: https://doi.org/10.30795/jfootankle.2026.v20.2004

Original Article

High prevalence of intra-articular lesions identified by arthroscopy during syndesmotic screw removal after ankle fracture fixation

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Abstract

Objective: To determine the prevalence of intra-articular lesions and evaluate syndesmotic stability using ankle arthroscopy performed at the time of syndesmotic screw removal in patients with surgically treated Weber B and C ankle fractures.

Methods: A prospective observational study was conducted, including patients with unstable ankle fractures classified as Weber B or C who underwent open reduction and internal fixation with syndesmotic screw placement. Ankle arthroscopy was performed during routine syndesmotic screw removal 6–8 weeks after the index procedure. Arthroscopic findings, including chondral lesions of the talar dome, synovitis, intra-articular fibrosis, meniscoid lesions, loose bodies, and syndesmotic instability, were recorded. Chondral lesions were classified according to the Outerbridge classification.

Results: Twenty-two patients were included in the study. Arthroscopic evaluation revealed chondral lesions of the talar dome in 16 patients (72.7%), synovitis in 17 patients (77.3%), and diffused intra-articular fibrosis in 20 patients (90.9%). Residual syndesmotic instability was identified in two patients (9.1%). Most chondral lesions were classified as Outerbridge grade II or III. No statistically significant association was identified between mechanism of injury and arthroscopic findings.

Conclusion: Arthroscopy evaluation during syndesmotic screw removal revealed a high prevalence of intra-articular lesions following ankle fracture fixation. Arthroscopic evaluation may therefore represent a valuable diagnostic and therapeutic adjunct for identifying intra-articular lesions that may contribute to persistent postoperative symptoms.

Level of Evidence IV; Prospective Observational Study.

Keywords: Ankle fractures; Ankle arthroscopy; Syndesmotic instability; Osteochondral lesion; Talar dome.

Introduction

Ankle fractures are among the most common injuries treated by orthopedic surgeons, with an estimated incidence of approximately 174 per 100,000 individuals annually[1]. Population-based studies have also demonstrated important epidemiological variations and associations between patient characteristics and fracture patterns[2].

Despite advances in surgical fixation techniques, postoperative complications and functional limitations remain relatively frequent after ankle fracture surgery[3,4]. In addition, intra-articular lesions such as chondral lesions, synovitis, loose bodies, and fibrotic bands are commonly associated with ankle fractures and may contribute to persistent postoperative symptoms. Several arthroscopic studies have reported intra-articular lesions in up to 70% of ankle fractures, emphasizing the importance of evaluating the ankle joint beyond fracture reduction alone[5-7]. In particular, osteochondral lesions of the talar dome have been reported in a high proportion of patients with ankle fractures[6].

Study performed at the Hospital General Dr. Manuel Gea Gonzalez, Ciudad de México, México.

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How to cite this article: Cuellar-Avaroma A, Ramírez-Guerrero JA, King-Martínez AC. High prevalence of intra-articular lesions identified by arthroscopy during syndesmotic screw removal after ankle fractures fixation. J Foot Ankle. 2026;20(2):e2004.

Although magnetic resonance imaging (MRI) can detect osteochondral injuries, ankle arthroscopy remains the gold standard for direct visualization of intra-articular pathology and allows simultaneous treatment of detected lesions[8].

In addition, arthroscopy provides a dynamic assessment of the distal tibiofibular joint and may help identify subtle syndesmotic injuries that are not always evident on conventional imaging[9].

Recent studies have suggested that arthroscopically assisted fixation of ankle fractures may improve the detection of intra-articular pathology without increasing complication rates[10]. Because syndesmotic screws are frequently removed after fracture healing, arthroscopy performed at the time of screw removal represents a valuable opportunity to evaluate the ankle joint and identify associated intra-articular pathology.

The objective of this study is to determine the prevalence of intra-articular lesions and evaluate syndesmotic stability using ankle arthroscopy at the time of syndesmotic screw removal in patients with surgically treated Weber B and C ankle fractures.

Methods

Study design

A prospective observational study was conducted to evaluate the prevalence of intra-articular lesions in patients with surgically treated ankle fractures. Arthroscopic evaluation was performed at the time of routine syndesmotic screw removal following open reduction and internal fixation (ORIF).

The study was conducted at a general hospital for a period of 36 months. Institutional ethical approval was obtained prior to study initiation, and all patients provided informed consent for participation.

Patients were eligible for inclusion if they were aged ≥18 years, had an acute unstable ankle fracture classified as Danis-Weber B or C, underwent surgical treatment with ORIF, received a syndesmotic screw during the index procedure, and had planned syndesmotic screw removal between 6 and 8 weeks postoperatively. Patients were excluded if they had a history of previous ankle surgery, open fractures, pilon fractures, pathological fractures, incomplete clinical data, or refused to participate. A total of 22 consecutive patients met the inclusion criteria and were included in the analysis.

Fracture classification and mechanism of injury: Fractures were classified according to the Danis-Weber classification system based on preoperative radiographs. The mechanism of injury was determined using the Lauge-Hansen classification, which categorizes fractures as Supination–External Rotation (SER) and Pronation–External Rotation (PER).

Radiographic evaluation included standard anteroposterior, lateral, and mortise views of the ankle.

Surgical technique and arthroscopic evaluation: All patients underwent ORIF of the ankle fracture according to standard surgical techniques. Syndesmotic instability was evaluated intraoperatively, and fixation was performed using a trans-syndesmotic screw when indicated.

Routine removal of the syndesmotic screw was performed 6–8 weeks after the index procedure. At the time of screw removal, ankle arthroscopy was performed using standard anteromedial and anterolateral portals. Arthroscopic evaluation included systematic inspection of the talar dome, tibial plafond, medial and lateral gutters, and syndesmotic recess.

The presence of intra-articular pathology was recorded, including chondral lesions of the talar dome, synovitis, diffuse intra-articular fibrosis, meniscoid lesions, loose bodies, and syndesmotic instability. Chondral lesions were classified according to the Outerbridge classification system, and the anatomical distribution of talar dome lesions was documented using the Raikin nine-zone classification[11,12].

The primary outcome of the study was the prevalence of intra-articular lesions detected by ankle arthroscopy.

Statistical analysis

Statistical analysis was performed using SPSS software (version 20.0; IBM Corp., Armonk, NY, USA).

Descriptive statistics were used to summarize patient demographics and arthroscopic findings. Continuous variables were expressed as mean ± standard deviation, whereas categorical variables were reported as absolute frequencies and percentages.

The association between the mechanism of injury (SER vs PER) and arthroscopic findings was evaluated using the chi-square (χ^2) test. A p-value < 0.05 was considered statistically significant.

Results

A total of 22 patients met the inclusion criteria and were included in the analysis. The mean age was 33.1 ± 7.2 years (range, 17-46 years). Thirteen patients (59.1%) were male, and nine (40.9%) were female. Fourteen fractures (63.6%) occurred in the right ankle and eight (36.4%) in the left ankle.

Fractures were classified as Weber B in 16 patients (72.7%) and Weber C in 6 patients (27.3%). According to the Lauge-Hansen classification, the most common mechanism of injury was SER-IV**,** which occurred in 18 patients (81.8%)**,** followed by PER-IV in four patients (18.2%)**.** Patient demographics, fracture characteristics, and mechanisms of injury are summarized in Table 1.

Arthroscopic evaluation performed at the time of syndesmotic screw removal revealed a high prevalence of intra-articular pathology. Chondral lesions of the talar dome were identified in 16 patients (72.7%)**,** making them the most common intra-articular finding.

Synovitis was observed in 17 patients (77.3%), while diffuse intra-articular fibrosis was present in 20 patients (90.9%). Other less frequent findings included meniscoid lesions in three patients (13.6%) and loose bodies in one patient (4.5%).

Arthroscopic findings are summarized in Table 2. Representative arthroscopic findings are shown in Figure 1.

The anatomical distribution of talar dome lesions was analyzed according to the Raikin nine-zone classification. Most lesions were in the anteromedial and central regions of the talar dome (zones 2 and 3). The distribution of chondral lesions according to the Raikin[11] classification is illustrated in Figure 2.

Among the 16 patients with chondral lesions, the severity of cartilage damage was classified according to the Outerbridge classification[12]. The most common grades were Outerbridge grade II (31.2%) and grade III (37.5%), indicating partial-thickness cartilage damage or deep fissuring. Outerbridge grades I and IV were observed less frequently. The severity distribution of chondral lesions is summarized in Table 3.

The relationship between the mechanism of injury (SER vs PER) and arthroscopic findings was evaluated using the chi-square test. No statistically significant association was found between the injury mechanism and the presence of chondral lesions, synovitis, or diffuse fibrosis ($p > 0.05$).

However, residual syndesmotic instability was more frequently observed in PER injuries, although this difference did not reach statistical significance. The results of the chi-square analysis are presented in Table 2.

Table 1. Patient demographics, fracture characteristics, and mechanism of injury (n = 22)

Variable	Value
Age (years), mean ± SD (range)	33.1 ± 7.2 (17–46)
Male	13 (59.1%)
Female	9 (40.9%)
Right ankle	14 (63.6%)
Left ankle	8 (36.4%)
Supination–External Rotation (SER IV)	18 (81.8%)
Pronation–External Rotation (PER IV)	4 (18.2%)
Weber B	16 (72.7%)
Weber C	6 (27.3%)

Discussion

The present study demonstrated a high prevalence of intra-articular pathology in patients with surgically treated ankle fractures. Arthroscopic evaluation performed at the time of syndesmotic screw removal revealed chondral lesions in 72.7% of patients, diffuse intra-articular fibrosis in 90.9%, and synovitis in 77.3% of cases. These findings confirm that intra-articular damage remains highly prevalent even after anatomical fracture reduction.

Ankle fractures are among the most common injuries treated by orthopedic surgeons and represent a significant

Table 2. Association between mechanism of injury and arthroscopic findings (Chi-square analysis)

Arthroscopic finding	SER (n = 18)	PER (n = 4)	Total n (%)	χ^2	p-value
Chondral lesion	13	3	16 (72.7)	0.04	0.84
Synovitis	14	3	17 (77.3)	0.02	0.88
Diffuse fibrosis	17	3	20 (90.9)	0.41	0.52
Meniscoid lesion	2	1	3 (13.6)	0.89	0.34
Loose bodies	1	0	1 (4.5)	0.25	0.62
Syndesmotic instability	1	1	2 (9.1)	3.12	0.07

SER: Supination–External Rotation;PER: Pronation–External Rotation.

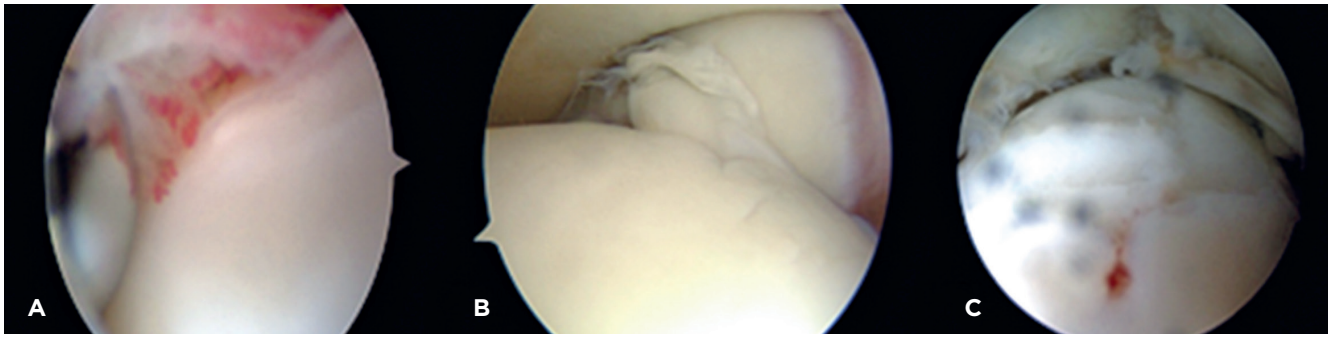

Figure 1. Arthroscopic findings (A) synovitis of the anterior ankle joint, (B) chondral lesion of the talar dome, and (C) fibrotic intra-articular band causing anterior ankle impingement.

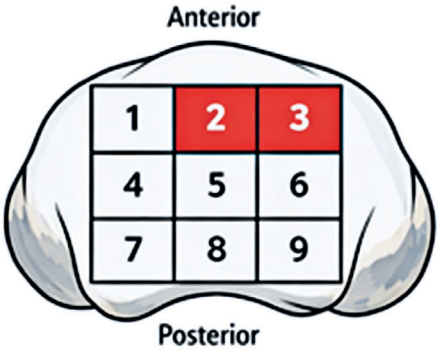

Table 4. Distribution of chondral lesions by Raikin zones.

Zone	Patients	Percentage
1	0	0%
2	6	27%
3	6	27%
4	0	0%
5	0	0%
6	0	0%
7	0	0%
8	0	0%

Figure 2. Distribution of talar dome chondral lesions according to the Raikin nine-zone classification, showing most lesions located in zones 2 and 3.

Table 3. Severity of chondral lesions according to the Outerbridge classification (n = 16)

Outerbridge grade	Description	n	%
Grade I	Cartilage softening	3	18.8
Grade II	Partial-thickness fissures	5	31.2
Grade III	Deep fissuring	6	37.5
Grade IV	Exposed subchondral bone	2	12.5

cause of long-term functional impairment. Population-based studies have reported an incidence of approximately 174 per 100,000 individuals per year, highlighting the clinical relevance of optimizing their management[1]. Epidemiological studies have also demonstrated associations between patient characteristics and fracture patterns in surgically treated ankle fractures[2]. In addition, complications following ankle fracture surgery remain relatively common and may negatively affect functional recovery[3]. Several factors have been identified as potential contributors to these adverse outcomes, including soft-tissue conditions at the time of injury and the mechanism of trauma[4]. In a recent multicenter propensity score–matched analysis (TRON study), Sugino et al.[13] reported that delayed surgical treatment after ankle fracture was associated with worse functional outcomes and a higher incidence of complications. These findings highlight the multifactorial nature of postoperative recovery after ankle fractures and emphasize the importance of identifying additional factors that may contribute to persistent symptoms, including unrecognized intra-articular pathology.

Several arthroscopic investigations have demonstrated a high prevalence of osteochondral lesions associated with ankle fractures. In one of the largest arthroscopic series, Hintermann et al.[5] reported osteochondral lesions of the talar dome in approximately 63% of patients with acute ankle fractures. Similarly, Lambers et al.[6] described osteochondral lesions in up to 70% of ankle fractures, emphasizing the importance of intra-articular evaluation in these injuries. These findings are consistent with the present study, in which chondral lesions were identified in 72.7% of patients, as shown in Table 4.

Comparable results were reported by Chen et al.[7], who observed intra-articular cartilage lesions in approximately 72% of patients undergoing arthroscopic evaluation of acute ankle fractures. Similar findings were reported by Aktas et al.[14], who found a high incidence of talar dome cartilage lesions in patients with ankle fractures. The consistency of these findings across multiple studies suggests that osteochondral injury is a common consequence of ankle trauma and may contribute to persistent postoperative symptoms and the development of post-traumatic osteoarthritis.

Although MRI can detect osteochondral injuries with reasonable sensitivity, arthroscopy remains the gold standard for evaluating intra-articular pathology. Arthroscopy allows direct visualization of cartilage surfaces, synovial tissue, and fibrotic structures while also permitting simultaneous treatment of detected lesions. This advantage is particularly relevant in patients presenting with persistent postoperative symptoms despite apparently satisfactory radiographic findings[8].

In the present study, residual syndesmotic instability was identified in 9.1% of patients. Accurate assessment of the distal tibiofibular joint remains challenging using conventional imaging modalities. Arthroscopic evaluation allows dynamic evaluation of the syndesmosis and may detect subtle instability that cannot be identified using radiographs alone. Arthroscopic correlates of subtle syndesmotic injuries have been previously described by Guyton et al.[9].

Table 4. Comparison of the prevalence of chondral lesions reported in previous arthroscopic studies

Study	Year	Study design	n	Arthroscopy timing	Chondral lesions (%)
Hintermann et al.	2000	Prospective	288	Acute fracture	63
Lambers et al.	2021	Retrospective	100	Acute fracture	70
Chen et al.	2019	Prospective	86	Acute fracture	72
Aktas et al.	—	Retrospective	52	Acute fracture	68
Present study	2025	Prospective	22	Screw removal	72.7

Diffuse intra-articular fibrosis was frequently observed in our cohort. Post-traumatic fibrosis and scar tissue formation have been described as potential causes of anterior ankle impingement and chronic postoperative pain following ankle fracture surgery. Arthroscopic debridement of fibrotic bands may therefore play an important role in the management of patients with persistent symptoms after ankle fracture fixation[15].

In recent years, increasing attention has been directed toward arthroscopically assisted fixation of ankle fractures. A systematic review and meta-analysis by Zhuang et al.[16] demonstrated that arthroscopically assisted fixation improves detection of intra-articular pathology without increasing complication rates. Similarly, recent evidence suggests that ankle arthroscopy performed in association with fracture fixation does not increase complication rates compared with conventional treatment methods[10].

Despite these advantages, the routine use of arthroscopy in all ankle fractures remains controversial. Additional prospective studies with larger sample sizes and long-term functional follow-up are required to determine whether systematic arthroscopic evaluation improves clinical outcomes.

This study has several limitations. First, the sample size was relatively small. Second, arthroscopy was performed at the time of syndesmotic screw removal rather than during the initial fracture fixation procedure. Finally, long-term functional outcomes were not evaluated. Despite these limitations, the routine use of arthroscopy in all ankle fractures remains controversial, and additional studies with larger patient cohorts and long-term follow-up are required.

Conclusion

Arthroscopic evaluation during syndesmotic screw removal revealed a high prevalence of intra-articular lesions following ankle fracture fixation. These findings highlight the potential role of ankle arthroscopy as a valuable diagnostic and therapeutic adjunct for identifying and managing intra-articular lesions that may contribute to persistent postoperative symptoms.

Authors' contributions: Each author contributed individually and significantly to the development of this article: ACA *(https://orcid.org/0000-0002-6129-954X) Conceptualization, study design, surgical procedures, manuscript drafting, manuscript revision; JARG *(https://orcid.org/0009-0003-9938-4074) Methodology, data collection, statistical analysis, interpretation of data, manuscript drafting; ACKM *(https://orcid.org/0000-0003-2457-9654) Supervision and critical revision of the manuscript. All authors read and approved the final manuscript. *ORCID (Open Researcher and Contributor ID).

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