

ORIGINAL RESEARCH ARTICLE

STUDY OF A VARIATION OF LUMBOSACRAL PLEXUS: SCIATIC NERVE AND ITS CLINICAL SIGNIFICANCE

Gulam Anwer Khan^{1*}, Ajeevan Gautam¹, Shuvechha Shakya¹, Amit Shrestha¹

¹Department of of Anatomy, Chitwan Medical College, Bharatpur-13 Chitwan, Nepal

Received: 21 Jul, 2022

Accepted: 22 Dec, 2022

Published: 31 Dec, 2022

Key words: Common peroneal nerve; Lumbosacral plexus; Piriformis; Sciatic nerve; Tibial nerve.

***Correspondence to:** Gulam Anwer Khan, Department of Anatomy, Chitwan Medical College, Bharatpur-5 Chitwan, Nepal.

Email: aanwer227@gmail.com

DOI: <https://doi.org/10.54530/jcmc.1130>

Citation

Khan GA, Gautam A, Shakya S, Shrestha A. Study of a variation of lumbosacral plexus: sciatic nerve and its clinical significance. Journal of Chitwan Medical College.2022;12(42):51-4.

ABSTRACT

Background: The pelvis is a home to pelvic parts of the sympathetic and parasympathetic nervous systems, the sacral and coccygeal plexuses, and the lumbosacral trunk. The lower spine's sciatic nerve is made up of a combination of motor and sensory fibers from spinal nerves fourth lumbar to third sacral segment (ventral rami). The objective of study was to determine morphological variations in origin and formation of branching pattern of sciatic nerve.

Methods: A descriptive cross-sectional study was conducted on twenty-four (forty-eight lower limbs) cadavers available in the Department of Anatomy at School of Basic Sciences, Chitwan Medical College. All damaged cadavers were excluded. The cadavers for undergraduate first year medical students dissected as per Cunningham's Manual. The branching pattern of the sciatic nerve was noted. All Variation of each sacral plexus was photographed. Statistical analysis was done using Microsoft Excel and SPSS version 20. Both gluteal regions were studied for the locations and variation of the sciatic nerve.

Results: Forty-eight lower limbs were examined. Among them forty-two lower limbs (87.5 percent) showed a normal anatomy of the sciatic nerve. Six lower limbs (12.5 percent) showed variations in the sciatic nerve.

Conclusions: The study concluded that there are variations in origin and formation of branches of sciatic nerve. Variations of sciatic nerve observed could be beneficial for various surgical interventions like nerve release and pain management in compressed nerve.



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INTRODUCTION

The lumbosacral trunk, the sacral and coccygeal plexuses, and the pelvic portions of the sympathetic and parasympathetic nervous systems are all located in the pelvis. Together, these neurons provide somatic and autonomic innervation to the pelvic visceral organs, the pelvic floor and perineum, the gluteal region, and the lower leg.¹

Spinal nerve's motor and sensory division (ventral rami of fourth lumbar to third sacral segment) combine to form the sciatic nerve in the lower spine. These spinal nerves forms part of the lumbosacral plexus.²

Sciatic nerve is two centimeter wide, leaves the pelvis through the greater sciatic foramen below the piriformis. It descends between the greater trochanter and ischial tuberosity in gluteal region. Its two terminal branches are common peroneal and tibial nerve. The posterior compartment of thigh; hip joint and knee joint receive motor supply. The whole tibial and foot area except anteromedial tibial region and medial margin of foot receives sensory supply.²

Sciatica is a term used to describe discomfort that travels down each leg following the sciatic nerve's course, which branches from the lower back via the hips and buttocks. The most frequent causes of sciatica are nerve compression by a herniated intervertebral disc, a bone spur of spine, or a narrowing of the spine that results inflammation, discomfort, and frequently some numbness.³

Neurosurgeons, Anatomists, Forensic expert, Pathologists, and Anthropologists are interested in the anatomical variations in branches of lumbosacral plexus for determining the location of the nerve plexus in archeological remains or forensic evidence.⁴ The study aimed to determine the variation in branching of lumbosacral plexus and sciatic nerve.

METHODS

The study was conducted at Department of Anatomy, School of Basic Sciences of Chitwan Medical College from 26th December 2021 to 15 May 2022 A.D. Ethical approval was granted from CMC-IRC/078/079/070. A descriptive cross-sectional study was conducted on twenty-four formalin fixed cadavers available

in the department using conventional sampling method. The routine dissection of cadavers for undergraduate first year medical students as per the guidelines of Cunningham's Manual of Dissection. Gluteal region, back of thigh and popliteal fossa were exposed. Gluteus maximus was reflected from its insertion. Biceps femoris was retracted to expose sciatic nerve in popliteal fossa. The course of sciatic nerve above and below the level of piriformis muscle was observed. The entire course and variations in branching of sciatic was observed.

Abnormal pattern of sciatic nerve is classified according to Beaton and Anson⁵ based on variations of the piriformis and Sciatic Nerve which is as follows: Type 1: Undivided nerve below undivided muscle. Type 2: Divisions of nerve between and below undivided muscle. Type 3: Divisions above and below undivided muscle. Type 4: Undivided nerve between heads. Type 5: Divisions between and above heads. Type 6: Undivided nerve above undivided muscle.

All damaged cadavers were excluded from the study. Both the sides of the gluteal region were studied for the locations and variation of the plexus and the sciatic nerve. The branching pattern of the sciatic nerve was noted by observing the nerve plexus. The photographs were taken as a document for all types of variation of the sacral plexus on each side. Statistical analysis was done using Microsoft Excel 2019 and SPSS version 20 and analyzed as frequency and distribution.

RESULTS

Twenty-four formalin fixed cadavers comprising of forty-eight lower limbs were used for this study. Among them forty-two lower limbs (87.5 percent) showed a normal anatomy of the sciatic nerve. Six lower limbs (12.5 percent) showed variations in the sciatic nerve. Of the six limbs (12.5 percent), the one lower limbs (2.08 percent) show variations of the sciatic nerve in relation to piriformis muscle, it was coming out from under surface of the piriformis muscle. Remaining five lower limbs reported up to three muscular branches just below the piriformis.

Table 1: Pattern of Distribution of Sciatic Nerve

Sciatic Nerve	n (%)
Normal pattern	42(87.5)
Abnormal pattern	6(12.5)
Type 1: Undivided nerve below undivided muscle	-
Type 2: Divisions of nerve between and below undivided muscle	5(83.33%)
Type 3: Divisions above and below undivided muscle	-
Type 4: Undivided nerve between heads	1(16.66%)
Type 5: Divisions between and above heads.	-
Type 6: Undivided nerve above undivided muscle.	-



Figure 1: Picture Showing Type 2 Variation of Sciatic nerve (green and yellow marked unnamed branches from sciatic nerve to biceps femoris and semitendinosus, orange triangle: piriformis muscle, blue marked sciatic nerve, blue triangle marked, yellow marked and green marked unnamed branches).

On tracing sciatic nerve below the piriformis one lower limb showed three unusual branches to two different muscles. One was going to biceps femoris and remaining two were innervating semitendinosus from upper and lower part. Remaining five lower limbs showed division of sciatic nerve above the apex of the popliteal fossa.

In the study we also explored the sciatic nerve for its division into tibial and common peroneal nerve. We found forty-five lower limbs showed normal pattern of division at the apex of popliteal fossa. Three lower limbs showed the variation. Among those three lower limbs sural nerve was coming out above its original site of formation i.e., at the upper part of popliteal fossa.

DISCUSSION

The ventral and dorsal divisions of the ventral rami of the fourth to third sacral segment of spinal nerves make up the sciatic nerve, the biggest branch of the lumbosacral plexus. The common peroneal and tibial components can split from each other at different levels from their origin because the sciatic nerve is created when the vast dorsal component of the sacral plexus (common fibular nerve) and the ventral component (tibial nerve) travel downward close together.^{4,6}

A study on cadaveric study of variation in division of sciatic nerve was conducted in India and reported normal course of sciatic nerve in eighty five percent lower limbs.⁷ Our study also reported that 87.50 percent of the study population with normal division. In a study on variation in high division of the sciatic nerve and its relation with piriformis muscle reported 91.8 percent of lower limb had normal course of sciatic nerve.⁸ Our study also reported that 87.50 percent of the study population with normal division. Guvencer et al.⁸ reported forty eight percent of sciatic nerve divides in the gluteal region. The findings of the study are against our findings. The difference might be because of different study area, study sample.

Matejcik V⁹ in his study of fifty adult cadavers reported lowest connection between lumbosacral trunk at first sacral nerve at

ten cases, double fourth lumbar nerve root in twenty-five cases, double third lumbar vertebrae in four cases, double second and third lumbar nerve root with fifth lumbar vertebrae in two cases. Double first sacral nerve root from sacral foramina was present sixteen times, second sacral nerve root eight times, third sacral nerve root once and first along with second sacral nerve root four times. First second and third nerve roots were branched in various distance following sacral foramina in fifteen cases. Lumbosacral trunk was thickened in nineteen cases; a share from fourth root was thicker as fifth lumbar root in eleven cases. The lowest connection between lumbosacral trunk and first sacral root was observed in ten cases. Sciatic nerve was branched into tibial and peroneal portions already in small pelvis in two cases.

Berihu Birhane A et al in their study on forty-two lower limbs of twenty-eight formalin fixed lower limbs reported that fourteen lower limbs (twenty five percent) showed variations in the sciatic nerve. Six lower limbs (nine percent) out of fourteen, Common peroneal component and tibial component arises below the Piriformis Then rejoin posterior to quadratus femoris muscle and bifurcate at the superior angle of popliteal fossa. The rest one lower limb (two percent), the common peroneal component emerges above the Piriformis and tibial component emerges below the Piriformis and descends separately along their course. The variations in findings might be due to geographical, topographic and racial variation.¹⁰

Yusuf ZC et al. conducted research on ten human anatomic specimens. The finding of study showed that first lumbar root is the thinnest (4.1 mm): a fourth lumbar vertebra is the largest (5.5 mm) root of the lumbar plexus. The iliohypogastric nerve is the longest (210 mm) and the ilioinguinal nerve is the thinnest (1.2 mm) nerve of the lumbar plexus.¹¹

Gabrielli C et al.,¹² found 13.7%, Prakash et al.¹³, found 16.3%, Ogeng'o JA et al.¹⁴, found 20.1%, Ugrenovic S et al.¹⁵, found 4%, Pokorny D et al.¹⁶, found 20.9%, Guvencer M et al.⁸, found 48%, Patel S et al.⁶, found 8.2%, Adibatti M et al¹⁶., found 8%. In the present study we found 6%of cases having variation in branching of sciatic nerve. Divisions of sciatic nerve in the pelvis, in the gluteal region or in the upper part of the posterior compartment of thigh may result in involvement of only one of the two divisions during popliteal fossa injury. This can also explain the reduced severity of presentation of the sciatic neuropathy.

Mallikarjun A et al¹⁷.in their study of fifty cadavers reported eight percent sciatic nerve coming out before exiting pelvis. The findings are against our findings. We did not report any report on sciatic nerve coming out before exiting pelvis. This difference might be because of difference in sample size.

Shewale A. D. et al¹⁸ in their research forty-five properly embalmed cadavers showed that in sixty six of the ninety gluteal regions (73.33 percent) sciatic nerve exited the pelvis through the greater sciatic foramen below piriformis without division. In two specimens (2.22 percent) both the nerves were separate and the tibial nerve was in separate rootlet form. In ten specimens (11.11 percent) both the components were emerging below in piriformis compartment but separately emerging. In ten specimens (11.11 percent) the components were separate but the common peroneal nerve was piercing the piriformis muscle. Only in two specimens (2.23 percent) the common peroneal nerve was passing above the piriformis and tibial nerve below the muscle.

CONCLUSION

Morphology of Sciatic Nerve in the Nepalese population is similar from that of other populations. These findings may be of useful in surgical approaches and interventions. Variations such as high division and trifurcation of nerve can lead to nerve injury during deep intramuscular injections, failure of sciatic nerve block anesthesia during various surgical procedures, piriformis syndrome or inadvertent damage to sciatic nerve during varicose vein stripping. Variations in the course of SN may complicate surgery and in the interpretation of sciatic neuropathy. Hence preoperative nerve imaging and extra operative diligence are recommended during various surgical interventions of the gluteal regions.

ACKNOWLEDGEMENT

We would like to thank the CMC IRC for ethical clearance and whole heartedly thank the administration and department without whom the study would not have been possible.

CONFLICT OF INTEREST: None

FINANCIAL DISCLOSURE: None

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