



Posterior ankle arthroscopy portal safety regarding proximity to the tibial and sural nerves

MARIOS TRYFONIDIS, Christopher G. WHITFIELD, Charalambos P. CHARALAMBOUS, Wal K. BARAZA, Aamir I. ZUBAIRY, Chris M. BLUNDELL

From the University of Sheffield Medical School, Sheffield, United Kingdom

The aim of this cadaveric study was to assess the relative safety of posterior ankle arthroscopy portal sites regarding their distance from the tibial and sural nerves. We dissected 20 embalmed cadaveric lower limbs, carefully exposed the nerves, preserving their original position, and established the entry points of five posterior ankle portals using pins. We measured distances with a digital calliper and used Friedman test and Wilcoxon Signed Ranks tests for statistical analyses. There was unequal safety between the five portals ($p = 0.00001$). There was no statistically significant difference between the two posterolateral or two posteromedial portals. The trans-Achilles tendon portal as expected was significantly further away from either nerve ($p = 0.00001$). In conclusion, the trans-Achilles portal is the safest portal in terms of its distance from the nerves but has the disadvantage of surgical injury to the Achilles tendon. The two medial and two lateral posterior portals are equivalent in terms of safety.

Keywords: ankle arthroscopy ; portal ; safety ; tibial nerve ; sural nerve.

INTRODUCTION

A number of different posterior ankle arthroscopy portal sites have been described so far, with each portal having different advantages, disadvantages and risks of complications (1,3-10). One of the most serious complications is nerve damage, which occurs in up to 4.5% of arthroscopic

procedures and is most commonly related to portal placement (4). There have been limited studies so far though assessing the relative safety of the different portals used in posterior ankle arthroscopy in terms of their distance from nerve branches (1,5,8,9). The aim of this cadaveric study was to assess the relative safety of posterior ankle arthroscopy portal sites regarding their distance from the sural and tibial nerves.

■ Marios Tryfonidis, MRCS, Specialist Registrar in Trauma & Orthopaedics.

Buckinghamshire Hospitals NHS Trust, United Kingdom.

■ Christopher G. Whitfield, MRCS, Senior House Officer.
Department of Orthopaedics, Northern General Hospital, Sheffield, United Kingdom.

■ Charalambos P. Charalambous, FRCS (Tr & Orth), Specialist Registrar in Trauma & Orthopaedics.

■ Aamir I. Zubairy, FRCS (Tr & Orth), Consultant Orthopaedic Surgeon.

Burnley General Hospital, United Kingdom.

■ Wal K. Baraza, MRCS, Senior House Officer.

■ Chris M. Blundell, FRCS (Tr & Orth), Consultant Orthopaedic Surgeon.

Department of Orthopaedics, Northern General Hospital, Sheffield, United Kingdom.

Correspondence : Mr Marios Tryfonidis, Flat 8 Bankside, Corporation Street, High Wycombe HP13 6TA, United Kingdom. E-mail : martryfon1@yahoo.com

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MATERIALS AND METHODS

We obtained 20 embalmed cadaveric lower limbs by performing below knee amputation on six male and four female cadavers. Using standard dissection tools we then removed the skin and subcutaneous fat down to the subtalar joint level to expose the Achilles tendon as well as tibial and sural nerves. The dissections were performed by two authors (CGW and WKB). Careful dissection ensured preservation of the original position of the nerves. This was achieved by avoiding any disruption of the soft tissue under the nerves and therefore maintaining the support of each nerve at its original position. The next step was to mark the level of the talocrural joint by placing pins next to each of the malleoli and joining them with a string passing all the way round the ankle. Each portal site was then marked with pins (performed by CPC) at the respective landmark along the level of the talocrural joint line (fig 1) :

1. Posteromedial portal - just medial to the Achilles tendon (4,9,10).
2. Posterolateral portal – just lateral to the Achilles tendon (4,9,10).
3. Trans-Achilles tendon portal – through the fibres of the Achilles tendon (10).
4. Alternative posteromedial portal – directly behind the medial malleolus adjacent to the posterior tibial tendon (1).
5. Alternative posterolateral portal – immediately posterior to the peroneal tendon sheath (1).

Finally, having placed pins on each nerve and at each portal site we measured the distance (performed by MT) of each portal to its nearest nerve (i.e. distance between the needles of the pins) using a digital calliper (No. 500-191, Mitutoyo, Japan, accurate to 0.02 mm, resolution of 0.01 mm). The trans-Achilles tendon portal was assessed for both nerves and the shortest distance was recorded. The two medial portals were assessed for the tibial nerve and the two lateral portals were assessed for the sural nerve.

Statistics

In view of the limited number of cadavers in our dissecting room we did not perform power analysis as we used all available cadaveric limbs for dissection and measurements. In addition, as there had been no similar study done before we did not know what effect sizes to expect.

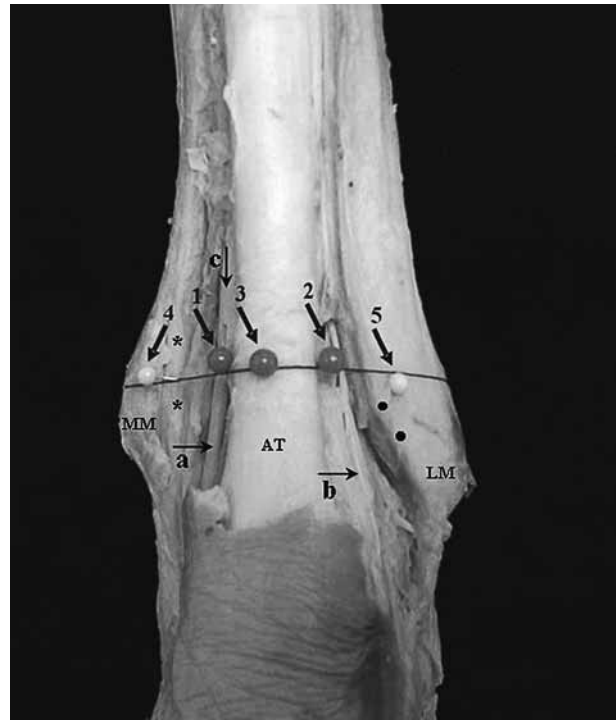


Fig. 1. — Right ankle dissection demonstrating posterior ankle portal entry sites :

pin 1 – posteromedial portal, **pin 2** – posterolateral portal, **pin 3** – trans-Achilles tendon portal, **pin 4** – alternative posteromedial portal, **pin 5** – alternative posterolateral portal. MM = medial malleolus, LM = lateral malleolus, AT = Achilles tendon, a = tibial nerve, b = sural nerve, c = posterior tibial artery (cut), * = tibialis posterior tendon, • = peroneal tendon sheath

We used the measurements obtained to produce a database in SPSS for Windows 11.5 (SPSS Inc, Chicago, IL), which served as a tool for statistical analysis. We assessed the portal sites separately and considered the observations obtained from each limb of the same body to be independent. Median values and non-parametric statistical tests were used due to the small size of our sample which was also not normally distributed.

We performed an overall assessment of the relative safety of each set of portals using Friedman test analysis. We then used Wilcoxon Signed Ranks tests to perform paired comparisons of a portal with each other. The latter statistical analysis was carried out in combination with Holm's correction test to prevent a type I statistical error. The multiplicity correction was necessary in order to deal with a 'Bonferroni situation' where multiple statistical tests were performed in the same context, using the same sub-set of data (2). The correction was not

Table I. — Distances of posterior ankle portals to the nearest nerve branch

	Minimum	Maximum	Median
Posteromedial portal	6.05 mm	20.11 mm	11.36 mm
Posterolateral portal	3.84 mm	17.83 mm	11.97 mm
Trans-Achilles tendon portal	16.39 mm	24.90 mm	18.78 mm
Alternative posteromedial portal	6.28 mm	15.34 mm	10.19 mm
Alternative posterolateral portal	2.44 mm	15.72 mm	10.01 mm

Table II. — Results of paired comparisons using multiple Wilcoxon Signed Ranks tests for posterolateral and posteromedial ankle portals

	p value
Posteromedial portal Vs Posterolateral portal	0.71
Posteromedial portal Vs Alternative Posteromedial portal	0.08
Posterolateral portal Vs Alternative Posterolateral portal	0.08
Alternative Posteromedial portal Vs Alternative Posterolateral portal	0.68

used for the Friedman's test because it was a one-off test, whereas the pair tests were repeatedly testing differences using the same sub-set. Statistical significance was defined as $p < 0.05$.

RESULTS

The median distances of the nearest nerve to each of the posterior ankle portals are shown in table I. Friedman test analysis revealed unequal safety between the 5 posterior ankle portals assessed $p = 0.00001$. Paired comparisons using Wilcoxon Signed Ranks tests showed that the unequal safety was only due to the fact that the trans-Achilles tendon portal was significantly further away from a nerve than each of the other four portal sites $p = 0.0001$. There was no statistically significant difference regarding the distance to the nearest nerve between the posteromedial and posterolateral portal, the posteromedial and alternative posteromedial portal, the posterolateral and alternative posterolateral portal or between the alternative posteromedial and alternative posterolateral portal (table II).

DISCUSSION

Arthroscopic procedures using posterior ankle portals are relatively new and are still evolving. The most established posterior portals are the ones placed lateral and medial to the Achilles tendon (4,9)

as the use of the trans-Achilles tendon portal has always been discouraged due to the risk of tendon damage (4). Alternative posterior portal sites have been described posterior to the peroneal tendon sheath as well as anterior to the posterior tibial tendon (1). A portal via the posterior tibial tendon sheath has also been described (6) but this was not assessed in our study. Regardless of the portal used, nerve injury is one of the most serious complications. Injury to the sural and tibial nerve may either affect their function (in various degrees) or result in painful neuromas with significant morbidity.

Previous studies have looked at the safety of using the pair of portals placed on either side of the Achilles tendon or the pair placed adjacent to the posterior tibial tendon and posterior to the peroneal tendon sheath (1,5,8,9). To the best of our knowledge there has been no other study comparing various portal sites described for posterior ankle arthroscopy regarding their distance from the tibial and sural nerves.

The results of our study suggest that the posterior ankle portal sites are essentially equidistant to the tibial (medial portals) or sural (lateral portals) nerves, except for the trans-Achilles tendon portal site, which as expected was significantly further away from a nerve than any of the other posterior ankle portals. Considering the reluctance to use the trans-Achilles tendon portal this potentially gives the surgeon the option of four portals to consider

utilising during posterior ankle arthroscopy. Personal preference, experience and access to a lesion would seem to be the main factors as to which pair of portals to be used and not necessarily the risk of nerve damage, as all these four posterior portals are equidistant to nerve branches, and the risk of nerve damage would depend primarily on surgical technique during the procedure.

A limitation of our study is the small size of our sample of cadaveric lower limbs available for dissection. In addition under UK law at the time of the study we were unable to replicate subtalar arthroscopy procedures with arthroscopy instruments or simulate the portals with pins in our cadavers. We were only allowed and therefore obliged to perform the dissections first and then use pins to mark the portal sites for the purposes of measurements in our study. Further studies with larger number of dissections may be required to confirm our findings.

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