Modern Concept in Posterior Ankle Arthroscopy

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Abstract

Ankle arthroscopy has evolved rapidly within the last twenty-five years and is now the principal method of treatment of ankle disorders. It would be prudent for an aspiring orthopaedic surgeon to include this technique in his or her armamentarium of surgical techniques. This will provide the surgeon an inclusive option to obtain accurate diagnosis and to discuss management options with the patient. The minimally invasive technique is biologically friendly by preserving the soft tissue envelope. This will also meet patient expectations to achieve an earlier and predictable functional recovery from ankle pathology. This review article will briefly mention historical aspects and outline the basic technique and relevant benefits of ankle arthroscopy. Indications and contra-indications of ankle arthroscopy will be discussed with pertinent review of literature. Complications and outcomes of the procedure will also be highlighted.

Keywords: Ankle arthroscopy, technique, indications

Introduction

Advances in orthopaedic endoscopy have made minimally invasive surgery commonplace in the modern era, and yet it was only 20 years ago that a reproducible and safe method for posterior ankle arthroscopy (PAA) was developed[1]. Considering the anatomic orientation about the posterior hindfoot, there is significant concern with respect to the posterolateral saphenous vein and sural nerve as well as the posteromedial neurovascular bundle in relation to the posterior tibial tendon. Prior to 2000, access to the posterior aspect of the hindfoot involved two anterior portals with a concomitant posterolateral portal. The technique developed by Dijk et al allowed for arthroscopic interventions to safely address pathologies of the posterior hindfoot, by using simple anatomic landmarks and a stepwise approach to guiding arthroscopic tools to their points of interest. The medial and lateral arthrotomy counterparts to posterior hindfoot access have been shown to be successful, but are associated with a range of complications. In a 41 patient case series using a posterolateral incision for os trgonum resection, 8 patients experienced sural nerve sensory loss (4 permanently)[2].In an older study by Marotta et al a 12 patient case series of ballet dancers were treated for posterior os trigonum with a similar posterolateral approach. Residual symptoms occurred in 8 patients as well as a single tibial nerve neurapraxia that went on to resolve[3]. When considering the arthroscopic alternative there has been an associated faster time to recovery in the early postoperative period, less soft tissue scarring, and a decreased rate of complication. In a 2008 study, 23 patients underwent 24 PAAs; 11 were for os trigonum excision, 5 for posterior talar process decompression, 5 for flexor halluces longus tenolysis, 1 loose body removal, 1 osteochondritis lesion debridement, and 1 arthrotomy. The average time until return to work was one month, 5 instances of numbness around the scar were reported, and there was a single case of postoperative ankle stiffness[4]. In a larger case series by Nickisch et al 189 PAAs were examined specifically for postoperative complications. Complications were recorded in 8.5% of procedures, including plantar numbness, sural nerve dysethesia, Achilles tendon tightness, complex regional pain syndrome, infection, and one cyst that developed around the posteromedial portal; of the complications only two persisted (one case of plantar numbness, and a case of sural nerve dysethesia)[5]. There are a number of cadaveric anatomical studies demonstrating the efficacy of PAA[6]. Lijoi et al demonstrated that the posteromedial portal is on average 13.3mm (range, 11 to 17mm) from the posterior tibial nerve, 14.7 mm (range, 8 to 20mm) from the calcaneal branch, and 17.3mm (range, 15 to 21mm) from the posterior tibial artery[6]. In another study Sitler et al, used oil filled cannulas in place of arthroscopic instruments to allow for Magnetic Resonance confirmation of anatomical distances, they showed that on average there was a 3.2mm (range, 0 to 8.9mm) distance to the sural nerve, a 4.8mm (range, 0 to 11mm) distance to the saphenous vein, a 6.4mm (range, 0 to 16.2mm) distance to the tibial nerve, a 9.6mm (range, 2.4 to 20.1mm) distance to the posterior tibial artery, a 17mm (range, 19 to 31mm) distance to the medial calcaneal nerve, and a 2.7mm (range, 0 to 11.2mm) distance to the flexor halluces tendon[7]. With respect to both the cadaveric and clinical studies there

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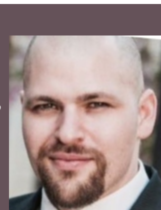

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Figure 1: Patient Position. The patient is prone, with the ankle placed over the edge of the table.

Figure 2: Incision Orientation and Landmarks. (A) The Posterolateral incision is made 5mm anterior to the labeled Achilles Tendon. (B) Posterior View of landmarks and both posterior arthroscopy portals. (C) The Posteromedial incision, labeled 5mm anterior to the Achilles tendon.

is strong evidence that the technique proposed by Dijk et al adequately maintains a safe distance from the posteromedial neurovascular bundle. However, in retrospect the less considered posterolateral structures are in a closer proximity to the portal, and as demonstrated in the study by Nickisch et al are at risk for complication (7 cases of sural nerve dysthesia) [5]. Recent anatomical cadaveric studies have proposed techniques that may further distance pertinent structures upon PAA portal entry. Balci et al performed a cadaveric study using 20 posteriorankles from 10 fresh cadavars, changes in the distance to nearby anatomical structures from posterolateral, transmalleolar, and posteromedial portals were measured when the ankles were in neutral, 15 degrees of dorsiflexion, and 30 degrees of plantarflexion. They found that the distance between the traditional portal and neurovascular structures increased in 15 degrees of dorsiflexion, however the results were not found to be statistically significant[9]. In a consistent finding Urguden et al also showed that the neurovascular structures were distanced from portal sites upon dorsiflexion[10]. In contrast to these findings a recent Japanese study showed plantarflexion to be the optimal ankle position[11]. When considering the anatomy of the hindfoot, plantarflexion will relax neurovascular structures while dorsiflexion will pull them taut. In a 2012 study by Zengerink and Dijk a comprehensive study was performed on 1305 consecutive ankle arthroplasties to determine the complication rate for ankle arthroscopy[12]. Their complication rate was less than half of that reported in the literature (3.5% vs 10.3), with 1.9% due to neurological complications. The primary reason for this inconsistency was the use of dorsiflexion during anterior ankle arthroscopy; 23.8% of their patient population underwent PAA with neutral alignment. Taking these findings into account along with those from the cadaveric study by Tonogai et al we feel that the anatomical distances may increase from portal entry, but the primary advantage will be in the relaxation of nearby neurovascular structures. The aim of our review is to further elaborate on the two portal PAA technique, withadditional considerations being proposed with respect to complications encountered within the literature[8,4,5]. We hypothesize that additional scrutiny towards ankle positionand posterolateralportal entry will optimize the surgical approach and reduce iatrogenic sural injury.

Surgical Technique

Standard 2 Portal Technique

The patient is placed into prone position, with the ankle over the edge of the table (FIGURE 1) followed by induction of general or spinal anesthesia. A tourniquet is placed above the knee (300mm Hg) and a bump cushion is placed at the distal aspect of the tibia allowing for free manipulation of the ankle. The distal Achilles tendon is drawn. The tip of the medial and lateral malleolus is palpated and marked. Lines are made posteriorly, and parallel to the plantar surface of the foot. The posterolateral and posteromedial vertical incisions are made 5mm anterior to the Achilles tendon, just proximal to previously drawn lines (FIGURE 2). At this point manipulation of ankle flexion may be considered. In an updated operative technique described by Dijk et al published in 2009, the ankle is placed in "slight plantarflexion". Considering the findings by Tonogai et al this may be pertinent in relation to sural nerve injury[11,12]. The senior author (SGP) places the ankle in neutral flexion prior to incision, but recommends no additional dorsiflexion, or plantarflexion beyond resting plantarflexion. The posterolaterally marked vertical line is the first to undergo a stab incision followed by careful dissection of the subcutaneous tissue. A mosquito is placed through the portal and aimed at the

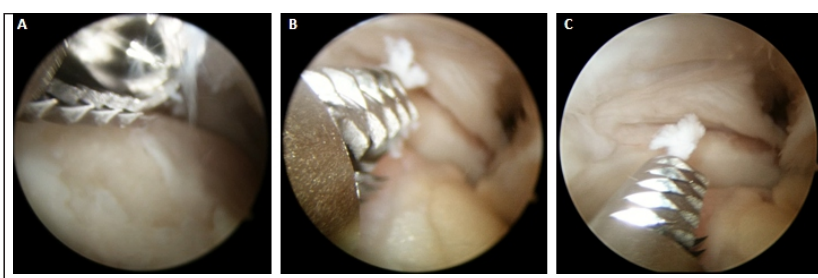

Figure 3. Flexor Hallucis Longus (FHL) Tendon identification. (A) Crural Fascia has been released and the subtalar joint is visible. (B) The shaver is used to remove additional crural fascia, as well as the Rouviere ligament. (C) Careful debridement allows for the identification of The FHL tendon, and a medially located neurovascular bundle.

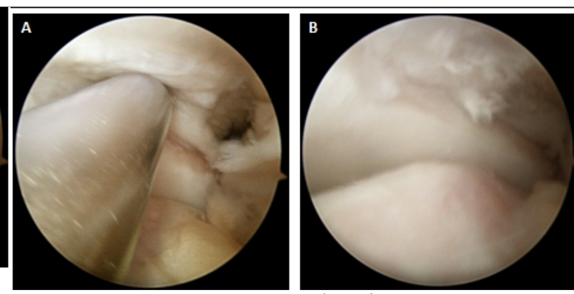

Figure 4. Flexor Hallucis Longus (FHL) Tendon Debridement. (A) Debridement along the lateral aspect of the FHL tendon. (B) The FHL tendon is encountered with care and protected.

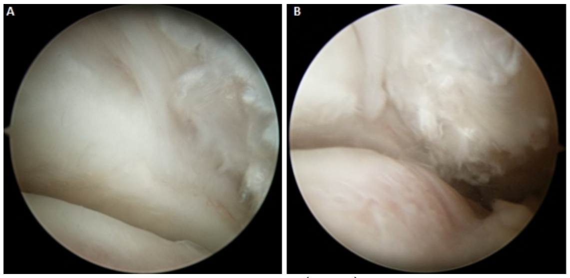

Figure 5. Flexor Hallucis Longus (FHL) Tendon Inspection. The FHL tendon is inspected proximally (A) and distally (B) as it enters into the fibro-osseous canal.

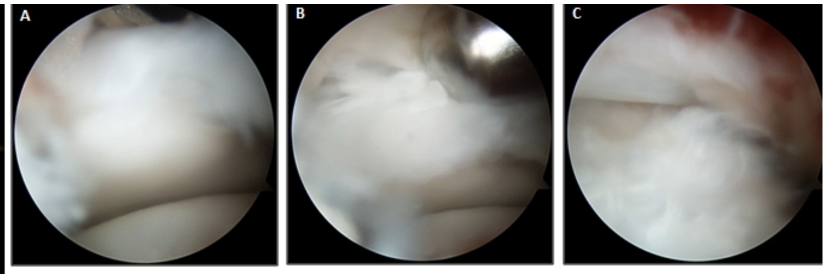

Figure 6. Identification of the Posterior Talofibular Ligament. (A) Debridement is carried out superiorly from the subtalar joint. As the shaver is advanced anteriorly (B), the posterior talofibular ligament is encountered (C).

posterior aspect of the ankle, in line with the second toe. At this point, the mosquito is opened and removed to provide a soft tissue tunnel. This maneuver is then repeated. The posteromedial portal incision is then made. Again, a mosquito is placed through the portal and aimed at the posterior aspect of the ankle, in line with the second toe. At this point, the mosquito is opened and removed to provide a soft tissue tunnel. This maneuver is then repeated. An arthroscopic cannula from the small joint arthroscopy (2.7mm) is then inserted with the trocar pointed at the posterior talar process. This may now be exchanged for the arthroscope (2.7mm at 30 degrees) with the tip based in the extra-articular fatty tissue. A shaver is placed into the opposing portal. Once the tip of the shaver touches the arthroscope, the shaft may be used as a pathway for guidance into the appropriate location. Once the shaver reaches the most distal aspect of the arthroscope, the arthroscope may be be partially retracted until the shaver comes into view. This step-wise introduction of the shaver should be used for the introduction of all future instruments, subsequently the inverse of the sequence should be used for the removal of all instruments as well. [8,14]. The shaver is then used to methodically resect the extra-articular fatty tissue. The posterior fold of the posterior joint capsule of the ankle and subtalar joints is visualized. The arthroscope may then be inserted into the posterolateral subtalar joint, additional dissection may be undertaken to increase the crural fascia opening for additional instrument introductions. With the Crural fascia opening already made, the cranial portion of the posterior talar body must be released. This is accomplished by further release along a specialized lateral aspect of the crural fascia, known as the Rouviere ligament. A very important safety landmark may now be identified, the flexor halluces longus (FHL) tendon (FIGURE 3), with the neurovascular bundle running immediately medially.The lateral aspect may now be considered a safe zone. Passive manipulation of the hallux can serve to reinforce the anatomical finding of the FHL[19]. Carefully, with the shaver, this is debrided, and slowly worked medially. The FHL is carefully encountered and protected (FIGURE 4). This defines the medial extent of the debridement. The tendon sheath can be slowly debrided and the tendon examined proximally and distally into the fibro-osseous canal (FIGURE 5). Careful identification of the FHL tendon, originating from Dijk et al's original technique that made posterior arthroscopy a mainstream procedure, has made neurovascular injuries to this structure less prevalent[1]. However, strict guidance around this structure remains paramount, especially duringdebridement of the FHL tendon, tibiotalar access, and os trigonum removal. Additional landmarks can also be visualized, the posterior talofibular ligament superiorly, the intermalleolr ligament proximally, and also proximally the transverse ligament. Dorsiflexion of the ankle allows for individual identification of these ligaments[19,20]. Identification of these ligaments are important for tibiotalar joint access as retraction of the intermalleolar and transverse ligaments are required. Additionally, the diagnostic technique described by Smyth et al, the 4 quadrant approach, requires identification of the intermalleolar ligament and its superior tibial insertion. These two landmarks serve as a means to break the hindfoot into 4 quadrants, which is helpful in assessing pathology and pertinent anatomical structure[19]. Further, identification of the posterior talofibular ligament is important as it is one of the structures that needs to be released in order to remove a symptomatic os trigonum (FIGURE 6); the other two structures being the talocalcaneal ligament and flexor retinaculum[8]. Traction of the calcaneus and subsequent distraction of the posterior compartment allows for more instrumentation to enter the ankle joint for arthrodesis preparation, osteochondral microfracture, or for further inspection of the talar dome and tibial plafond[8]. An additional accessory portal has been used for arthrodesis, located 1cm proximal and 1 cm posterior to the lateral malleolus; the use of this portal is beyond the scope of this review. Medially the deep portion of the deltoid ligament can be visualized for inspection, in the same vicinity an interior approach to this region allows for access to the posterior tibial tendon. A wide range of pathology may be addressed once fully oriented in the hindfoot[13,14,15,16,17].

Conclusion

Posterior arthroscopy has been primarily used for the resection of os-trigonum lesions or the treatment of posterior osteochondral lesions, loose bodies, ossicles, calcifications, avulsions, osteophytes, chondromatosis, and synovitis[13,14]. Pathologies of the subtalar and tibiotalar joints, in particular osteoarthritis, loose bodies, and osteophytes have routinely been treated with posterior arthroscopy. When considering extrarticular structures, the treatment of hindoot tendons, the deltoid ligament, and symptomatic os trigonum may also be treated arthroscopically [14,15,16,17,18]. The broad applications of posterior arthroscopy have made it a novel method of addressing hindfoot pathology. Mitigating complication, while seemingly miniscule in our sample sizes, may have much broader impacts on an epidemiological scale. Of most importance is extra care to the typically overlooked complications involving the sural nerve and posterolateral portal approach. Considering the technique described by Dijk etal, and cadaveric findings by Tonogai et al there exists implications that must be addressed[12,14].

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Conflict of Interest: NIL
Source of Support: NIL

How to Cite this Article

Tracey J, Parekh S G. Modern Concept in Posterior Ankle Arthroscopy. Asian Journal of Arthroscopy May-Aug 2018;3(2): 9-12