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Original Article

Arthroscopic assessment in acute ankle fractures

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Abstract

Objective: The goal of the present study is to carry out an inventory of intra-articular injuries through arthroscopy in patients with ankle fractures.

Methods: This observational cross-sectional study evaluated 28 patients who underwent ankle arthroscopy before and after ankle osteosynthesis. Five items were assessed: medial malleolus reduction, intra-articular loose bodies, osteochondral lesion, lateral ligament integrity, and deltoid integrity.

Results: Sample included 12 (42.86%) male patients and 16 (57.14%) female patients aged around 45.7 years. Out of 28 cases, 20 were Danis-Weber type B fractures. Intra-articular lesions of the ankle were found in 24 patients. A total of 17 (60.71%) patients had syndesmotic injuries, while 16 (57.14%) patients had osteochondral lesions. Lateral and medial ligament injuries were found in five patients each. Medial malleolar fractures were identified in 12 patients, four of which were poorly reduced.

Conclusion: Ankle fractures are commonly associated with intra-articular ankle injuries. Danis-Weber type C fractures frequently present with severe osteochondral and ligamentous injuries.

Level of evidence IV; Therapeutic studies; Case series.

Keywords: Arthroscopy; Ankle fractures; Ankle joint.

Introduction

Approximately 70% of patients with unstable ankle fractures treated with open reduction and internal fixation (ORIF) present good outcomes[1], but some patients have unpredicted worse functional outcomes[2].

As arthroscopy allows the identification of traumatic cartilage injuries to which unsatisfactory results can be attributed in fracture treatment[3-5], there has been an increase in arthroscopy-assisted ORIF of acute ankle fractures[6].

The goal of the present study is to carry out an assessment of intra-articular injuries in patients with ankle fractures using arthroscopy.

Methods

Patient selection and assessment

The present observational cross-sectional study involved a population of patients with ankle fractures treated surgically between August 2020 and August 2021. After Research Ethics Committee approval was obtained, patients between 18 and 60 years old with acute fractures (up to 21 days) were included in the study upon signing an informed consent form. Patients with isolated unimalleolar fracture, tibial pilon fracture, open fracture, infection, or neoplasia of the lower limbs, as well as patients with a score equal to or greater than 3 as per the American Society of Anesthesiologists (ASA) and patients with external fixation of the ankle, were excluded.

Participants were evaluated clinically and by ankle radiographs (anteroposterior, true anteroposterior, and lateral views), foot radiographs (anteroposterior, oblique, and lateral views), and a computed tomography of the ankle. Preoperative radiographs were evaluated according to Danis-Weber's classification by two independent surgeons.

Surgical procedures

Surgical protocol was similar for all cases. Patients were in the supine position with a cushion below the ipsilateral hip. Heels were positioned at the end of the operating table,

Study performed at the National Institute of Traumatology and Orthopaedics, Rio de Janeiro, RJ, Brazil

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allowing ankle dorsal and plantar flexion, as well as stress maneuvers during arthroscopy. A tourniquet was applied to the proximal thigh to prevent compression of leg muscles and interference with the ankle arthroscopy access.

The procedure began with the first stage of ankle arthroscopy. An anteromedial longitudinal incision, medial to the tibialis anterior tendon, was performed using a #11 blade scalpel. Blunt dissection was completed until reaching the joint capsule, preventing injury to the sensory nerves. The ankle joint was assessed using a trocar with a conical blunt tip and cannula, followed by the introduction of a 3.5 mm arthroscope. The ankle and dorsum of the foot were palpated before the anterolateral portal incision to avoid lesions of the intermediate dorsal cutaneous nerve. Then, skin incision was performed and blunt dissection was used to reach the deeper layers up to the joint capsule.

Arthroscopy was performed without joint traction. The joint was irrigated with 0.9% saline solution supplied by gravity flow and, after cleaning the joint, an assessment was carried out to look for injuries. The distal tibia and talar dome were inspected for osteochondral injuries; the medial and posterior malleolus, for fractures; the deltoid and lateral ligament complex, for ruptures; and the distal fibula, to view the fracture, as well as the relationship of the fibula with the distal tibia, so as to evaluate syndesmosis injury. Loose bodies, where present, were removed. Visualization of the posterior malleolus was hampered by not using posterior portals in the ankle and not using joint traction.

Articular cartilage lesions were classified according to depth and location as determined by arthroscopic inspection and palpation with a millimeter probe considering the largest diameter of the lesion and its greatest depth. The location of talar osteochondral lesions was determined according to the quadrants proposed by Raikin et al.[7] and classified according to the International Cartilage Repair Society (ICRS) grading system[8].

A syndesmosis stress test was performed during arthroscopy, followed by parallel or single screw fixation if considered unstable. Once arthroscopy was completed, fractures underwent ORIF.

The second step of arthroscopy began after ankle osteosynthesis, evaluating the quality of medial malleolus reduction. The stability achieved after syndesmosis fixation was assessed by visualizing the fixed syndesmosis as well as by carrying out a stress test (external rotation of the ankle) while checking the behavior of the syndesmosis. If unstable, a new fixation attempt was made. Then, the stability of the deltoid and lateral ligament complex after repair were evaluated.

Statistical analysis

Data were tabulated in a Microsoft Excel® spreadsheet for subsequent analysis and summarized by frequency. Chi-square test was used for comparing the frequencies of intra-articular findings, quality of reduction, and lesion location.

Results

Twenty-eight participants who underwent arthroscopically-assisted ankle osteosynthesis were included (Figure 1). Demographic data is presented in Table 1.

Intra-articular injuries were identified in 85.71% of study participants. The most commonly observed changes were syndesmosis injury, in 17 participants (60.71%); presence of osteochondral injuries, in 16 participants (57.14%); and ligament injuries (35.7%) and loose bodies (35.7%), in 10 participants each. In four individuals, no intra-articular lesions were found.

Intra-articular findings were identified in 100% of type C Danis-Weber fractures and in 80% of type B fractures (Table 2). Statistical analysis did not reveal differences among intra-articular findings regarding the type of fracture (p = 0.95).

Medial malleolus fractures were present in 12 participants. Statistical analysis did not reveal any difference in the quality of reduction of the medial malleolus considering the type of fracture (p = 0.23; Table 3).

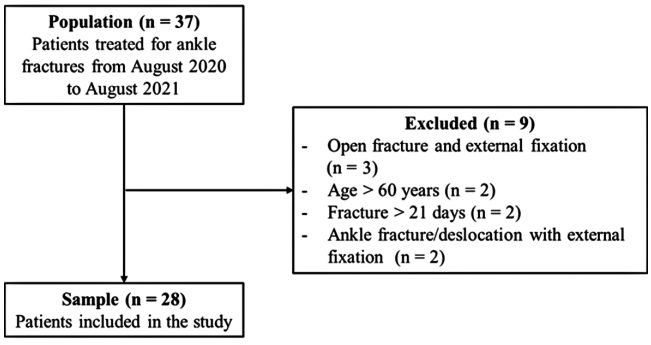

Figure 1. Study flowchart.

Table 1. Demographic data of the population included in the study.

Characteristics	
Age in years at lesion (Average ± SD)	45.7 ± 10.88
Sex	
Male	8 (33.33%)
Female	16 (66.67%)
Comorbidities	
Diabetes	5 (20.8%)
Hipertension	5 (20.8%)
Tabagism	4 (16.67%)
Danis-Weber classification	
Danis-Weber type B	20 (71.43%)
Danis-Weber type C	8 (28.57%)

Raikin's zone 6 presented 63.16% of osteochondral lesions. Statistical analysis did not reveal differences in the location of the injuries considering the type of fracture (p = 0.6; Table 4).

Lesions located in Raikin's zone 6 were deeper than those observed in zone 4 and zone 1 both in patients with Danis-Weber type B and Danis-Weber type C fractures (Table 5).

Discussion

The present study, an arthroscopic assessment of intra-articular injuries in patients with acute Danis-Weber types B and C ankle fractures, identified intra-articular injuries that would not have been diagnosed without the aid of arthroscopy.

Table 2. Intra-articular pathological findings in each patient according to the Danis-Weber classification

Intra-articular findings	Danis-Weber type B fracture	Danis-Weber type C fracture	Total
Loose body	6	4	10
Osteochondral lesion	10	6	16
Syndesmotic lesion	9	8	17
Ligamentary lesion	6	4	10
No lesion	4	0	4

Table 3. Quality of medial malleolus reduction

Quality of reduction	Danis-Weber type B fracture	Danis-Weber type C fracture	Total
Anatomic	7	1	8
Non-anatomic	2	2	4

Table 4. Location of the talar osteochondral injury in relation to the type of fracture

Location of the osteochondral injury	Danis-Weber type B frature	Danis-Weber type C frature	All fractures
Zone 1	0	1	1 (5.26%)
Zone 2	2	1	3 (15.79%)
Zone 3	0	0	0
Zone 4	3	0	3 (15.79%)
Zone 5	0	0	0
Zone 6	7	5	12 (63.16%)
Zone 7	0	0	0
Zone 8	0	0	0
Zone 9	0	0	0

Poor results in ankle fracture treatment may occur due to unrecognized and, therefore, untreated intra-articular injuries[9]. In a systematic review including patients with ankle fractures who underwent treatment with ORIF, only 79% had good to excellent long-term outcomes, not necessarily correlating with fracture severity, despite anatomical reduction[10]. Data on functional outcome after Danis-Weber type B ankle fractures in patients submitted to ORIF showed that, after two years of surgery, 36% of patients had complete recovery, 44% reported problems during work, and 61% reported problems in sports activities[11]. On the other hand, a retrospective study showed that arthroscopy-associated ORIF did not increase the complication rate and led to improvements in patient-reported outcomes, although arthroscopy made the procedure last 10 minutes longer than usual[12].

In the present study, intra-articular injuries were identified using arthroscopy in 89.29% of participants with ankle fractures, of which 54.58% presented osteochondral injuries. Arthroscopy-assisted treatment of ankle fractures increased from 3.65 to 13.91 per 1,000 ankle fractures, respectively, in 2010 and 2019[13]. Osteochondral injuries of the ankle frequently cause pain and disability[14,15]. Chondral injuries were detected in 78% of patients with acute ankle fractures undergoing arthroscopy, but in 100% of those who had associated dislocation[16]. Prevalence of intra-articular injuries identified with arthroscopy in patients with ankle fractures ranged from 77.5%[17], through 63.3%[18], to 62.2%[19] depending on the study.

Table 5. Size, location, depth, and International Cartilage Repair Society classification of osteochondral lesions

Lesion	Size	Depth	Location	ICRS classification
A	< 2 mm	< 2 mm	6	2
B	< 2 mm	2–4 mm	6	3
C	2–4 mm	< 2 mm	6	2
D	2–4 mm	2–4 mm	6	3
E	< 2 mm	< 2 mm	4	2
F	2–4 mm	< 2 mm	4	2
G	< 2 mm	< 2 mm	1	2
H	2–4 mm	< 2 mm	2	2
I	< 2 mm	< 2 mm	2	2
J	2–4 mm	< 2 mm	2	2
L	< 2 mm	< 2 mm	4	2
M	2–4 mm	2–4 mm	6	3
N	< 2 mm	< 2 mm	6	2
O	< 2 mm	2–4 mm	6	3
P	2–4 mm	< 2 mm	6	2
Q	< 2 mm	< 2 mm	6	2
R	< 2 mm	2–4 mm	6	3
S	2–4 mm	< 2 mm	6	2
T	2–4 mm	< 2 mm	6	2

ICRS: International Cartilage Repair Society.

In the present study, we diagnosed 16 osteochondral lesions that would not have been identified and treated if arthroscopy had not been performed. The majority of osteochondral lesions were found in the talus (87.5%), which is in line with previously published studies[5,20]. Most talar injuries were medial, in the Raikin zone 6 (67.16%)[6]. Since arthroscopy was performed without traction, no lesions were identified on the posterior talus. A retrospective study demonstrated that 75% of involved patients had new injuries diagnosed us arthroscopy, with osteochondral injuries (41.9%) and posterior malleolus fractures (32.6%) being the most common ones[21]. In the present study, Danis-Weber type C fractures showed higher incidence of osteochondral injuries compared to type B fractures, as reported by another author[5]. On the other hand, other studies found no significant differences in the incidence of osteochondral injuries between Danis-Weber type B and type C ankle fractures[2,4].

The syndesmosis, which is fundamental in maintaining ankle stability[22], can be injured either isolated or in association with ankle fractures[23]. In Danis-Weber type C fractures, syndesmosis injuries are present in up to 80% of cases[24,25]. In this study, we identified syndesmosis injuries, respectively, in 100% and 45% of participants with Danis-Weber type C and type B fractures. The integrity of the syndesmosis is not well demonstrated in external rotation Danis-Weber type B fractures, but some studies report injuries in up to 40% of cases[24,25]. Diagnosing syndesmosis injury can be difficult due to its anatomical variation[26,27]. The squeeze test and the ankle external rotation test[26], when positive, are highly specific, although presenting low sensitivity for identifying syndesmotic injury[28].

Ankle arthroscopy is both a diagnostic and therapeutic method[29], providing a direct view of the syndesmosis during dynamic testing[30]. Direct visualization of articular lesions allows a higher safety and precision in diagnosis and treatment, besides guiding extra-articular stabilization, if indicated[29]. The syndesmosis is considered unstable when a diastasis over 2 mm is identified[31,32]. In the present study, all syndesmosis injuries were diagnosed and treated with the aid of arthroscopy. Some studies evidenced that postoperative syndesmosis malreduction is detected in 16% of plain radiographs and in up to 52% of computed tomography scans[33-35]. It is believed that these unsatisfactory results are largely attributable to indirect reduction without tibiofibular joint visualization, as well as to the difficult reduction assessment, dependent on inaccurate fluoroscopic images[27,36]. Reduction accuracy can be improved by direct visualization of the syndesmosis[27,37].

The medial ligament complex has an important role in ankle joint stability[38], and many case series have reported satisfactory results and no complications with the surgical treatment of deltoid ligament associated to ankle fracture[39,40]. Exploring the deltoid ligament is recommended where there is a doubt on the medial clear space congruence in true anteroposterior radiograph[41]. On the other hand, a systematic review suggested that, after adequate fibular reduction and medial clear space normalization, exploring and reconstructing the deltoid ligament would not be necessary[18]. Hence, it is still unknown whether an untreated deltoid ligament lesion would be a source of persistent pain or pronation deformity. A statistically significant correlation between the lack of deltoid ligament repair and Danis-Weber type C ankle fracture malreduction and failure was identified[42]. In the present study, we found five deltoid ligament partial injuries without ankle instability, and hence no repair was performed. Arthroscopy helps visualizing the deltoid ligament during stress maneuvers, which, combined with fluoroscopic evaluation, gives the surgeon more confidence to decide whether or not to reconstruct this structure.

In fractures of the medial malleolus, an articular surface step-off is probably more related to the risk of post-traumatic osteoarthritis than a medial cortical surface step-off[43]. In the present study, reduction was observed in 12 medial malleolus fractures, all of these being evaluated by arthroscopy. In four participants, reduction was not anatomical. Of the participants in whom arthroscopy did not reveal anatomical reduction, in two (50%) intraoperative radioscopy did not show any deviation that was noticeable using the method. Therefore, arthroscopy was essential in the diagnosis of joint mal reduction, since cortical alignment alone was not reliable. In these patients, osteosynthesis was redone, achieving anatomical reduction in one of the two participants.

The present study's strength is that it evaluated patients at a same treatment center and with similar fracture patterns. However, we can mention as limitations the lack of a control group and the lack of posterior ankle joint evaluation during arthroscopy.

Conclusion

Ankle intra-articular injuries are diagnosed and treated with arthroscopy-assisted osteosynthesis. Danis-Weber type C fractures present a higher incidence and severity of osteochondral and ligament injuries than type B fractures.

Authors' contributions: Each author contributed individually and significantly to the development of this article: ZRSMP *(https://orcid.org/0000-0003-4758-0893) Conceived and planned the activities that led to the study, interpreted the results of the study, participated in the review process, performed the surgeries, data collection, formatting of the article, clinical examination; TASN *(https://orcid.org/0000-0001-7988-6307) Conceived and planned the activities that led to the study, interpreted the results of the study, participated in the review process, performed the surgeries, data collection, statistical analysis, bibliographic review, survey of the medical records, formatting of the article, clinical examination; VAM *(https://orcid.org/0000-0003-0241-5237) Conceived and planned the activities that led to the study, interpreted the results of the study, participated in the review process, performed the surgeries, data collection, survey of the medical records, formatting of the article, clinical examination; EBS *(https://orcid.org/0000-0001-8577-6403) Conceived and planned the activities that led to the study, interpreted the results of the study, participated in the review process, statistical analysis, bibliographic review, formatting of the article, clinical examination. All authors read and approved the final manuscript. *ORCID (Open Researcher and Contributor ID).

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