

A unique case of bilateral sciatic nerve variation within the gluteal compartment and associated clinical ramifications

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CASE STUDY

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ABSTRACT

An abnormal course of a nerve either through or around a muscle may yield multiple or anomalous muscle innervation. Further, if nerves are inappropriately trapped within the confines of a muscle or irregular boundaries, variant emergence of a nerve could give rise to symptoms of an entrapment neuropathy. Upon routine dissection in the Department of Anatomy at the American University of Antigua College of Medicine, bilateral variants in the emergence of the sciatic nerve from the pelvis to the gluteal compartment were discovered in an elderly adult female cadaver. In the left gluteal compartment, the sciatic nerve had a high division where the peroneal division exited the pelvis superior to the piriformis muscle while the tibial division exited inferior to the piriformis. In the right gluteal compartment, the peroneal division was observed to have exited the pelvis between a split piriformis muscle before it joined the tibial division of the sciatic nerve. Knowledge of such variations in the course of the sciatic nerve may improve diagnosis and treatment of pathologies in this region.

Key Words

Sciatic nerve, tibial nerve, peroneal nerve, anatomical variation

Implications for Practice:

1. What is known about this subject?

Anatomical variation of nerves and their course may confer a challenge in clinical and surgical practice for both diagnosis and intervention. This study identifies between-side variation of nerve location within the gluteal compartments of a single cadaver.

2. What new information is offered in this case study?

The presentation of the variation described shows the piriformis muscle lying between the two branches of the sciatic nerve in the left gluteal compartment, and the piriformis muscle being pierced by the common peroneal nerve in the right gluteal compartment. We also identify the statistical probability of the occurrence of both of these isolated variations in the same cadaver as approximately 1/10,000.

3. What are the implications for research, policy, or practice?

The identification of variant sciatic nerve location in the gluteal region may contribute to improvement in diagnosis and intervention of pathologies in this area. Further prospective analyses that investigate the rate of occurrence, associated risk and any potential relationship to morphological variation could prove helpful for clinicians and surgeons.

Background

Knowledge and analysis of nerve variance is clinically imperative for several reasons. In the course of a surgical procedure, it is important to be cognizant of usual morphology in addition to that of morphological variation. Nerve entrapment as a result of variant nervous pathways in the lower limb have the potential to lead to piriformis syndrome, sciatica, or coccygodynia, and may present

unique clinical challenges in relation to selecting the appropriate therapy to alleviate a patient's pain.¹ Further, muscle power, tone, and function may be compromised with the occurrence of distal neuropathy whereby a nerve, being irritated in an abnormal location, loses its capacity to effectively innervate a distal muscle.²

The sciatic nerve is the largest peripheral nerve in the human body, originating from roots L4–S3. It emerges from the pelvis via the greater sciatic foramen, running inferior to the piriformis muscle, and entering the gluteal compartment. The major components of the sciatic nerve include the common fibular nerve and tibial nerve, respectively. The common fibular nerve arises from dorsal divisions of ventral rami of L4–S2 while the tibial nerve arises from ventral divisions of ventral rami of L4–S3.³ The sciatic nerve is responsible for the innervation of the posterior compartment of the thigh as well as all the muscles of the leg and foot.

The piriformis muscle assists in forming the posterolateral wall of the pelvis, attached medially to the sacrum and laterally to the greater trochanter of the femur. Functionally, the piriformis contracts to provide external rotation, abduction and extension of the hip, depending on the initial thigh position. It also assists with hip stabilisation by assisting the maintenance of the position of the head of the femur in the acetabulum. The muscle bridges the pelvis, from its attachment at the sacrum, through the greater sciatic notch, and in doing so is located posterosuperiorly to the sciatic nerve.⁴ The piriformis is innervated by direct branches from the sacral plexus, specifically arising from S1–S2 nerve roots.^{4,5} It is relatively uncommon to observe deviation from this schema.³

Piriformis syndrome occurs when the sciatic nerve is entrapped by the piriformis muscle as it exits the sciatic notch in the gluteal region. This can potentially occur when the piriformis muscle is hypertrophied and mechanically compromises the adjacent sciatic nerve. Piriformis syndrome is considered as a differential diagnosis with variations of the sciatic nerve where the sciatic nerve pierces the piriformis muscle.⁶ Pharmacologic interventions used in the treatment of piriformis syndrome may include intramuscular injections of steroids, anesthetics, or botulinum toxin.⁷

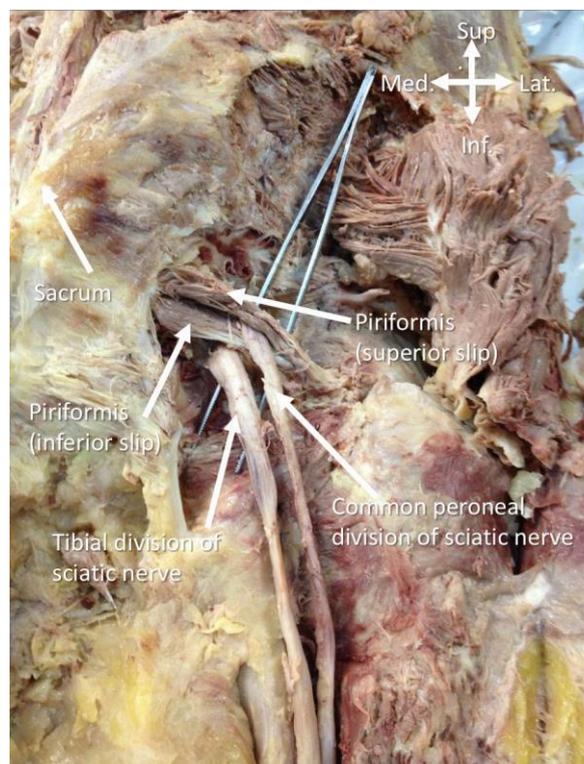
Peripheral neuropathy involving the sciatic nerve presents with pain, tingling or numbness in the buttocks, and weakness of muscles innervated by this nerve. This can sometimes be triggered by activities such as climbing stairs

or running. Most commonly this occurs iatrogenically but may also be due to other causes.⁸ Surgical decompression of the sciatic nerve may provide variable relief in some cases.⁹

Case details

In the course of routine dissection of an elderly female Caucasian cadaver, bilateral variants were discovered in the gluteal compartment. In the right gluteal compartment, the piriformis muscle was found to be bifid (Figure 1). The common peroneal nerve was found to emerge into the gluteal compartment by piercing the piriformis muscle, effectively separating it into superior and inferior muscle slips (Figure 1). The tibial nerve was found emerging from the lower border of the inferior muscle slip of the piriformis.

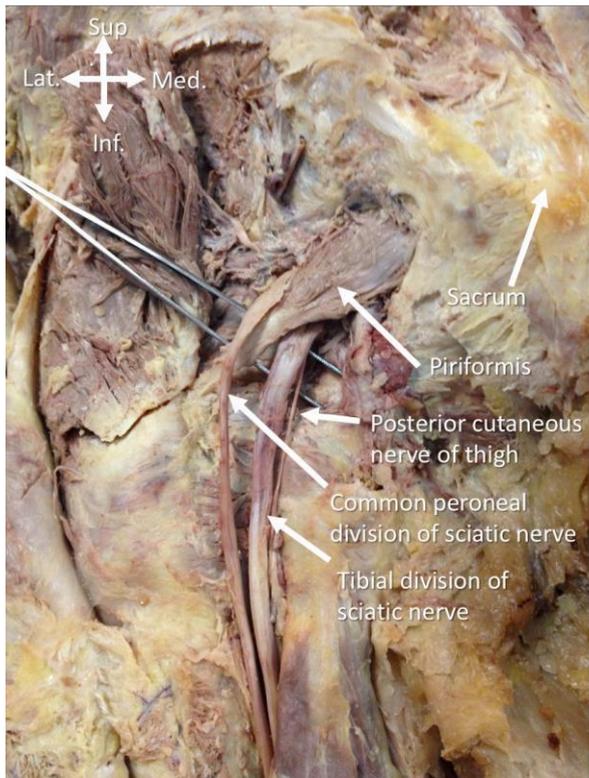
Figure 1: Right gluteal compartment



The common peroneal division of the sciatic nerve piercing a bifid piriformis muscle.

On the left side the common peroneal nerve exited the pelvis superior to the piriformis muscle, while the tibial nerve coursed inferior to the piriformis muscle. The two divisions subsequently joined distal to their emergence around the piriformis (Figure 2).

Figure 2: Left gluteal compartment



A bifid piriformis muscle penetrated by the common peroneal nerve with the tibial nerve passing posteroinferior to the distal portion of the piriformis.

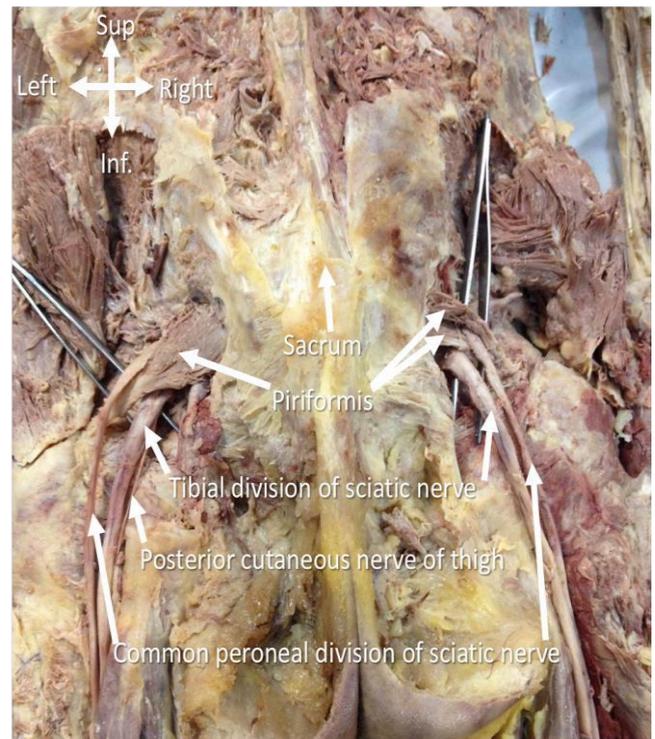
The nerve supply to the posterior compartment of the thigh, the flexor compartment of the leg, and the extensor compartment of the leg appeared to have a regular path and distribution, bilaterally (Figure 3).

Discussion

Bilateral variants in the gluteal compartment appear uncommonly in most anatomical studies.^{2,3,10} However, various clinical manifestations may potentially be associated with altered morphological relations between the piriformis muscle and the sciatic nerve. Given the asymmetric presentation of the sciatic nerve's emergence from the pelvis in this case, variation of the innervation between the gluteal compartments' muscles should be considered.² We did not investigate this specifically.

Sciatica, described as lower back, gluteal, and thigh pain, is experienced as a result of compression or irritation of the sciatic nerve or its roots.⁵ Given the anatomical variation observed and the variable passage of the sciatic nerve through and around the piriformis muscle, sciatica may have been present in this individual.^{10,11}

Figure 3: Right and left gluteal compartments



Asymmetric variation of piriformis muscle morphology showing different neuromuscular relations between the muscle, the common peroneal, and tibial nerves.

Another clinical ailment in the posterior gluteal region is coccygodynia, defined as pain in and around the coccyx, typically worsening when sitting and upon rising from a seated position. Aberrant formation or presentation of accessory muscle slips of the piriformis muscle, or normal muscle being split into multiple slips, have been considered to provide a likely morphological basis for coccygodynia as a result of the unusual relation between the variant muscle slip and sciatic nerve, or branch thereof.¹² As it applies to this case study, there was the potential for coccygodynia to have been present bilaterally in this individual based on the anatomical variations observed.

The rarity of this case is due to the variation between opposite gluteal compartments in the same cadaver.¹⁰ Smoll suggested the probability of observing the presentation in the right gluteal compartment, where the peroneal division pierced the piriformis, to be 13.8 per cent (829 cases/5,987 total limb dissections = 0.138).^{13,14} Smoll also indicated the probability of observing the presentation in the left gluteal compartment, where a split sciatic nerve encompassed the piriformis, to only be 0.0835 per cent (5 cases/5,987 total limb dissections = 0.000835).^{13,14} Therefore, the probability of identifying both of these variations within the same cadaver, as is presented in this case study, is 0.011 per cent or 1 in 10,000 individuals.

Conclusion

Anatomical variants in the pelvic and gluteal regions are of interest to clinicians to guide accurate diagnosis and intervention.¹⁰ Visual screening of this zone (such as using ultrasound) could be of assistance with posterior gluteal pathology, and suspected piriformis syndrome, to prevent iatrogenic surgical damage, and knowledge of within-individual variations such as those described are therefore important for clinical practice.⁸

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PEER REVIEW

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CONFLICTS OF INTEREST

The authors declare that they have no competing interests.