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Cadaveric Variation In The Branching Pattern Of The Posterior Cutaneous Nerve Of The Thigh: A Case Report

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ABSTRACT

Background: The posterior cutaneous nerve of the thigh (PCNT), also known as the posterior femoral cutaneous nerve, is a sensory branch of the sacral roots derived from S1–S3 nerve roots. It supplies the gluteal, perineal, and posterior thigh regions. Anatomical variations in the origin or course are uncommon but clinically significant, as they may impact outcomes in gluteal and posterior thigh procedures such as hip replacements, hamstring repairs, and nerve blocks. **Case Description**: During the dissection of a well-preserved 63-year-old male cadaver, a unique variation of the PCNT was found on the right side. The nerve exhibited a dual origin from the sciatic as well as pudendal roots and was pierced by the inferior gluteal vessels below the piriformis muscle, and contributed fibers to the sciatic nerve. Several oblique communicating fibers were also observed between S1, S2, and S3. The left side showed normal anatomy. **Methods**: Dissection of the gluteal region was conducted as per the steps mentioned in Cunningham's manual of dissection. Morphometric measurements were obtained with digital calipers, referenced from the inferior border of the piriformis muscle. **Conclusion**: Anatomical variations may have significant clinical consequences, particularly during surgical or anaesthetic interventions in the gluteal or thigh areas. This unique variation, pierced by the inferior gluteal vessels,may predispose the PCNT to vascular compression or iatrogenic injury. This could result in neuralgia, hypoesthesia, or sensory loss in its distribution areas. Embryological factors such as anomalies in neural crest cell migration or neurotrophic signaling may contribute to such variations. Understanding such variants is crucial for surgeons to minimize complications during regional procedures.

Keywords: Inferior gluteal vessels, Piriformis muscle, Sacral plexus, Posterior cutaneous nerve of the thigh

INTRODUCTION

The posterior cutaneous nerve of the thigh (PCNT), also known as the posterior femoral cutaneous nerve, is a sensory nerve of sacral origin (1). It arises from the dorsal divisions of the first and second sacral rami and the ventral divisions of the second and third sacral rami. The nerve exits the pelvis via the greater sciatic foramen inferior to the piriformis, then descends deep to the gluteus maximus alongside the inferior gluteal vessels, lying posterior or medial to the sciatic nerve (2). It supplies cutaneous sensation to the gluteal, perineal, and posterior thigh regions. The functional integrity of the PCNT is therefore essential for normal sensation in these areas, and anatomical variants carry clinical importance (2,3).

Variants in the origin, course, and branching pattern of the PCNT are well documented. Such differences can affect surgical outcomes in procedures involving the gluteal and posterior thigh regions—e.g., hip arthroplasty, hamstring repair (4), and regional nerve blocks (5). Atypical relationships with adjacent structures, including the piriformis muscle and regional vessels, may predispose the nerve to compression or increase the risk of iatrogenic injury. Understanding these variations is crucial for surgeons, anatomists, and clinicians to optimise patient care (1,3).

This report describes a rare anatomical variant identified in a cadaveric specimen: the PCNT was pierced by the inferior gluteal vessels and subsequently contributed fibres to the sciatic

nerve. This observation provides additional insight into regional relationships and underscores the value of meticulous anatomical knowledge in surgical planning and diagnostic assessment.

CASE REPORT

During routine teaching dissection of the gluteal region in a well-preserved, properly embalmed male cadaver aged approximately 63 years, an unusual variation of the posterior cutaneous nerve of the thigh (PCNT) was identified. The donor had no recorded history of trauma or surgery and was used for anatomical teaching. Dissection followed *Cunningham's Manual of Practical Anatomy: Vol. 1 – Upper and Lower Limbs* (1). After reflecting the skin, the cutaneous nerves were identified. The gluteus maximus was then divided from its inferior margin and reflected superiorly, approximately 2–3 cm medial to its femoral insertion. Because the inferior gluteal vessels and nerve enter the deep surface of the muscle and are prone to inadvertent injury, two fingers were inserted deep to the lower edge and the division was made carefully between the fingers towards the upper border, directly superior to the greater trochanter. Both lateral and medial portions of the muscle were reflected towards their insertions, keeping dissection close to the deep surface to avoid injury to the PCNT. The inferior gluteal vessels and nerve were identified as they entered the lower part of the gluteus maximus. Branches of the inferior gluteal nerve and the PCNT were traced cranially to their emergence at the lower border of the piriformis. The perineal branch of the PCNT, curving medially below the ischial tuberosity towards the perineum, was also observed. Findings were documented systematically for each side.

Right side: On the right, the PCNT showed an atypical origin and branching pattern. The nerve arose from both the sciatic and pudendal plexuses. Measurements taken from the inferior border of the piriformis were as follows (Fig. 1A,B): the length of the S2 segment nerve before division was 50.4 mm; the pudendal root measured 66.2 mm and joined the medial division of S2, which extended for 65.6 mm before continuing towards the perineal region; and the sciatic fibre measured 62.5 mm, joining the lateral division of S2 (66.0 mm) to form the PCNT. Several oblique connecting fibres were present (Fig. 1B,C): fibres connecting S3 to S1 measured 20.3 mm and 26.1 mm, respectively, and fibres connecting S1 to S2 measured 11.7 mm and 6.6 mm. At 56.0 mm distal to the inferior border of the piriformis, the PCNT was pierced by the inferior gluteal vessels—an uncommon anatomical variant. Distal to this point, the PCNT contributed fibres to the sciatic nerve, with the contribution extending obliquely for 78.3 mm.

Left side: On the left, the PCNT followed the typical anatomical course described in standard texts (1,2). It originated exclusively from the sacral plexus and descended without contributions from the pudendal plexus and without being pierced by the inferior gluteal vessels. Its relationship to the sciatic nerve and inferior gluteal vessels was in keeping with standard descriptions.

DISCUSSION

This study highlights an anatomical variation of the posterior cutaneous nerve of the thigh (PCNT) in a cadaveric specimen, characterised by piercing of the nerve by the inferior gluteal vessels on the right side—an association not previously reported in the literature. The PCNT also showed a dual origin from sciatic and pudendal roots. By contrast, the left side followed the standard course described in anatomical texts (1,2).

Anatomical variations of the PCNT—especially its origin, course, and relationship to the piriformis and adjacent structures—are well documented (Table 1). These variants have practical implications for interventions in the gluteal and posterior thigh regions.

The present observation expands existing descriptions by documenting PCNT traversal by the inferior gluteal vessels, a configuration rarely noted. Windhofer et al. (2002) reported the PCNT within a common sheath or looping around the descending branch of the inferior gluteal artery (4). Vascular traversal may complicate gluteal surgery, nerve blocks (5), or hamstring repair (4), and pulsation or dilatation of the vessel could compress or irritate the nerve, increasing the risk of iatrogenic injury. Resultant PCNT neuralgia may manifest as burning pain, paraesthesia, or numbness in the gluteal, perineal, or posterior thigh regions; severe cases may produce hypoesthesia or anaesthesia. Awareness of such variants is therefore crucial during procedures involving the gluteal region, including cryoablation

for neuropathic pain, to minimise complications and optimise outcomes (6–9).

Aneurysms and pseudoaneurysms of the inferior gluteal artery have also been described, presenting with pain and paraesthesia along the sciatic distribution, sometimes accompanied by weakness and atrophy in tibial and common peroneal territories, with difficulty in plantar flexion and dorsiflexion (10).

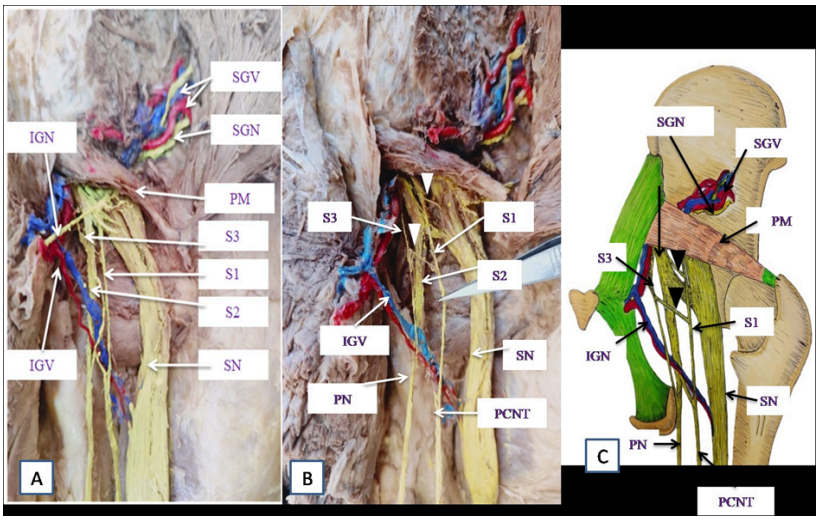

Figure 1: *(A) Left gluteal region showing the normal course of the inferior gluteal vessels (IGV) and PCNT (2). (B) Right gluteal region: the PCNT is pierced by the inferior gluteal vessels below the piriformis (arrow). White arrowhead indicates oblique fibre connections between S1 and S3, and between S1 and S2. (C) Schematic illustrating the relationships between nerve and inferior gluteal vessels. Red, artery; blue, vein; yellow, nerve; green, tendon; brown, muscle. Abbreviations: PN, perineal nerve; PCNT, posterior cutaneous nerve of the thigh; SGN, superior gluteal nerve; SGV, superior gluteal vessel; IGV, inferior gluteal vessel; IGN, inferior gluteal nerve; SN, sciatic nerve; GMa, gluteus maximus; GMi, gluteus minimus.*

Table 1: *Selected reports of PCNT variation.*

Study	Location	Findings
Bansal et al., 2024 [5]	India	PCNT arising by two or three roots; frequent variation in relation to piriformis.
Gottlieb et al., 2020 [6]	USA	Concurrent variations in PCNT and sciatic nerve, with PCNT piercing piriformis.
Windhofer C. et al., 2002[4]	Austria	PCNT within a common connective sheath and/or looping with the descending branch of the inferior gluteal artery
Present Study	India	PCNT pierced by inferior gluteal vessels on the left side.

Embryological basis for the variation

Development of the PCNT reflects coordinated processes including neural crest cell migration, Schwann-cell differentiation, and growth-factor signalling (e.g., BMP4 and NGF/TrkA). BMP4 influences axonal pathway guidance, while NGF/TrkA supports survival and differentiation of dorsal root ganglion neurons. Aberrant neural crest migration or signalling may produce atypical nerve–vessel relationships—such as vascular piercing of the PCNT—by altering fascicular routing during development. Further molecular and genetic research is warranted to clarify these mechanisms (11–13).

Study limitations: As measurements were obtained from a single cadaveric specimen, tissue quality and dimensions may not reflect those of the wider patient population. Nerve mobility within surrounding tissues—particularly in cadaveric material—may introduce distortion during dissection and measurement, and small-calibre branches may have been missed

Conclusion

This cadaveric observation confirms that the PCNT can vary in its origin, course, and relationship to neighbouring vascular structures, including the inferior gluteal artery. Recognising these patterns is clinically important: vascular intersection or traversal may increase the risk of compression, irritation, or iatrogenic injury during hip surgery, gluteal nerve blocks, and hamstring repair. Incorporating awareness of such variants into pre-operative planning and procedural technique can enhance surgical precision, reduce complications, and improve patient outcomes. Future studies should explore genetic, developmental, and population-level contributors to these variations.

Conflict of interest: None declared.

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