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Posterior ankle and hindfoot endoscopy: A cadaveric study

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ABSTRACT

Background: The list of indications of posterior ankle endoscopy is expanding and includes various soft tissue and bony pathologies of the posterior ankle. Some of the indications, e.g. release of frozen ankle, debridement of posteromedial soft tissue impingement of the ankle and debridement or fixation of the posteromedial osteochondral lesion of the talus, require approach to the posterior ankle medial to the flexor hallucis longus tendon. The purpose of this study was to assess the risk of injury to the posterior tibial neurovascular bundle during posterior ankle endoscopy.
Methods: Fourteen fresh frozen foot and ankle specimens were used. A metal rod was inserted into the posteromedial, posterolateral and modified posteromedial portals and touched the medial border of the posterolateral talar tubercle and the posteromedial corner of the ankle mortise in turn. The neurovascular bundle and FHL tendon were examined for any kink.
Results: The neurovascular bundle was kinked in all specimens (100%) with the rod at the posteromedial corner of the ankle mortise through the posteromedial portal and was kinked in 11 specimens (79%) with the rod through the modified posteromedial portal. The neurovascular bundle was kinked in 1 specimen (7%) with the rod through the posterolateral portal.
Conclusions: The neurovascular bundle was at risk during instrumentation of the posteromedial ankle through the posteromedial portal but was safe through the posterolateral portal.

1. Introduction

Endoscopic approach for diagnosis and treatment of posterior ankle pathology was first described by van Dijk et al. [1]. It has been proven to be an effective and safe procedure for bony posterior ankle impingement due to os trigonum/Steida's process [2–8]. The overall complication rate was reported to be 3.8–8.5% after posterior hindfoot endoscopy for posterior ankle impingement, flexor hallucis longus (FHL) tenosynovitis, os trigonum syndrome, or a fractured Stieda process while the rate of complications in open posterior hindfoot and ankle surgery for the same pathologies ranged from 10% to 24% [9,10]. Although rare, injury to the tibial nerve and its branches for procedures around the posterior talar process has been reported [5,10–14]. The list of indications of posterior ankle endoscopy is expanding and includes various soft tissue and bony pathologies of the posterior ankle [10,15–21]. Some of the indications, e.g. release of frozen ankle, debridement of posteromedial soft tissue impingement of the ankle and debridement or fixation of the posteromedial osteochondral lesion of the talus, require approach to the posterior ankle medial to the FHL tendon [20,22–24]. van Dijk et al. has suggested instrumentation of the posteromedial ankle through the posteromedial portal, keeping the instrument lateral to the FHL tendon and pushing the tendon medially [1,5,13,19]. It was believed that the neurovascular bundle would be protected. However, we believed that the tibial nerve can be injured by this maneuver. The purpose of this study was to assess the risk of injury to the posterior tibial neurovascular bundle during posterior ankle endoscopy. We hypothesized that the instrumentation to the posteromedial ankle was risky through the posteromedial portal and safe through the posterolateral portal. Instrumentation of the posteriormedial ankle via the posterolateral portal and arthroscope via the classical posteromedial portal may cause crowding of the instruments at the posteromedial ankle as the portals are at the same level. A modified posteromedial portal located proximal to the posteromedial portal may provide a better arthroscopic view [25]. The risk of injury to the posterior tibial neurovascular bundle during instrumentation via the modified posteromedial portal was also tested.

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2. Methods

Fourteen foot and ankle specimens from 7 fresh frozen cadavers (5 males and 2 females) were used. The average age of succumb was 69 years old (54–89). None of the cadavers had deformity, trauma or any surgery of their foot and ankle regions. All cadavers were put in prone position. The skin of the heel was removed. The posteromedial and posterolateral portals were identified at the sides of the Achilles close to its insertion as described by van Dijk et al. [1,5,13,19]. The modified posteromedial portal was located at the intersection between the medial margin of the Achilles tendon and a line joining the under-surface of the first metatarsal and the sustentaculum tali [25]. The flexor retinuaculum was identified and preserved. Minimal dissection was performed above the retinaculum to identify the posterior tibial neurovascular bundle and the flexor hallux longus (FHL) tendon with preservation of the annular ligament around the tendon. A metal rod was inserted into the portals and touched the medial border of the posterolateral talar tubercle and the posteromedial corner of the ankle mortise in turn. The ankle was kept in neutral position. The neurovascular bundle and FHL tendon were examined for any kink. If the neurovascular bundle was kinked, the level of the kink in relation to the flexor retinaculum and the location of the FHL tendon in relation to the rod and the bundle were recorded. Moreover, the ability of relieving the kink of the bundle by lateral shift of the rod through the standard and modified posteromedial portals was also recorded.

3. Results

The results of the cadaveric study were summarized in Table 1.

3.1. Posteromedial portal

The neurovascular bundle was kinked in one specimen (7%) with the rod at the medial side of the posterolateral talar tubercle while it was kinked in all specimens (100%) with the rod at the posteromedial corner of the ankle mortise. The bundle was directly compressed by the rod in 4 specimens (29%) while the rod pushed the FHL tendon to compress the neurovascular bundle in 10 specimens (71%). The neurovascular bundle was pushed towards the superior edge of the flexor retinaculum in 12 specimens (86%). The kink cannot be relieved by lateral shift of the rod in all specimens (Video 1).

3.2. Modified posteromedial portal

The neurovascular bundle was kinked in none of the specimens (0%) with the rod at the medial side of the posterolateral talar tubercle while it was kinked in 11 specimens (79%) with the rod at the posteromedial corner of the ankle mortise. The bundle was directly compressed by the rod in 4 specimens (36%) while the rod pushed the FHL tendon to compress the neurovascular bundle in 7 specimens (64%). The compression was above the flexor retinaculum and relieved by lateral shift of the rod (100%) (Video 2).

3.3. Posterolateral portal

The neurovascular bundle was kinked in none of the specimens (0%) with the rod at the medial side of the posterolateral talar tubercle while it was kinked in 1 specimen (7%) with the rod at the posteromedial corner of the ankle mortise.

4. Discussion

The most important finding of this study is that the neurovascular bundle was at risk during instrumentation of the posteromedial ankle through the posteromedial portal. Approach to the posteromedial corner of the ankle was safer with the posterolateral portal as the instrumentation portal and the modified posteromedial portal as the visualization portal.

From this study, instrumentation around the posterior talar tubercle through the posteromedial portal was safe. However, in case of os trigonum or Steida process, the posterior talar tubercle can be larger than normal and resection of the medial part of the

Table 1
Summary of the findings of the cadaveric study.

Specimen number	Laterality	Rod in the standard posteromedial portal		Rod in the modified posteromedial portal		Rod in the posterolateral portal	
		Medial border of the posterior talar tubercle	Posteromedial corner of ankle mortise	Medial border of the posterior talar tubercle	Posteromedial corner of ankle mortise	Medial border of the posterior talar tubercle	Posteromedial corner of ankle mortise
1	R	n	b, e, h	n	b, d, g	n	n
2	L	b, f, h	b, e, h	c	b, d, g	n	c
3	R	n	a, d, h	n	a, d, g	n	n
4	L	n	a, e, h	n	a, d, g	n	n
5	R	c	a, e, h	c	a, d, g	n	c
6	L	n	a, e, h	n	a, d, g	n	n
7	R	n	a, e, h	n	a, d, g	n	c
8	L	n	b, e, h	n	b, d, g	n	c
9	R	n	a, d, h	n	c	n	n
10	L	n	a, e, h	n	c	n	n
11	R	n	a, e, h	n	c	n	n
12	L	n	a, e, h	n	a, d, g	n	n
13	R	n	a, e, h	n	a, d, g	n	n
14	L	n	b, e, h	n	b, d, g	n	a

a: kink of the neurovascular bundle, FHL tendon between the rod and the bundle.
b: kinking of the neurovascular bundle directly by the rod, FHL tendon posterior to the bundle.
c: kink of the FHL tendon only.
n: both the neurovascular bundle and FHL tendon was not kinked.
d: compression of the neurovascular bundle above the upper border of the flexor retinaculum.
e: compression of the neurovascular bundle at the upper margin of the flexor retinaculum.
f: compression of the neurovascular bunle below the upper border of the flexor retinaculum.
g: compression of the neuovascular bundle can be released by lateral tilt of the rod.
h: compression of the neurovascular bundle cannot be released by lateral tilt of the rod.