

Ankle arthroscopy

Anatomy & Pathophysiology

BONY ANATOMY

- The ankle mortise is formed by the tibial plafond, medial malleolus, and lateral malleolus [20].
- The ankle mortise articulates with the dome of the talar body [20].
- The talar dome is wider anteriorly and narrower posteriorly [20].
- The ankle mortise widens 1 to 1.5 mm during motion from plantar flexion to dorsiflexion [20].
- Medial and superior clear spaces appear wider with the foot in plantar flexion [20].
- The ankle joint is responsible for most sagittal plane motion of the foot and ankle [20].
- Ankle range of motion includes 23 to 48 degrees of plantar flexion [20].
- Ankle range of motion includes 10 to 23 degrees of dorsiflexion [20].
- The distal fibula has a convex medial surface that articulates with the concave incisura fibularis of the distal lateral tibia [20].
- The fibula rotates approximately 2 degrees within the incisura during ankle motion and ambulation [20].
- Ankle dorsiflexion results in external rotation and proximal translation of the fibula [20].
- The talocrural angle is approximately 83 degrees and should be symmetrical with the contralateral ankle [26].
- The medial clear space should be less than 5 mm and no more than 2 mm greater than the tibiotalar clear space [26].
- The tibiofibular clear space, measured 10 mm above the joint line, is relatively constant with rotation [26].
- The tibiofibular overlap, measured 10 mm above the joint line, is highly variable dependent on rotation [26].
- The “ball sign” on an AP view is an unbroken curve connecting the recess in the distal tip of the fibula and the lateral process of the talus when the fibula is out to length [26].
- Absence of the ball sign indicates a short and malreduced fibula [26].

- The size of the medial clear space more than doubles depending upon the rotational position of the limb [26].
- There is a significant increase in medial clear space with ankle plantarflexion [26].

LIGAMENTOUS ANATOMY

- The lateral ankle ligaments function as restraints to varus and inversion forces at the ankle [20].
- The anterior talofibular ligament (ATFL) originates from the anteroinferior aspect of the lateral malleolus, 1 cm proximal to its tip, and extends to the lateral aspect of the talar neck [20].
- The calcaneofibular ligament (CFL) extends from the tip of the lateral malleolus to the lateral aspect of the calcaneus [20].
- The posterior talofibular ligament (PTFL) extends from the posterior lateral malleolus to the posterolateral talus [20].
- The ATFL is the weakest ankle ligament [20].
- The PTFL is the strongest ankle ligament [20].
- The distal tibiofibular joint (ankle syndesmosis) and fibula provide stability against lateral talar translation [20].
- The deltoid ligament complex is the primary ankle stabilizer during stance [20].
- The deep deltoid ligament extends from the apex of the medial malleolus to the medial talar body [20].
- The deep deltoid ligament functions primarily to resist lateral talar translation and external rotation [20].
- The posterior deep deltoid is the most important component of the deep deltoid ligament [20].
- The superficial deltoid ligament extends from the distal medial malleolus to the navicular bone, sustentaculum tali of calcaneus, medial talus, and spring ligament [20].
- The superficial deltoid ligament functions primarily to resist valgus and eversion ankle forces [20].
- The deltoid ligament consists of superficial and deep layers, with the deep portion organized into anterior and posterior deep tibiotalar ligaments [23].
- The deep posterior tibiotalar ligament is the strongest component of the deltoid complex [23].
- The deep deltoid ligament has the highest load to failure at $713.8 \text{ N} \pm 69.3$ compared with the lateral collateral ligaments [23].
- The dominant mode of failure for the deep deltoid ligament is an intrasubstance rupture near its talar insertion [23].
- The dominant mode of failure for the superficial deltoid ligament is at its insertion on the anterior malleolus [23].
- The deltoid ligament has a rich vascular supply from the medial tarsal artery, posterior tibial artery, and tibialis anterior artery [23].
- Valgus tilting of the talus within the mortise requires complete rupture of both the superficial and deep deltoid ligaments [23].

NEUROVASCULAR ANATOMY

- The superficial peroneal nerve penetrates the deep fascia and lies subcutaneously 8 to 10 cm proximal to the tip of the lateral malleolus, anterior to the subcutaneous border of the fibula shaft [22].
- The deep peroneal nerve accompanies the anterior tibial artery between the tendons of the anterior tibial and extensor digitorum longus muscles [22].
- The deep peroneal nerve usually lies just lateral to the anterior tibial artery [22].
- The saphenous nerve is located just medial or posterior to the saphenous vein in a slightly deeper plane 3 to 5 cm proximal to the tip of the medial malleolus [22].
- The intermediate dorsal cutaneous branch of the superficial peroneal nerve is at greatest risk of injury during placement of the anterolateral portal [11].
- The sural nerve and lesser saphenous vein are at greatest risk of injury during placement of the posterolateral portal [11].
- The tibial nerve and posterior tibial artery and veins are at greatest risk of injury during placement of the posteromedial portal [11].
- An accessory incision for lateral ligament repair should not surpass 22 mm distance from the lateral malleolus in the anterior direction to avoid damaging the superficial peroneal nerve [25].

PATHOPHYSIOLOGY

- More than 75% of ankle ligament injuries involve the lateral ligament complex, particularly the ATFL and CFL [15].
- Medial ligament injuries are usually seen in association with a fracture or joint injury [15].
- Syndesmosis disruption occurs in up to 11% of all ankle injuries [11].
- In rotational ankle fractures, 30% to 39% have a concomitant syndesmotic injury [11].
- Osteochondral defects and other chondral injuries may be present in 57 to 90% of patients with ankle fractures [11].
- Concomitant intra-articular injuries have been reported in up to 80% of patients with ankle fractures [17].
- Osteochondral lesions were present in 26% of Weber B fractures, 24% of Weber C fractures, and 20% of isolated medial malleolar fractures [17].
- Chondral lesions were identified in 78% of patients with acute ankle fracture, with talar dome chondral lesions present in 43% [17].
- Patients with complete syndesmosis disruption and instability were more likely to have chondral injury [17].
- Patients younger than 30 were less likely to have a chondral injury following acute ankle fracture [17].
- Anterolateral soft-tissue impingement is a common cause of chronic ankle pain after one or more lateral ankle sprains [11].
- Anterolateral soft-tissue impingement can occur with or without associated lateral ankle instability [11].
- The ankle joint synovial lining can become inflamed, resulting in generalized hypertrophic synovitis [31].

- Inflammatory arthropathies that cause diffuse ankle swelling and pain include rheumatoid arthritis, psoriatic arthritis, infection, and gout [31].
- Pigmented villonodular synovitis and synovial chondromatosis are processes that result in complex diffuse synovitis [31].
- Overuse and trauma can cause generalized inflammation of the ankle joint synovium [31].
- Injury to the ankle syndesmosis can result in persistent pain and dysfunction secondary to syndesmotic impingement [11].
- Anterior bony impingement is present in 12% of patients with chronic ankle instability [9].

Clinical Presentation

ACUTE LATERAL ANKLE INSTABILITY

- Acute lateral ankle instability is classified into three grades based on the severity of ligamentous disruption [47].
- Grade I acute lateral ankle instability involves no ligament disruption, minimal swelling/ecchymosis/tenderness, and no pain with weight bearing [47].
- Grade II acute lateral ankle instability involves ligament stretch without rupture, moderate swelling/ecchymosis/tenderness, and mild pain with weight bearing [47].
- Grade III acute lateral ankle instability involves complete ligament rupture, severe swelling/ecchymosis/tenderness, and severe pain with weight bearing [47].
- The history of an acute lateral ankle instability typically suggests an inversion injury [47].
- Physical examination for acute lateral ankle instability reveals localized tenderness, swelling, and ecchymosis over the anterior talofibular ligament and/or the calcaneofibular ligament [47].
- The anterior drawer test may demonstrate anterior talar subluxation in acute lateral ankle instability [47].
- Plantar flexion of the ankle during the anterior drawer test isolates the anterior talofibular ligament [47].
- Neutral plantar and dorsiflexion of the ankle during the anterior drawer test isolates the calcaneofibular ligament [47].
- Standard radiographs for acute lateral ankle instability should include weight-bearing mortise and lateral views [47].
- Radiographs of the foot should be obtained if tenderness exists around the anterior calcaneus or fifth metatarsal [47].
- The presence of lateral or medial osteophytes on radiographs suggests chronic recurrent laxity [47].
- Radiographs should rule out fractures of the lateral process of the talus, anterior process of the calcaneus, and base of the fifth metatarsal [47].
- A positive talar tilt test on stress radiographs is defined as more than 3° of tilt compared with the opposite side or 10° of tilt overall [47].

- A positive anterior drawer test on stress radiographs is defined as 3 mm greater translation compared with the opposite side, or an absolute value of 10 mm [47].
- MRI and magnetic resonance arthrography can show ligamentous disruption or attenuation but provide no distinct advantage over physical examination for acute lateral ankle instability [47].
- MRI is most useful when investigating other pathology such as peroneal tear, occult fractures, osteochondral lesions of the talus, bone bruising, tarsal coalition, or impingement lesions [47].
- MRI should be considered if pain persists for 8 weeks following an ankle sprain [47].
- Osteochondritis dissecans lesions are associated with acute lateral ankle instability in 15% to 25% of cases [47].
- Loose bodies are associated with acute lateral ankle instability in 20% of cases [47].
- Peroneal pathology is associated with acute lateral ankle instability in less than 25% of cases [47].
- More than 75% of ankle ligament injuries involve the lateral ligament complex, particularly the anterior talofibular ligament and calcaneofibular ligament [15].
- In an anterior talofibular ligament sprain, tenderness is maximal just distal and slightly anterior to the lateral malleolus [15].
- The slightest attempt at passive inversion of the ankle is extremely painful in an anterior talofibular ligament sprain [15].
- Stability assessment in the acute phase of an ankle ligament injury is not possible [15].
- The Ottawa ankle rules guide the need for X-ray in ankle ligament injuries [15].
- Anteroposterior, lateral, and mortise views of the ankle should be obtained for imaging ankle ligament injuries [15].
- Weight-bearing views are useful in helping determine stability in ankle ligament injuries [15].
- CT and MRI may be needed to fully characterize an injury or in those with persistent pain, swelling, instability, and impaired function over 6 weeks or longer [15].
- Ankle sprains represent the most common reason for missed athletic participation in adolescent athletes [32].
- The classic low ankle sprain is defined as a sprain resulting in injury to the lateral ligamentous structures of the ankle below the level of the distal tibiofibular syndesmosis [32].
- Low ankle sprains are typically inversion injuries [32].
- Excessive inversion of the plantarflexed foot leads to injury to the anterior talofibular ligament [32].
- Excessive inversion of the dorsiflexed foot causes injury to the calcaneofibular ligament and, less commonly, the posterior talofibular ligament [32].
- Acute low ankle sprains typically manifest by a large amount of lateral ankle swelling, pain with weight bearing, and pain in the lateral ankle [32].
- Physical examination for acute low ankle sprains characteristically shows focal tenderness to palpation over the involved lateral ankle ligamentous structures [32].
- Pain with resisted eversion of the foot is a sign of peroneal tendon injury during the inversion episode [32].

- The anterior drawer test may be positive in patients with a history of numerous ankle sprains [32].
- The anterior drawer test involves anterior translation of the slightly plantarflexed foot [32].
- Excessive anterior translation in the anterior drawer test represents chronic laxity of the injured anterior talofibular ligament [32].
- Inversion stress testing of the neutral foot may demonstrate increased laxity in the setting of an attritional calcaneofibular ligament [32].
- The Ottawa Ankle Rules are a reliable tool for determining when radiography is necessary in the evaluation of an acute ankle sprain [32].
- A fracture is suspected under the Ottawa Ankle Rules when there is difficulty with weight bearing, tenderness to palpation over the medial or lateral malleolus, tenderness over the navicular, or tenderness over the base of the fifth metatarsal [32].
- Weight-bearing AP, lateral, and mortise views are recommended when radiographs are necessary for an acute ankle sprain [32].
- Varus stress views can be used to evaluate for excessive talar tilt in the setting of anterior talofibular ligament laxity [32].
- External rotation stress views should be obtained to rule out a syndesmotic injury [32].
- MRI is rarely warranted for acute ankle sprains except in the setting of prolonged pain or instability [32].
- MRI is performed to evaluate for associated injuries such as peroneal tendon pathology, talar osteochondral lesions, fractures of the anterior calcaneal process, or fractures of the lateral talar process [32].
- As many as 42% of lateral process talar fractures are initially misdiagnosed as ankle sprains [32].
- Talar body and neck fractures can occasionally be overlooked in low-energy trauma patients thought to have minor ankle injuries [32].
- Patients with ankle sprains often recall a twisting mechanism, typically inversion [42].
- Injury to branches of the superficial peroneal nerve can cause numbness over the dorsal midfoot following an ankle sprain [42].
- Direct trauma to the area may cause injury, herniation, and subsequent entrapment of the superficial peroneal nerve [42].
- Patients with ankle sprains may develop complex regional pain syndrome [42].
- Complex regional pain syndrome is characterized by dysfunction in motor, sensory, and autonomic nerve systems [42].
- Pain in complex regional pain syndrome is out of proportion to findings on exam [42].
- Swelling, ecchymosis, and pain with weight bearing are common in ankle sprains [42].
- Assessment for recurrent instability requires evaluation for hindfoot varus [42].
- Patients should be questioned about symptoms of a loose body or osteochondral injury, such as locking or catching [42].
- AP, mortise, and lateral x-rays of the ankle are obtained for radiographic evaluation of ankle sprains [42].
- Weight-bearing x-ray is preferable if the patient can tolerate it [42].

- Foot x-rays should be obtained for any pain on examination, especially at the base of the fifth metatarsal or anterior process of calcaneus, to rule out fracture [42].
- Radiographs should be evaluated for lateral process of the talus fracture, anterior process fracture, osteochondral defects, and mortise or syndesmosis instability [42].
- CT scanning is considered for evaluation of a suspected or identified lateral process fracture [42].
- MRI is typically reserved for patients with continued pain despite weeks of conservative treatment or concern about a loose body or osteochondral defect [42].
- MRI may demonstrate attenuation or tear of the lateral ligamentous structures [42].
- Bone bruising is common in severe sprains and may result in longer time to pain-free activity and return to sports [42].

ANTEROLATERAL SOFT-TISSUE IMPINGEMENT

- Anterolateral soft-tissue impingement is a common cause of chronic pain after one or more lateral ankle sprains [38].
- Anterolateral soft-tissue impingement is characterized by hypertrophic synovium, inflamed/enlarged capsular tissues, and scarring [38].
- Anterolateral soft-tissue impingement occurs with or without associated lateral ankle instability [38].
- The most common site of anterolateral soft-tissue impingement is at the superior portion of the anterior talofibular ligament [38].
- Anterolateral soft-tissue impingement also occurs along the distal portion of the anterior-inferior tibiofibular ligament [38].
- Patients with anterolateral soft-tissue impingement typically report a history of persistent anterolateral ankle pain with activity [38].
- Physical examination for anterolateral soft-tissue impingement notes well-localized tenderness at the anterolateral ankle joint [38].
- A physical examination test specific for anterolateral soft-tissue impingement involves reproduction of pain with plantar flexion of the ankle, followed by thumb pressure at the anterolateral ankle joint, and dorsiflexion of the ankle [38].
- The physical examination test for anterolateral soft-tissue impingement has been reported to be reproducible and accurate [38].
- Diagnosis of anterolateral soft-tissue impingement is based primarily on the history and physical examination [38].
- Conventional MRI has a reported sensitivity and specificity of less than 50% for anterolateral soft-tissue impingement of the ankle [38].
- Clinical examination has a reported sensitivity of 94% and specificity of 75% for anterolateral soft-tissue impingement [38].
- A tibiotalar joint injection with anesthetic and/or steroid can aid in differentiating between intra- and extra-articular pathology contributing to impingement symptoms [38].

- Anterolateral soft-tissue impingement has been noted to occur with or without associated lateral ankle instability [11].

ACUTE TRAUMATIC ANKLE INJURIES

- The benchmark for assessment of syndesmotric instability is an intraoperative stress test including the Cotton test or external rotation stress test [11].
- Osteochondral defects can oftentimes be identified on plain radiographs [11].
- MRI is the best imaging study to evaluate the size, location, and presence of instability of osteochondral defects [11].
- Ankle arthroscopy has the highest sensitivity and specificity for diagnosing syndesmotric injuries missed on plain and stress view radiographs [11].
- Arthroscopic diagnosis of syndesmotric instability includes disruption of the deep portion of the posterior tibiofibular ligament [11].
- Arthroscopic diagnosis of syndesmotric instability includes rupture of the interosseous ligament with a syndesmotric gap greater than 2 mm [11].
- Arthroscopic diagnosis of syndesmotric instability includes a fracture of the posterolateral portion of the tibial plafond [11].
- Assessment of an ankle fracture requires a detailed history, a thorough physical examination, and radiographic imaging [34].
- High-energy mechanisms in ankle fractures indicate the likelihood of additional soft tissue complications, compartment syndrome, complex pilon fracture, or other associated injuries [34].
- Diabetes indicates an increased likelihood of wound complications owing to immunologic and vascular impairment [34].
- Poorly controlled diabetics are at risk of peripheral neuropathy, which may influence postoperative weight-bearing decisions [34].
- A history of smoking, alcohol abuse, and psychiatric illness increases the likelihood of complications in ankle fractures [34].
- Clinical examination for ankle fractures begins with inspection for deformity, bruising, blistering, skin integrity, and color [34].
- Palpation of the limb starts at the fibular head and progresses sequentially down the lateral aspect of the leg to the lateral malleolus and adjacent soft tissues [34].
- Palpation moves medially across the ankle joint to the medial malleolus and its adjacent soft tissue structures [34].
- Palpation of the skeleton of the foot excludes commonly associated or missed injuries such as fractures of the metatarsals or lateral talar process, or disruption of the midtarsal articulation [34].
- Palpation of the Achilles tendon and the Simmonds or Thompson's test exclude rupture of this structure [34].
- A distal neurovascular assessment includes assessment of temperature and capillary refill [34].

- Skin marking of palpable dorsalis pedis and posterior tibial arterial pulsations at presentation is helpful in later assessment if the condition of the limb deteriorates [34].
- The Ottawa ankle rules provide assistance in determining the need for x-ray in ankle fractures [34].
- The Ottawa ankle rules offer a highly sensitive and cost-effective method of identifying patients with ankle injuries most likely to have sustained a fracture [34].
- Pain exists near one or both of the malleoli plus one or more of the following: age >55 years old, inability to bear weight, or bone tenderness over the posterior edge or the tip of either malleolus [34].
- Ankle arthroscopy at the time of open reduction and internal fixation for ankle fractures aids in fracture reduction [11].
- Ankle arthroscopy at the time of open reduction and internal fixation allows for diagnosis of syndesmotic instability [11].
- Ankle arthroscopy at the time of open reduction and internal fixation allows for identification and treatment of chondral injuries, osteochondral defects, and loose bodies without significant soft-tissue dissection [11].
- Concurrent ankle arthroscopy at the time of open reduction and internal fixation provides better visualization and less disruption to surrounding soft tissues to view fracture reduction as well as intra-articular pathology [11].

GENERAL ANKLE INJURIES

- Injuries and disorders of the foot and ankle are common among athletes and active individuals [7].
- Both lateral and medial ankle sprains are the most common injuries, but other subtle injuries will often occur [7].
- Clinicians must be vigilant and perform a thorough history and physical examination for foot and ankle injuries [7].
- The use of advanced imaging is often helpful in diagnosis when combined with a thorough clinical examination [7].
- Many foot and ankle conditions can be managed nonsurgically, although surgical treatment is sometimes indicated [7].
- Ankle sprains represent one of the most common athletic injuries [7].
- Good evidence from high-level studies is available to guide management and treatment decision making for ankle sprains [7].
- Osteochondral lesions of the ankle respond poorly to nonsurgical treatment [7].
- The causes and locations of ankle impingement are numerous, and both open and arthroscopic procedures are used [7].
- Plantar fasciitis can be mimicked by calcaneal stress fracture or tarsal tunnel syndrome [7].
- Anatomic reduction is the most important factor in achieving a good outcome after a Lisfranc injury [7].
- A high index of suspicion should be maintained to diagnose a high-risk stress fracture of the foot or ankle [7].

- A prolonged recovery and delayed union or nonunion are common after high-risk stress fractures of the foot or ankle [7].

Investigations

IMAGING MODALITIES

- MRI is useful in evaluating for associated pathology to the peroneal tendons or talar articular surface in patients with chronic lateral ankle instability [28].
- MRI confirms the abnormal appearance of affected ligaments, which may be thickened or indistinct, but does not help determine functional instability [28].
- MRI can show osteophytes in anterior ankle impingement but is not very sensitive for soft-tissue impingement [30].
- MR arthrography or contrast-enhanced, fat-suppressed, three-dimensional (3D), fast-gradient recalled acquisition in the steady state with radiofrequency spoiling (CE 3D-FSPGR) MRI is more sensitive and specific for soft-tissue impingement than standard MRI but is less practical [30].
- In one study of anterior ankle impingement, 58% of patients had an associated diagnosis on MRI, which changed the surgical plan in 33% of cases [30].
- Anteromedial radiographic views are often helpful for visualizing osteophytes in anterior ankle impingement when lateral radiographs do not show them [30].
- Oblique radiographs have diagnostic value for the anterior ankle impingement syndrome [1, 16].
- Stress radiographs can be used to confirm instability in chronic lateral ankle instability, including a lateral radiograph obtained during the anterior drawer test and a mortise radiograph during the talar tilt test [28].
- Ultrasonographic examination has been used to evaluate the deltoid ligament in bimalleolar equivalent fractures [27].
- Preoperative computed tomography scans have a role in operative planning for malleolar ankle fractures [27].
- Axial CT imaging is used to evaluate normal tibiofibular relationships at the syndesmosis [27].
- MRI lacks additional diagnostic value for stability assessment of the ankle mortise in supination-external rotation-type ankle fractures [27].
- MR arthrography has been used for anatomic correlation of tibiofibular syndesmotic ligaments in cadavers [6].
- 3-Tesla magnetic resonance imaging is used for evaluation of posterior tibial tendon dysfunction with relevance to clinical staging [6].
- MRI features are described for osteochondral lesions of the talus [6].
- MRI has been used for the diagnosis of ligamentous and chondral pathology in the ankle [6].
- MRI and stress radiography have been used in the evaluation of chronic lateral ankle instability [6].
- MRI is used in pre-operative evaluation of the anterior talofibular ligament in chronic ankle instability [6].

- Associations between MRI findings and symptoms have been studied in patients with chronic ankle sprain [6].
- CT and MR imaging are used for the evaluation of the postoperative ankle and foot [6].
- Magnetic resonance imaging is used for the diagnosis of plantar plate injury with reference to intraoperative findings [6].
- Musculotendinous magnetic resonance imaging of the ankle is a subject of technical review [6].
- Magnetic resonance imaging is used for the evaluation of sports injuries involving the ankle [6].
- Imaging evaluation of traumatic ligamentous injuries of the ankle and foot is a subject of radiologic review [6].
- Technical considerations and best practices for MR imaging of the foot and ankle have been established [6].

ARTHROSCOPIC DIAGNOSTIC FINDINGS

- Arthroscopy is used for the diagnosis of full-thickness talar cartilage lesions in the setting of acute ankle fractures [16].
- Arthroscopy is used for the quantification of syndesmotric instability in a cadaveric model [16].
- Arthroscopy is used for the diagnosis of distal tibiofibular syndesmosis disruption in acute ankle fracture, with comparisons made to radiologic diagnoses [1, 16].
- Arthroscopy is used for the diagnosis of a tear of the tibiofibular syndesmosis [1].
- Arthroscopy is used for the assessment of occult intra-articular injury in acute ankle fractures [1].
- Arthroscopy is used for the diagnosis and treatment of combined intra-articular disorders in acute distal fibular fractures [1].
- Arthroscopic findings are associated with the unstable ankle [1].
- Arthroscopic findings in chronic lateral ankle instability include focal chondral lesions that may influence the results of ligament reconstruction [1].
- Articular lesions in ankles with lateral ligament injury have been characterized by arthroscopic study [1].
- Arthroscopy is used for the visualization of the tibial plafond during posterior malleolar fracture fixation [1].
- Arthroscopy is used for the diagnosis of anterolateral ankle impingement, with comparisons made to magnetic resonance imaging and clinical examination [1, 16].
- Anterolateral impingement of the ankle has been evaluated using MR imaging for effectiveness [1].
- Anterolateral ankle impingement has been assessed using MR arthrography of the anterolateral recess [1].
- Soft tissue impingement syndrome of the ankle has been evaluated for diagnostic efficacy of MRI and clinical results after arthroscopic treatment [1].
- MRI evaluation of anterolateral soft tissue impingement of the ankle has been described [4, 6].

CLINICAL EXAMINATION AND DIAGNOSTIC PROCEDURES

- Careful physical examination and diagnostic injection can help to pinpoint the diagnosis of anterior ankle impingement [30].
- The use of intraarticular injections for diagnosis has been questioned due to potential cytotoxicity to chondrocytes, although these concerns are based on in-vitro studies with no substantiating clinical evidence [30].
- Anterior drawer testing and talar tilt stress are performed to evaluate competency of the anterior talofibular ligament and calcaneofibular ligament, respectively [28].
- Patients with chronic lateral ankle instability should be assessed for evidence of global ligamentous laxity and weight-bearing hindfoot alignment [28].
- AP, mortise, and lateral weight-bearing radiographs of the ankle are performed in the evaluation of chronic lateral ankle instability [28].
- Clinicians must be vigilant and perform a thorough history and physical examination for foot and ankle injuries, as advanced imaging is often helpful when combined with clinical examination [7].

Treatment

ANKLE FRACTURES

- A meta-analysis by Lee et al. found that functional outcomes were better after arthroscopically assisted open reduction and internal fixation than conventional open reduction in patients with ankle fractures [17].
- Concomitant intraarticular injuries, such as syndesmotic disruption, ligament injury, and osteochondral lesions, have been reported in up to 80% of patients with ankle fractures [17].
- Chan et al. found that osteochondral lesions were present in 26% of Weber B fractures, 24% of Weber C fractures, and 20% of isolated medial malleolar fractures [17].
- Da Cunha et al. identified chondral lesions in 78% of 116 patients with acute ankle fracture and talar dome chondral lesions in 43% [17].
- Patients with complete syndesmosis disruption and instability were more likely to have a chondral injury than those without [17].
- Patients younger than 30 were less likely to have a chondral injury [17].
- Arthroscopic evaluation of the joint before fixation of an ankle fracture has been found to be more sensitive than MRI and stress radiographs of the syndesmosis in detecting instability [17].
- A cadaver study showed that stress radiographs were inadequate in distinguishing between an intact ligament and a single disrupted ligament, whereas arthroscopy better demonstrated an isolated ligament disruption [17].
- Gonzalez et al. found fair-quality evidence for the use of ankle arthroscopy in detecting intraarticular injuries, but insufficient evidence for improvement of functional outcome, reduction in complication rates, or operative time [17].

- Fuchs et al. found no statistically significant improvement in patients with unstable ankle fractures who had concomitant ankle arthroscopy, but also found no increased complications [17].
- The average operative time for concomitant ankle arthroscopy during fracture fixation was increased by only 15 minutes [17].
- There is a grade I (incomplete) recommendation for supplementing ankle fracture fixation with arthroscopy [17].
- Wagener et al. achieved primary reduction in six of seven patients with talar neck fractures using arthroscopy, with one patient requiring removal of a fracture fragment through a small arthrotomy [17].
- In the study by Wagener et al., six of seven patients were pain free and excellent functional outcomes were achieved in five patients [17].
- Two patients in the Wagener et al. study had restricted ankle motion, and a reduction in subtalar motion was noted in all patients [17].
- In patients with chronic syndesmosis injuries, arthroscopic debridement of the associated intraarticular pathologic process can be done without screw fixation if there is no lateral displacement of the talus [17].
- Patients with chronic widening of the syndesmosis can benefit from arthroscopic debridement and percutaneous placement of screws across the syndesmosis after reduction [17].
- Arthroscopic diagnosis of syndesmotic instability includes disruption of the deep portion of the posterior tibiofibular ligament, rupture of the interosseous ligament with a syndesmotic gap > 2 mm, or a fracture of the posterolateral portion of the tibial plafond [11].
- Concurrent ankle arthroscopy at the time of open reduction and internal fixation provides better visualization and less disruption to surrounding soft tissues to view fracture reduction and intra-articular pathology [11].

ANKLE INSTABILITY

- Arthroscopy is recommended before open lateral ankle ligament surgery because concomitant intraarticular pathologic processes are often associated with chronic ankle instability [9].
- Yasui et al. found that ankle arthroscopy did not decrease the rate of reoperations required after ankle ligament reconstruction, but there was a lower rate of ankle arthrodesis as a second procedure and lower complications in patients who had arthroscopy [9].
- Lopes et al. reported significant improvements in AOFAS and Karlsson scores at a mean 10-month follow-up in 286 patients undergoing arthroscopic ligament repair or reconstruction for chronic ankle instability [9].
- Neurologic complications occurred in 10% of patients in the Lopes et al. series, involving transient dysesthesia and neuroma [9].
- Cutaneous complications and infection occurred in 4.2% of patients in the Lopes et al. series that required surgical revision [9].
- The rate of cutaneous complications in the Lopes et al. series was at least half that of open surgery [9].

- Li et al. found no significant differences between arthroscopic and open repair of the talofibular ligament in AOFAS score, Karlsson Ankle Functional Score, and Tegner activity score in 60 patients [9].
- Two systematic reviews and one study of 119 patients showed complication rates between 11.5% and 18% for arthroscopic ligament repair or reconstruction [9].
- Two-stage arthroscopy was associated with significantly higher complication rates compared with single-stage arthroscopy [9].
- Higher complications were noted with suture anchor fixation (29%) compared with suture fixation (9%) in the study by Araoye et al. [9].
- A cadaver study showed no difference in the strength of the repair with open or arthroscopic Broström techniques [9].
- A systematic review of level IV studies found that all patients had subjective improvement of instability with arthroscopic Broström techniques, but there was a 17% complication rate [9].
- Entrapment of the peroneus tertius, extensor tendons, and the superficial peroneal nerve can occur when tying sutures for the anterior talofibular ligament [9].
- Yeo et al. found no significant differences in outcome scores, anterior talar translation, or talar tilt between an open modified Broström procedure and an all-inside arthroscopic modified Broström in 48 patients [9].
- Yeo et al. found that the arthroscopic modified Broström procedure was successful regardless of whether generalized ligamentous laxity was present [9].
- A study by Rigby and Cottom of 62 patients showed similar findings to Yeo et al. and noted the added advantage of earlier bearing in arthroscopically treated patients [9].
- There is a grade C (poor evidence) recommendation for thermal capsular shrinkage to treat ankle instability due to sparse evidence in the orthopaedic literature [9].

IMPINGEMENT

- Excellent or good results can be expected approximately 75% of the time with arthroscopic removal of anterior ankle bone spurs and scar/synovitis when joint-space narrowing is not present [11].
- Treatment for posterior ankle impingement including os trigonum syndrome, a prominent posterior talar process, or posterior process fracture can be effectively treated via posterior ankle arthroscopy [11].
- A physical examination test specific for anterolateral soft-tissue impingement involves reproduction of the pain with plantar flexion of the ankle, followed by thumb pressure at the anterolateral ankle joint, and dorsiflexion of the ankle [11].

ARTHRODESIS

- Ankle arthrodesis has been performed through open, mini-open, and arthroscopically assisted approaches with generally favorable union rates [40].
- One study reported on 101 ankles in 97 patients who underwent arthroscopic ankle arthrodesis on average 86 months prior and demonstrated that 95% of the ankles achieved fusion with the primary procedure [40].

- There are no data to support one approach over another for ankle arthrodesis, so the approach should be at the discretion of the surgeon based on previous incisions/wounds and any hardware removal needed [40].
- A comparison study found that the nonunion rate was 15.4% for compression screws alone versus 7.7% when anterior plate augmentation was used, though these rates were not significantly different [40].
- Factors that seem to improve results in ankle arthrodesis include arthroscopic or mini-incision technique, the use of more than two screws or an adjunct plate (or fibular strut), and a diagnosis of primary osteoarthritis [45].
- With modern techniques, attention to detail, and management of concurrent medical conditions, fusion rates of better than 90% should be expected in standard, uncomplicated ankle arthrodesis [45].
- Thevendran et al. noted fair evidence (grade B) to advocate the use of internal fixation and evolving grade B evidence suggesting that minimally invasive techniques may be equivalent to open procedures in selected patients [45].
- Fourman et al. found that more patients with rhBMP-2 had fusion (93%) than did those without rhBMP-2 (53%) in 82 patients with comorbidities who required complex ankle arthrodesis [45].
- Saltzman et al. reported that the use of pulsed electronic magnetic field devices with immobilization and limited weight bearing was successful in only five of 19 delayed unions of foot and ankle arthrodeses [45].
- Better results have been reported with revision arthrodesis for nonunion, with 75% to 94% successful fusion [45].

ARTHRITIS AND DEBRIDEMENT

- Arthroscopic or open debridement of the arthritic ankle can be effective in the overall management plan but must be used judiciously and with realistic expectations of the outcome [33].
- Efficacy has been shown in several studies for the removal of anterior impingement osteophytes from the tibia and/or talus [33].
- Patients with mechanical locking of the ankle from a demonstrable loose body may benefit from arthroscopic management [33].
- Debridement of more advanced arthritic ankles likely provides only short-term relief and is not recommended in most cases [33].
- Increased motion following removal of impinging osteophytes in a joint with irregular arthritic surfaces may lead to different or increased pain postoperatively [33].
- Aggressive removal of osteophytes may lead to anterior extrusion of the talus postoperatively [33].
- Arthroscopic or open debridement can be done in combination with other procedures such as osteotomy and distraction arthroplasty [33].
- Periarticular osteotomies of the tibia, fibula, or hindfoot are reasonable approaches to the management of localized arthritis of the ankle [33].
- The goal of realignment osteotomies is to unload the more arthritic portion of the joint and provide a more anatomic mechanical axis to the ankle to redistribute joint contact forces and loads [33].
- Realignment surgery can delay the need for arthrodesis or arthroplasty in younger patients [33].

- Chondral loss primarily in the medial or lateral gutter of the ankle with minimal involvement of the superior surface of the talus, especially with supramalleolar deformity, seems best suited for realignment osteotomy [33].
- Ahn et al. reported improvements in AOFAS scores, VAS scores, and medial-distal tibial angle in 18 patients with medial ankle osteoarthritis and mortise widening after opening wedge distal osteotomy without fibular osteotomy [33].
- Excellent clinical results were obtained in ankles with more than 7 degrees of talar tilt and good results in an ankle with 11 degrees of tilt in the Ahn et al. study [33].

SEPTIC ARTHRITIS AND ARTHROFIBROSIS

- In one series of 78 infected joints that included five ankles, there was a 91% cure rate with arthroscopic treatment for septic arthritis [9].
- In another series of 89 infected joints, three of which were ankles, there were 61% good/excellent, 20% satisfactory, and 19% poor functional outcomes [9].
- There is a grade C (poor evidence) recommendation for the use of arthroscopy for the treatment of septic arthritis of the ankle [9].
- There are only small series (level IV studies) on the use of arthroscopy to treat arthrofibrosis of the ankle, most of which report promising results [9].
- There is a grade C (poor evidence) recommendation for the use of ankle arthroscopy in the treatment of arthrofibrosis [9].

COMPLICATIONS

- Complications of arthroscopic ankle surgery using small joint instruments and contemporary noninvasive distraction techniques occur in about 5% to 7% of patients [11].
- The most common complication of arthroscopic ankle surgery is neurologic injury, occurring in approximately 80% of complications [11].
- Approximately half of the neurologic injuries involve the intermediate dorsal cutaneous branch of the superficial peroneal nerve [11].
- A synovial cutaneous fistula is a more common complication with ankle arthroscopy than with arthroscopy of other joints [11].
- The structure at greatest risk of injury during placement of the anterolateral portal is the intermediate dorsal cutaneous branch of the superficial peroneal nerve [11].
- The structures at greatest risk of injury during placement of the posterolateral portal are the sural nerve and the lesser saphenous vein [11].
- The structures at greatest risk of injury during placement of the posteromedial portal during posterior ankle arthroscopy are the tibial nerve and posterior tibial artery and veins [11].
- Pseudoaneurysm of the anterior tibial artery has been reported after ankle arthroscopy and treated with ultrasound-guided compression therapy [2].

- Pseudoaneurysm of the dorsalis pedis artery has been reported after ankle arthroscopy [2].
- Leg anterior compartment syndrome has been reported following ankle arthroscopy after Maisonneuve fracture [2].
- Iatrogenic articular cartilage injuries have been reported during ankle arthroscopy [2].
- Risk of infection after intra-articular steroid injection at the time of ankle arthroscopy has been evaluated in a Medicare population [2].
- Postoperative complications of posterior ankle and hindfoot arthroscopy have been documented [2].
- Complications associated with foot and ankle arthroscopy have been reviewed [2].
- Incidence of and risk factors for venous thromboembolism after foot and ankle surgery have been studied [2].
- Efficacy of arthroscopic treatment for resolving infection in septic arthritis of native joints has been evaluated [2].
- Complications after ankle and hindfoot arthroscopy have been reviewed [2].
- Complications in ankle arthroscopy have been reviewed [2].
- Complications of ankle arthroscopy utilizing a contemporary noninvasive distraction technique have been reviewed [2].
- Pseudoaneurysm following ankle arthroscopy has been the subject of a systematic review of case series [2].

Complications

GENERAL AND NEUROLOGICAL

- Neurological complications of ankle arthroscopy have been reported [1].
- Neurologic complications occurred in 10% of patients undergoing arthroscopic ligament repair or reconstruction for chronic ankle instability, manifesting as transient dysesthesia and neuroma [9].
- Entrapment of the peroneus tertius, extensor tendons, and the superficial peroneal nerve can occur when tying sutures for the anterior talofibular ligament during arthroscopic repair [9].

VASCULAR

- Pseudoaneurysm of the anterior tibial artery after ankle arthroscopy has been reported [2].
- Pseudoaneurysm of the dorsalis pedis artery after ankle arthroscopy has been reported [2].
- A systematic review of case series regarding pseudoaneurysm following ankle arthroscopy has been published [2].

SOFT TISSUE AND COMPARTMENT

- Leg anterior compartment syndrome following ankle arthroscopy after Maisonneuve fracture has been reported [2].

- Cutaneous complications occurred in 4.2% of patients undergoing arthroscopic ligament repair or reconstruction for chronic ankle instability, with some requiring surgical revision [9].
- The rate of cutaneous complications in arthroscopic ligament repair or reconstruction was at least half that of open surgery [9].

INFECTION

- Infection occurred in 4.2% of patients undergoing arthroscopic ligament repair or reconstruction for chronic ankle instability, with some requiring surgical revision [9].
- The risk of infection after intra-articular steroid injection at the time of ankle arthroscopy in a Medicare population has been evaluated [2].

IATROGENIC AND TECHNICAL

- Iatrogenic articular cartilage injuries during ankle arthroscopy have been reported [2].
- Complications associated with foot and ankle arthroscopy have been described [2].
- Complications after ankle and hindfoot arthroscopy have been described [2].
- Postoperative complications of posterior ankle and hindfoot arthroscopy have been described [2].
- Complications of ankle arthroscopy utilizing a contemporary noninvasive distraction technique have been described [2].

LIGAMENT RECONSTRUCTION SPECIFICS

- Complication rates for arthroscopic ligament repair or reconstruction range between 11.5% and 18% [9].
- Two-stage arthroscopy is associated with significantly higher complication rates compared with single-stage arthroscopy [9].
- Higher complications are noted with suture anchor fixation (29%) compared with suture fixation (9%) in arthroscopic ligament repair or reconstruction [9].
- A 17% complication rate was observed in a systematic review of level IV studies for arthroscopic Broström techniques [9].

ARTHRODESIS SPECIFICS

- Complications following arthroscopic ankle arthrodesis have been reported [1].
- The incidence of nonunion after isolated arthroscopic ankle arthrodesis has been reported [8].
- Risk factors for failure of arthroscopic ankle fusion have been analyzed in a series of 52 ankles [12].

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