Technical Note

Posterior Hindfoot Needle Endoscopy in the Office Setting

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Abstract: Posterior hindfoot disorders encompass a spectrum of bony, cartilaginous, and soft-tissue pathology. Traditional open surgical techniques have been increasingly replaced by less-invasive arthroscopic and endoscopic approaches. Recent innovations such as the advent of the needle arthroscope continue to push the boundary of minimally invasive interventions. This Technical Note highlights our technique for posterior hindfoot needle endoscopy for common posterior hindfoot pathologies in the wide-awake office setting, including indications, advantages, and technical pearls.

Posterior hindfoot disorders encompass a wide spectrum of pathologies including posterior ankle impingement syndrome (PAIS), disorders of the flexor hallucis longus (FHL) tendon, osteochondral lesions, and coalitions.[1] PAIS causes deep posterior pain with ankle plantarflexion. Causes can be anatomic, such as a pathologic posterolateral talar process known as a Steida process or an os trigonum, overuse-related, such as seen in ballet dancers or soccer players, or post-traumatic in nature.[2] FHL tendinopathy usually occurs

at the level of the fibro-osseous tunnel behind the medial malleolus due to a relatively avascular zone at this area. Repetitive use may cause tenosynovitis, hypertrophy, stenosis, and subluxation and is exacerbated by predisposing anatomic variants such as a low-lying muscle belly.[3,4] Osteochondral lesions of the talar dome or less commonly the tibial plafond usually result from an inversion or eversion injury and frequently are misdiagnosed as simple ankle sprains.[5] Coalitions are either congenital or post-traumatic in nature and involve the partial union of at least one facet of the hindfoot joints.[5]

Treatment of posterior hindfoot disorders has been performed historically with open surgical approaches; however, multiple complications, including adhesions, symptomatic scar formation, wound breakdown, neurovascular injury, and stiffness have been reported after these procedures.[4] van Dijk et al.[6] first presented a 2-portal endoscopic hindfoot technique that has since been adopted by and expanded upon by many surgeons as a minimally invasive alternative.[5] Studies have shown lower complication rates, shorter recovery time, less blood loss, and less postoperative pain while maintaining comparable functional outcomes.[7] Recent advances in needle arthroscopy including chip-on-tip image sensor technology have allowed surgeons to push the boundaries of minimally invasive surgery. Advantages and disadvantages as well as pearls and pitfalls of the proposed technique can be found in Table 1 and Table 2, respectively. This Technical Note highlights our technique for posterior hindfoot needle endoscopy, which

Table 1. Advantages and Disadvantages of the Proposed Technique

Advantages	Disadvantages
Minimally invasive with ability to perform in the wide-awake office setting	Difficult to convert to open procedure if necessary
Allows patient to participate in understanding of their condition	Potential for patient pain or discomfort during the procedure
Potential for quicker recovery, improved cosmesis, decreased blood loss, and decreased wound complications	Learning curve
Direct visualization for diagnostic purposes which may be better than magnetic resonance imaging	
Reduced cost and resource use	

can be employed both in the operating room or in the wide-awake office setting (Table 3, Video 1).

Surgical Technique (With Video Illustration)

Preoperative Planning/Positioning

The patient is positioned comfortably on an examination table in the prone position with the foot over the edge of the bed. If the patient is interested in observing the procedure, then a mirror may be placed at the head of the bed, allowing him or her to view the procedure and video monitor. If difficulty with joint access is anticipated, traction options should be available including a traditional ankle stirrup or manual traction by an assistant. If using a stirrup, it is vital that the straps are secure and out of the way of anticipated portals.

With the ankle in neutral position, the relevant surface anatomy is marked on the skin of the posterior hindfoot including the Achilles tendon and the malleoli. The location of the lateral border of the third metatarsal is marked on the plantar aspect of the foot. A line parallel to the sole of the foot is drawn from the tip of the lateral malleoli extending to the medial aspect of the ankle. The posteromedial and posterolateral portals are marked along this line, 5 mm anterior to the medial/lateral borders of the Achilles tendon, respectively (Fig 1).

A local block consisting of 15 mL of 2% lidocaine and 0.5% bupivacaine in a 1:1 ratio is delivered to the hindfoot via the anticipated portals. Wheals are raised subcutaneously over the portal sites followed by deeper injection in line with the anticipated instrument tracts. The remaining anesthetic is injected into the tibiotalar and subtalar joints.

Portal Placement

The posterolateral portal is established using a number 11 blade. Blunt dissection is carried subcutaneously using a mosquito clamp with care to avoid the sural nerve. A blunt trocar is then inserted into the portal in the direction of the third metatarsal marking to avoid medial neurovascular injury and then the blunt trochar is swapped for the 1.9-mm 0° viewing angle needle arthroscope (NanoScope; Arthrex, Naples, FL). After the camera is exchanged over the trochar, it is connected to the (DualWave; Arthrex) with integrated inflow and outflow fluid management system at a pressure of 35 mm Hg. The arthroscope is first positioned in the extra-articular space and poor initial visualization is expected due to the abundant fatty tissue posterior to the talus.

The posteromedial portal is then created under direct visualization. During blunt dissection, the surgeon should ascertain the position of the mosquito clamp by

Table 2. Pearls and Pitfalls of the Proposed Technique

Pearls	Pitfalls
Creation of portals with stab incisions through skin only followed by blunt dissection	Improper placement of posterolateral portal places sural nerve at risk of injury
Direction of instruments toward lateral border of third metatarsal during initial portal placement	Iatrogenic injury to medial neurovascular bundle during instrument insertion if inserting instruments directed too medially
Careful initial debridement of fatty tissue with direct visualization of instrument and triangulation (place instrument and camera at 90° to facilitate localization)	Careless initial debridement before establishing adequate visualization leading to iatrogenic injury
Debridement of hypertrophied intermalleolar ligament in cases of posterior ankle impingement	Failure to debride intermalleolar ligament in posterior ankle impingement leading to residual pain and mechanical symptoms
Passive flexion/extension of hallux to identify flexor hallucis longus tendon	Mistaking flexor digitorum longus or posterior tibial tendons for flexor hallucis longus tendon
Awareness of full working length of shaver especially while working near the flexor hallucis longus tendon	Damage to the flexor hallucis longus tendon due to length of shaver while working on other structures
Calcaneal distraction and ankle dorsiflexion to facilitate entry into the posterior tibiotalar joint	Damage to articular cartilage from aggressive attempts to pass instruments into joint space
Inserting a probe into the subtalar joint to assess range of motion in non-osseous coalition followed by resection	Attempting to resect large coalitions or osseous coalitions which are not amenable to arthroscopic treatment

Table 3. Step-by-step Guide to Performing the Proposed Technique

Step 1: Position the patient comfortably in the prone position with the operative foot free. Mark out relevant surface anatomy and anticipated portals.

Step 2: Inject local anesthesia superficially to anticipated portals and deep in anticipated instrument tracts. Finish with injection into the tibiotalar and subtalar joints.

Step 3: Establish portals with a superficial stab incision followed by blunt dissection. Start with posterolateral portal and finish with posteromedial portal under direct visualization.

Step 4: Carry out careful initial debridement of fatty tissue with triangulation and direct visualization until intermalleolar ligament is seen.

Step 5: Perform diagnostic endoscopy starting with superolateral quadrant and moving counter-clockwise for right ankles and a clockwise for left ankles

Step 6: Assess the posteroinferior tibiofibular ligament and intermalleolar ligament in the superolateral quadrant and check for posterior impingement with plantarflexion.

Step 7: Identify the flexor hallucis longus tendon in the superomedial quadrant with passive motion and assess for tenosynovitis, stenosis, and subluxation.

Step 8: Assess the posterolateral talar process in the inferomedial quadrant and look for the presence of a Stieda lesion or os trigonum.

Step 9: Assess the posterior talofibular ligament and calcaneofibular ligament in the inferolateral quadrant.

Step 10: Debride posterior capsule and assess cartilaginous surfaces of posterior tibiotalar joint and subtalar joints.

Step 11: Ask patient to actively range their ankle to assess for any remaining impingement.

Step 12: Apply wound closure and soft dressing or splint as indicated.

triangulation. We find that placing the instrument and camera at 90° with small manual movements facilitates this greatly. Once the clamp is visualized, it is exchanged for a 2.0-mm shaver and careful debridement of fatty tissue is conducted until the posterior structures are visualized. It is important to be systematic and patient during initial debridement to avoid iatrogenic injury. Debridement is carried out until the intermalleolar ligament (IML) is visualized (Fig 2).

Operative Technique

A diagnostic endoscopy is then carried out in a systematic fashion by dividing the hindfoot into four quadrants. The quadrants are divided by the IML horizontally and the center of the ankle vertically (Fig 3). We prefer to start with the superolateral quadrant and move in a counterclockwise direction for right ankles and a clockwise direction for left ankles.

In the superolateral quadrant, the posterior inferior tibiofibular ligament and IML are identified. A hypertrophied IML is commonly associated with posterior impingement and requires debridement. The ankle should be passively plantarflexed to visualize any impingement of the ligaments. The superomedial quadrant contains the FHL tendon, which lies just lateral to the neurovascular bundle and thus serves as an important boundary (Fig 4). It is essential that all instrumentation stays in the safe zone lateral to the FHL tendon for this reason. The surgeon should be aware of the full working length of the shaver, particularly with longer blades, as the most proximal aspect of the shaver can damage the FHL tendon if not careful. The great toe may be passively flexed to aid in identification of the FHL tendon. Anomalous or low-lying muscle bellies, tenosynovitis, and impingement of the FHL tendon are frequent causes of posterior ankle pain and should be explored and addressed accordingly. An advantage of the small-caliber needle arthroscope is the ability to enter the tendon sheath and identify any additional stenosis or adhesions with passive great toe flexion. The tendon can be followed inferiorly past the flexor retinaculum into the inferomedial quadrant. While in the inferomedial quadrant, the surgeon should also look for the posterolateral talar process and the presence of a Stieda process or os trigonum (Fig 5). These can be
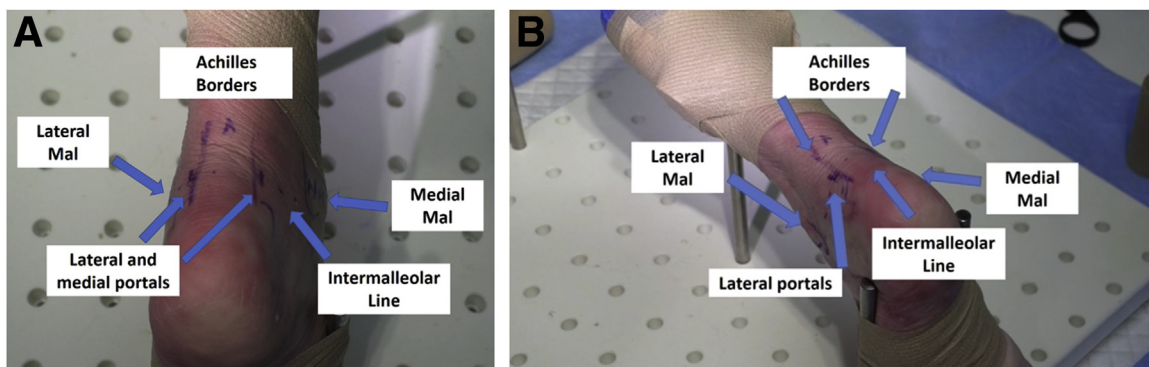
Fig 1. (A) The patient is positioned prone with the foot and ankle hanging off the foot of the bed. Relevant preoperative surface anatomy markings and portal locations are indicated on a posteromedial view of the left ankle in clockwise orientation: Achilles border; medial malleolus; intermalleolar line; medial portal; lateral portal; lateral malleolus. (B) Relevant preoperative surface anatomy markings and portal locations are indicated on a posterolateral view of the left ankle.
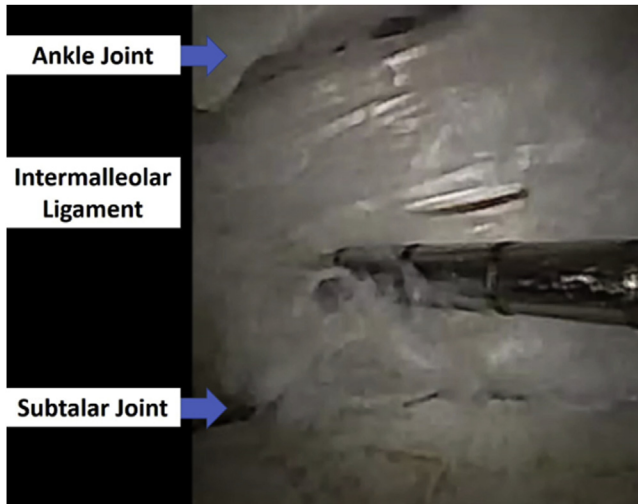
Fig 2. Debridement is carried out until the intermalleolar ligament is visualized. Arthroscopic view depicts the intermalleolar ligament crossing transversely dividing the upper and lower hemispheres of a left ankle in the 4-quadrant model. The lower hemisphere allows access to the subtalar joint. The upper hemisphere grants access to the ankle joint

addressed by switching portals for improved visualization and careful shaving or removal with a small osteotome. Care must be taken when working in this area to avoid iatrogenic cartilage lesions in the subtalar joint. Lastly, the camera is directed toward the inferolateral quadrant where the posterior talofibular ligament and calcaneofibular ligament reside.

The tibiotalar and subtalar joints can then be examined after resection of the posterior capsule (Fig 6 and 7). Distraction of the calcaneus and dorsiflexion of ankle may be necessary for full visualization of the tibial plafond and talar dome. Osteochondral lesions, synovitis, osteophytes, hypertrophic capsule, and impingement should be identified and addressed. Osteochondral defects and subchondral cysts can be debrided and microfractured or drilled to produce fibrocartilage repair tissue.

Portals are sealed primarily using adhesive wound closure strips (Steri-Strip; 3M, Saint Paul, MN) or with simple nylon sutures if the surgeon feels they are necessary. Sterile dressings and a compression bandage are applied.

Postoperative Protocol

Patients are usually allowed to begin weight-bearing as tolerated immediately after surgery with emphasis on regaining range of motion of the ankle. However, treatment of significant osseous injury may require protocol modifications based on surgeon discretion.

Discussion

Hindfoot endoscopy has been revolutionary in the treatment of posterior hindfoot disorders. Described techniques employ small joint arthroscopes (most commonly 2.7-mm 30° viewing arthroscopes) and although less invasive, still require anesthesia in a formal operating room.[4,5] Our technique employs the use of a 1.9-mm 0° viewing arthroscope, which allows a view of the posterior ankle space equivalent to the larger arthroscopes with the ability to perform the procedure in the wide-awake office setting.

To our knowledge, this is the first report of a posterior hindfoot needle endoscopy technique. Scholten et al.[8] reported on 55 patients who underwent endoscopic treatment of PAIS with a mean follow-up of 36 months
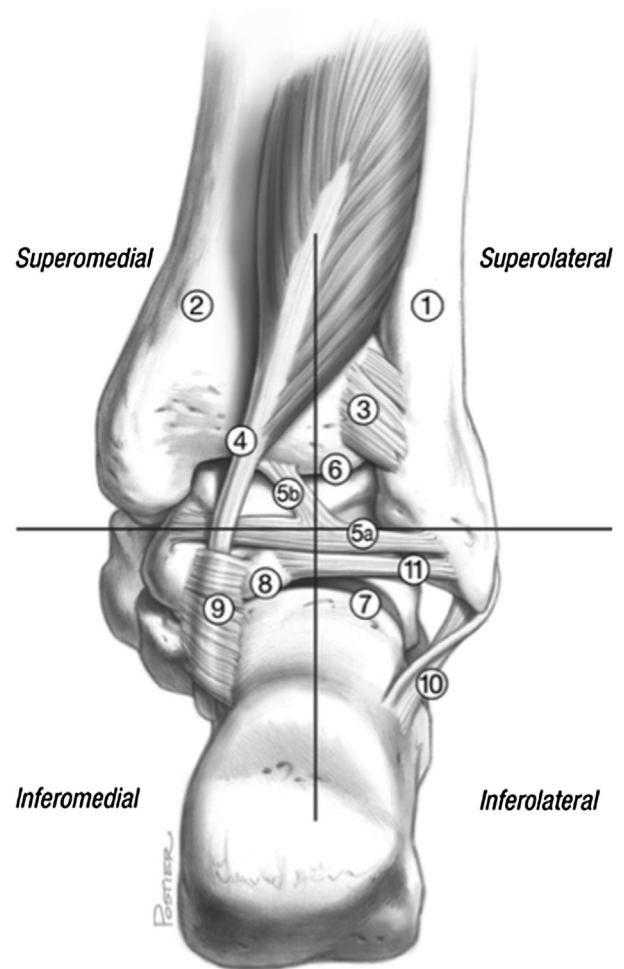

Fig 3. Four-quadrant technique for extra-articular hindfoot structures as defined by the intermalleolar ligament demonstrated on a right ankle. (1) Fibula. (2) Tibia. (3) Posterior inferior tibiofibular ligament. (4) Flexor hallucis longus tendon. (5a) Intermalleolar ligament. (5b) Superior tibial insertion of the intermalleolar ligament. (6) Tibiotalar joint. (7) Subtalar joint. (8) Posterolateral talar process. (9) Flexor hallucis longus retinaculum. (10) Calcaneofibular ligament. (11) Posterior talofibular ligament. Illustration copyright of and reproduced with permission from J.G. Kennedy, MD. (From Smyth NA, Murawski CD, Levine DS, Kennedy JG. Hindfoot arthroscopic surgery for posterior ankle impingement: A systematic surgical approach and case series. Am J Sports Med 2013;41:1869-1876.)

Fig 4. Superomedial quadrant of a left ankle demonstrating flexor hallucis longus tendon, which serves as an important landmark as it delineates the location of the neurovascular bundle, which lies medial to the FHL tendon. It is essential that all instrumentation stays in the safe zone lateral to the FHL tendon for this reason. The surgeon should be aware of the full working length of the shaver, particularly with longer blades, as the most proximal aspect of the shaver can damage the FHL tendon if not careful. The great toe may be passively flexed to aid in identification of the FHL tendon. (FHL, flexor hallucis longus.)

and found an improvement of mean American Orthopaedic Foot and Ankle Society (AOFAS) hindfoot score from 75 points preoperatively to 90 points at time of final follow-up with only one temporary complication. Ling and Walsh[9] reported on 52 patients who underwent endoscopic surgery for PAIS with a median
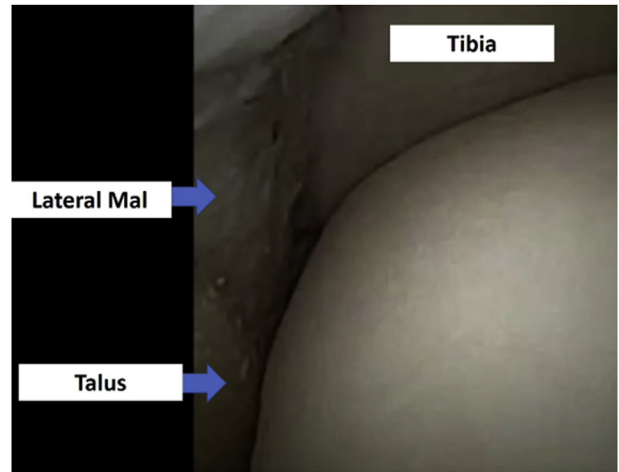

Fig 6. Trifurcation of tibial plafond, talar dome, and lateral malleolus of the tibiotalar joint of a left ankle, a typical location for osteochondral lesions. After resection of the posterior capsule, the tibiotalar joint can be visualized. Distraction of the calcaneus and dorsiflexion of ankle may be necessary for full visualization of the tibial plafond and talar dome. Osteochondral lesions, synovitis, osteophytes, hypertrophic capsule, and impingement may be identified and addressed.

follow-up time of 4.8 years and found that mean work and sporting function scores improved from 5.9 to 9.6 points and 2.9 to 8.8 points, respectively. In a similar study, Sugimoto et al.[10] reported on 72 patients who received posterior ankle arthroscopy in the treatment of PAIS with a mean follow-up of 60 months and found the average preoperative AOFAS score improved significantly from 79.6 to 97.6 postoperatively. Ogut et al.[11] reported on isolated endoscopic tenosynovectomy of the FHL on 11 patients and found an improvement of mean AOFAS score from 48.7 to 83.2. Guo et al.[12] compared open versus endoscopic excision of symptomatic os trigonum and found that the 25

Fig 5. Inferomedial quadrant of a left ankle demonstrating intermalleolar ligament and posterolateral talar process, a location of possible Stieda lesion or os trigonum.
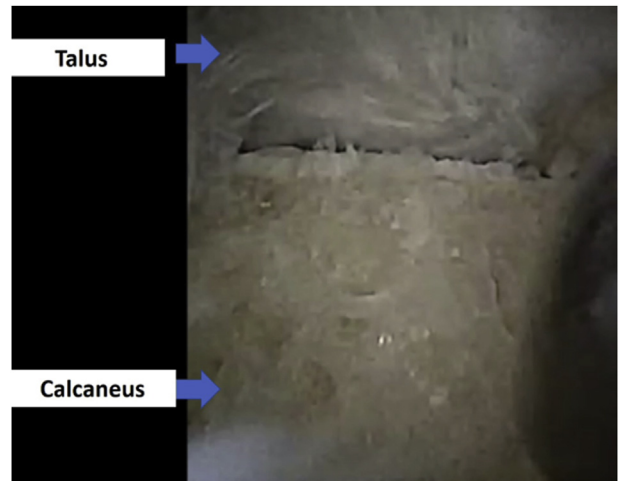
Fig 7. Extra-articular view of subtalar joint of left ankle. After resection of the posterior capsule, the subtalar joint can be examined.

patients undergoing endoscopic surgery had a significantly shorter mean return to activity time (6.0 weeks vs 11.9 weeks, P < .001) compared with the 16 patients undergoing open surgery without significant differences in outcome measures or complication rates. Thus, it appears that endoscopic treatment of hindfoot disorders is at least as effective as open treatment and may provide additional benefits.

The advantages of this minimally invasive technique include improved cosmesis, less blood loss, reduced wound/anesthesia complications, and faster recovery. More importantly, needle arthroscopy allows patients to undergo a diagnostic and therapeutic procedure in the office setting and actively participate in the understanding of their condition. It also allows for savings in health care costs with operating room time, staff, anesthesia, and equipment. As technology advances and the demand for minimally invasive and in-office procedures rises, the role of needle arthroscopy continues to expand.

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