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Arthroscopic Approaches to the Ankle Joint

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This chapter reviews anterior and posterior arthroscopic approaches to the ankle and subtalar joints. The specific anatomy relevant to arthroscopy is reviewed including the major tendon, vascular, nerve and ligament structures along with the bony anatomy of the joints. A step by step discussion of portal placement, portal establishment, and diagnostic arthroscopy of the joints is presented, first for anterior approaches and then for posterior approaches.
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Introduction

In the early days of arthroscopy, the ankle joint was deemed unsuitable for arthroscopic procedures owing to its unique anatomy of complex curved articular surfaces constrained by tight ligament structures.[1] Improvements in optics, miniaturization of arthroscopes, and the development of techniques for joint distraction contributed to improved arthroscopic visualization of the ankle joint and expanding applications of arthroscopy for surgical procedures. The first series on ankle arthroscopy demonstrating intra-articular pathology was published in a textbook chapter in 1977.[2] Ankle arthroscopy has since emerged as a valid option for treating a variety of intra-articular and periarticular pathologies with less complications and quicker rehabilitation compared with traditional open techniques. As technology advances and new techniques are developed, surgical indications for ankle arthroscopy will likely continue to expand.

Ankle arthroscopy allows improved direct visualization of intra-articular pathology compared with traditional open approaches. As with any surgical procedure, the surgeon must have a complete understanding of the arthroscopic anatomy along with the proper indications and potential limitations of the procedure. The ankle joint is made up of highly congruent articulations among the tibial plafond, the talus, and the distal fibula, with stability maintained by strong ligament structures. The overall complexity of ankle arthroscopy is compounded by its geometry and proximity to the neurovascular structures.

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Anterior Ankle Arthroscopy

Anatomy

The tibial-talar articulation is highly congruent, meaning that the convexity of the talus is nearly the same as the concavity of the tibial plafond, providing the ankle with increased stability. The osseous structures and their relation to important tendon, nervous, and vascular structures dictate portal placement and patient positioning. The medial malleolus is easily identifiable at the anterior medial border of the ankle and extending distally approximately 1 cm from the joint line. The medial malleolus divides the anterior medial from the posterior medial structures of the ankle. The posterior tibial tendon courses immediately posterior to the medial malleolus, curving distally to insert on the navicular. The flexor digitorum longus, tibial nerve, posterior tibial artery, and flexor hallucis longus (FHL) lie posterior to the posterior tibial tendon in that order. The great saphenous vein and saphenous nerve lie anterior to the medial malleolus superficial to the extensor retinaculum. Palpation anterior and lateral to the medial malleolus reveals an anatomical "soft spot" bordered by the shoulder of medial malleolus medially and the anterior tibial tendon laterally. It is often associated with an indentation in the tibial plafond termed the notch of Harty. This soft spot represents an anatomical safe zone for portal placement. The tibialis anterior tendon lies immediately lateral to this soft spot. The extensor hallucis longus (EHL) tendon lies lateral to the tibialis anterior tendon and can be identified by flexing and extending the great toe. The extensor digitorum longus (EDL) is less prominent and lateral to the EHL; it divides into 4 slips distal to the inferior extensor retinaculum inserting on the extensor expansion complex of the lesser phalanges. The peroneus tertius tendon is located on the anterior lateral joint line but is highly variable in size and shape and has been found to be absent in up to 10%

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of individuals,[3] making it an unreliable landmark for portal placement. The distal aspect of the fibula constitutes the lateral malleolus which is on average 2 cm distal to the joint line and 1 cm posterior to the medial malleolus. The lateral malleolus also functions as an osseous restraint for the peroneal longus and brevis tendons, which are located immediately posterior to it. At the level of the joint, the peroneus brevis lies anterior to the longus, and at the anterior inferior tip of the fibula, the peroneal tendons diverge to their respective insertions.

In addition to knowing the bony and musculotendinous anatomy, the surgeon must be familiar with the location of important neurovascular structures for safe portal placement. The saphenous nerve, the terminal branch of the femoral nerve that divides into 2 braches supplying sensation to medial hindfoot, lies anterior to the saphenous vein anterior to the medial malleolus. The anterior neurovascular bundle (anterior tibial artery and vein and the terminal branch of the deep peroneal nerve) is located between the EHL and the EDL tendons at the level of the tibiotalar joint. The superficial peroneal nerve (SPN) is located along the lateral third of the joint line, lateral to common digital extensor tendon. Knowledge of its location is particularly important because injury to the SPN is among the most commonly reported complications following anterior ankle arthroscopy.[4] The SPN travels within the lateral compartment of the leg piercing the fascia and becoming subcutaneous approximately 10.5 cm proximal to the tip of fibula.[5] As the SPN travels along the anterior medial aspect of the fibula at approximately 6.5 cm from the tip of the fibula, it divides into 2 prominent branches, the medial terminal branch and the intermediate dorsal cutaneous branch. The medial branch crosses the ankle joint line in the central third adjacent to the EHL tendon. As the medial branch continues distally, it divides into 3 smaller branches providing sensation to dorsal medial aspect of the foot. The intermediate dorsal cutaneous branch crosses the joint near the lateral boarder of the EDL tendon, and it is the branch most at risk during placement of the anterolateral portal. The intermediate branch is subcutaneous in location and often may be visualized and palpated by plantar flexing the ankle and fourth ray. Distally, the intermediate branch often combines with small peripheral branches of the sural nerve. The intermediate and medial branches of the SPN combined provide nearly all the sensation to the dorsum of the foot with the exception of the first web space which is innervated by the deep peroneal nerve. The sural nerve is the remaining nervous structure which is located on average 1-1.5 cm distal and 1.5-2 cm posterior to the tip of the fibula. The sural nerve has numerous small inconsistent branches as it travels toward the tuberosity of the fifth metatarsal providing sensation to the lateral boarder of the foot.

Indications for Anterior Ankle Arthroscopy

The indications for anterior ankle arthroscopy are continuing to evolve and expand with evidence-based results lagging behind. Glazebrook et al[6] reviewed 92 studies that were published as of August 2008 to assess the evidence for the use of ankle arthroscopy and determine indications. Each study was assigned a level of evidence based on the criteria of Wright et al[7] to determine the grade of recommendation. This comprehensive review of the existing literature which was mostly based on grade 4 studies (case series), examining the indications and grade of recommendation, found no grade A (level I and II studies) recommendations. Grade B (level II and III studies) recommendations were made for ankle impingement, osteochondral lesions, and ankle arthrodesis. Grade C (level IV and V studies) recommendations were made for ankle loose bodies, ankle instability, septic arthritis, and arthrofibrosis. Arthroscopy in the face of ankle osteoarthritis was given a C recommendation against arthroscopy. The use of endoscopy or arthroscopy continues to expand for periarticular surgery, fractures, and arthrodesis, but the literature is lagging behind.

As with any surgery, having an accurate diagnosis and surgical plan will greatly improve the chance of a successful outcome. When addressing osteochondral lesions of the talus (OCLTs), it is imperative the surgeon has a basic understanding of the location and size of the lesion. Preoperative imagining will help determine surgical positioning, approach, and portal placement. Other preoperative issues to consider are anterior vs posterior pathology, associated (open) surgery, combined procedures, skin condition, and placement of portals.

Positioning

The patient is positioned supine on a regular operating room table. A small bump is placed under the ipsilateral pelvis to facilitate a neutral alignment of the foot and ankle. The bed may be flexed at the hip and knee to facilitate traction. A tourniquet may be placed on the proximal thigh or calf although we typically endorse the use of a thigh tourniquet. After preparing and draping, a rolled bump is placed underneath the ankle to facilitate unloading the joint allowing better visualization and range of motion. Ankle distraction may be used as required depending on the location of the joint pathology. In general, most anterior joint and medial or lateral gutter surgery may be performed without distraction. Joint distraction is required for most posterior ankle pathology and noninvasive techniques have been proven to be safe when distraction of up to 14 kg is used for less than 60 minutes.[8] One of the authors (J.W.S.) positions the patient supine on the operating table with the operative hip and knee flexed and supported by a padded leg holder. Noninvasive distraction is used in all cases as it facilitates a complete joint examination with placement of a posterolateral portal for dedicated inflow or for instrumentation.

Arthroscopic Technique

We begin by using a marking pen to draw out the aforementioned topographic anatomy focusing on the tendinous structures and the course of the SPN. The anteromedial (AM) portal is marked at the anatomical medial soft spot just medial to the anterior tibial tendon. An 18-gauge needle is used to locate the optimum position for the portal and then the joint is injected with 10-20 mL of normal saline. This allows the surgeon to judge joint orientation and also assists in distracting the joint capsule. Correct intra-articular position is verified if the ankle everts during joint insufflation with saline. A 5-mm