

The Posterior Femoral Cutaneous Nerve and Branches are in Proximity to the Surgical Approach During Proximal Hamstring Repair



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Purpose: The purpose of our study is to identify the location of the posterior femoral cutaneous nerve (PFCN) and its branches in relation to the proximal hamstring tendon. **Methods:** Fifteen lower torso human cadaveric specimens were dissected in prone position. Skin and subcutaneous tissues were reflected to expose the gluteal and hamstring musculature. The distance between the ischial tuberosity and lateral border of the hamstring, PFCN, perineal branch of the PFCN, and descending femoral branch of the PFCN was measured with digital calipers. Measurements were repeated three times and averaged. **Results:** The PFCN was 30.5 ± 11.4 mm lateral to the central tip of the ischial tuberosity (range: 15.7 to 52.0 mm). The average longitudinal distance from the tip of the ischial tuberosity to the point where the perineal branch crossed the hamstrings was 24.1 ± 15.0 mm (range: 9.9 to 52.2 mm). The average longitudinal distance to the point where the descending cutaneous branch crossed the hamstrings was 83.3 ± 21.3 mm (range: 41.3 to 110.3 mm). The PFCN was nearest to the inferior border of the gluteus maximus 45.8 ± 13.6 mm lateral to the ischial tuberosity (range: 13.6 to 62.1 mm). Eleven specimens (73%) had one identifiable perineal branch; four (27%) had two distinct perineal branches. **Conclusions:** The PFCN was in close proximity to the surgical approach used during proximal hamstring repair, with the perineal branch consistently crossing the surgical field transversely. The location of these nerves varied substantially among the specimens tested, with some nerves less than 1 cm from the ischial tuberosity and 27% of specimens with two perineal branches.

Introduction

Acute surgical intervention for proximal hamstring avulsion injuries is recommended for 2-tendon avulsions with more than 2 cm of retraction and for complete 3-tendon tears regardless of the extent of retraction.^{1,2} Acute surgical repair has been reported to result in higher patient satisfaction, more frequent return to sport at the preinjury level, equivalent isokinetic strength testing, and low complication rates.^{1,3} However, patients treated surgically may develop

disabling burning pain or numbness in the posterior thigh consistent with neuropathy or neuritis of the posterior femoral cutaneous nerve (PFCN) or its branches.⁴

The surgical anatomy of the inferior gluteal nerve and sciatic nerve in relation to the proximal hamstring origin has been well described.⁵ The posterior femoral cutaneous nerve originates from the sacral plexus and exits the pelvis through the greater sciatic foramen below the piriformis muscle along with the sciatic nerve. In this location, it is intimately associated with the surgical approach required for repair of the proximal hamstring. The perineal branch often crosses in the surgical field during proximal hamstring repair.⁶ Netter's *Atlas of Human Anatomy* illustrates the posterior femoral cutaneous nerve giving off two perineal branches and then continuing down the thigh as the descending cutaneous nerve.⁷ Gray's *Anatomy of the Human Body* labels one nerve as the perineal branch, but also depicts two unlabeled branches at the level of the ischial tuberosity that may represent inferior cluneal branches or other perineal branches.⁸ The final destination of the nerve determines the nomenclature

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Full ICMJE author disclosure forms are available for this article online, as supplementary material.

Received February 13, 2022; accepted April 13, 2022.

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2666-061X/22216

<https://doi.org/10.1016/j.asmr.2022.04.012>

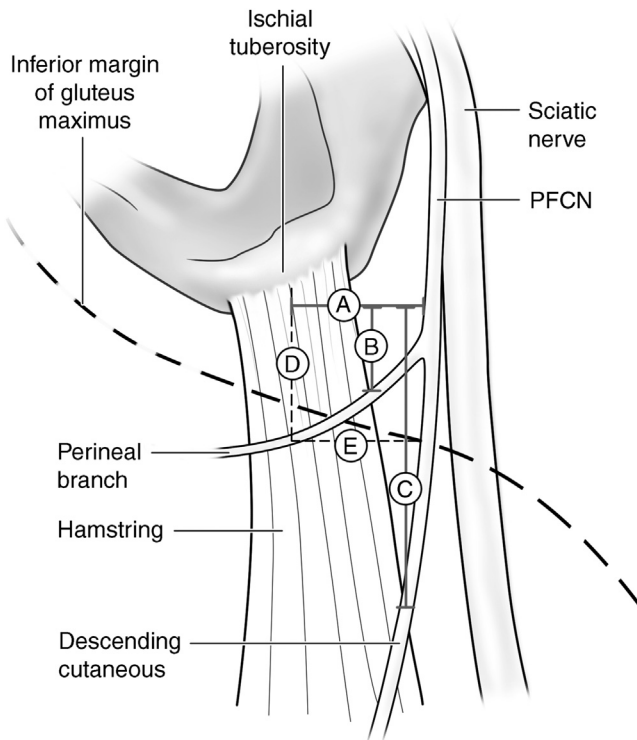


Fig 1. Illustration depicting study measurements. (A) Horizontal distance from ischial tuberosity to posterior femoral cutaneous nerve (PFCN). (B) Longitudinal distance along lateral edge of hamstring tendons from ischial tuberosity to crossing location of the perineal branch (when seen). (C) Longitudinal distance along lateral edge of hamstring tendons from ischial tuberosity to crossing location of descending cutaneous branch. Longitudinal (D) and horizontal (E) distances to where PFCN is closest to inferior margin of gluteus maximus.

of the nerve branch; for example, the inferior cluneal nerves turn upward around the lower border of the gluteus maximus and innervate the skin on the buttock, while the perineal branches supply sensation to the skin at the upper and medial aspect of the thigh. Surgical technique guides describing proximal hamstring injuries have discussed the expected location of the perineal branches as deep to the fascia, running obliquely across the biceps femoris.⁶ Additional literature has reported the location of the perineal branch of the PFCN being an average of 4 cm below the ischial tuberosity.⁹ There is a paucity of literature regarding the variability in the location of the PFCN and its branches, relative to the surgical approach to the proximal hamstring origin.

Unexpected variations in the location of these nerves could represent an increased risk of complications during surgery for proximal hamstring injuries. The purpose of this study was to identify the location of the PFCN and its branches in relation to the proximal hamstring tendon. We hypothesized that the PFCN

would be in close proximity to the surgical approach and that there would be variation in position and number of branches.

Methods

Fifteen lower torso human cadaveric specimens obtained through the Maryland Anatomy Board Donation Program were dissected in the prone position. The average age was 69.4 years (range: 35-95), with 10 male and 5 female specimens. The skin and subcutaneous tissues were reflected carefully to expose the gluteal and hamstring musculature, and careful dissection was performed to minimize distortion of the native anatomy that would alter the pertinent measurements. The distances between the ischial tuberosity, lateral border of the hamstring origin, PFCN, perineal branch of the PFCN, and descending femoral branch of the PFCN were measured with digital calipers (Fig 1). All dissections and measurements were performed by a single surgeon. To minimize potential measurement error, measurements were repeated three times and averaged. Descriptive statistics, including mean, range, and standard deviation, were calculated.

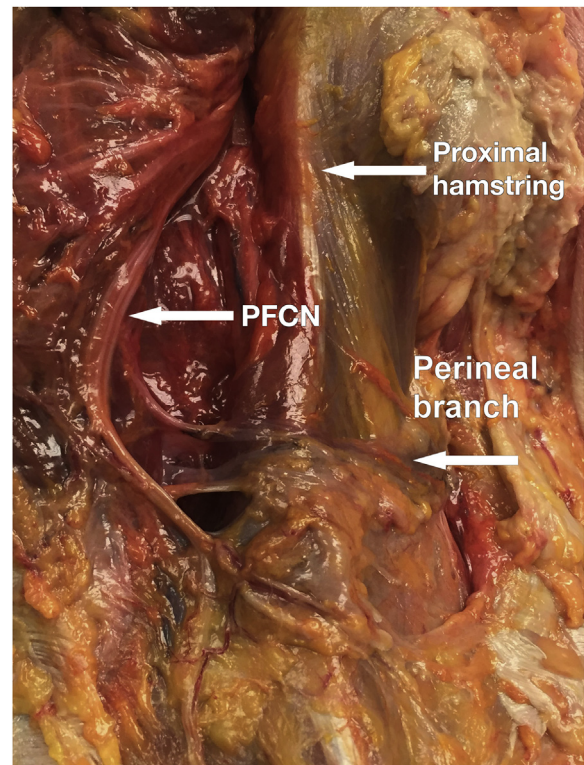


Fig 2. Photograph shows dissection of the posterior thigh of a left lower extremity demonstrating a more distal crossing of the perineal branch of the posterior femoral cutaneous nerve (PFCN). Additionally, the proximal hamstring and PFCN are labeled accordingly. The image is oriented such that the top border is superior, and the left border is lateral.

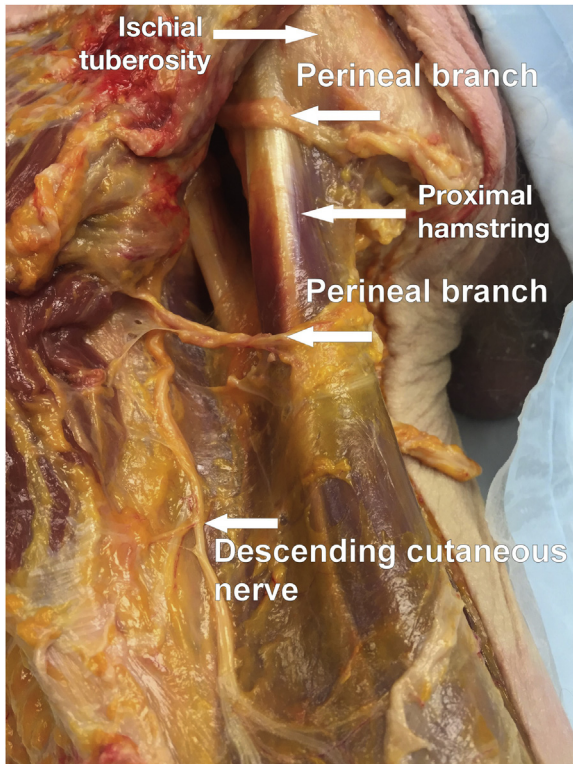


Fig 3. Photograph shows dissection of the posterior thigh of a left lower extremity demonstrating two distinct perineal branches crossing the proximal hamstring, with the descending femoral cutaneous nerve continuing distally down the thigh. Additionally, the proximal hamstring and ischial tuberosity are labeled accordingly. The image is oriented such that the top border is superior, and the left border is lateral.

Results

The PFCN was located directly on top of the sciatic nerve and was easily visible during the surgical approach to the proximal hamstring. The PFCN was 30.5 mm (SD: 11.4, range: 15.7 to 52.0) lateral to the central tip of the ischial tuberosity. The average longitudinal distance from the tip of the ischial tuberosity to the point where the perineal branch began to cross transversely over the hamstring tendons was 24.1 mm (SD: 15.0, range: 9.9 to 52.2). The average longitudinal distance to where the descending cutaneous branch began to cross the hamstring tendons was 83.3 mm (SD: 21.3, range: 41.3 to 110.3 mm). The PFCN was nearest to the inferior border of the gluteus maximus 45.8 mm (SD: 13.6, range: 13.6 to 62.1) lateral to the ischial tuberosity. Eleven specimens (73%) had one identifiable perineal branch; four specimens (27%) had two distinct perineal branches (Figs 2 and 3).

Discussion

In this study, the PFCN was located in close proximity to the surgical approach for repair of the proximal hamstring tendons, with the perineal branch

consistently crossing the surgical field transversely. Among the 15 specimens included, there was noted to be substantial anatomic variation in the location of these cutaneous nerves. The perineal branch was found an average of 2.4 cm below the tip of the ischial tuberosity, but with significant variation in its location. It was located as proximal as 1 cm above the tip of the tuberosity or as distal as 5.2 cm below the tip. Four specimens had two distinct perineal branches. These findings suggest that careful dissection immediately below the fascia is crucial to identify and protect the branches of the PFCN.

Surgical approach for repair of the proximal origin of the hamstring tendons is made in the prone position via either a transverse or longitudinal incision. To expose the ischium, the inferior border of the gluteus maximus muscle must be retracted superiorly after the posterior fascia of the thigh has been divided. In the current study, the PFCN was nearest to the inferior border of the gluteus maximus between 13.6 and 62.1 mm lateral to the ischial tuberosity. Considering this proximity, it is possible to inadvertently cause a traction injury to the PFCN nerve with a retractor placed underneath the gluteus maximus. The current findings suggest that risk of nerve injury may be reduced by using gentle retraction with retractor placement as close to the ischial tuberosity as possible. The findings also suggest that the sciatic and posterior femoral cutaneous nerves should be identified in all surgical cases to avoid injury. In the present study, the PFCN was consistently lateral to the central tip of the ischial tuberosity. It was always in direct contact with the sciatic nerve in this location, superficial to the sciatic nerve when exposed from a posterior surgical approach. Therefore, these findings suggest that the sciatic nerve can be localized by identifying the PFCN, or vice versa. In patients with chronic injury, the sciatic and posterior femoral cutaneous nerves can be scarred onto the lateral border of the hamstring tendons. In that case, the nerves can be identified outside the zone of injury more proximally and then dissected away from the avulsed hamstring tendons more distally.

A recent study by Kachniarz et al. described the anatomical branching pattern of the PFCN, as well as clinical outcomes following resection of the nerve to alleviate sitting pain.¹⁰ The authors described an anatomical variant of the PFCN in which there is a high division of the nerve, above the level of the ischial tuberosity, resulting in medial and lateral divisions as it runs distally. In these instances, the lateral branch supplies the lateral buttock and posterior thigh, and the medial branch supplies the medial buttock, ischial tuberosity, and perineum. Of note, there was found to be no association between anatomical variation of the PFCN and patient outcomes following resection to alleviate sitting pain. Excellent or good results were

obtained in 79% of patients, while 21% of patients experienced no improvement.¹⁰ Conversely, in the present study, a high division of the PFCN was not observed in any of the cadaveric specimens.

The results of this cadaveric study can be correlated with clinical outcomes following proximal hamstring repair. In vivo studies support early operative intervention for complete proximal hamstring ruptures in athletes with generally good outcomes, but some patients experience complications related to pain or numbness consistent with injury to the PFCN or branches.^{2,11-17} A case series by Cohen et al., including 52 patients who underwent proximal hamstring repair with a mean of 33 months of follow-up, reported that 98% were satisfied with their outcome after surgery, and at latest follow up, 67% reported that they were able to participate in strenuous activities.⁴ However, 9.6% of patients reported burning pain or numbness in the posterior thigh or foot postoperatively, consistent with neuropathy or neuritis of the posterior femoral cutaneous nerve (PFCN) or its branches. Additionally, in a systematic review by Van der Made et al., symptoms of numbness/tingling in the incisional area were reported in 34 patients of 387 operative cases (9%) and in the posterior thigh in 30 patients (8%).¹⁷ Careful dissection and placement of retractors can be implanted in an attempt to avoid such complications during proximal hamstring repair.

The PFCN was in close proximity to the surgical approach used during proximal hamstring repair, with the perineal branch consistently crossing the surgical field transversely. The location of these nerves varied substantially among the specimens tested, with some nerves less than 1cm from the ischial tuberosity and 27% of specimens with two perineal branches. On the basis of our findings, we recommend careful dissection immediately below the fascia to limit risk of injury to the PFCN and its branches during hamstring repair. We also recommend exhibiting caution when placing retractors lateral to the ischial tuberosity.

Limitations

It should be noted that this study is not without limitations. As anatomic measurements were taken using cadaveric specimens, tissue quality and structural proportions may not be representative of our standard patient population. Distortion of the structures during dissection and measurement is possible because the nerves are mobile in their surrounding tissues, particularly in cadaveric specimens. It is conceivable that small-caliber nerve branches may have been missed in the dissection. Additionally, the age range of the cadaveric specimens included in this study is not consistent with the typical young, active patient population that is prone to proximal hamstring avulsions.

Conclusion

The PFCN was in close proximity to the surgical approach used during proximal hamstring repair, with the perineal branch consistently crossing the surgical field transversely. The location of these nerves varied substantially among the specimens tested, with some nerves less than 1 cm from the ischial tuberosity and 27% of specimens with two perineal branches. On the basis of our findings, we recommend careful dissection immediately below the fascia to limit risk of injury to the PFCN and its branches during hamstring repair. We also recommend exhibiting caution when placing retractors lateral to the ischial tuberosity.

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