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ORIGINAL RESEARCH

Clinical Implications and Anatomical Variations of the Sciatic Nerve Divisions in Relation to the Piriformis Muscle: A Human Cadaveric Study

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Abstract
Background- The sciatic nerve is indeed the largest nerve in the human body, arising from the lumbosacral plexus and carrying both tibial and common peroneal components. Its course and relationship to the piriformis muscle are important considerations due to potential variations that may impact clinical procedures and cause conditions such as sciatica and piriformis syndrome.
Materials and methods- A study was conducted to evaluate the course and division of the sciatic nerve (SN) in approximately 20 cadavers (40 lower limbs).The dissections focused on the gluteal region, back of the thigh, and popliteal fossa, during which the gluteus maximus muscle was reflected and the biceps femoris muscle retracted to expose the nerve in the popliteal fossa.Data analysis was done using SSPS software.
Results- In this study, which involved 20 cadavers and a total of 40 gluteal regions, the course and division of the sciatic nerve (SN) were investigated. The examination of 40 specimens or limbs revealed variations in the division of the sciatic nerve, with 70% showing a normal division at the superior angle of the popliteal fossa, 17.5% displaying a high division within the pelvis, and 12.5% demonstrating a high division in the back of the thigh.
Conclusion- Understanding the variations in the course and division of the sciatic nerve (SN) is crucial for surgeons planning surgical interventions in the gluteal region. Variant SN anatomy can lead to conditions like piriformis syndrome and impact the success of nerve blocks.
Keywords- gluteal, piriformis, syndrome

Introduction

The sciatic nerve is indeed the largest nerve in the human body, arising from the lumbosacral plexus and carrying both tibial and common peroneal components. Its course and relationship to the piriformis muscle are important considerations due to potential variations that may impact clinical procedures and cause conditions such as sciatica and piriformis syndrome.[1,2] Variations in the sciatic nerve's emergence into the gluteal region and its relationship to the piriformis muscle have been associated with sciatica and piriformis syndrome.

The anatomy of the sciatic nerve can present in various forms as it exits the greater sciatic foramen in relation to the piriformis muscle.[3]

The six main anatomic variants include the undivided sciatic nerve exiting below the piriformis (Type I), division of the nerve with one part passing through the piriformis and the other below it (Type II), division with one part anterior and the other posterior to the piriformis (Type III), undivided nerve passing through the piriformis (Type IV), division with one part exiting through the piriformis and the other above it (Type V), and a division from the superior aspect of the piriformis posteriorly (Type VI). Understanding these variations is crucial for clinicians to navigate potential implications for

conditions like sciatica and piriformis syndrome, as well as during surgical procedures involving the sciatic nerve and piriformis muscle.[4]

The poor result of hip joint surgery, postoperative palsy of the sciatic nerve, is another clinical significance of these variations. In certain variations between the sciatic nerve and the piriformis muscle, stretching the sciatic nerve or its branches during surgery carries a higher risk.[4]The posterior paratrochanteric portal (posterior portal) during arthroscopic surgery is also affected by variations in the sciatic nerve and the piriformis muscle.[5] Leg and buttock pain is frequently misdiagnosed as piriformis syndrome. In approximately 6–8% of cases, piriformis syndrome is the cause of sciatica. [6]

Aim and objectives: The study aimed to identify any possible variations in the course and division of the sciatic nerve, contributing valuable anatomical insights for medical education and clinical practice.

Materials and methods

The present descriptive study was conducted to evaluate the course and division of the sciatic nerve (SN) in 20 cadavers (40 lower limbs) at Department of Anatomy, Nalanda Medical College Patna, Bihar, India for a period of two years from January 2019 to December 2020.The study adhered to ethical standards and guidelines for anatomical research. Approval for the study was obtained from the Institutional Ethics Committee, and all cadavers used in the study were handled with respect and care. These human cadavers were sourced from the anatomical collection of the department.

Inclusion criteria: forty lower limbs (20 cadavers) and gluteal regions of formalin-fixed male cadavers without any gross pathology.

Exclusion criteria: The pathological cadavers were excluded from the study.

The dissections focused on the gluteal region, back of the thigh, and popliteal fossa, during which the gluteus maximus muscle was reflected and the biceps femoris muscle was retracted to expose the nerve in the popliteal fossa. The exit of the nerve from the pelvis, its relation to the piriformis, and the level of nerve division were carefully recorded and delineated topographically with respect to the region of division. After being used in anatomy education, the levels of the SN bifurcation into TN and CFN parameters in all thirty lower limbs and the gluteal regions were captured on camera and recorded.

The present study was divided into five groups based on how the SN was divided into TN and CFN.[7,8]

Group I: TN and CFN course separately below the PM, after which SN divides in the pelvic region and exits the gluteal region.

Group II: TN lies below the PM, and CFN pierces the pelvic region, where SN separates in the pelvic region before exiting the gluteal region.

Group III: At the level of the obturator internus muscle, in the gluteal region, SN divides into TN and CFN.

Group IV: In the upper part of the posterior aspect of the thigh, SN divides into TN and CFN.

Group V: In the middle of the posterior aspect of the thigh, SN divides into TN and CFN.

Statistical Analysis

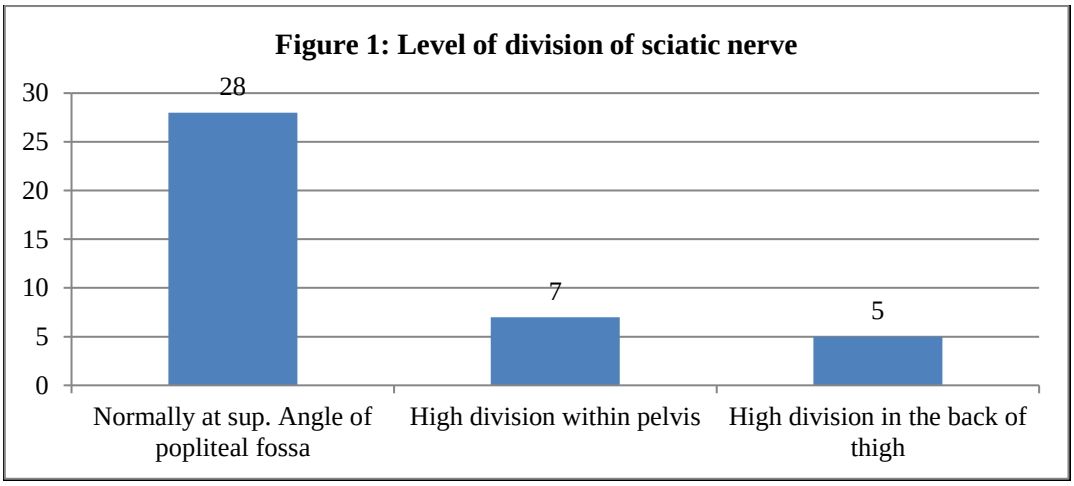
Data analysis was done using Microsoft Office Excel and SSPS software.

Results

In this study, which involved 20 cadavers and a total of 40 gluteal regions, the course and division of the sciatic nerve (SN) were investigated. The examination of 40 specimens or limbs revealed variations in the division of the sciatic nerve, with 70% showing a normal division at the superior angle of the popliteal fossa, 17.5% displaying a high division within the pelvis, and 12.5% demonstrating a high division in the back of the thigh.

Table 1: Depicting the level of division of sciatic nerve

Level of division	Number of specimens/ limbs (n=40)	Percentage (%)
Normally at sup. Angle of popliteal fossa	28	70
High division within pelvis	7	17.5
High division in the back of thigh	5	12.5
Total	40	100



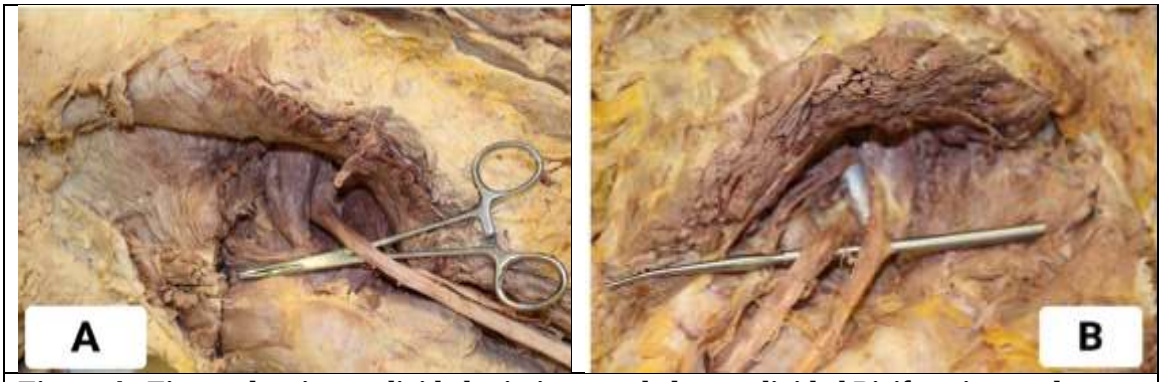


Figure A: Figure showing undivided sciatic nerve below undivided Piriformis muscle
Figure B: showing the division of the sciatic nerve between (Common Peroneal nerve) and below (Tibial nerve), the Piriformis muscle

Discussion

The sciatic nerve, the largest nerve in the human body, arises from spinal nerves L4-S3 and comprises fibers from both the lumbosacral plexus divisions.[9] Exiting the pelvis beneath the piriformis muscle, it courses through the posterior thigh compartment, passing deep to the biceps femoris muscle and adjacent to various muscles like the adductor magnus, semitendinosus, and semimembranosus. This nerve provides innervation to a substantial area including the thigh, leg, and foot.[10,11]

In our study, which involved 20 cadavers and a total of 40 gluteal regions, the course and division of the sciatic nerve (SN) were investigated. The examination of 40 specimens or limbs revealed variations in the division of the sciatic nerve, with 70% showing a normal division at the superior angle of the popliteal fossa, 17.5% displaying a high division within the pelvis, and 12.5% demonstrating a high division in the back of the thigh.An earlier study reported a high incidence of high division of the sciatic nerve (SN).[12]This pelvic division likely stems from the nerves' separate development during embryogenesis. The level at which the nerve divides can impact the severity of neurological deficits in sciatic neuropathy.[13] For example, division in the gluteal region or proximal to the popliteal fossa could lead to selective involvement of one nerve division in popliteal fossa injuries, potentially explaining the challenges in achieving complete nerve block during popliteal anesthesia.Variations in the sciatic nerve anatomy highlight the intricate complexity and diversity that can exist among individuals. Understanding these variations is crucial for surgical procedures, nerve blocks, and overall clinical management to prevent potential complications.[14]Atoni D. Atoni et al examined sciatic nerve variations in relation to the piriformis muscle, its prevalence, pattern and the course of its bifurcation loci. Twenty-eight formalin fixed male cadavers comprising 56 lower limbs were used for this study. Dissection of the gluteal region and posterior compartment of the thigh was conducted to expose the sciatic nerve. Variations in the sciatic nerve anatomy, their relationship to the

piriformis muscle and points of bifurcation, and other observable features were noted and recorded. Fifty-two lower limbs (93%) showed normal anatomy of the sciatic nerve. Four regions (7.1%) showed variations in the morphology of the sciatic nerve. Of these, one (1.8%) showed a variation of the sciatic nerve with the piriformis muscle. This single case showed a common peroneal nerve emerging on the left between the heads of a double piriformis muscle - a variant not described in the original Beaton and Anson classification, with the tibial nerve deep to the muscle. In two other limbs, the sciatic nerves showed a normal relationship with the piriformis, but had variations in the bifurcation loci (bilateral). The divisions were in upper third and middle third of the right and left thighs respectively. Knowledge of the level of bifurcation and distribution of the sciatic nerve and its location is important.[15]

Limitation of the study

In the present study, the sample size was small.

Conclusion

Understanding the variations in the course and division of the sciatic nerve (SN) is crucial for surgeons planning surgical interventions in the gluteal region. Variant SN anatomy can lead to conditions like piriformis syndrome and impact the success of nerve blocks.

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