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Arthroscopically Assisted Technique for Acute Complex Ankle Fractures: A Literature Review

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ABSTRACT

Background: Complex Ankle fractures are a serious condition due to their significant morbidity. Open reduction/internal fixation (ORIF) is the standard technique for managing such types of fractures. In spite of the anatomical reduction, the patient may still suffer from some residual symptoms. Recently, arthroscopic-assisted reduction and internal fixation (ARIF) have given promising results as it can identify and manage concomitant intraarticular injuries.

Objective: This review article aimed to assess the role of ARIF in treating ankle fractures.

Methods: Ankle, Fracture and Arthroscopy were all searched by Science Direct, Google Scholar, and PubMed. The writers also assessed references from pertinent literature, although they only included the most recent or comprehensive study, which ran from January 2006 to February 2023. Documents in languages other than English were not included since there were insufficient sources available for translation. Excluded papers included dissertations, conference abstracts, unpublished publications, oral presentations, and other works not included in longer scientific investigations.

Conclusion: ARIF did not show superiority to ORIF in relieving pain and improving the function in those with ankle fractures. However, it provides a reliable tool for diagnosis and treats intra-articular pathology. Finally, the choice between ARIF and ORIF should be dependent upon the specific case and surgeon's evaluation of patients' needs and goals.

Keywords: Ankle, Fracture, Arthroscopy.

INTRODUCTION

Ankle fractures represent 9% of all fractures and 36% of all lower extremity fractures. Operative management through ORIF is the standard method for managing ankle fractures aiming at anatomic reduction of the joint and restoring its stability [(1)]. Inadequate reduction of ankle fractures leads to poor outcomes and persistent pain, stiffness, recurrent swelling, and chronic instability. Also, even successful anatomic reduction does not mean having favourable outcomes because of missed associated intra-articular injuries [(2)].

Recently, ARIF helps confirm the anatomical reduction and direct the visual assessment of the cartilage and intra-articular ligaments. Intra-articular injuries can be managed immediately with the removal of soft tissue interposition and loose-bodies, performance of chondroplasty, or micro-fracturing [(3)].

Absolute contraindications are neurovascular injuries and massive oedema or swelling precluding the palpation of anatomical landmarks. Relative contraindications include some fracture dislocations that significantly distort the anatomical landmarks of the ankle or marked localized soft tissue swelling. Open fractures are still controversial [(4)].

Table (1): Ankle fracture classification: The AO/OTA classification of malleolar segment fractures is usually used for classifying malleolar fractures. It is correlated to the Weber classification and Lauge-Hansen classification [(5)].

Location of fibular fracture	Weber classification	Lauge-Hansen classification	AO/OTA classification of tibial malleolar fractures
Infra-syndesmotic	Type A	SAD I, II	44-A1 (isolated lateral) 44-A2 (lateral, medial) 44-A3 (lateral, medial, and posterior)
Trans-syndesmotic	Type B	SER I, II, III, IV	44-B1 (isolated lateral) 44-B2 (lateral, medial) 44-B3 (lateral, medial, and Volkmann's fracture)
Supra-syndesmotic	Type C	PER I, II, III, IV; PA I, II, III	44-C1 (simple diaphyseal) 44-C2 (multi-fragmentary) 44-C3 (proximal)

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DIAGNOSIS

The patient often has a history of falling from height, twisting ankle injury or a motor- vehicle accident. Young male patients are more likely to have intra-articular injuries. Patients commonly presents with tenderness, swelling, ecchymosis, and distorted of the anatomic contour of their ankles. Lateral skin creases usually disappear due to swelling. The skin blistering often occurs in the first 36 h post-injury [(6)].

The basic radiographic examination includes true antero-posterior, mortise (A-P with 15° internal rotation), and lateral views of patient's ankle. For an accurate anatomic description, CT scan obtained in transverse and sagittal planes have to be combined with 3D CT reconstruction [(7)].

TREATMENT

The treatment aims at restoration and maintenance of ankle articular congruity. Non-surgical treatment is indicated in non-displaced and stable fractures, unfit patients, or unsuitable soft-tissue conditions. Displaced unstable fractures with fair soft tissue conditions necessities surgical interference. Ankle arthroscope provides benefits for direct visualization of intra-articular pathologies, debridement of loose-bodies, acute management of osteochondral injuries, and direct assessment of articular fracture reduction [(8)].

Operative technique: Under spinal or general anesthesia, the person is placed in a supine or unstable lateral position according to the surgeon preference and if the posterior malleolus fracture will be addressed. An antibiotic was given before tourniquet inflation (1 gram third-generation cephalosporin) as broad spectrum. A tourniquet was also advocated [(2)].

Ankle arthroscopy (Figure 1): The joint was inflated with saline, which had adrenaline added by 1ml for 200 ml saline and blunt dissection was performed to create the portals. Arthroscope is inserted through a standard antero-medial portal (5 mm distal to the joint line, just medial to the anterior tibial tendon). Afterward, the standard antero-lateral portal was performed in the same way (5 mm underneath the joint line, just lateral to the extensor tendons). Also, a postero-lateral portal was used if needed (This portal is created in the triangular space between the Achilles tendon and peroneal tendon, about 10 mm more distal than the corresponding antero-lateral portal). An arthroscopic ankle examination was performed including medial gutter and deltoid ligament, lateral gutter and lateral ankle ligament, and syndesmotic ligament injuries. All loose bodies and soft tissue interposition were removed and if the deltoid ligament was interposed in medial ankle gutter it was also reduced [(8)].

After the fixation of the fracture, another arthroscopic examination was done to confirm the anatomical reduction and also to confirm the syndesmotic stability by direct vision of its components and hooking of the distal fibula in sagittal and coronal planes [(7)].

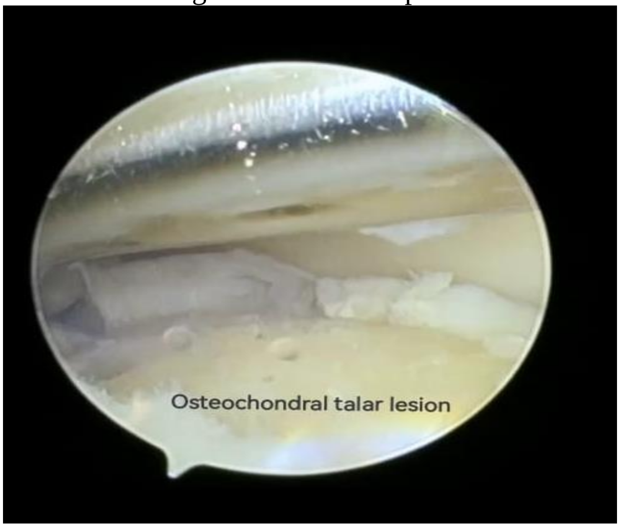

Figure (1): Arthroscopic finding associated with ankle fracture [(6)]

Lateral malleolus:
If the patient suffers from a fracture of the large posterior malleolus amenable for fixation and of the lateral malleolus, stabilization of these two fractures is achieved by the same postero-lateral approach. In case of the presence of a lateral malleolus fracture and a small posterior fragment, a standard lateral incision is used. Peroneal tendons underdo retraction to access the fibula. The fibular fracture is reduced. A one-third tubular plate is used after reduction and restoring the length and rotation [(8)].

Medial malleolus:
The incision starts 2 cm distal to the medial malleolus's tip, extending toward the middle of the distal tibia. Exposure of the anteromedial part of fracture to confirm anatomical reduction. Temporary fixation by k-wires and confirm suitable reduction by image intensifier. Two 4 mm lag screws are used for fixation after the anatomical reduction is confirmed. A washer is utilized in osteoporotic bone. Medial tension band wiring is utilized in comminuted fractures or when the fragments are very distal or small [(8)].

Syndesmotic instability:
After stabilization of all fractures, the syndesmotic complex's stability is assessed using an external rotation test and hook test with confirmatory arthroscopic assessment if both tests are negative [(8)].

If there is persisting instability, a reduction clamp is used to reduce the syndesmosis. The reduction is then tested by an intra-operative image intensifier and arthroscopic look. If the reduction is sufficient, a syndesmotic tricortical fully threaded 3.5 mm cortical screw was inserted 30 degrees from posterior to anterior parallel to the tibial plafond and 1-2 cm above the ankle joint while it is in a neutral position [(8)] **(Figure 2).**

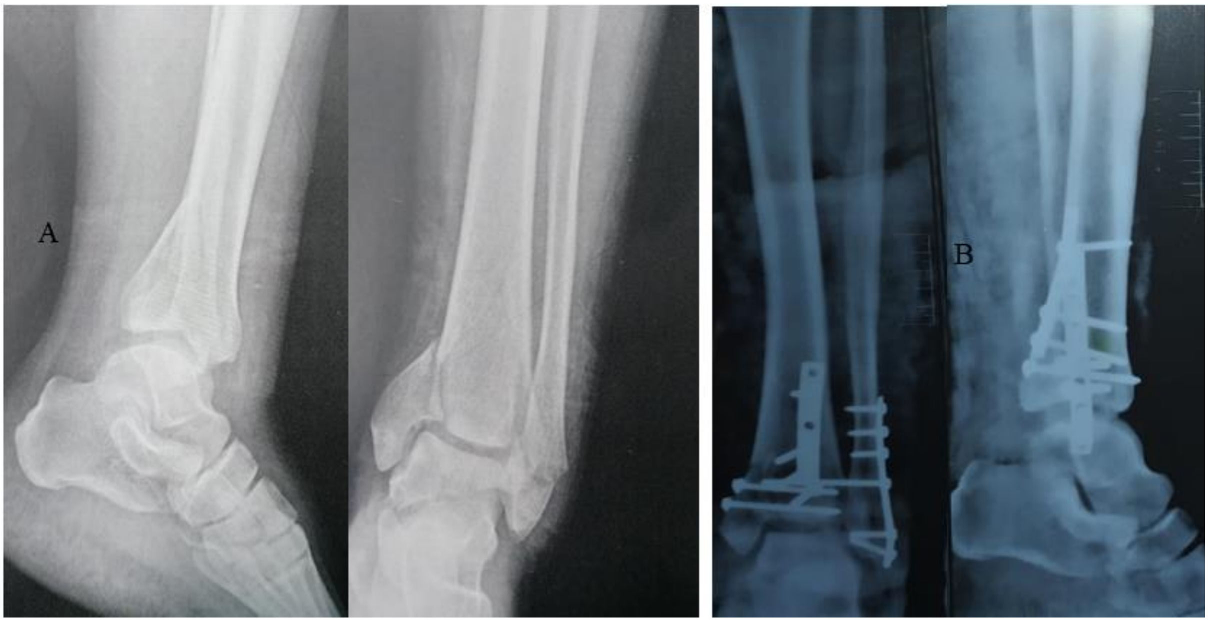

Figure (2): A) Complex Tri-malleolar ankle fracture. B) shows post-operative follow up [7]

COMPLICATIONS

Common complications include pin-track infection, cutaneous nerve injury, symptomatic hardware, instability, and osteoarthritis [9].

DISCUSSION

The most common injury causing loss of ankle congruity is ankle fracture. Ankle fractures represent 9% of all fractures and 36% of all lower extremity fractures [10].

When managing malleolar ankle fractures, surgeons have traditionally used open reduction internal fixation (ORIF). However, neither method provides the surgeon with a direct view of the articular surface or enables him to detect the presence of any loose bodies that may be interposed [11].

Recently, arthroscopy-assisted fracture reduction has gained popularity as a treatment option for intra-articular fractures. It provides direct vision of the reduction and avoids missed ligament injuries. The reduction accuracy for ankle fractures is considered the most significant variable that affects the treatment result [12].

Ono *et al.* [13] performed fixation of 105 malleolar fractures using arthroscopy to verify anatomical reduction and treat intra-articular abnormalities. Patients reported overall favourable outcomes after a 3.8-years average follow-up period**. Liu *et al.*** [14] reported that 7% of cases in the ORIF group had osteoarthritic changes corresponding to grade 1 van Dijk classification system. No changes were observed in the ARIF group. **Turhan *et al.*** [15] reported that only 5% of patients in the ARIF group had grade 1 osteoarthritis changes. However, grade 1 and grade 2 osteoarthritic changes were reported in 3 cases and 2 cases in the ORIF group, respectively.

Angthong *et al.* [16] demonstrated that immediate post-operative fracture reduction was not significantly different among ARIF and ORIF groups. The arthritic alterations in the post-operative follow-up period (at 16 weeks) were observed in 75% and 83.3% of cases in ARIF and ORIF groups respectively.

Acute ankle fractures often result in syndesmotic damage. One of the primary causes of patients' less favourable prognosis and lingering symptoms may be latent syndesmotic instability. Ankle fracture with tibiofibular syndesmosis disruption requires an accurate diagnosis [17]**.**

Lubberts *et al.* [18] in a cadaveric study, showed that arthroscopy could reliably determine the presence of syndesmotic instability in multiplanar translation assessment, according to the study's findings

In addition, **Kellet *et al.*** [19] observed that stress radiography Intra-operative cannot detect about half of instabilities confirmed by arthroscopy.

It is similar to **Chen *et al.*** [20] who found that 41.6% of thirty-six patients with Weber B ankle fractures had a syndesmotic injury requiring fixation. In another study, it was reported that 36.7% of Weber B had syndesmotic injury that required fixation [21].

In the systematic review by **Zhang *et al.*** [22] it was concluded that early cartilage damage following ankle fractures can reliably indicate the onset of osteoarthritis. In ankle fractures, arthroscopy enabled both the visualization and management of occult cartilage lesions in the ARIF group, however ARIF showed no difference with ORIF as regards osteoarthritic changes.

In a systematic review, **Chen *et al.*** [23] stated that the frequency of osteochondral lesions in ankle fractures was an independent predictor of post-traumatic osteoarthritis ranging from 20.0%- 88.9%, with a mean incidence of 63.3%.

Hintermann *et al.*[24] reported a higher prevalence of osteochondral lesions as 228 out of 288 cases (79.2%) had acute ankle fractures and chondral lesions. Chondral lesions were present in 78% (90 of 116 cases) with 39 of these cases (i.e., 43%) had a full thickness talar chondral lesion [25].

CONCLUSION

ARIF did not show superiority to ORIF in relieving pain and improving the function in those with ankle fractures. However, it provides a reliable tool for diagnosis and treats intra-articular pathology. Finally, the choice between ARIF and ORIF should be dependent upon the specific case and surgeon's evaluation of patients' needs and goals.

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