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# Study of Variation of the Sciatic Nerve in Cadavers: A Descriptive Cadaveric Analysis

**Umeshwar Prasad Thakur [1], Pranav Kumar Yadav [2], Tirtha Narayan Shah [3], Abdullah Rain [4], Keshav Raj Bhandari [5]**

[1]Department of Anatomy, Karnali Academy of Health Sciences, Jumla, Nepal, [2]Department of Anatomy, Universal College of Medical Sciences, Bhairahawa, Nepal, [3]Department of Biochemistry, Karnali Academy of Health Sciences, Jumla, Nepal, [4]Department of Surgery, Koshi Zonal Hospital, Biratnagar, Nepal, [5]Department of Community Medicine, Madan Bhandari Academy of Health Sciences, Hetauda, Makawanpur, Nepal.

**ABSTRACT**

**Background:** The sciatic nerve, the longest and widest nerve in the human body, is prone to anatomical variations that may influence clinical procedures like sciatic nerve block, hip surgeries, and management of sciatica. This study aimed to investigate the anatomical variations of the sciatic nerve in cadavers to aid clinicians in minimizing iatrogenic complications.

**Method:** A total of 50 adult cadavers (45 male, 5 female) were examined through systematic dissection of the gluteal region. The emergence, course, and division level of the sciatic nerve were observed and classified.

**Result:** Out of 50 cadavers, 38(76%) exhibited the classical pattern, while 12(24%) showed variations. High division of the sciatic nerve (above the piriformis) was seen in 8 cases (16%), including 7 males and 1 female. In 3 cases (6%), the nerve divided within the piriformis, and in 1 cadaver (2%), the common fibular nerve passed above the piriformis while the tibial nerve passed below.

**Conclusion:** The study highlights the prevalence of anatomical variations in the sciatic nerve, which has significant implications in regional anesthesia and surgical procedures. Recognizing such variants is essential for preventing nerve damage and optimizing patient outcomes.

**Key words:** sciatic nerve; anatomical variation; cadaveric study; nerve division.

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## INTRODUCTION

The sciatic nerve is the largest and longest nerve in the human body, originating from the lumbosacral plexus (L4–S3) and emerging through the greater sciatic foramen below the piriformis muscle.[1] It traverses the gluteal region and posterior thigh before dividing into the tibial and common fibular nerves, typically at the apex of the popliteal fossa. However, numerous anatomical studies have reported variations in the emergence, course, and division level of the sciatic nerve, particularly in relation to the piriformis muscle.[2] These variations are of substantial clinical importance, especially in procedures like sciatic nerve block, hip replacement, intramuscular injections, and surgical interventions involving the gluteal region.[3] Variations in the sciatic nerve can lead to conditions such as piriformis syndrome, neuropathic pain, or failed regional anesthesia. The Beaton and Anson classification system describes several types of sciatic nerve–piriformis relationships, some of which involve early nerve division, altered muscle penetration, or separation of nerve components.[4] The frequency of such variations may differ across populations due to genetic and developmental factors, thus highlighting

**Correspondence:** Mr. Keshav Raj Bhandari, Department of Community Medicine, Madan Bhandari Academy of Health Sciences, Hetauda, Makawanpur, Nepal. E-mail: krbhandari54@gmail.com, Phone: +977-9851110070.

the need for population-specific anatomical data.[5] Despite the clinical relevance, data on sciatic nerve variation from cadaveric studies in South Asian populations remains limited.[6] Therefore, this study aimed to examine the anatomical variations of the sciatic nerve in adult human cadavers, documenting their frequency, type, and sex-wise distribution. Such knowledge is essential for anatomists, anesthesiologists, and surgeons to improve diagnostic accuracy, avoid iatrogenic injuries, and enhance surgical outcomes.

## METHODS

This descriptive cadaveric study was conducted over a period of two months (September to October, 2025) in the Department of Anatomy at a tertiary medical institution (Karnali Academy of Health Sciences, Jumla, and Nepal Medical College and Teaching Hospital, Attarkhel, Jorpati, Kathmandu, Nepal. The aim was to examine the anatomical variations in the sciatic nerve with respect to its origin, course, and division pattern. Institutional ethical approval was obtained from Karnali Academy of Health Sciences, Jumla, Nepal prior to the commencement of the study (Ref No: 2025/075). All cadavers used were part of authorized teaching and research programs. The sample size was determined using the formula:

Sample size (n)= $[Z^2*p*(1-p)]/e^2 = 61.5 \cong 60$

Where, n = required sample size, Z = Z-score for 95% confidence interval (1.96), p = estimated prevalence of variation in aortic arch branching pattern from previous studies, assumed to be 20% (0.20), e=margin of error taken as 10% (0.10). Thus, the minimum required sample size was approximately 61.5 cadavers. However, due to the availability of cadavers during the study period and institutional constraints, 50 cadavers (45 males and 5 females) were included. Although slightly less than the calculated size, this number still provides a reasonable basis for descriptive anatomical analysis, especially given the observational nature of the study and the uniform methodology applied across all dissections. Inclusion Criteria: i) Adult cadavers (both sexes) used for routine academic dissection. ii) Intact gluteal region and sciatic nerve pathway. iii) No history of surgical intervention or trauma in the pelvic/gluteal region. Exclusion Criteria: i) Cadavers with prior hip or pelvic surgery. ii) Cadavers with decomposed, damaged, or mutilated gluteal region. iii) Congenital abnormalities of the lower limb identified on gross inspection. Bilateral gluteal dissections were carried out on each cadaver using standard anatomical dissection techniques. The gluteal region was carefully exposed by reflecting the gluteus maximus muscle to visualize the greater sciatic foramen and the structures emerging through it. The sciatic nerve was identified in relation to the piriformis muscle, and its pattern of exit and level of division into the tibial and common fibular nerves was documented. Variations were classified according to the Beaton and Anson classification system.[7] Data were entered in Microsoft Excel 2019. Descriptive statistics, including frequencies and percentages, were used to present the prevalence of normal and variant patterns. Sex-wise and side-wise distributions were also analyzed.

## RESULTS

The study was conducted on a total of 50 adult cadavers, which included 45 males and 5 females. Male cadavers accounted for the majority of the sample, representing 90 % of the total, while female cadavers comprised only 10 % (Table 1). This sex-wise distribution indicated a predominance of male specimens in the available cadaver pool used for anatomical dissection and analysis of sciatic nerve variations.

**Table 1. Sex wise distribution of cadavers. (n=50)**

| Sex | Number of Cadavers (%) |
|---|---|
| Male | 45(90.0) |
| Female | 5(10.0) |

Variations in the sciatic nerve were observed in both male and female cadavers. Out of the 45 male cadavers, 34(68 %) exhibited the normal pattern of the sciatic nerve, while 11(22 %) showed anatomical variations. Among the 5 female cadavers, 4(8 %) demonstrated the normal pattern, and 1(2 %) displayed

a variation. Overall, the normal anatomical course of the sciatic nerve was observed in 38 cadavers (76%), whereas variations were found in 12 cadavers (24 %). These findings indicated that variations were more commonly observed in male cadavers compared to female cadavers. (Table 2).

**Table 2. Variation prevalence among the cadavers. (n=50)**

| Sex | Normal Pattern (%) | Variation (%) |
|---|---|---|
| Male | 34(68.0) | 11(22.0) |
| Female | 4(8.0) | 1(2.0) |
| Total | 38(76.0) | 12(24.0) |

Among the 12 cadavers that exhibited sciatic nerve variations, three distinct types of anatomical deviations were identified. The most common variation was a high division of the sciatic nerve above the piriformis muscle, observed in 8 cadavers-7 males and 1 female (Table 3). The second most frequent variation was the division of the sciatic nerve within the piriformis muscle, found in 3 male cadavers, with no such cases reported among females. Additionally, a rare variation in which the common fibular nerve emerged above the piriformis while the tibial nerve passed below was noted in 1 male cadaver. These findings highlighted that the majority of variations were seen in male cadavers, with high division above the piriformis being the most prevalent type.

**Table 3. Variation types reported among the selected cadavers. (n=12)**

| Variation Types | Male (n) | Female (n) |
|---|---|---|
| High division above piriformis (n=8) | 7 | 1 |
| Division within piriformis (n=3) | 3 | 0 |
| Fibular nerve above, tibial below (n=1) | 1 | 0 |

## DISCUSSION

The sciatic nerve, the largest peripheral nerve in the human body, typically emerges from the pelvis through the greater sciatic foramen below the piriformis muscle as a single trunk and then bifurcates into the tibial and common fibular nerves at the superior angle of the popliteal fossa. However, the present study demonstrated a 24% prevalence of variations in this classical course among 50 cadavers, which is in concordance with earlier studies reporting variation rates between 16 % and 30 % across different populations.[8,9] The most frequent variation observed in this study was the high division of the sciatic nerve above the piriformis muscle, found in 8 cadavers (16 %), which aligns closely with Beaton and Anson's Type II configuration.[3] Embryologically, this variation is attributed to altered timing in the splitting of the sciatic nerve during limb bud development. Normally, the nerve divides at a distance from the piriformis, but premature division may cause one or both branches to adopt separate courses around or through the muscle. Clinically, this variant poses a challenge during sciatic nerve blocks, as anesthetic administration below the bifurcation point may result in incomplete blockade, particularly of the common fibular component.[10] This also increases the risk of iatrogenic injury during deep gluteal injections and hip surgeries.

The second most common variant was division of the nerve within the piriformis muscle (3 cadavers, 6 %), classified as Type III by Beaton and Anson. This intramuscular division is known to predispose individuals to piriformis syndrome, a neuromuscular condition where the nerve is compressed within the muscle belly, leading to buttock pain and sciatica-like symptoms. Compared to our study, Juan Pablo et al. reported this variant in 5 % of specimens, indicating a comparable prevalence.[11] A rare configuration, seen in 1 male cadaver (2%), involved the common fibular nerve passing above the piriformis and the tibial nerve below. This corresponds to Beaton and Anson's Type IV. Although uncommon, this variation has serious implications during posterior surgical approaches to the hip or sacral plexus interventions, as nerve branches are more prone to misidentification and injury. Notably, males in the study showed a higher proportion of variations (22%) than females (2%), although this observation may be influenced by the small number of female cadavers (n=5). Still,

similar male-dominant patterns have been reported in review article by P. Frideriki et al. possibly reflecting sex-linked differences in musculoskeletal development or pelvic morphology.[12]

Comparatively, Branca et al. reported a 28% overall variation rate in the Italian population, while the Indian study by Prakash et al. noted a 20% variation.[6,13] Our study's findings (24%) are thus within this global range, reinforcing the necessity for population-specific anatomical databases, especially in clinical settings where regional anesthesia and orthopedic interventions are routine.

In summary, the sciatic nerve exhibits a notable degree of anatomical variability, which has both scientific and clinical significance. Preoperative imaging, nerve localization techniques, and thorough anatomical knowledge are essential to avoid complications. This study contributes to the limited literature on sciatic nerve variations in the South Asian population and emphasizes the importance of incorporating such anatomical data into surgical training and procedural protocols.

## CONCLUSIONS

The present cadaveric study revealed that while the majority of cadavers exhibited the classical course of the sciatic nerve, a significant proportion (24%) demonstrated anatomical variations in its relation to the piriformis muscle. The most common variation was high division of the sciatic nerve above the piriformis, followed by intramuscular division and separate emergence of tibial and fibular components. These variations have considerable clinical relevance, especially during procedures such as sciatic nerve blocks, hip surgeries, and diagnosis of piriformis syndrome. Understanding the frequency and types of these variations is essential for anatomists, anesthesiologists, orthopedists, and surgeons to prevent iatrogenic nerve injuries and improve patient outcomes. The findings of this study underscore the importance of regional anatomical research and support the integration of cadaveric knowledge into clinical practice and education. Further studies on larger and more diverse populations are recommended to establish comprehensive anatomical reference standards.

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