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Fifteen out of 16 elite athletes showed concomitant low-grade cartilage lesions of the ankle with unstable syndesmotic injuries: concerns from a prospective case series

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ABSTRACT

Objectives This study aimed to determine the incidence rate and characterise the location and severity of cartilage lesions in the ankle in elite athletes undergoing suture-button stabilisation for unstable distal syndesmotic injuries using needle arthroscopic examination. The feasibility and safety of ad hoc needle arthroscopy and its assisted interventions were also assessed.

Methods This prospective case series included elite athletes undergoing surgical stabilisation between April 2021 and June 2023. Procedures involved suture button fixation and needle arthroscopy, conducted by a single ankle fellow-trained surgeon. Ankle cartilage lesions were graded using the Cheng and Ferkel classification and located using the nine-zone grid. The study followed the STROBE statement.

Results This study included 16 elite athletes undergoing surgery for distal syndesmotic injuries, with 75% having acute and 25% chronic injuries. Cartilage lesions were prevalent (n=15/16, 94%), mainly at the talar dome (90%), and primarily scored as grade 1 (33%) or grade 2 (67%). Distal tibia cartilage damage occurred in 13% of cases. All patients were diagnosed with an instability of the syndesmosis confirmed through needle arthroscopy and were treated with a suture button (one or two buttons) fixation.

Conclusion In 15/16 elite athletes with syndesmotic injuries, concomitant ankle cartilage lesions were identified through needle arthroscopy. In addition, most of the lesions were classified as grade 1 or 2, denoting superficial damage. Needle arthroscopic interventions proved feasible and safe for confirming syndesmotic instability and addressing intra-articular pathologies.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Previous research has indicated that syndesmotic injuries often result in concomitant intra-articular pathologies, such as cartilage damage, which can lead to post-traumatic osteoarthritis if left untreated. Conventional ankle arthroscopy has been the gold standard for diagnosing syndesmotic instability and associated injuries, but it is invasive and costly.

WHAT THIS STUDY ADDS

⇒ This prospective case series, focused on elite athletes undergoing suture-button stabilisation for unstable distal syndesmotic injuries, found an exceptionally high incidence (94%) of concomitant cartilage lesions in the ankle. Most of these lesions were classified as grade 1 or 2, indicating superficial damage. The study also introduced needle arthroscopy as a minimally invasive alternative, showing its feasibility and safety in confirming syndesmotic instability and addressing intra-articular pathologies.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ The study highlights the need for a comprehensive assessment of cartilage lesions in (elite) athletes with syndesmotic injuries, suggesting a potential underdiagnosis of these injuries. This information may influence clinical practice by encouraging awareness and thorough evaluation of concomitant cartilage damage in individuals with syndesmotic injuries, potentially improving patient outcomes and rehabilitation strategies. Furthermore, the findings underscore the necessity for more prospective cohort studies to validate and build on these results.

INTRODUCTION

Syndesmosis injuries are usually a result of trauma that involves external rotation and hyper dorsiflexion of the ankle, which causes both syndesmotic instability and concomitant intra-articular pathology (eg, cartilage damage, impingement or loose bodies).[1] When these pathologies are left untreated, they can increase the risk of post-traumatic osteoarthritis, which leads to chronic pain and disability.[2] Conventional ankle arthroscopy can be used to identify and address these pathologies.[3] It remains the gold standard for diagnosing syndesmotic instability and allows for evaluating the anterior inferior tibiofibular

ligament.[4 5] However, it is invasive, costly and used more frequently for treatment than diagnosis. In contrast, a novel needle arthroscope with a 1.9 mm diameter offers a minimally invasive alternative for the visualisation and assessment of syndesmotic instability and associated injuries.[6] Due to the small diameter, it induces minimal soft tissue damage and expects speedier recovery.

Recent findings from a systematic review revealed that at least 21% of individuals with an isolated syndesmosis injury also showed concomitant (osteo)chondral lesions.[7] Nevertheless, within this review, only one study, retrospectively conducted by Rellensmann *et al*,[1] focused primarily on intra-articular pathologies observed through arthroscopy (incidence: 61%).

Consequently, the primary aim of this study was to determine the incidence rate of cartilage lesions in the ankle joint during needle arthroscopic examination in elite athletes undergoing suture-button stabilisation for unstable distal syndesmotic injuries. Second, the study aimed to evaluate the location and severity of cartilage lesions. Additionally, the feasibility and safety of ad hoc needle arthroscopy and its assisted interventions are assessed. It was hypothesised that the incidence of cartilage lesions in elite athletes undergoing suture-button stabilisation for unstable distal syndesmotic injuries would be higher than that reported in the current literature.

METHODS

The present study is a prospective, single-centre, non-randomised case series. Our department is a tertiary referral academic trauma level-1 hospital that is also an (inter)national referral centre recognised for diagnosing and treating cartilage and osteochondral lesions of the foot and ankle. The study followed the 'Strengthening the Reporting of Observational studies in Epidemiology' (STROBE) statement.[8]

Patient selection

This prospective study consecutively encompasses all elite athletes who underwent a surgical stabilisation procedure for unstable distal syndesmotic injuries, specifically suture button fixation (TightRope, Arthrex, Naples, USA), from April 2021 to June 2023, at the Department of Orthopedic Surgery and Sports Medicine of the Amsterdam UMC. The inclusion criteria involved elite athletes (defined as athletes who played at the highest national or international level) diagnosed with an acute (defined as occurring within 12 weeks) or chronic isolated unstable ankle joint syndesmosis injury, as defined by ligamentous injuries with or without tibiofibular avulsion fractures, as suggested by the consensus statement by van Dijk *et al*.[9] The injury was diagnosed through a combination of trauma mechanism, physical examination and an additional CT scan and MRI scan. Patients were excluded if they had undergone previous ankle cartilage repair, had concurrent bone fracture surgery, exhibited ankle infection or had an apparent history of ankle osteoarthritis.

Table 1 OCL classification during needle arthroscopy

Grade	Definition*
0	Smooth, intact, but soft or ballotable
1	Rough surface
2	Fibrillations/fissures
3	Flap present or bone exposed
4	Loose, non-displaced fragment
5	Displaced fragment

*Cheng and Ferkel.[11]
OCL, osteochondral lesion.

Surgical technique

All surgical procedures were conducted by a proficient, experienced foot and ankle academic orthopaedic surgeon (GMMJK). A step-by-step needle arthroscopic examination of the ankle was performed.[10] The cartilage was assessed in all compartments to identify lesions and graded according to the Cheng and Ferkel[11] classification, ranging from grade 0 to grade 5 (table 1). Additionally, the location of the lesions was pinpointed on a nine-grid scheme.[12] When intra-articular pathologies such as unstable cartilage lesions, loose bodies or impingement were identified, needle arthroscopy-assisted interventions (eg, debridement) were performed. This surgical technique has been previously described elsewhere.[6] The distal tibiofibular syndesmosis was stabilised by a suture button (TightRope, Arthrex, Naples, USA). Subsequently, after initial fixation, an intra-articular needle arthroscopic inspection was conducted to confirm a stabilised syndesmosis. If the syndesmosis remained unstable, a second suture button was introduced.

Outcomes

The primary outcome of this study was the incidence of cartilage lesions in the ankle, assessed intraoperatively through needle-arthroscopic examination.

The secondary outcomes were the location and grade of the cartilage lesions through the nine-grid scale and the Cheng and Ferkel[11] scoring system (table 1), respectively. Furthermore, various variables related to the surgery were collected: the operation duration, identification of unstable joints through needle arthroscopy before suture button placement, the number and nature of ad hoc needle arthroscopy-assisted interventions (along with their safety and feasibility) and number of suture buttons. Additionally, any complications, defined as 'any undesirable, unintended and direct result of an operation affecting the patient, which would not have occurred had the operation gone as well as could reasonably be hoped[13]', were separately recorded for both the needle arthroscopic procedure and the suture button fixation.

Statistical analysis

Statistical analyses were performed through STATA V.15.1 (StataCorp). Continuous outcome variables were

Table 2 Patient demographics

	Total (n=16)	Acute (n=12)	Chronic (n=4)
Male, n (%)	12 (75)	10 (83)	2 (50)
Age, median (range)	22 (17–31)	22 (17–31)	24 (20–27)
BMI, mean, kg/m^2 (SD)	23 (1.9)	23 (2.2)	23 (0.7)
Side, right, n (%)	8 (50)	6 (50)	2 (50)
Sport, n (%)			
Football	9 (56)	9 (75)	0
Rugby	2 (13)	1 (8)	1 (25)
Basketball	2 (13)	2 (17)	0
Field hockey	1 (6)	0	1 (25)
Tennis	1 (6)	0	1 (25)
Short track	1 (6)	0	1 (25)
Isolated ligamentous	13 (81)	10 (83)	3 (75)
Bony avulsion lesions	3 (19)	2 (17)	1 (25)

BMI, body mass index.

reported as means and SDs in the case of normally distributed data and as medians and IQRs or otherwise. Standard preoperative patient demographics were extracted.

Inter-rater reliability for the incidence, location and grade of cartilage lesions was determined by two independent raters (GMMJK, JD). Both raters scored the cartilage damage by reviewing the intraoperative video directly after the operation. In cases where discrepancies arose, a consensus meeting involving a third reviewer (ABW) was conducted to resolve any differences. Cohen's kappa value was used to test inter-rater reliability for cartilage lesions' incidence, location and grade. To conduct a subanalysis, we compared acute (<12 weeks) vs chronic lesions (>12 weeks).

RESULTS

This study enrolled a cohort of 16 elite athletes, with a median age at the time of surgery of 22 years (range: 17–31). Seventy-five per cent of the participants (n=12) were male, and a predominant segment (56%, n=9) was engaged in football. Seventy-five per cent (n=12) presented with an acute injury, with a median duration of 24 days (IQR: 18–63) from the moment of injury to the date of surgical intervention. The remaining 25% (n=4) exhibited a chronic injury (which were all referrals from other hospitals) with a median duration of 143 days (IQR: 126–303). All patient demographics are summarised in table 2.

Incidence, location and grade of cartilage lesions

The primary outcome, encompassing the incidence of any cartilage lesion, unveiled an incidence rate of 94% (15 out of 16 patients), resulting in a total of 20 lesions (kappa: 0.46; 95% CI 0.09 to 0.83, agreement: 90%). In the acute group, there was an incidence of 92% (11 out of 12 patients), and in the chronic group 100% (4 out of 4, table 3). Ninety per cent were located at the talar dome. Among these lesions, 33% were classified as grade 1, representing a rough surface, according to Cheng and Ferkel (figure 1), while 67% were classified as grade 2, representing fibrillations or fissures (figure 2). No grades 3, 4 or 5 lesions were identified (kappa: 0.29: 95% CI 0 to 0.72, agreement: 83%). The distribution of cartilage lesions on the talar dome in the nine-zone grid revealed that 17% of these lesions were localised in the centromedial region, 39% in the centre direct region and 44% in the centrolateral region (kappa: 0.60; 95% CI 0.38 to 1, agreement: 85%) (figure 3). Cartilage damage on the distal tibia was observed in two patients (13%), with one case classified as grade 2 and the other as grade 3 (table 3).

Surgery

The mean operation time, including putting a plaster cast, was 58 min (SD 14), with 47.4 min (SD 14) dedicated to suture button fixation and putting the plaster cast and 9.9 min (SD 4.2) to needle arthroscopy. In the acute group, the mean operation time was 61 min (SD 13), involving 50 min (SD 15) for suture button fixation and 10 min (SD 5) for needle arthroscopy. For the chronic group, the mean operation time was 50 min (SD 13), with 39 min (SD 9) for suture button fixation and 10 min (SD 3) for needle arthroscopy (table 3). All patients (100%) presented instability in the distal syndesmosis, confirmed by needle arthroscopic inspection before suture button placement. Needle arthroscopy-assisted interventions were necessary for 75% of the total patients (12 out of 16), with 75% required in the acute group (9 out of 12) and 75% in the chronic group (3 out of 4). These interventions were primarily needed to address and treat soft tissue impingement in most cases and, in some instances, to manage loose bodies or chondral flaps. A single suture button was sufficient in most patients (n=13; 81%). However, in three individuals (19%), the distal syndesmosis remained unstable after initial placement (confirmed by needle arthroscopy), and a second suture button was added, all in the acute group. In one patient, an interruption of the anterior fibula cortex occurred during suture button placement that required a replacement of the suture button without further consequence for the patient. No complications (0%) were associated with needle-arthroscopic interventions.

DISCUSSION

The most important finding of this study is that 15 out of 16 elite athletes with a syndesmotic injury showed concomitant cartilage lesions in the ankle, as observed through needle arthroscopy. In addition, it is noteworthy that most of the lesions were classified as grade 1 or 2, denoting superficial cartilage damage. Furthermore, for the majority of patients, a needle arthroscopy-assisted

Table 3 Surgery characteristics, acute versus chronic

	Total (n=16)	Acute (n=12)	Chronic (n=4)
Duration of the surgery, mean (SD)			
Total, min	58 (14)	61 (13)	50 (13)
Suture button fixation (+including cast)	47 (14)	50 (15)	39 (9)
Needle arthroscopy	10 (4)	10 (5)	10 (3)
Unstable joint before suture button fixation, n (%)	16 (100)	12 (100)	4 (100)
Debridement, n (%)	12 (75)	9 (75)	3 (75)
Suture buttons fixation, n (%)			
1	13 (81)	9 (75)	4 (100)
2	3 (19)	3 (25)	0
Stable joint after suture button fixation, n (%)	16 (100)	12 (100)	4 (100)
Complications, n (%)			
Tightrope	1 (6)	1 (8)	0
Needle arthroscopy	0	0	0
Incidence cartilage damage, no of patients (%)	15 (94)	11 (92)	4 (100)
Talar dome, n (%)	18	14	4
Grade 1	6 (33)	6 (43)	0
Grade 2	12 (67)	8 (57)	4 (100)
Grade 3	0	0	0
Grade 4	0	0	0
Grade 5	0	0	0
Distal tibia, n (%)	2	1	1
Grade 1	0	0	0
Grade 2	1 (50)	1 (100)	0
Grade 3	1 (50)	0	1 (100)
Grade 4	0	0	0
Grade 5	0	0	0

intervention was required to address concomitant injuries, predominantly involving soft-tissue impingement. These needle arthroscopic interventions were feasible and safe for confirming syndesmotic instability and addressing potential intra-articular pathologies.

In a recent systematic review,[7] an overall pooled incidence rate of 21% among 402 patients in a review of 9 studies, with 22% in the acute group and 24% in the chronic group. In contrast to these findings, our current study—in elite athletes only—observed a notably higher overall incidence of 94%, comprising 92% in the acute group and 100% in the chronic group. These discrepancies may be attributed to the design of our study. Unlike most of the reviewed papers, our study was designed to evaluate cartilage lesions of the ankle prospectively. This means that a complete evaluation of the cartilage was structured using an evaluation form during surgery. In contrast, in the reviewed studies, cartilage lesions were only secondarily reported if noted, which increases the chance of missed (superficial) lesions due to less attention or lack of structured reporting. Indeed, a retrospective study with a primary objective to assess the incidence of concomitant cartilage trauma found an incidence of 61% cartilage damage.[1] None of the other studies had this as the primary aim, and the second-highest incidence of cartilage damage reached a maximum of 27%.[7] Furthermore, four of the nine included studies used MRI as a diagnostic tool to assess cartilage lesions, which has been reported to underestimate the prevalence of cartilage lesions.[14] These findings suggest a potential underreporting, highlighting the need for more prospective cohort studies to confirm our results.

Most (95%) of the lesions were classified as grades 1 and 2, which raises questions on the clinical impact of these findings: whether the lesions will cause complaints or start a degenerative process. It is widely acknowledged that most osteoarthritis cases were post-traumatic.[15] Nevertheless, the specific patients at risk of developing post-traumatic osteoarthritis after an ankle injury remain unidentified. Early detection and implementation of individualised preventive interventions may be crucial in averting cartilage damage during the initial phase of the degenerative cascade: the subclinical phase.[16] In our study, we identified almost exclusively superficial

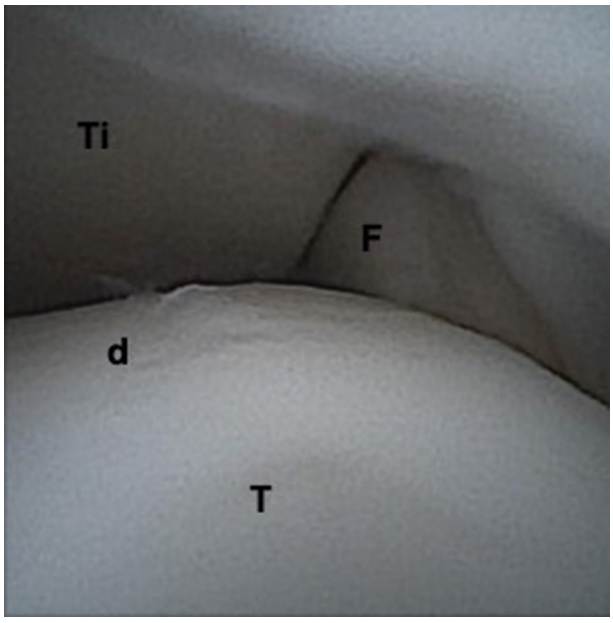

Figure 1 Cartilage damage grade 1 on the talar dome, seen with needle arthroscopy. d, cartilage damage; f, fibula; T, talar dome; Ti, distal Tibia.

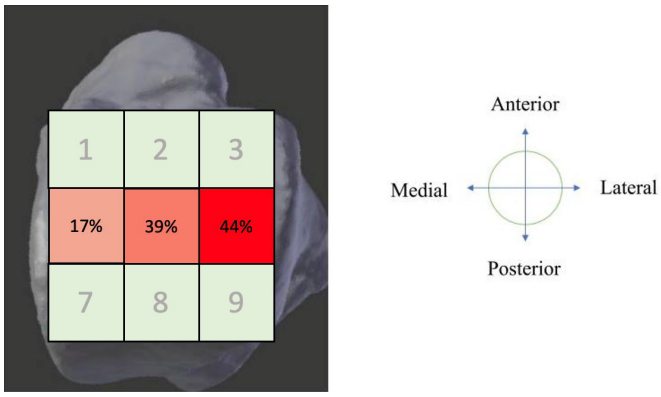

Figure 3 Distribution of the cartilage damage in the nine-zone grid.

cartilage lesions. Nevertheless, biomechanical studies have shown the potential of even minor trauma to alter the biomechanical properties of cartilage, emphasising the possibility that even these superficial lesions may start the osteoarthritic process.[17] Preventing the progression of such lesions is crucial, especially in elite athletes, who may experience extreme loading of the injured cartilage. However, our results indicate that underdiagnosis is a potential concern. Thus, a higher incidence of cartilage lesions in non-elite athletes than reported in the current literature can be expected.

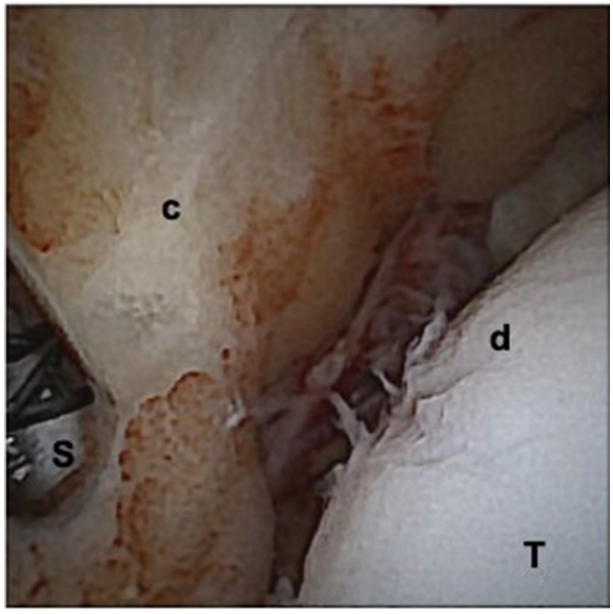

Figure 2 Cartilage damage grade 2 on the talar dome, seen with needle arthroscopy. c, Joint capsule; d, cartilage damage; S, 3.0 mm Shaver; T, talar dome.

The needle arthroscopic technique described herein offers a minimally invasive approach to confirm syndesmotic instability, address cartilage damage and potentially treat intra-articular pathologies. The primary advantage of using needle arthroscopy in these patients lies in its ability to confirm syndesmotic instability before the placement of the primary suture button, allowing for identifying and managing any intra-articular pathologies. Furthermore, it enables the confirmation or negation of stability after the initial placement of the suture button. This postfixation inspection provides the option to consider a second suture button if syndesmotic instability persists. In addition, a needle arthroscopic intervention was conducted in most patients to address concomitant injuries. Needle arthroscopy is a technique analogous to conventional arthroscopy. Arthroscopy can be used to detect and debride cartilage injuries.[3] However, needle arthroscopy uses small-bore instrumentation.[18] Using needle arthroscopy in these patients offers potential advantages: it enables a direct and simultaneous interventional approach to cartilage lesions, unstable cartilaginous flaps (ie, grade III or higher) or soft tissue impingements. This can be achieved using a small-bore shaver for removal, debridement and joint cleaning. The utilisation of small-bore equipment not only foresees a potential quicker recovery from the arthroscopic intervention but, although beyond the scope of this study, may also enhance the likelihood of a successful return to the preinjury level of sports.[19 20] Additionally, needle arthroscopy offers an improved patient-centred consultation, as it can be conducted under local anaesthesia for different indications due to the small-bore instrumentation.[21 22] It should be noted that needle arthroscopy might face problems for various reasons, including difficult insertion in case of joint osteoarthritis, compromised vascular status and substantial osteophytes.[23] In addition, there is a learning curve as the 0° inclination and 120°C field of view make it challenging to obtain a comprehensive view of the joint.[18]

The findings of this study must be considered within the context of its limitations. First, including a relatively small number of elite athletes in this prospective cohort may lead to potential overestimation or underestimation of the results. Second, the limited follow-up duration of 3 months restricts our ability to track the progression of the cartilage lesions over a more extended period. Third, the study revealed a mild variability in inter-rater reliability, with high agreements and kappa ranging from fair to substantial in detecting cartilage damage, grade scoring and location. This variability can be attributed to the subtle differences in grading scores, particularly between grades I and II, as well as the overlap in locations of cartilage damage, such as along the borders of locations 4, 5 and 6. Fourth, another important note is that elite athletes, due to their high-intensity sport, may already have asymptomatic cartilage lesions before the syndesmotic injury occurs. Consequently, it cannot be definitively stated in advance that the syndesmotic injury causes the superficial cartilage lesion. However, concerning the distribution of the anatomical location of the cartilage lesions, 81% of the lesions were located in the centrodirect (37%) or centrolateral zone (44%). This distribution makes it more likely that the lesions result from a syndesmotic trauma mechanism (ie, external rotation with hyperdorsiflexion of the ankle). Hence, further prospective studies should focus on accurately reporting concomitant cartilage lesions in individuals following a syndesmosis injury.

Clinical implications

These findings underscore the importance of a comprehensive assessment for cartilage lesions in (elite) athletes presenting with syndesmotic injuries, as a large part of the cases may exhibit concomitant cartilage damage. Our study suggests a potential underdiagnosis and emphasises the need for awareness and thorough evaluation in this patient population. Additionally, applying needle arthroscopy to address associated injuries highlights its utility as a minimally invasive tool and offers a direct approach to cartilage lesions. Considering the cartilage injuries, this may contribute to improved patient outcomes and safer rehabilitation.

CONCLUSION

In our cohort of elite athletes who suffered a syndesmotic injury, a very high incidence of concomitant cartilage lesions in the ankle was found. Most lesions were classified as grade 1 or 2, denoting superficial damage. Furthermore, needle arthroscopy is a minimally invasive method to confirm syndesmotic instability and treat potential intra-articular pathologies.

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Patient and public involvement Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Patient consent for publication Not applicable.

Ethics approval This study involves human participants and the present study is a prospective, single-centre, non-randomised, case series. This study was approved by the local Medical Ethics Committee at the Department of Orthopedic Surgery and Sports Medicine (reference number MEC 08/326). Participants gave informed consent to participate in the study before taking part.

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REFERENCES

1 Rellensmann K, Behzadi C, Usseglio J, *et al*. Acute, isolated and unstable Syndesmotic injuries are frequently associated with intra-Articular Pathologies. *Knee Surg Sports Traumatol Arthrosc* 2021;29:1516–22.
2 Carbone A, Rodeo S. Review of current understanding of post-traumatic osteoarthritis resulting from sports injuries. *J Orthop Res* 2017;35:397–405.
3 Marín Fermín T, Hovsepian JM, D'Hooghe P, *et al*. Arthroscopic Debridement of Osteochondral lesions of the Talus: A systematic review. *The Foot* 2021;49:101852.
4 Takao M, Ochi M, Oae K, *et al*. Diagnosis of a tear of the Tibiofibular Syndesmosis. The role of Arthroscopy of the ankle. *J Bone Joint Surg Br* 2003;85:324–9.
5 Vega J, Dalmau-Pastor M, Malagelada F, *et al*. Ankle Arthroscopy: an update. *J Bone Joint Surg Am* 2017;99:1395–407.
6 Walinga AB, Dahmen J, Stornebrink T, *et al*. Needle Arthroscopic inspection and treatment of (Osteo)Chondral lesions of the ankle in unstable Syndesmotic injuries treated with Suture button fixation: A standardized approach. *Arthrosc Tech* 2023;12:e1121–6.
7 Dahmen J, Jaddi S, Hagemeijer NC, *et al*. Incidence of (Osteo)Chondral lesions of the ankle in isolated Syndesmotic injuries: A systematic review and meta-analysis. *Cartilage* 2022;13:19476035221102569.
8 von Elm E, Altman DG, Egger M, *et al*. The strengthening the reporting of observational studies in epidemiology (STROBE) statement: guidelines for reporting observational studies. *Journal of Clinical Epidemiology* 2008;61:344–9.
9 van Dijk CN, Longo UG, Loppini M, *et al*. Classification and diagnosis of acute isolated Syndesmotic injuries: ESSKA-AFAS consensus and guidelines. *Knee Surg Sports Traumatol Arthrosc* 2016;24:1200–16.
10 Vega J, Malagelada F, Karlsson J, *et al*. A step-by-step Arthroscopic examination of the anterior ankle compartment. *Knee Surg Sports Traumatol Arthrosc* 2020;28:24–33.
11 Cheng JC, Ferkel RD. The role of Arthroscopy in ankle and Subtalar degenerative joint disease. *Clin Orthop Relat Res* 1998;1998:65–72.
12 Raikin SM, Elias I, Zoga AC, *et al*. Osteochondral lesions of the Talus: localization and morphologic data from 424 patients using a novel anatomical grid scheme. *Foot Ankle Int* 2007;28:154–61.

13 Sokol DK, Wilson J. What is a surgical complication? *World J Surg* 2008;32:942–4.
14 Krakowski P, Karpiński R, Jojczuk M, *et al*. Knee MRI Underestimates the grade of cartilage lesions. *Applied Sciences* 2021;11:1552.
15 Delco ML, Kennedy JG, Bonassar LJ, *et al*. Post-traumatic osteoarthritis of the ankle: A distinct clinical entity requiring new research approaches. *J Orthop Res* 2017;35:440–53.
16 Dahmen J, Karlsson J, Stufkens SAS, *et al*. The ankle cartilage Cascade: incremental cartilage damage in the ankle joint. *Knee Surg Sports Traumatol Arthrosc* 2021;29:3503–7.
17 Blom RP, Mol D, van Ruijven LJ, *et al*. A single axial impact load causes Articular damage that is not visible with micro-computed tomography: an ex vivo study on Caprine Tibiotalar joints. *Cartilage* 2021;13(2_suppl):1490S–1500S.
18 Stornebrink T, Altink JN, Appelt D, *et al*. Two-Millimetre diameter operative Arthroscopy of the ankle is safe and effective. *Knee Surg Sports Traumatol Arthrosc* 2020;28:3080–6.
19 D'Hooghe P, Grassi A, Alkhelaifi K, *et al*. Return to play after surgery for isolated unstable Syndesmotic ankle injuries (West point grade IIB and III) in 110 male professional football players: a retrospective cohort study. *Br J Sports Med* 2020;54:1168–73.
20 Fermín TM, Al-Dolaymi AA, D'Hooghe P. Acute ankle sprain in elite athletes how to get them back to the game? *Foot Ankle Clin* 2023;28:309–20.
21 Walinga AB, Stornebrink T, Janssen SJ, *et al*. Needle Arthroscopy for bacterial arthritis of a native joint: surgical technique for the shoulder, elbow, wrist, knee, and ankle under local anesthesia. *Arthrosc Tech* 2022;11:e1641–8.
22 Stornebrink T, Janssen SJ, Kievit AJ, *et al*. Bacterial arthritis of native joints can be successfully managed with needle Arthroscopy. *J Exp Orthop* 2021;8:67.
23 Stornebrink T, Stufkens SAS, Mercer NP, *et al*. Can bedside needle Arthroscopy of the ankle be an accurate option for intra-Articular delivery of Injectable agents *World J Orthop* 2022;13:78–86.