Ankle Arthroscopy for Ankle Fractures

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Abstract: In many patients who undergo open reduction—internal fixation of ankle fractures, there is a failure to achieve good clinical outcomes despite radiographic evidence of anatomic reduction. One possible reason for this is the high incidence of concomitant intra-articular pathology associated with ankle fractures that may go unrecognized using traditional open approaches. Arthroscopy in the setting of acute operative management of ankle fractures provides a means to completely assess intra-articular pathology, as well as provide direct therapeutic intervention in many instances. Arthroscopic management techniques include debridement of loose intra-articular fragments, assisted fracture reduction, microfracture of chondral injuries, and assessment of syndesmotic stability. The indications for arthroscopy in the setting of ankle fractures have not been fully defined; however, it is our practice to perform an arthroscopic assessment of all ankle fractures requiring surgical intervention. We present a sample of our experience using this technique that shows the severity of intra-articular pathology that is often found and occurs even in association with fracture patterns with seemingly innocuous radiographic appearances.

Operative management of ankle fractures is most typically performed through an open approach to achieve the primary goals of anatomic reduction and rigid fixation. This is guided by intraoperative gross inspection and fluoroscopic assessment; however, this technique may fail to fully address the entire injury because intra-articular pathology cannot be entirely visualized and therefore may be neglected. This oversight likely contributes to the failure of 20% of patients undergoing open reduction—internal fixation of ankle fractures to achieve good or excellent results despite radiographic evidence of satisfactory reduction.[1] Ankle arthroscopy in the setting of acute operative management of ankle fractures provides a means of achieving complete intra-articular visualization and management of potential pathologic findings.[2] We present several cases that show the utility of ankle arthroscopy in the management of ankle fractures and describe our technique and experience with this approach.

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Surgical Technique

It is our practice to perform ankle arthroscopy in conjunction with all ankle fractures requiring open reduction—internal fixation (Tables 1 and 2). Both arthroscopic and open procedures are performed with the patient in the supine position under general anesthesia. Nerve blocks are avoided in general to mitigate masking of potential compartment syndrome, as well as to facilitate management of any postoperative neuropathic symptoms. Preoperative assessment of the soft-tissue envelope is required to ensure that surgery can be performed safely; the wrinkle test is useful for this.

The patient is positioned on a standard operating table with the heel at the end of the table. A bump of folded blankets is placed under the ipsilateral hip to optimize positioning for both arthroscopic and open lateral approaches to distal fibular fractures. A proximal thigh tourniquet aids visualization during the arthroscopic and open procedures while avoiding compression of the leg muscles. A Ferkel thigh holder (Smith & Nephew, Andover, MA) is used to provide countertraction facilitating arthroscopic visualization. It is positioned so that the knee is flexed and the heel is just touching the bed. The extremity is sterilely prepared and draped above

Table 1. Benefits and Risks of Arthroscopy for Ankle Fractures

Benefits
Minimally invasive direct visualization of intra-articular pathology
Removal of loose bodies
Acute management of osteochondral injuries (e.g., chondroplasty and microfracture)
Identification of prognostic findings
Atraumatic management of interposed tissue blocking reduction or avoidance of arthrotomies
Arthroscopic-assisted fracture reduction
Direct visualization of syndesmotic injuries
Tailoring of rehabilitation process to reflect intra-articular pathology
Risks and limitations
Soft-tissue fluid extravasation
Iatrogenic neurovascular injury
Possible increase in technical difficulty because of distorted anatomy due to injury
Increased operative time
Cost

the level of the knee. Care is taken to identify the relevant surface anatomy for arthroscopy: medial malleolus, tibialis anterior, superficial peroneal nerve, and peroneus tertius (Fig 1). Additional time may be required for this in the fracture setting because of swelling and deformity.

Table 2. Pearls for Effective Arthroscopy for Ankle Fractures

The patient's skin is assessed preoperatively to ensure that skin wrinkling is present.
The patient is positioned with a bump under the ipsilateral hip so that the foot is perpendicular to the floor.
The surgeon should carefully locate the surface anatomy, including the superficial peroneal nerve, to which the anterolateral portal should be lateral, and the tibialis anterior tendon, to which the anteromedial portal should be medial.
Traction and countertraction are used to facilitate intra-articular access and avoid iatrogenic intra-articular damage.
The joint is pre-insufflated to ensure appropriate portal location before attempting introduction of instruments.
Blunt dissection is used for portal establishment to avoid neurovascular injury.
Hematoma is evacuated before arthroscopy to facilitate visualization.
The surgeon should use either gravity or low-pressure inflow to avoid excessive fluid extravasation.
The procedure should be performed expeditiously to avoid excessive fluid extravasation.
The surgeon should be well-versed in ankle arthroscopy before performing this procedure in the setting of an ankle fracture, which may be technically difficult.
Intra-articular pathology should be assessed with fastidious documentation to help direct any necessary future interventions.
A 1.9-mm small-joint arthroscope should be available to access tight ankles (especially in the setting of isolated lateral malleolus fractures).
A wide assortment of arthroscopic instruments, including various grabbers and curettes, should be available to facilitate access within the joint.

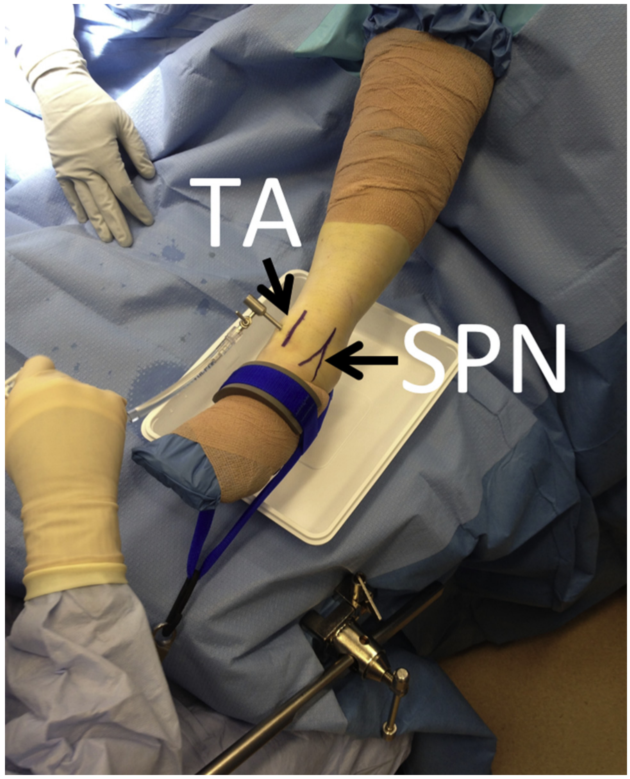

Fig 1. Intraoperative photograph showing identification of the relevant surface landmarks, including the tibialis anterior tendon (TA) and superficial peroneal nerve (SPN) to which the anteromedial and anterolateral portals should be based medially and laterally, respectively.

The limb is exsanguinated before placement of a sterile Guhl noninvasive distractor (Smith & Nephew) (Fig 2). The joint is pre-insufflated with 10 to 15 mL of arthroscopy fluid using an 18-gauge needle at the level of the intended anteromedial portal, and intra-articular placement is confirmed by distention of the lateral joint. A skin incision is made over the anteromedial portal, and blunt dissection is carried down to the capsule. A cannula with a blunt trocar is introduced and directed toward the lateral malleolus; however, anatomic distortion due to the injury may be present, and efforts should be made to accommodate this. A 2.9-mm 30° arthroscope is used, and joint irrigation should be supplied by gravity or low-pressure inflow (20 mm Hg) to mitigate excessive extravasation of fluid. The anterolateral portal position is confirmed with an 18-gauge needle and established in the same manner as the anteromedial portal. The anteromedial portal is primarily used for viewing and the anterolateral portal for instrumentation; however, the surgeon may use either portal for both purposes. A 3.0-mm arthroscopic shaver (Arthrex, Naples, FL) is introduced, and hematoma and fibrous tissue are debrided. Visualization of the joint should include the (1) anterior tibial lip, (2) lateral malleolus, (3) lateral ankle ligaments, (4) lateral

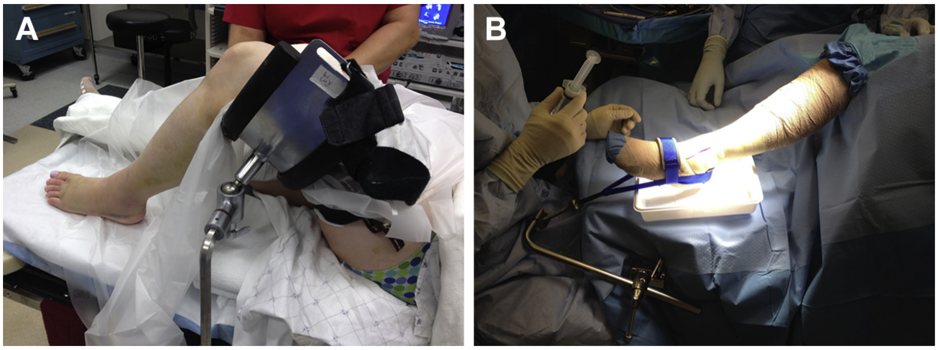

Fig 2. (A) Intraoperative photograph showing patient positioning with a bump under the ipsilateral hip and a Ferkel thigh holder in place to provide countertraction. (B) After appropriate skin preparation and draping, the noninvasive Guhl ankle distractor is positioned to facilitate atraumatic instrument passage.

talar dome and shoulder, (5) syndesmosis, (6) central talus and posterior tibial plafond, (7) medial malleolus, (8) deltoid ligament, and (9) medial talar dome and shoulder. Common findings in our experience include disruption of the anterior-inferior tibiofibular ligament and intra-articular displacement, loose bodies, and osteochondral lesions of the talus and tibial plafond, interposition of the posterior tibial tendon at medial malleolar fracture sites, and fragmentation of the posterior lip of the tibial plafond with disruption of the posterior tibiofibular ligament. Fastidious documentation of chondral injury is performed throughout arthroscopy. Transchondral fractures are typically managed with debridement and removal of loose bodies, chondroplasty to bleeding bone with a 3.0-mm arthroscopic shaver (Arthrex), or curettage and microfracture with a microfracture chondral pick (Arthrex) to a depth of 6 mm. Fixation of large osteochondral fragments may be attempted. Interposition of tissues at fracture sites that may impede reduction is also addressed. The syndesmosis is evaluated by releasing traction and visualizing the tibiofibular joint while an external rotation force is provided. Opening of the joint by more than 2 mm is suggestive of injury; however, we rely on fluoroscopic stress examination to guide syndesmotic fixation.[3] After arthroscopy, the distractor and thigh holder are removed, and open reduction—internal fixation can be performed without repositioning the patient.

Discussion

The incidence of intra-articular pathology associated with ankle fractures is high, with concomitant osteochondral lesions reported in 63% to 73% of individuals and ligamentous disruption in most patients.[2,4,5] Despite this, the clinical significance of intra-articular injury associated with ankle fractures has not been established. Such a relationship can be reasonably surmised, however, given that inferior clinical outcomes and intra-articular injuries are independently associated with more severe ankle fracture patterns.[2,5,6] Thus it is plausible that intra-articular lesions contribute to the poor clinical results of some patients despite radiographic evidence of anatomic reduction. To this end, Utsugi et al.[7] reported a greater incidence of osteochondral injury identified by arthroscopy in patients with worse functional outcomes at a mean of 12.4 months after open treatment of ankle fractures. In addition, osteochondral defect size may portend prognostic information because larger lesions are generally associated with worse clinical outcomes.[8] Thus assessment of concomitant intra-articular pathology in the setting of ankle fractures may provide important prognostic information.

Diagnosis of intra-articular pathology may also facilitate subsequent intervention in patients in whom there is a failure to achieve satisfactory clinical results. For instance, an arthroscopically documented osteochondral lesion may assist the surgeon in selecting the appropriate management option, such as bone marrow stimulation with microfracture or tissue transplantation. Likewise, ligamentous injuries may be identified by arthroscopic assessment at the time of injury, which may facilitate selection of appropriate reconstructive techniques in the patient with complaints of continued pain and instability.

The role of arthroscopy for therapeutic purposes in the setting of acute ankle fracture has not been fully defined because of a paucity of data on the topic.[9] However, several studies have reported outcomes of arthroscopic treatment of intra-articular sequelae after operative management of ankle fractures.[7,10,11] Such reports may provide valuable insight into the potential role of acute arthroscopic intervention to address these lesions and prevent the occurrence of such sequelae. Utsugi et al.[7] reported effective management of arthrofibrosis with arthroscopic debridement in patients who had undergone open reduction—internal fixation of ankle fractures. Other authors have reported similar findings in patients requiring intervention for continued pain after operative fracture management.[10] It is plausible that acute intra-articular debridement of loose fragments and displaced tissue may aid in decreasing postoperative fibrosis and thereby improve

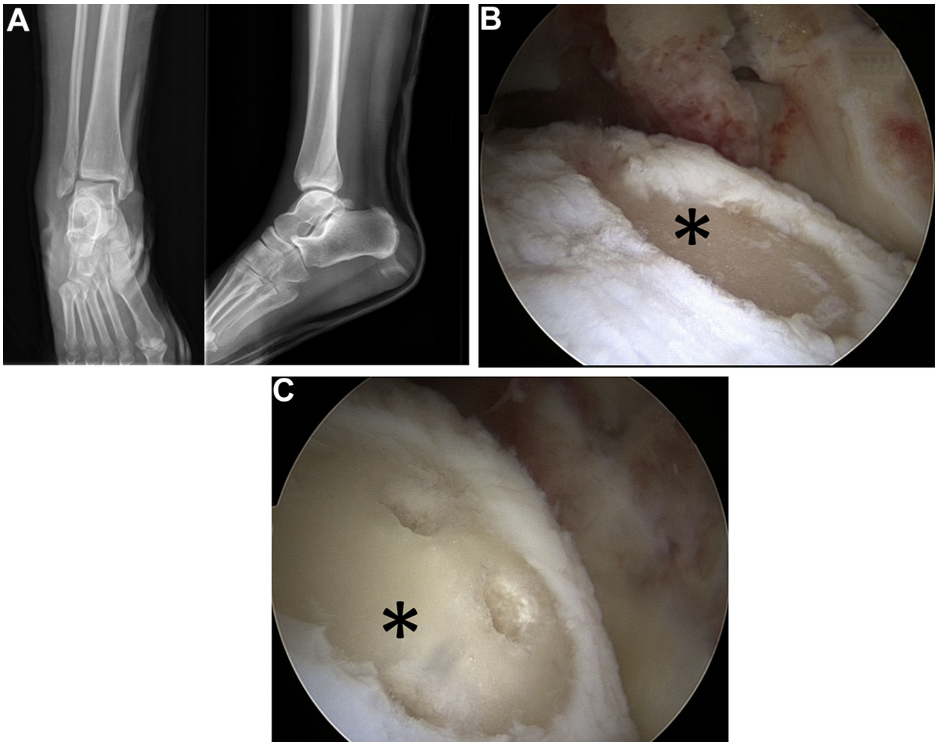

Fig 3. (A) Anteroposterior and lateral radiographs showing a bimalleolar ankle fracture. (B) An osteochondral lesion (asterisk) measuring 1.4 cm in diameter is visualized from the anteromedial portal on the anterolateral talar dome. (C) The lesion (asterisk) has been debrided to stable edges using arthroscopic curettes and microfracture performed with a pick.

patient function. In addition, it has been our experience that loose bodies are not reliably identified on injury radiographs and may therefore be neglected without direct visualization.

Arthroscopy at the time of operative ankle fracture management provides a means to acutely address osteochondral and chondral injuries commonly associated with ankle fractures. Such lesions are frequently encountered in the talus (Video 1).[2,5] The success rate of arthroscopic debridement and microfracture of osteochondral lesions outside of acute ankle fractures is 80%.[12] Given the high incidence of osteochondral lesions identified by arthroscopy in patients with poor function after operative treatment of ankle fractures, acute arthroscopic intervention of these injuries may decrease the need for subsequent procedures and improve clinical outcomes[7,10] (Fig 3).

In our experience, fracture dislocations and Maisonneuve fractures have a very high incidence of loose bodies and osteochondral lesions, which is understandable. We have found, however, that even Weber type B fractures can create significant cartilage lesions of the lateral talus due to the proximal fibular spike.

Another common finding and proposed source of disability in patients who have undergone operative treatment of ankle fractures is anterolateral impingement, for which displaced soft tissue and bone are potential sources.[11] In our experience, it is not uncommon for loosely attached osteochondral fractures to be found on the anterior tibia, which may contribute to the development of this sequela (Video 1). We advocate for routine debridement to a stable margin for such lesions.

We also report 2 individuals who were found to have interposition of the posterior tibialis tendon in the medial malleolar fracture site. In 1 case repeated reductions were attempted in the emergency department because of unsatisfactory alignment. At the time of arthroscopy, the interposed tendon was identified and removed from the fracture to facilitate reduction without having to resort to open reduction with a medial approach (Fig 4). Similarly, arthroscopy may be used to directly visualize fracture reduction to allow hardware fixation through a minimally invasive approach, which may improve reduction accuracy and preserve blood supply.

The use of arthroscopy in the setting of ankle fractures is not routine for most surgeons, and there is insufficient evidence from which to derive specific indications.[9] The former may be because of the associated learning curve of a new technique, as well as concern regarding distortion of normal anatomic relations due to the injury and fluid extravasation with compartment ischemia. The use of noninvasive traction often assists in reducing the deformity and restoring normal anatomic relations. Familiarity with the relevant surface anatomy also assists in this regard. We have not found fluid extravasation problematic in our experience and attribute this to keeping the arthroscopic procedure time shorter than 30 minutes and using only low-pressure irrigation. We also carefully

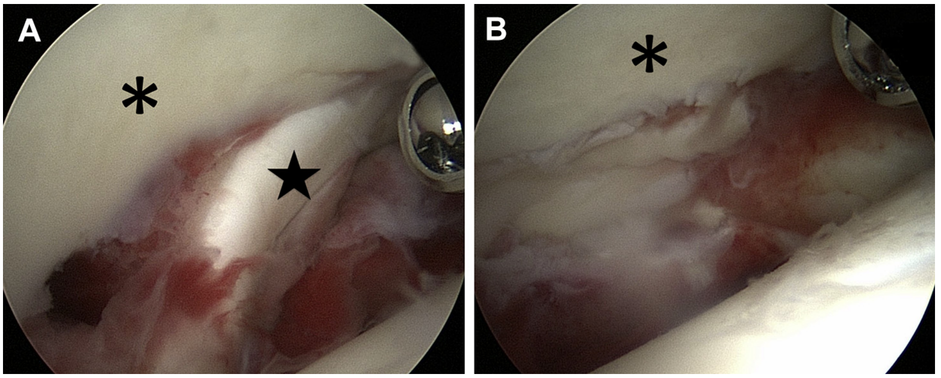

Fig 4. (A) The posterior tibialis tendon (star) is identified within the medial malleolar fracture site and is clearly blocking reduction of this fragment as viewed from the anteromedial portal. (B) The posterior tibialis tendon has been reduced from the fracture site arthroscopically. Asterisks indicate the medial tibial plafond.

assess the soft-tissue envelope to ensure that excessive swelling is not present. We have not had any complications from arthroscopy, which is consistent with other reports.[2] Our contraindications to arthroscopy in the setting of ankle fractures include neurovascular injury, open fracture, and significant swelling indicated by a lack of skin wrinkles.

The use of arthroscopy in the setting of ankle fractures has provided us with a safe, reliable means of diagnosis and intervention of intra-articular pathology associated with ankle fractures. Our experience with this technique in over 20 patients has shown significant osteochondral injury in most patients and loose bodies in over half. Although the clinical significance of these lesions has not been determined specifically in the ankle fracture setting, arthroscopic assessment and management of osteochondral lesions have proven prognostic and therapeutic benefit in the non-fracture setting.[7,8,12] It is our opinion that extrapolation of these principles to the management of associated intra-articular pathology in the setting of acute ankle fractures is reasonable. Its routine implementation represents an intervention that is low risk and has high potential benefit even though further investigation is required to fully define the long-term clinical outcomes.

References

1. Stufkens SA, van den Bekerom MP, Kerkhoffs GM, Hintermann B, van Dijk CN. Long-term outcome after 1822 operatively treated ankle fractures: A systematic review of the literature. *Injury* 2011;42:119-127.
2. Hintermann B, Regazzoni P, Lampert C, Stutz G, Gächter A. Arthroscopic findings in acute fractures of the ankle. *J Bone Joint Surg Br* 2000;82:345-351.
3. Wagener ML, Beumer A, Swierstra BA. Chronic instability of the anterior tibiofibular syndesmosis of the ankle. Arthroscopic findings and results of anatomical reconstruction. *BMC Musculoskelet Disord* 2011;12:212-218.
4. Loren GJ, Ferkel RD. Arthroscopic assessment of occult intra-articular injury in acute ankle fractures. *Arthroscopy* 2002;18:412-421.
5. Leontaritis N, Hinojosa L, Panchbhavi VK. Arthroscopically detected intra-articular lesions associated with acute ankle fractures. *J Bone Joint Surg Am* 2009;91:333-339.
6. Gardner MJ, Demetrakopoulos D, Briggs SM, Helfet DL, Lorich DG. The ability of the Lauge-Hansen classification to predict ligament injury and mechanism in ankle fractures: An MRI study. *J Orthop Trauma* 2006;20:267-272.
7. Utsugi K, Sakai H, Hiraoka H, Yashiki M, Mogi H. Intra-articular fibrous tissue formation following ankle fracture: The significance of arthroscopic debridement of fibrous tissue. *Arthroscopy* 2007;23:89-93.
8. Choi WJ, Park KK, Kim BS, Lee JW. Osteochondral lesion of the talus: Is there a critical defect size for poor outcome? *Am J Sports Med* 2009;37:1974-1980.
9. Glazebrook MA, Ganapathy V, Bridge MA, Stone JW, Allard JP. Evidence-based indications for ankle arthroscopy. *Arthroscopy* 2009;25:1478-1490.
10. Thomas B, Yeo JM, Slater GL. Chronic pain after ankle fracture: An arthroscopic assessment case series. *Foot Ankle Int* 2005;26:1012-1016.
11. Dawe EJ, Jukes CP, Ganesan K, Wee A, Gougoulias N. Ankle arthroscopy to manage sequelae after ankle fractures. Knee Surg Sports Traumatol Arthrosc in press, available online 24 June, 2014. doi:10.1007/s00167-014-3140-0.
12. Donnenwerth MP, Roukis TS. Outcome of arthroscopic debridement and microfracture as the primary treatment for osteochondral lesions of the talar dome. *Arthroscopy* 2012;28:1902-1907.