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An Anatomic Safe Zone for Posterior Ankle Arthroscopy: A Cadaver Study

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ABSTRACT

Posterior ankle arthroscopy has traditionally been associated with concern for injury to the posterior tibial nerve and vessels, and this concern is greatest when the patient is positioned supine. Positioning the patient prone could be a safer method for posterior ankle arthroscopy. The purpose of this cadaver study was to determine the anatomic safe zone devoid of vital structures relative to the posteromedial and posterolateral arthroscopic portals created. In addition, exposure of the posterior ankle was evaluated by direct visualization and fluoroscopy to determine the relative utility of these portals. Based on our findings, which are consistent with other previously reported results, we believe that a wide range of ankle pathology can be suited to treatment by means of posterior arthroscopy with the patient in the prone position.

There is a general belief that the risk of injury to the tibial nerve and posterior tibial artery is too great and the indications are too narrow to warrant posterior ankle arthroscopy (1). The majority of these beliefs stem from performing posterior ankle arthroscopy with the patient in a supine or lateral position. However, placing the patient in a prone position may provide improved access with decreased difficulty.

Several vital structures are indeed contained within the posterior ankle compartment. Anatomic studies by Sitler et al and Tryfondidis et al have evaluated the safety and efficacy of utilizing posterior portals in posterior ankle arthroscopy (2,3). A prone position and proper placement of posterior portals along with cautious arthroscopic technique as described by van Dijk (4) allow for effective evaluation of the posterior ankle while minimizing harm to vital structures.

Posterior hindfoot and ankle pathology includes, but is not limited to, osteochondral defects, loose bodies or fragments, cystic bony lesions, fractures of the posterior process, os trigonum syndrome, posterior ankle impingement syndrome, periarticular osteophytes, arthrosis, scar tissue, synovitis, flexor hallucis longus tendinopathy or impingement, Haglund's disease, and insertional Achilles tendinopathy.

Anatomic areas of interest are frequently deep to, and in close proximity to, vital structures contained within the compartment of the posterior ankle. This can make accurate clinical diagnosis rather difficult. Imaging modalities such as ultrasound, magnetic resonance imaging, computed tomography, and scintigraphy, are frequently used and necessary for diagnostic purposes.

Good outcomes have been reported with surgical treatment of the posterior ankle compartment. However, some literature reports long postoperative recovery along with vascular and neurologic injuries. Abramowitz et al reported a 10% neurologic complication rate with an open technique (5).

Arthroscopy provides an excellent method for evaluating and treating posterior ankle problems. It allows direct macroscopic visualization of structures at 5 to 6 times their normal size and enhanced inspection of articular surfaces. Also, arthroscopy provides a minimally invasive technique to address pathology, thereby facilitating expedited rehabilitation, earlier resumption of sports, decreased scarring, and decreased postoperative morbidity, all in an outpatient setting (6–8).

The purpose of this study is to determine the anatomic safe zone devoid of vital structures relative to the posteromedial and posterolateral arthroscopic portals created. In addition, exposure of the posterior ankle was evaluated by direct visualization and fluoroscopy to determine the relative utility of these portals. This work supports a similar study by Sitler et al, in which the proximity of anatomic structures at risk was calculated via MRI in addition to anatomic dissection (2).

Materials and Methods

Seven fresh-frozen cadaver legs were procured for the purpose of this study. Each leg was placed in a prone position for arthroscopic evaluation. Surface anatomy including the distal tibia, distal fibula, and the Achilles was palpated and outlined with

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a skin marker. A line was drawn corresponding to the level of the talocrural joint across the posterior aspect of the ankle just proximal to the tip of the lateral malleolus (Fig. 1).

The posterolateral portal was created first. A small vertical skin incision was made along the lateral border of the Achilles tendon at the level of the ankle joint. A mosquito hemostat was used to bluntly dissect through the subcutaneous layer in the direction of the first web space. The hemostat was exchanged with a cannula and blunt trocar oriented in the same direction after it came into contact with bone. The trocar was anchored against the groove at the ankle joint just lateral to the posterior process.

A posteromedial portal was created by making a small vertical incision along the medial border of the Achilles tendon at the level of the ankle joint. A mosquito hemostat was used to blunt dissect the subcutaneous tissue toward the cannula in the posterolateral portal. The cannula was used as a guide for the hemostat to move anteriorly toward the ankle joint, staying in contact at all times until reaching the bone. The trocar was then replaced with a 30° 3.0-mm arthroscope with the view oriented laterally, to protect the lens of the camera. The hemostat was replaced with a full-radius shaver, introduced into the posterolateral portal and advanced anteriorly along the shaft of the arthroscope. The scope was slowly withdrawn until the shaver was visualized. Throughout the procedure, the instruments were kept lateral to the flexor hallucis tendon to ensure the neurovascular bundle was not compromised. A cavity was created by debriding adipose tissue near the camera. The posterior capsule of the ankle and subtalar joints was then visualized and debrided. Access was gained into the ankle joint where the talar dome, tibial plafond, and surrounding structures were inspected.

Kirshner wires (0.062-in.) were introduced under direct visualization through the lateral and medial malleoli, with the points contacting the lateral and medial talar shoulders, respectively. The tips of the Kirshner wires were placed at a level on the talus defined as a *useful level* to identify and address potential pathology (Figs. 2–4).

The arthroscopy equipment was removed from the leg with the Kirshner wires left in place, and a lateral fluoroscopic image was taken (Figs. 5–7). The percentage of accessible talar dome was determined by dividing the distance from the tips of the Kirshner wires to the posterior-most aspect of the talar dome (area visualized = A_v) by the total articular surface of the talar dome (total area = A_t) (Fig. 6).

Upon completion of arthroscopy, the wires were removed from the medial and lateral malleoli, and the cannulas were replaced in the posterior portals. The posterior compartment of the ankle was then grossly dissected, and anatomic structures of interest were identified and their distances from the nearest cannula were measured (Table). To minimize disruption of the anatomy, each structure was measured immediately after identification. Measurements were recorded to the nearest millimeter with a caliper.

Results

Visualization of the posterior ankle was found to be sufficient for diagnostic and therapeutic purposes. On average, 52% (range 46% to 59%) of useful exposure of the talar dome was visualized.

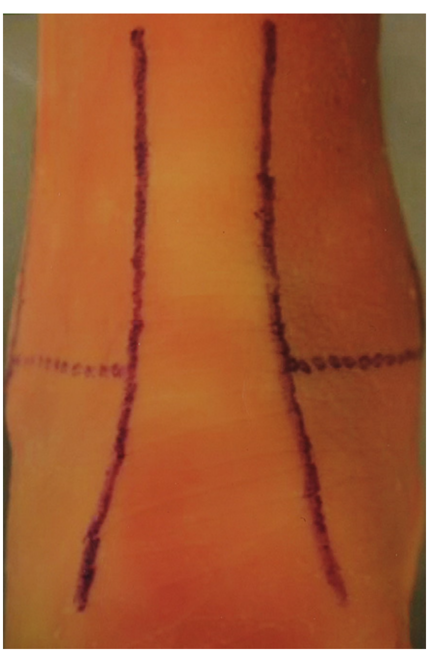

Fig. 1. Lines showing anatomical landmarks.

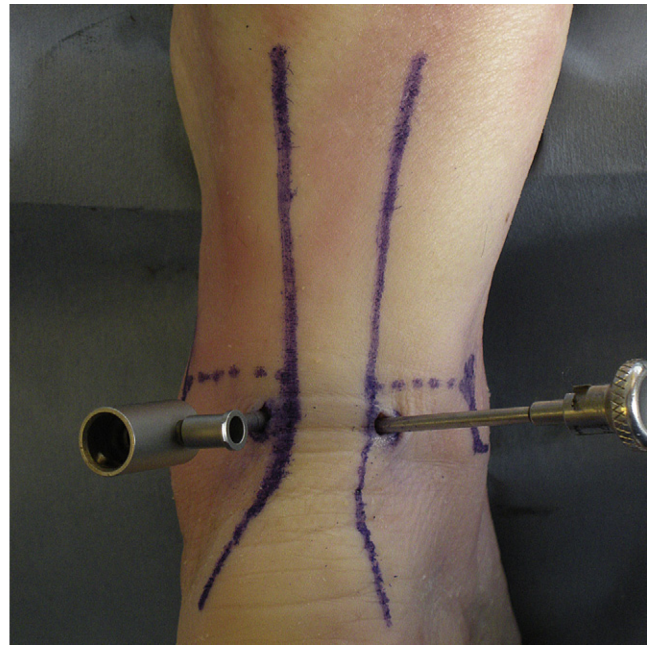

Fig. 2. Placement of portals.

Relative to the posterolateral portal, the median distance from the sural nerve and lesser saphenous vein was 7.1 (range 4 to 11) mm and 10.1 (range 8 to 12) mm, respectively. The posteromedial portal was found to be 2.3 (range 1 to 5) mm from the flexor hallucis longus tendon, 7.9 (range 5 to 9) mm from the tibial nerve, and 12.3 (range 10 to 13) mm from the posterior tibial artery.

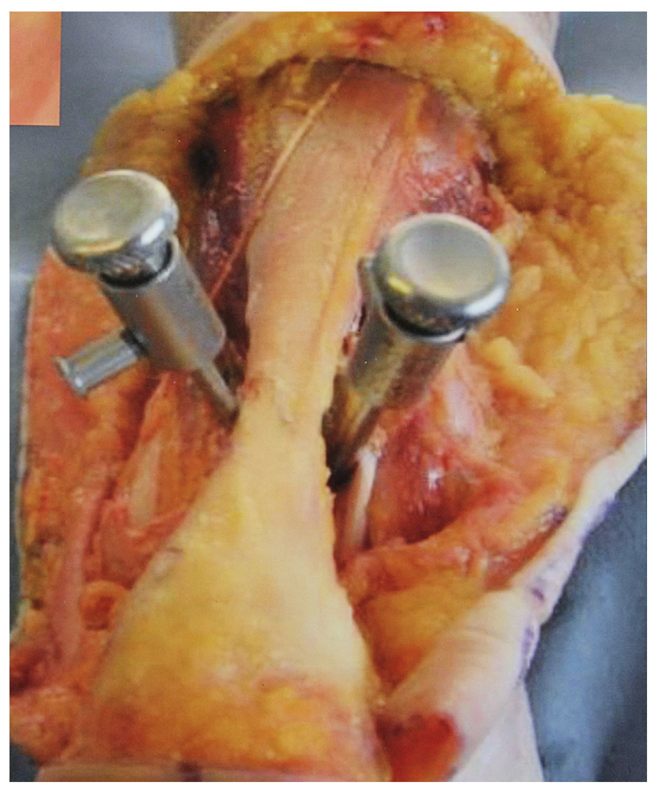

Fig. 3. Dissection showing cannula placement.