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Composite anatomical variations of the sciatic nerve in relation to the piriformis muscle observed in cadaveric studies

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Abstract

Introduction: The sciatic nerve originating from the ventral rami of the lumbosacral plexus (L4–S4) has motor and sensory innervation to the lower limbs. Its course and division patterns exhibit considerable anatomical variability, particularly in relation to the piriformis muscle with vital clinical significance, like piriformis syndrome and sciatica. This study aims to find out such variations via cadaveric dissection in local population.

Method: This descriptive observational study was performed on 50 lower limbs from 25 adult embalmed cadavers (15 male and 10 female) in the Department of Anatomy, Birat Medical College, Nepal, from 20 Sep to 30 Oct 2025. Ethical approval was obtained. Dissections of the gluteal and posterior thigh regions were carried out bilaterally to trace the sciatic nerve in relationship with the Piriformis muscle, photographed, and classified into six-types according to Beaton and Anson's classification system. Data were analysed descriptively for frequency and percentages.

Result: Among the 50 sciatic nerves examined, Type A was most prevalent observed in 36(72%). Type D and Type F patterns were identified in 6 specimens each (12% each). Additionally, a novel variation, not included in Beaton and Anson's classification, was observed in 2 specimens (4%), where the Sural nerve arose directly from the sciatic nerve on both sides.

Conclusion: The study highlights the high frequency of anatomical variability in the formation and division of the sciatic nerve within the gluteal region which is vital for clinicians, surgeons, and anaesthesiologists to minimize iatrogenic complications during interventions.

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Introduction

The sciatic nerve (SN) is the largest and thickest nerve in the human body. It originates from the ventral rami of lumbosacral plexus, from the L4-S4 spinal nerves, and carries both sensory and motor fibres, in the gluteal region, and lies inferior to the piriformis muscle (PM). The SN descends from the pelvis into the posterior compartment of thigh via the greater sciatic foramen, where it innervates the hamstring muscle. It divides into two major branches: the tibial nerve (TN) and common peroneal nerve (CPN) just above the popliteal fossa.[1]

It was traditionally believed that there is no further communication between the TN and CPN after they branch, but a recent study reported that 75% of the SN examined in cadaver had some form of reconnection between the two branches.[2] Most commonly, this bifurcation occurs near the apex of the popliteal fossa. In a notable anatomical variant, the TN and CPN emerge separately from the sacral plexus with the CPN typically piercing the PM at the greater sciatic notch, while the TN exits beneath the muscle.[3] This anatomical variation can lead to nerve compression, resulting in piriformis syndrome.[4] It can also lead to sciatica, and accidental nerve injury after intramuscular injections, or ineffective SN block during popliteal anaesthesia[5]. Anatomical variations in SN and its relationship with the PM holds significant surgical relevance.[6] This study used cadaveric dissections to evaluate SN relationship with PM in local population.

Method

This descriptive observational study was carried out during routine cadaveric dissections, first- and second-year bachelor students (MBBS) practical classes, Department of Anatomy at Birat Medical College and Teaching Hospital, Biratnagar, Nepal. Over a period of one and half months, from 20 Sep to 30 Oct 2025, a total of 50 lower limbs from 25 adult embalmed cadavers (15 male and 10 female), free of pathological and congenital anomalies, were meticulously dissected. All cadavers available during the study period were included in the research. Ethical clearance was obtained from the institutional review committee of this medical college (Ref; IRC-25-2082 83).

Surgical dissection of the gluteal region was performed bilaterally in each cadaver with precision. The fascia lata was incised at the level of the greater trochanter, and the gluteus maximus muscle (GMM) was carefully separated to access the retro trochanteric space. Following the removal of the trochanteric bursa, the gluteus medius, PM, and adjacent structures including the SN and other external rotators were systematically exposed. Further dissection was extended into the posterior compartment of the thigh, where the semitendinosus was separated from the long head of the biceps femoris to trace the continuation of the SN. The nerve was exposed using blunt instrument (forceps) to prevent any damage to surrounding structures. Particular attention was given to the anatomical relationship between the SN and the PM, with detailed documentation and photographic records of any variations in the division of the TN and CPN.

Anatomical variations were identified and classified according to the Beaton and Anson classification system which categorizes the structural relationships between the SN and the PM in the gluteal region into six distinct Types as shown in Figure 1.[7] There is also an additional Type G which is interchangeably used with Type F (Type F=G) or as a specific unclassified variant for the undivided nerve above the undivided muscle:

- Type-A: standard pattern. The whole SN travels below the PM. No divisions.
- Type-B: The TN travels below the PM and CPN travels through PM forming two bellies.
- Type-C: The TN travels below the PM and CPN travels above the PM.
- Type-D: The whole SN travels through the PM forming two bellies. No divisions of nerve.
- Type-E: The TN travels through the PM forming two bellies and CPN travels above the PM.

- Type-F: The whole SN travels above the PM, no divisions.

Result

Out of a total of 50 sciatic nerves (right side=25, left side=25) from 25 cadavers (male 30, female 20), the Type A (Figure 2a) was most prevalent configuration, observed in 72% (36 out of 50, including both right and left sides), Table 1. Type D (Figure 2b) and Type F (Figure 3a) were present in 6(12%). Sural nerve originated directly from the sciatic nerve on both sides (Figure 3b), representing a new-Type variant (in 2 out of 50, i.e. N Type 4%), Table 1. This variant does not conform to any category described in the Beaton and Anson classification system, Figure 1.

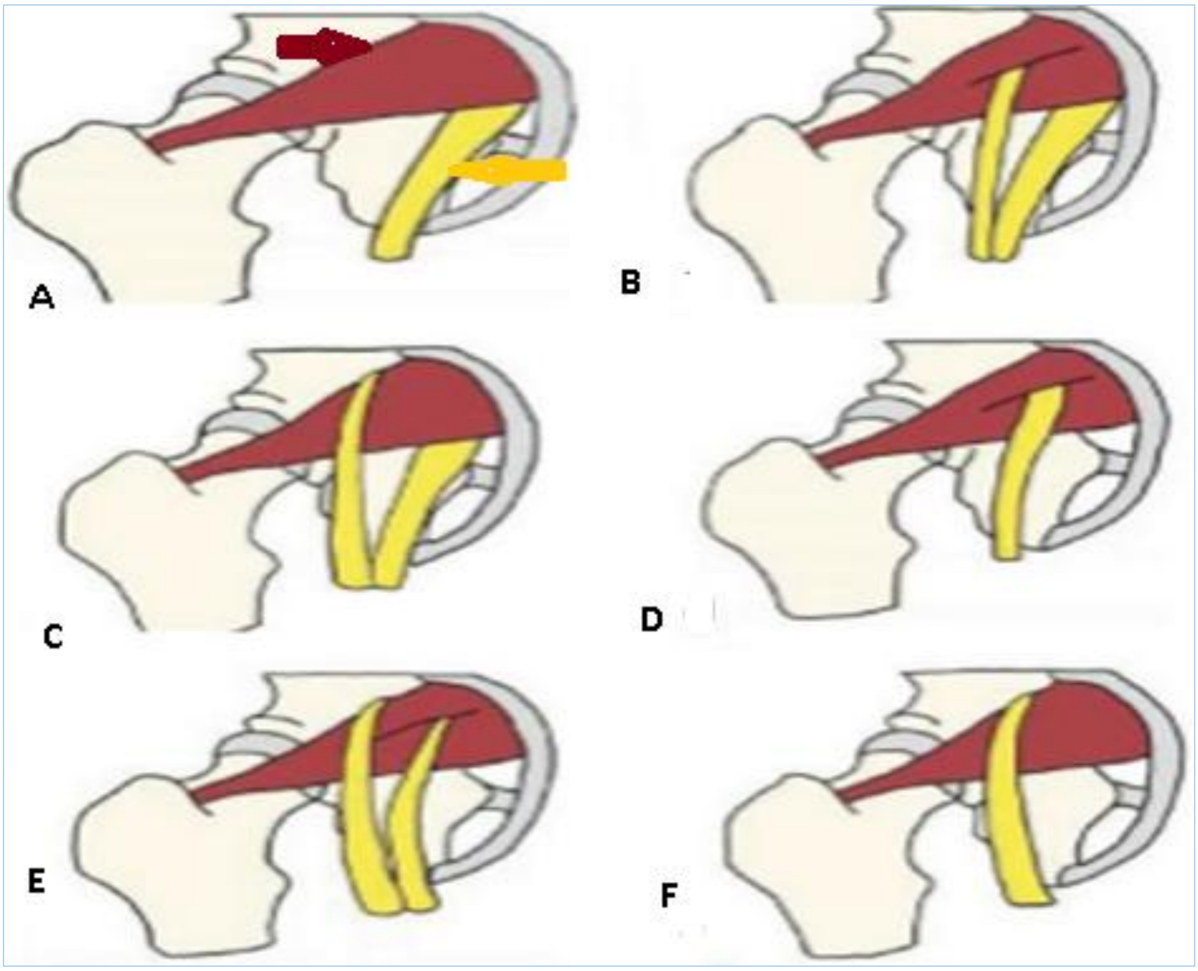

Figure 1. Beaton and Anson classification for relationships between the sciatic nerve (yellow arrow) and the piriformis muscle (brown arrow)[7]

Table 1: Configuration 50 sciatic nerve including left and right from 25 cadavers (male 15, female 10), n=50

Configuration sciatic nerve Type	n=50	%
A-The whole SN travels below the PM, no division	36	72
D- The whole SN travels through the PM forming two bellies, no divisions of nerve	6	12
F- The whole SN travels above the PM, no divisions	6	12
N- Sural nerve was observed to arise directly from the SN	2	4

SN: sciatic nerve, PM: piriformis muscle

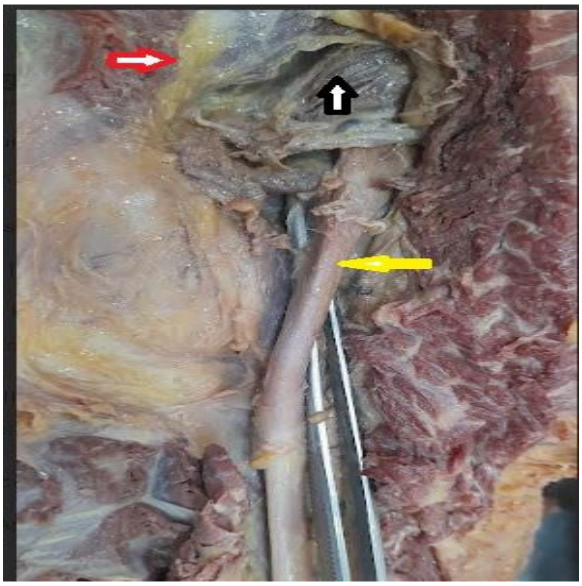
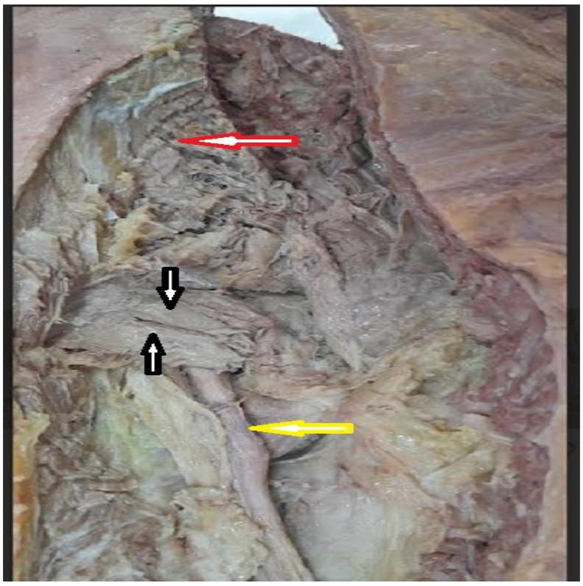

Figure 2a. Type A configuration (black arrow-PM, yellow arrow-SN, red arrow- gluteus maximus muscle GMM); Figure 2b. Type D (black arrow-PM, yellow arrow-SN, red arrow-GMM)

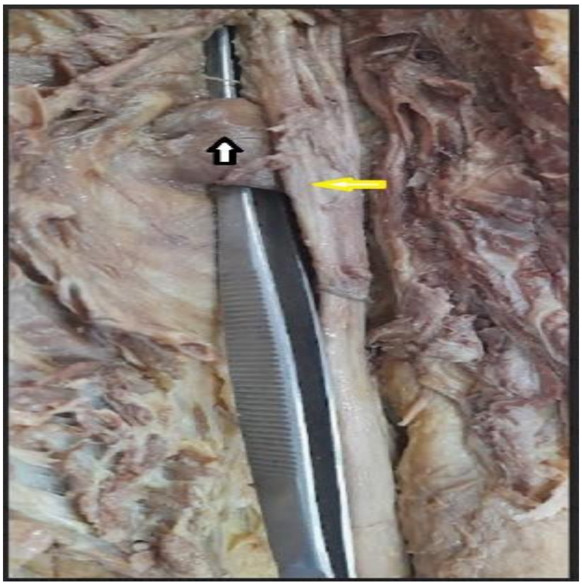
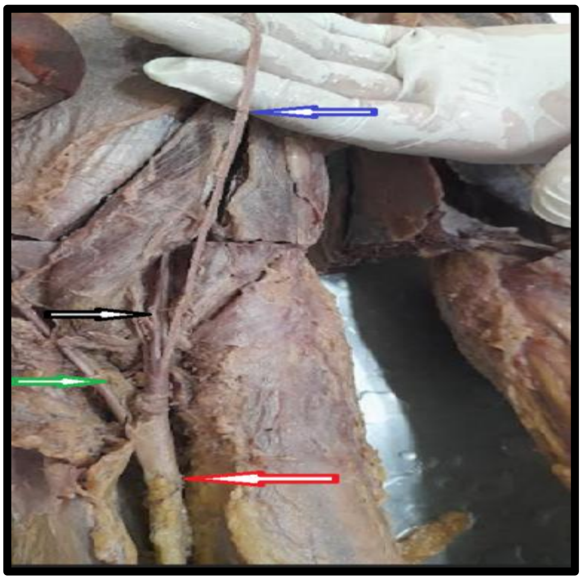

Figure 3a. Type F (black arrow-PM, yellow arrow-SN);
Figure 3b. Type N (blue arrow- sural nerve, black arrow-tibial nerve, green arrow- common perineal nerve, red arrow- SN)

Discussion

In present study, from 25 cadavers (15 male, 10 female), providing 50 sciatic nerves from 30 males and 20 females lower limbs, Type A were most prevalent, observed in 36(72%) according to Beaton and Anson classification. This configuration of Type A is frequently documented in anatomical literature, representing the most prevalent variant in which both nerves descend independently throughout their course.[7, 8]

Notably, the morphology of the sciatic nerve exhibits ethnic and regional variability.[9,10] Research conducted on Ethiopian subjects from sub-Saharan Africa revealed that Types D and F are uncommon, with only Types A and C identified.[11] Comparative studies employing the Beaton and Anson classification[7] indicate that Type A and D variants are consistently present across all human populations. Branches of the SN passage through the infra-piriform foramen (IP) as two separate nerves in 24%. One branch of the SN left the pelvis through the IP and other through a different route in another 24%.[12]

In a study of 51 cadavers, it was found that out of 102 lower limbs examined, 90 contained normal anatomy (Type A, 89%). Two distinct variations of anatomy in the cadavers examined, one variation was the common fibular branch of the sciatic nerve passing through the piriformis muscle (occurring in 9 out of 102 or 8.8% of lower limbs examined); another variation was the common fibular branch passing over the piriformis (found in 3 out of the 102 limbs or 2.9%).[13]

Another study reports that in 85% of the gluteal regions, the classic pattern was found, in which the two components of the sciatic nerve fuse with each other proximal to the piriformis muscle, and the fused sciatic nerve emerges at the lower border of the piriformis muscle.[14]

Case reports reveals that SN bifurcated into two branches at intrapelvic region in a case of piriformis syndrome.[15] Another report of 6.15% cases of CPN passing between the tendinous parts of the piriformis muscle, likely of a practical significance for the development of the piriformis syndrome.[16]

Types A and D have been reported among American[9] and Eastern European[17] populations, although a separate study in Eastern Europe documented only Types A and C.[17] Among Indian[18] Type A and Japanese[19,20] populations Type B have been found predominantly.

More recently, expanded the classification with twelve variants beyond the original Beaton and Anson Types have been proposed.[21] This includes rare case where the sciatic nerve emerged already divided, with the common peroneal nerve passing between the two heads of a bifid piriformis, while the tibial nerve coursed beneath it.[21]

These variations are clinically relevant, particularly in selecting appropriate management strategies for patients presenting with piriformis syndrome or sciatica.[22]

In a meta-analysis of (n=3974 limbs) the most common patterns were Type A, Type C, and Type B with a pooled prevalence of 51.5% (95% CI: 0.293-0.591), 31.2% (95% CI: 0.143-0.410), and 13.8% (95% CI: 0.035-0.234), respectively.[23] In contrast, the present study at Birat Medical College representing a selected Nepalese population from eastern region, identified Type A as the most prevalent in 72%, Type D and Type F each in 6(12%) out of 50 specimens. Interestingly we observed, a variant not mentioned in classical Beaton and Anson configuration system, i.e. the sural nerve in both lower limbs originated from the sciatic nerve within the popliteal fossa in one cadaver (2 limbs, 4%). This observation adds value and may help guide surgery and also could reduce the potential risk of inadvertently damaging the nerve.

This study has several limitations. First, the sample size (n=50 limbs) is relatively small and was drawn from a single geographic region within Nepal (eastern part), which may limit the generalizability. Second, the convenience sampling (available cadavers during the study period) may not be fully representative of the living population in terms of age or health status. Third, as a descriptive cadaveric study, causal or clinical correlation cannot be established. between anatomical variation and predispositions of clinical syndromes. Finally, even with standardized dissection technique, interpretation, and classification of certain variants (particularly those involving fibrous bands or subtle divisions) can be somewhat subjective.

Conclusion

The present cadaveric study from eastern Nepal highlights a considerable morphological variability of the sciatic nerve in its relationship with the piriformis muscle in a selected Nepalese population. Majority of specimens displayed the classical Beaton and Anson Type A configuration, in which the undivided sciatic nerve exits inferior to the piriformis muscle. Interestingly we observed, a variant not mentioned in classical classification system, i.e. the sural nerve originating from the sciatic nerve within the popliteal fossa.

Author contribution

Conception, design: SKY, RKA; Data acquisition: SKY, RKA; Data analysis, interpretation: All; Drafting: SKY, RY, RKA; Revision: All; Final approval of the version to be published: All

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Conflict of interest

None

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Supplementary material

Data and supplementary material that support the findings of this study are available from the corresponding author upon reasonable request.

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