

Achilles tendon repair

Anatomy & Pathophysiology

BONY ANATOMY

- The ankle mortise is formed by the tibial plafond, medial malleolus, and lateral malleolus [3].
- The ankle mortise articulates with the dome of the talar body [3].
- The talar dome is wider anteriorly and narrower posteriorly [3].
- The ankle mortise widens 1 to 1.5 mm during motion from plantar flexion to dorsiflexion [3].
- Medial and superior clear spaces appear wider with the foot in plantar flexion [3].
- The distal fibula has a convex medial surface that articulates with the concave incisura fibularis of the distal lateral tibia [3].
- The fibula rotates approximately 2 degrees within the incisura during ankle motion and ambulation [3].
- Ankle dorsiflexion results in external rotation and proximal translation of the fibula [3].

LIGAMENTOUS ANATOMY

- The lateral ankle ligaments function as restraints to varus and inversion forces at the ankle [3].
- 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 [3].
- The calcaneofibular ligament (CFL) extends from the tip of the lateral malleolus to the lateral aspect of the calcaneus [3].
- The posterior talofibular ligament (PTFL) extends from the posterior lateral malleolus to the posterolateral talus [3].
- The ATFL is the weakest ankle ligament [3].
- The PTFL is the strongest ankle ligament [3].
- The distal tibiofibular joint and fibula provide stability against lateral talar translation [3].
- The deltoid ligament complex is the primary ankle stabilizer during stance [3].
- The deep deltoid ligament extends from the apex of the medial malleolus to the medial talar body [3].

- The deep deltoid ligament functions primarily to resist lateral talar translation and external rotation [3].
- The posterior deep deltoid is the most important component of the deep deltoid ligament [3].
- The superficial deltoid ligament extends from the distal medial malleolus to the navicular bone, sustentaculum tali of the calcaneus, medial talus, and spring ligament [3].
- The superficial deltoid ligament functions primarily to resist valgus and eversion ankle forces [3].
- The deltoid ligament consists of superficial and deep layers, with at most six bands of which only three are constant: the tibionavicular ligament, tibiocalcaneal ligament, and deep posterior tibiotalar ligament [8].
- The tibiocalcaneal portion of the superficial deltoid ligament is the strongest component and resists eversion of the calcaneus [8].
- The deep portion of the deltoid ligament is organized into two short, thick, discrete bands: the anterior and posterior deep tibiotalar ligaments [8].
- The anterior and posterior deep tibiotalar ligaments are intra-articular but extrasynovial [8].
- The deep posterior band comprises the largest band of the deltoid complex [8].
- The deep deltoid ligament has the highest load to failure at $713.8 \text{ N} \pm 69.3$ compared with the lateral collateral ligaments [8].
- The dominant mode of failure for the deep deltoid ligament is an intrasubstance rupture near its talar insertion [8].
- The failure of the superficial deltoid ligament is most commonly at its insertion on the anterior malleolus [8].
- Valgus tilting of the talus within the mortise requires complete rupture of both the superficial and deep deltoid ligaments [8].

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 [6].
- The deep peroneal nerve accompanies the anterior tibial artery between the tendons of the anterior tibial and extensor digitorum longus muscles, just lateral to the extensor hallucis longus tendon [6].
- 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 [6].

BIOMECHANICS

- The ankle joint is responsible for most sagittal plane motion of the foot and ankle [3].
- Ankle plantar flexion ranges from 23 to 48 degrees [3].
- Ankle dorsiflexion ranges from 10 to 23 degrees [3].
- The ankle joint also contributes to inversion, eversion, and rotation [3].

Investigations

- MRI is sensitive for detecting osteochondral lesions of the ankle, but the edema pattern frequently overestimates the severity of the injury [12, 13].
- Linear fluid signal deep to subchondral bone on MRI indicates an unstable osteochondral lesion [12, 13].
- MRI has a sensitivity of 92% for predicting stable versus unstable osteochondral lesions [12, 13].
- CT scans are helpful for evaluating bony lesions, determining the integrity of subchondral bone, identifying cysts, and preoperative planning for osteochondral lesions [12, 13].
- AP, mortise, and lateral weight-bearing ankle x-rays may not demonstrate subtle osteochondral lesions [12, 13].
- Advanced imaging is often helpful in the diagnosis of foot and ankle injuries when combined with a thorough clinical examination [16].
- MRI is used for the evaluation of chronic Achilles tendon ruptures [1].
- MRI is used for the evaluation of traumatic ligamentous injuries of the ankle and foot [1].
- MRI is used for the evaluation of musculotendinous structures of the ankle [1].
- MRI is used for the evaluation of sports injuries involving the ankle [1].
- MRI is used for the pre-operative evaluation of the anterior talofibular ligament in chronic ankle instability [1].
- MRI is used for the evaluation of anterolateral soft tissue impingement of the ankle [1, 18].
- MRI is used for the evaluation of osteochondral lesions of the talus [1].
- MRI is used for the evaluation of posterior tibial tendon dysfunction [1].
- MRI is used for the diagnosis of plantar plate injury with reference to intraoperative findings [1].
- MRI is used for the evaluation of tibiofibular syndesmotic ligaments [1].
- MRI is used for the evaluation of chronic lateral ankle instability in conjunction with stress radiography [1].
- MRI is used for the evaluation of associations between imaging findings and symptoms in patients with chronic ankle sprain [1].
- MRI is used for the evaluation of accuracy in diagnosing ligamentous and chondral pathology in the ankle [1].
- MRI is used for the evaluation of peroneal tendon abnormalities on routine imaging of the foot and ankle [15].
- MRI is used for the evaluation of entrapment neuropathies of the lower extremity, including the knee, leg, ankle, and foot [19].
- Ultrasonography is used for the examination of the deltoid ligament in bimalleolar equivalent fractures [17].
- Ultrasonography is used for the point-of-care diagnosis and management of superficial peroneal nerve entrapment [19].

- MRI lacks additional diagnostic value for stability assessment of the ankle mortise in supination-external rotation-type ankle fractures [17].
- CT imaging is used to evaluate normal tibiofibular relationships at the syndesmosis [17].
- Preoperative computed tomography scans are used in operative planning for malleolar ankle fractures [17].
- Radiographic evaluation of the normal distal tibiofibular syndesmosis is a standard investigative approach [17].
- Fluoroscopy is used to assess if the syndesmosis is reduced [17].
- Radiographic identification of primary lateral ankle structures is possible [2].
- Gravity stress radiographs are used to assess the effect of ankle position on deltoid ligament integrity and medial clear space measurements [2].
- Stress radiography is used in the evaluation of chronic lateral ankle instability [1].
- The use of advanced imaging is often helpful in diagnosis when combined with a thorough clinical examination for foot and ankle disorders [16].

Treatment

OPERATIVE TECHNIQUE: LINDHOLM REPAIR

- The patient is positioned prone for the procedure [14].
- A posterior curvilinear incision is made extending from the midcalf to the calcaneus [14].
- The deep fascia is incised in the midline to expose the tendon rupture [14].
- Ragged ends of the tendon are debrided [14].
- Tendon ends are apposed using a box type of mattress suture made of heavy nonabsorbable suture material or wire [14].
- Fine interrupted sutures are also used to appose the tendon ends [14].
- Two flaps are fashioned from the proximal tendon and gastrocnemius aponeurosis [14].
- Each flap is approximately 1 cm wide and 7 to 8 cm long [14].
- The flaps are left attached at a point 3 cm proximal to the site of rupture [14].
- Each flap is twisted 180 degrees on itself so that its smooth external surface lies next to the subcutaneous tissue [14].
- The flaps are turned distally over the rupture [14].
- Each flap is sutured to the distal stump of the tendon and to one another [14].
- The flaps cover the site of rupture completely [14].
- The wound is closed with care taken to approximate the tendon sheath over the site of repair [14].

OPERATIVE TECHNIQUE: LYNN REPAIR

- The tendon sheath is opened in the midline [14].
- The foot is held in 20 degrees of plantar flexion during the repair [14].
- The ends of the Achilles tendon are sewn together with 2-0 absorbable sutures without excising the irregular edges [14].
- If the plantaris tendon is intact, its insertion on the calcaneus is divided [14].
- The plantaris tendon is fanned out to form a membrane using forceps, beginning distally [14].
- The fanned-out plantaris membrane is placed over the repair of the Achilles tendon [14].
- The plantaris membrane is sutured in place with interrupted sutures [14].
- When possible, the Achilles tendon is covered for 2.5 cm both proximal and distal to the repair [14].
- If the plantaris tendon is ruptured, it is dissected free from the Achilles tendon for several centimeters [14].
- The ruptured plantaris tendon is divided proximally using a tendon stripper [14].
- The plantaris tendon is pulled distally into the incision and fanned out as a free graft [14].
- The sheath of the Achilles tendon is closed as far distally as possible without tension [14].

POSTOPERATIVE CARE

- Postoperative care for these repairs is the same as that used after treatment of acute rupture of the Achilles tendon [14].

References

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