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When treating ankle fractures, arthroscopic assistance is preferable to open reduction internal fixation: A Comprehensive Systematic Review

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ABSTRACT

Background: This study aims to provide when treating ankle fractures, asthroscopic assistance is preferable to open reduction internal fixation. **Methods:** Following PRISMA 2020 guidelines, this systematic review focused exclusively on full-text articles published in English between 2014 and 2024. **Result:** The study conducted a comprehensive review of over 100 publications sourced from reputable databases, including ScienceDirect, SagePub, and PubMed. Following an initial screening, five publications were identified as warranting more in-depth analysis. Consequently, a thorough review of these selected studies was performed to ensure a detailed and rigorous evaluation. **Conclusion:** When it comes to helping patients with ankle fractures feel better and function better, ARIF was not proven to be any better than ORIF. The decision between ARIF and ORIF will ultimately rely on the particular situation and the surgeon's evaluation of the patient's requirements and objectives.

Keyword: ankle fractures, asthroscopic assistance, open reduction internal fixation.

INTRODUCTION

Ankle fracture is one of the most common injuries, often accompanied by cartilage lesions and ligament injuries. The standard treatment protocol for unstable ankle fractures is open reduction and internal fixation (ORIF). Despite receiving ORIF and achieving perfect anatomical reduction, some patients still complain residual persistent pains and unsatisfactory functional outcomes. Approximately 1% of patients with ankle fractures develop end-stage ankle osteoarthritis after ORIF and undergo total ankle replacement or ankle arthrodesis.[1–3]

The residual pain and progression of osteoarthritis may be ascribed to concomitant intra-articular injuries occurring at the time of the initial fracture. The incidence of intra-articular injuries associated with rotational ankle fractures is as high as 63%–79%. A systematic review reported the incidence of chondral or osteochondral lesions (OCLs) identified by ankle arthroscopy after in rotational ankle fracture to be 54.5%. These OCLs are believed to contribute to residual pain, dysfunction, locking, and early arthritis of ankle fractures. Therefore, several groups of authors have emphasized the value of ankle arthroscopy in the treatment of acute fractures.[1,4]

Certain individuals may continue to have prolonged ankle discomfort and disability even after the anatomical decrease; this could be due to untreated intra-articular lesions. With arthroscopy, intra-articular conditions such chondral lesions or ligament disruptions could be found and treated in ankle fracture cases. A meta-analysis revealed that 65% of individuals with ankle fractures had chondral or osteochondral injuries. Because of this, the treatment of ankle fractures using arthroscopically aided reduction and internal fixation (ARIF) was advocated. Verification of the anatomic reduction, inspection of all intra-articular structures, and prompt treatment of intra-articular lesions were made possible by ARIF. From 3.65 instances per 1000 ankle fractures in 2010 to 13.91 cases per 1000 ankle fractures in 2019, there has been a notable increase in the use of ARIF. The best

course of treatment for ankle fractures has recently acquired favor again, and five new studies contrasting ORIF and ARIF have been published.[5–7]

METHODS

Protocol

The investigation was carried out with scrupulous conformity to the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) 2020 criteria, guaranteeing strict respect to accepted methodological principles. Strictly following PRISMA 2020 standards demonstrates a dedication to improving the clarity, replicability, and systematic thoroughness of the review process. The study incorporated thorough methodologies for conducting literature searches, extracting data, and synthesizing findings. These methods were well implemented to minimize biases and guarantee the strength of the conclusions.

Criteria for Eligibility

The present study offers a comprehensive examination of the when treating ankle fractures, asthroscopic assistance is preferable to open reduction internal fixation. Through the methodical examination and integration of data from other studies, this research seeks to clarify patterns and guide the improvement of patient care approaches for this group with multiple health conditions.

The main aim of this thesis is to highlight important themes that arise from a wide range of scholarly literature, therefore enhancing our awareness of the when treating ankle fractures, asthroscopic assistance is preferable to open reduction internal fixation. In order to guarantee the thoroughness and precision of the study, strict criteria for inclusion and exclusion were implemented. Only English-language peer-reviewed papers published from 2014 to 2024 were considered suitable for inclusion. Materials eligible for inclusion must also possess a DOI for the purpose of confirming their authenticity. In order to preserve the focus and integrity of the dataset, the analysis in question deliberately omitted non-research materials, including reviews, editorials, and duplicate entries from the same publication.

The systematic methodology employed in this study guarantees that the data used is both pertinent and trustworthy, therefore establishing a strong basis for deriving significant findings and progressing clinical practice.

Search Strategy

We used " when treating ankle fractures, asthroscopic assistance is preferable to open reduction internal fixation" as keywords. The search for studies to be included in the systematic review was carried out using the PubMed, SagePub, and Sciencedirect databases.

Data retrieval

The authors conducted a thorough preliminary review of each article by examining its abstract and title to assess relevance before proceeding with a more detailed investigation. Only studies that aligned with the study's objectives and met the predefined inclusion criteria were considered for further review. This method allowed for the identification of a clear and consistent pattern across the research.

Full-text articles were restricted to those published in English to maintain consistency in the language of the studies. A rigorous screening process was applied to select content that was directly relevant to the study's focus and adhered to all established inclusion criteria. Articles not meeting these criteria were systematically excluded from further analysis and not included in the final evaluation.

The evaluation process included a comprehensive review of various factors such as study design, titles, authors, publication dates, research locations, and methodologies. This meticulous approach ensured that the content analyzed was of the highest relevance and quality, thereby strengthening the overall findings of the study.

Quality Assessment and Data Synthesis

The authors performed a meticulous review of each article's abstract and title to identify those deserving further investigation. After this initial screening, all

relevant documents underwent a comprehensive examination. The results of this evaluation guided the selection of review papers, ensuring that only the most pertinent studies advanced to detailed analysis. This rigorous approach streamlined the selection process and facilitated a thorough and nuanced assessment of the existing research and its context.

Table 1. Search Strategy

Database	**Search Strategy**	***Hits***
Pubmed	*("tonsilectomy ankle fractures" OR " asthroscopic assistance" AND "children open reduction internal fixation")*	866
Science Direct	*("tonsilectomy ankle fractures" OR " asthroscopic assistance" AND "children open reduction internal fixation")*	214
Sagepub	*("tonsilectomy ankle fractures" OR " asthroscopic assistance" AND "children open reduction internal fixation")*	113

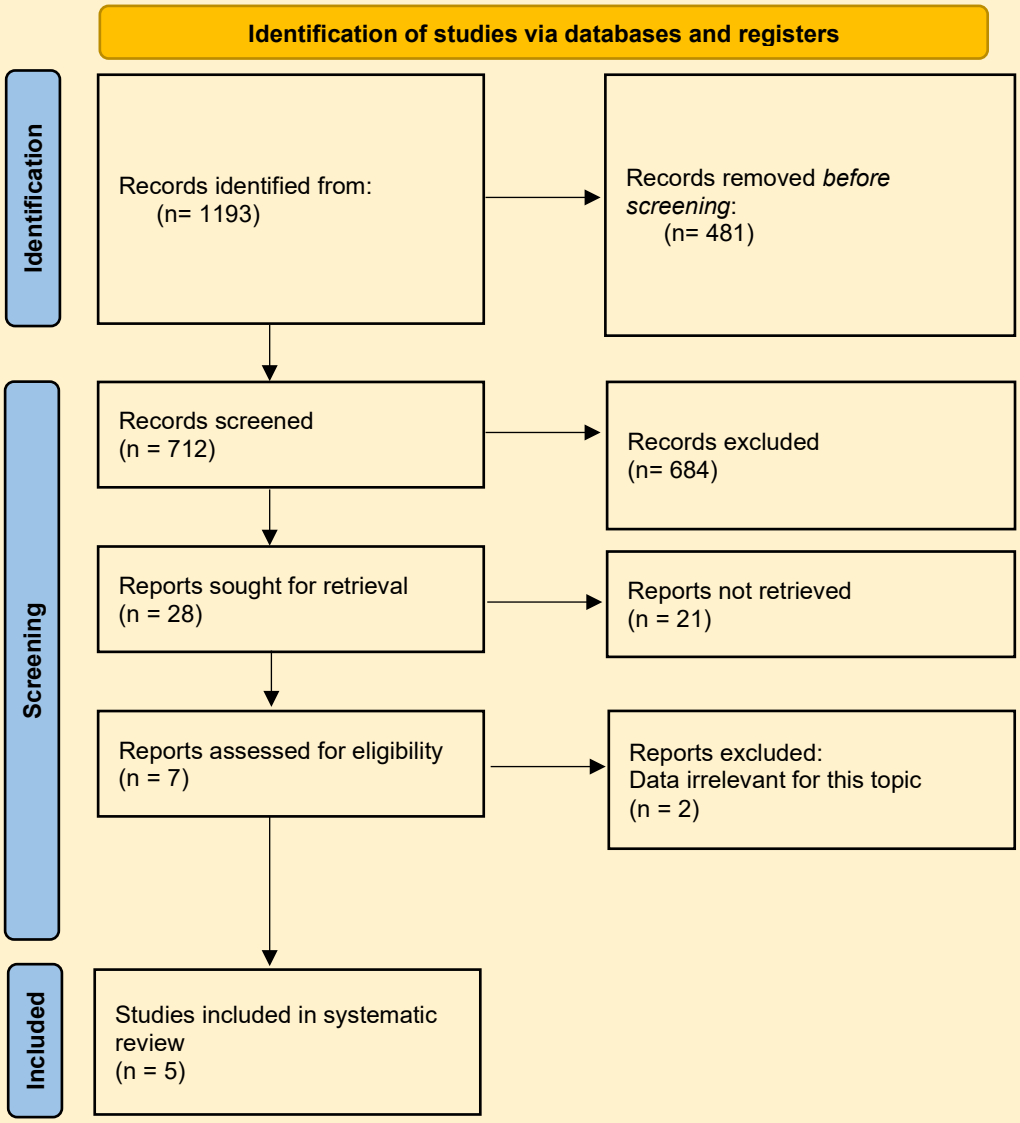

Figure 1. Article search flow chart

Table 2. Critical appraisal of Study

Parameters	(Ceccarini, P et al., 2020)	(Angthong, c et al., 2016)	(Baumbach, SF et al., 2020)	(Chiang, CC et al., 2018)	(Liu, C et al., 2020)
1. Bias related to temporal precedence Is it clear in the study what is the "cause" and what is the "effect" (ie, there is no confusion about which variable comes first)?	Yes	Yes	Yes	Yes	Yes
2. Bias related to selection and allocation Was there a control group?	No	No	No	No	No

3. Bias related to confounding factors					
Were participants included in any comparisons similar?	No	No	No	No	No
4. Bias related to administration of intervention/exposure					
Were the participants included in any comparisons receiving similar treatment/care, other than the exposure or intervention of interest?	Yes.	Yes.	Yes.	Yes.	No.
5. Bias related to assessment, detection, and measurement of the outcome					
Were there multiple measurements of the outcome, both pre and post the intervention/exposure?	No	No	No	No	No
Were the outcomes of participants included in any comparisons measured in the same way?	Yes	Yes	Yes	Yes	No
Were outcomes measured in a reliable way?	Yes	Yes	Yes	Yes	No
6. Bias related to participant retention					
Was follow-up complete and, if not, were differences between groups in terms of their follow-up adequately described and analyzed?	No	Yes	No	No	No
7. Statistical conclusion validity					
Was appropriate statistical analysis used?	Yes	Yes	Yes	Yes	No

RESULT

We initiated the investigation by systematically gathering a significant assortment of papers from reputable sources such as Science Direct, PubMed, and SagePub. After a thorough three-stage screening process, we selected five papers that were considered very pertinent to our ongoing systematic inquiry. Subsequently, we selected certain topics for further examination and meticulously evaluated each report. In order to expedite our study, we have included a concise summary of the evaluated information in Table 3.

Table 3. The literature included in this study

Author	Origin	Method	Sample	Result
Ceccarini, P et al., 2020[8]	Italy	s In this retrospective	144	At the final follow-up (mean 38 months), both patients treated with ankle

		study, we compared three homogeneous groups of selected patients with specific inclusion criteria (144 in total, mean age 38.2 years). They have been surgically treated for an ankle fracture (bimalleolar or trimalleolar without frank syndesmotic injuries) with open technique (ORIF) or arthroscopic ORIF (AORIF), between 2013 and 2017.		arthroscopic debridement at the time of ORIF and patients treated with arthroscopic debridement after ORIF showed a significant improvement of the FAOS, which reported 84 and 85 respectively at final follow-up.
Angthong, C et al., 2016[9]	Thailand	The patients of ARIF (n = 16) or ORIF (n = 29) to treat unstable ankle fracture between 2006 and 2014 were reviewed retrospectively.	45	Immediate-postoperative fracture configurations did not differ significantly between the ARIF and ORIF groups. There were anatomic alignments as 8 (50%) and 8 (27.6%) patients in ARIF and ORIF groups (P = 0.539) respectively. There were acceptable alignments as 12 (75%) and 17 (58.6%) patients in ARIF and ORIF groups (P = 0.341) respectively. The arthritic changes in follow-up

				period as at least 16 wk following the surgeries were shown as 6 (75%) and 10 (83.3%) patients in ARIF and ORIF groups (P = 0.300) respectively. Significantly more BMD tests were performed in patients aged > 60 years (P < 0.001), ARIF patients (P = 0.021), and female patients (P = 0.029). There was no significant difference in BMD test *t* scores between the two groups.
Baumbach, SF et al., 2020[10]	Germany	Acute, closed, bimalleolar equivalent, bimalleolar, or trimalleolar ankle fractures were included. The AORIF cohort was enrolled prospectively.	89	No significant differences (1 year vs 4 years) were identified for the OMAS (90 [10] vs 90 [11]) and TAS (4 [2] vs 5 [2]). The severity of the cartilage lesions (International Cartilage Repair Society [ICRS] grade <4 vs ICRS of 4) had no significant influence on the PROMs. Twenty-five patients per cohort (AORIF vs ORIF) were matched. The OMAS (90 [13] vs 75 [40]; P = .008) and FAAM Activities of Daily Living (ADL; 96 [11] vs 88 [30]; P = .034) revealed significantly better outcomes for AORIF. More patients in the AORIF cohort returned to sport (96% vs 77%; P = .035), with a higher FAAM Sports score (88 [37] vs 56 [47]; P = .008).
Chiang, CC et al., 2018[11]	Taiwan	The inclusion criteria for this study were patients aged 16 years or older, the presence of a	105	A total of 105 patients with SER fractures, 65 in the ARMIS group and 40 in the ORIF group, were included. Significantly lower incidences of complications (7.7% vs

		unilateral SER fracture, and injuries less than 2 weeks old. We retrospectively identified patients with SER fractures who underwent ORIF from January 2008 to December 2011 or ARMIS from January 2012 to December 2015.		27.5%, P ¼ .006) and reoperations (1.5% vs 12.5%, P ¼ .029) were found in the ARMIS group than in the ORIF group. More syndesmotic injuries were detected in the ARMIS group than in the ORIS group (80% vs 57.5%, P ¼ .021). The visual analog scale pain score was significantly lower on day 3 postoperatively in the ARMIS group than in the ORIS group (1.96 1.18 vs 2.83 1.07, P ¼ .027). The postoperative stay was shorter in the ARMIS group than in the ORIF group (3.66 1.39 days vs 4.46 2.23 days, P ¼ .024). The operative time was longer in the ARMIS group than in the ORIS group (105.22 27.13 minutes vs 93.59 22.79 minutes, P ¼ .038). A longer fluoroscopic time (0.43 0.25 minutes vs 0.17 0.07 minutes, P < .001) and a higher dose of irradiation (1,216.46 603.99 mGy vs 389.38 217.89 mGy, P < .001) were observed in the ARMIS group. No significant differences in radiographic measurements were found between the operative and nonoperative ankles in both groups.
Liu, C et al., 2020[12]	China	This prospective	77	In the ARPF group, 11 of 34 (32.4%) patients had

		study enrolled 77 patients with isolated medial malleolar fracture between November 2011 and February 2016. The patients were assigned to the ARPF (n = 34) and ORIF (n = 43) groups. The Olerud-Molander Ankle Score (OMAS), ankle range of motion (ROM), visual analog scale, and radiographic evaluation were determined at the scheduled follow-up.		chondral lesions. Tears of the deltoid ligament and anterior inferior tibiofibular ligament were noted in 3 (8.8%) and 15 (44.1%) patients, respectively. The mean follow-up was 5 years. The mean OMAS was higher in the ARPF group than in the ORIF group. The differences were statistically significant at 6 months (80.2 ± 4.0 for ARPF vs. 77.2 ± 4.1 for ORIF, P = 0.005) and 1 year (92.9 ± 4.9 vs. 88.1 ± 4.6, P < 0.001), but not at the latest follow-up (P = 0.081). Ankle ROM was markedly improved in the ARPF group unlike in the ORIF group at 6 months (dorsiflexion: P = 0.025; plantar flexion: P < 0.001) and 1 year (dorsiflexion and plantar flexion: P < 0.001). The improvement remained present at the latest follow-up in plantar flexion (P = 0.001) but not in dorsiflexion (P = 0.354).

DISCUSSION

Ankle fractures rank among the most common injuries that orthopedic surgeons treat, occurring at an incidence of 187 per 100,000 persons annually. Determining the risk-benefit ratios between nonoperative and surgical management still requires a comprehensive initial assessment of the fracture pattern, soft tissue health, and patient characteristics. Excellent outcomes have been shown when stable, reasonably aligned ankle fractures are treated closed. For displaced and

unstable fracture patterns, open reduction and internal fixation (ORIF) is currently the accepted standard of therapy. Historical evidence indicates that majority of these patients have satisfactory to outstanding outcomes. However, a small percentage of patients have surprisingly poor functional outcomes. Several authors have suggested that these negative outcomes could really be the result of an undiagnosed and thus untreated intra-articular lesion. This subgroup of patients has, among other things, contributed to the development of arthroscopically aided ORIF (AAORIF) for ankle fractures, even if the exact origin of these fractures is still unknown. The use of ankle arthroscopy in place of standard ankle ORIF—or perhaps as a substitute for it—has grown over time. Proponents claim that this technique can be used to identify and treat intra-articular injuries.[13]

Some patients, however, experience poor results after surgical repair with ORIF. In their observational study of 25 patients, Day et al reported a good to excellent functional outcome in only 52% and a poor outcome in 24% of patients with a follow-up of 10 to 14 years. Bhandari et al pointed out less satisfactory outcomes in several observational studies, ranging from 17% to 24%. The occurrence of poor outcomes following ankle fractures is theorized to be connected to concomitant intra-articular injuries not detectable with conventional ORIF. Imaging techniques like plain radiographs or magnetic resonance imaging scans are unable to detect these lesions reliably.[14]

Arthroscopy has been proposed as an additional tool to discover and treat these lesions, potentially improving patients' postoperative outcomes. Arthroscopy supports the process of fracture reduction by making it possible to assess the articular surface directly. Despite encouraging findings in favor of assistance, arthroscopy was performed in just 1% of ankle fracture cases between 2005 and 2011.[14]

Several studies have reported on the incidence of chondral lesions seen during arthroscopy at the time of ankle fracture ORIF, but those studies largely report the role of arthroscopy as a diagnostic or predictive tool for patient outcome. Very few studies have discussed the rates of arthroscopic intervention, the

procedures performed, and the association of these procedures with patient outcomes.[15]

A comprehensive review of arthroscopically assisted internal fixation techniques, including arthroscopically assisted open reduction and internal fixation (AAORIF), arthroscopically assisted percutaneous reduction and fixation (APRF) and arthroscopically guided minimally invasive screw fixation techniques (ARMIS), for foot and ankle fractures does not exist in the literature. Although this is attributable to a relative paucity of studies, an increasing number of works including randomized control trials (RCTs), case series, technical tips, and case reports have reported on these techniques and their benefits. Although several authors have suggested a variety of factors influencing outcomes, including sex, age, comorbid conditions (ie, smoking, diabetes), fracture severity, and concomitant injury, the majority of current studies emphasize that anatomic articular reduction is the primary modifiable factor that may influence outcomes. Although intraoperative direct visualization and radiographic assessment during open procedures have been the standard modalities for confirming anatomic reduction, the advent of arthroscopy has enabled direct visualization of structures that are typically more challenging to assess through imaging, such as the joints of the foot and ankle. In light of this, there is increasing support in the literature for arthroscopically assisted fracture fixation.[16,17]

With the increased use of ankle arthroscopy, the role of arthroscopy in the treatment of acute ankle fractures is becoming more appreciated. Thus there is a potential benefit to identifying ways to arthroscopically evaluate ankle instability. We have identified a diagnostic maneuver for use during ankle arthroscopy—the arthroscopic ankle drive-through sign.The arthroscopic ankle drive-through sign is an intraoperative finding characterized by the ability to easily pass an arthroscopic shaver through the medial ankle gutter between the medial malleolus and the talus without scuffing the articular cartilage on either side. In our experience, it is not possible to perform this maneuver in well-reduced and stable ankles. The senior author (M.C.D.) has performed over 500 ankle arthroscopies and has been unable to perform this maneuver in an ankle without a significant syndesmotic injury or in

fibula fractures with a medial-sided injury (deltoid rupture or medial malleolus fracture). The presence of the arthroscopic drive-through sign indicates instability due to syndesmotic or deltoid injury and can be a useful adjunct intraoperatively to evaluate ankle stability before and after fixation of the fibula.[18–20]

CONCLUSION

In conclusion, when it comes to helping patients with ankle fractures feel better and function better, ARIF was not proven to be any better than ORIF. The decision between ARIF and ORIF will ultimately rely on the particular situation and the surgeon's evaluation of the patient's requirements and objectives.

DISCLOSURE STATEMENT

Disclosure Statement : The authors have no conflicts of Interest to declare.

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