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ORIGINAL RESEARCH

Cross sectional study on the anatomical variability of the sciatic nerve and it's implications

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ABSTRACT

Aim: To explore the anatomical variability of the sciatic nerve and discuss its implications for clinical practice. **Materials and methods:** A study was undertaken to assess the course and branching of the sciatic nerve (SN) by examining around 25 cadavers, totaling 50 lower limbs. The dissections concentrated on the gluteal region, the posterior thigh, and the popliteal fossa. The topographical delineation aimed to enhance the understanding of the anatomical context surrounding SN division. Data analysis was done using basic quantitative indicators of frequency and proportions. **Results:** In this study, which involved 25 cadavers and a total of 50 gluteal regions, the course and division of the sciatic nerve (SN) were investigated. The examination of 50 specimens or limbs revealed variations in the division of the sciatic nerve, with 66% showing a normal division at the superior angle of the popliteal fossa, 20% displaying a high division within the pelvis, and 14% demonstrating a high division in the back of the thigh. **Conclusion:** Comprehending the variations in the course and branching of the sciatic nerve (SN) is vital for surgeons performing procedures in the gluteal region. These anatomical differences can lead to conditions like piriformis syndrome and may affect the efficacy of nerve blocks.

Keywords: sciatic, piriformis, lumbosacral

INTRODUCTION

The sciatic nerve, the largest nerve in the human body, originates from the lumbosacral plexus and includes both tibial and common peroneal components. Its pathway, particularly in relation to the piriformis muscle, is clinically significant due to anatomical variations that can influence procedures and lead to conditions like sciatica and piriformis syndrome. Differences in how the sciatic nerve emerges into the gluteal region and interacts with the piriformis muscle are linked to the development of these conditions.[1]

The sciatic nerve (SN) is the largest nerve in the human body, emerging from the pelvis through the union of the L4-S3 ventral nerve roots. Typically, the SN travels as a single trunk, exiting the greater sciatic foramen beneath the piriformis muscle (PM). However, variations in its anatomy often originate from developmental stages when the branches—the common peroneal nerve (CPN) and the tibial nerve (TN)—are distinct.[2]

Understanding these anatomical variations is crucial for avoiding complications in procedures like total hip arthroplasty (THA), SN blocks, and surgeries involving the gluteal or pelvic regions. The SN's relationship with the PM can predispose individuals to piriformis syndrome (PS), a common non-discogenic cause of sciatica due to nerve entrapment. The CPN is particularly vulnerable to injury, often due to its proximity to the skin surface. Variations in the SN's branching can complicate analgesia during SN blocks, leading to inadequate pain relief if only one branch is anesthetized.[3,4]

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Manipulation during orthopedic surgeries can stretch nerves, risking blood supply and potential injury. This concern is particularly significant during hip arthroscopy, which is used for conditions like avascular necrosis, as it may directly traumatize the sciatic nerve (SN), especially during portal placement. The classification of SN anatomical variations in relation to the piriformis muscle (PM) was first outlined by Beaton and Anson in 1937, identifying six major classes based on observed anatomy. Subsequent studies have refined this system, distinguishing between variations where the SN exits as a common trunk and those where it is pre-divided into the common peroneal nerve (CPN) and tibial nerve (TN). These variations are further categorized by the exit positions of the nerve divisions concerning the PM, which originates from different structural points, making this understanding critical for surgical considerations.[5,6]Overall,this study aims to explore the anatomical variability of the sciatic nerve and discuss its implications for clinical practice.

MATERIALS AND METHODS

A study was undertaken to assess the course and branching of the sciatic nerve (SN) by examining around 25 cadavers, totaling 50 lower limbs. The dissections concentrated on the gluteal region, the posterior thigh, and the popliteal fossa. To expose the nerve in the popliteal fossa effectively, the gluteus maximus muscle was reflected, and the biceps femoris muscle was retracted. Researchers carefully documented the exit of the nerve from the pelvis, its relationship with the piriformis muscle, and the specific level of nerve division. This topographical delineation aimed to enhance the understanding of the anatomical context surrounding SN division. Data analysis was done using basic quantitative indicators of frequency and proportions.

RESULTS

Table 1: Division Levels of the Sciatic Nerve in the Current Study

Level of division	Number of specimens/ limbs	Percentage (%)
Normally at sup. Angle of popliteal fossa	33	66
High division within pelvis	10	20
High division in the back of thigh	7	14
Total	50	100

The table provides a summary of the anatomical variation in the division level of a nerve or vessel (not specified here) in a sample of 50 limbs or specimens. In the majority of cases (66%), the division occurred at the typical location near the superior angle of the popliteal fossa. In 20% of cases, the division was observed at a higher level within the pelvis, while in 14% of cases, it occurred at a high division point in the back of the thigh. This data reflects the range of division levels observed, highlighting that while the majority follow the common anatomical pattern, a notable portion display higher division levels, either within the pelvis or thigh.

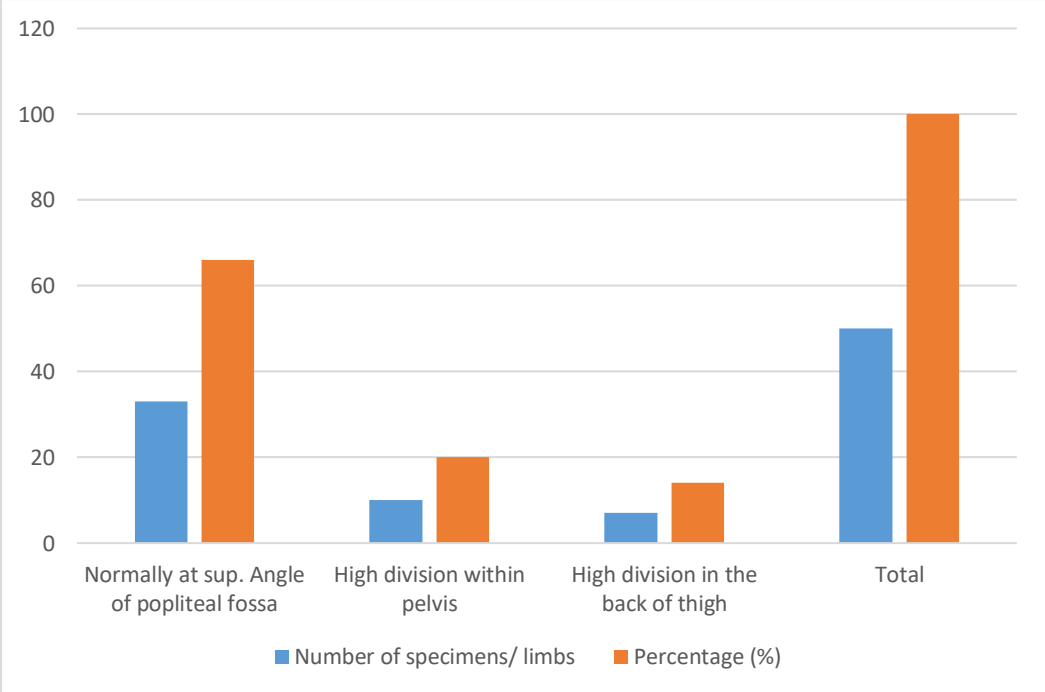

Fig 1. Division Levels of the Sciatic Nerve

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Table 2: Exit of the nerve from pelvis

Variable	Number	Percentage
As single branch through the infrapiriform foramen with no variation	48	96
As more than one branches through the infrapiriform foramen	2	4
Total	50	100

The table provides information about nerve exit patterns from the pelvis, a total of 50 cases were examined. It was found that in 96% (48 cases), the nerve exited as a single branch through the infrapiriform foramen, with no variation observed in these cases. In the remaining 4% (2 cases), the nerve exited as more than one branch through the infrapiriform foramen. This data indicates that a single-branch exit through the infrapiriform foramen is the predominant pattern, with minimal variation observed across cases.

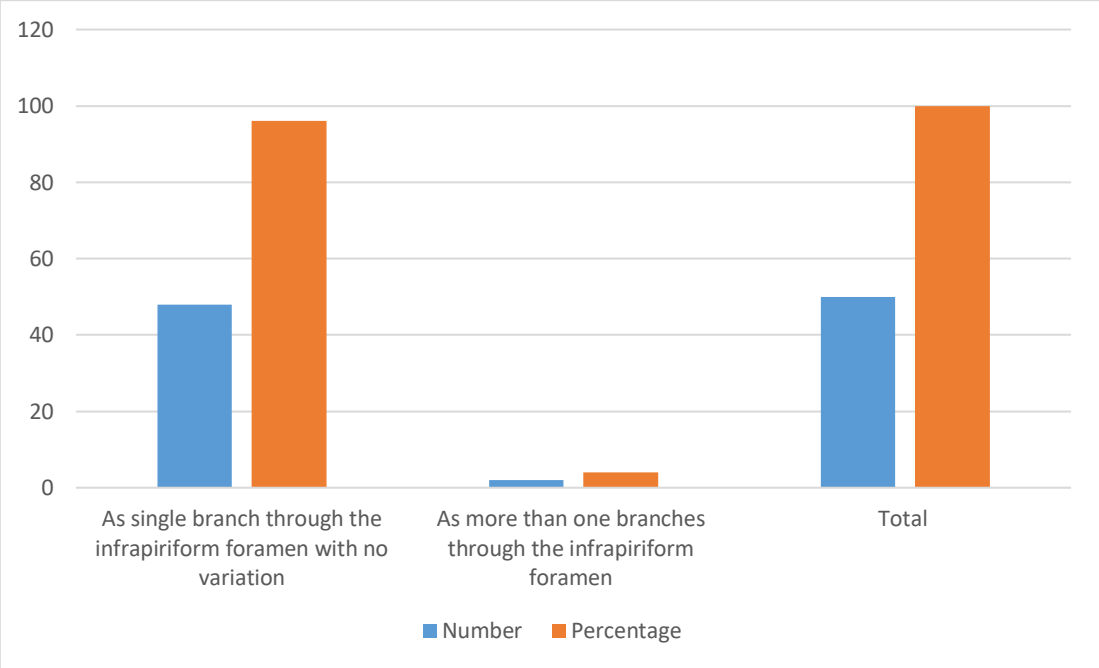

Fig 2. Exit of the nerve from pelvis

In this study, which involved 25 cadavers and a total of 50 gluteal regions, the course and division of the sciatic nerve (SN) were investigated. The examination of 50 specimens or limbs revealed variations in the division of the sciatic nerve, with 66% showing a normal division at the superior angle of the popliteal fossa, 20% displaying a high division within the pelvis, and 14% demonstrating a high division in the back of the thigh.In 48 of 50 lower limbs, the sciatic nerve exited the pelvis as a single branch through the infrapiriform foramen with no variation (96%). In two lower limbs, the common peroneal nerve and the tibial nerve entered deep gluteal region via the greater sciatic foramen below piriformis muscle separately.

DISCUSSION

The sciatic nerve (SN) is the largest nerve in the human body, responsible for innervating a significant portion of the lower limb. Understanding its anatomical variability is essential for clinical practice, particularly in surgeries and interventions involving the hip, thigh, and popliteal region. Variations in the course and branching of the SN can significantly impact surgical outcomes, anesthesia techniques, and the management of conditions such as sciatica or piriformis syndrome. Moreover, these variations may increase the risk of nerve injury during orthopedic procedures, necessitating a thorough anatomical comprehension to prevent complications.[7,8]

Cross-sectional studies offer valuable insights into the morphological characteristics of the sciatic nerve, contributing to an evidence-based understanding of its anatomical relationships. By evaluating multiple specimens, researchers can delineate common patterns and identify atypical presentations, enhancing the surgical knowledge crucial for safe and effective interventions.

In this study, which involved 25 cadavers and a total of 50 gluteal regions, the course and division of the sciatic nerve (SN) were investigated. The examination of 50 specimens or limbs revealed variations in the division of the sciatic nerve, with 66% showing a normal division at the superior angle of the popliteal fossa, 20% displaying a high division within the pelvis, and 14% demonstrating a high division in the back of the thigh.

In a study by Branca J et al.[9], they described six different case reports of anatomical variations of the SN and its interplay with the PM. The observations were made during dissection classes at the ICLO

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Teaching and Research Centre (Verona, Italy), on both male and female cadavers aged between 58 and 84 years. The SN was reported as a single and divided nerve into the tibial nerve (TN) and the common peroneal nerve (CPN), passing alone above, below, or between the PM. However, the two parts of the SN may also interact with the PM in different ways, adding to the anatomical variability. A thorough knowledge of the anatomical variations in any part of the human body is extremely important. The various techniques used, from imaging to autopsy or surgery, are also useful in the SN pathway. Thus, the anatomical features and the understanding of each variation are useful for a correct approach that can lead to an effective and correct treatment with a favorable outcome.

In another cross-sectional retrospective study conducted by Almuhaish MI et al.,[10] a total of 188 patients were examined for sciatic nerve anatomical variants. The findings revealed that the majority of patients (95.7%) exhibited the type 1 variant, while type 2 and type 3 variants were found in 3.2% and 1.1% of the cases, respectively. Importantly, the study found no statistically significant difference in the history of radiculopathy or sciatica among the various anatomical variants.The researchers concluded that anatomical variations of the sciatic nerve in relation to the piriformis muscle could be effectively identified through routine pelvic MRI scans, with type 1 being the predominant variant. This study reinforced the understanding of sciatic nerve anatomical variability in the pelvic region, which could be observed during standard MRI evaluations.

Thus understanding the anatomical variability of the sciatic nerve is crucial for optimizing clinical outcomes in surgical and interventional practices. The insights gained from studies on the SN not only enhance surgical knowledge but also have implications for diagnosing and managing conditions associated with nerve entrapment and injury. As our understanding of these variations continues to evolve, it becomes increasingly important to incorporate this knowledge into routine clinical assessments.

One significant limitation of our study is the relatively small sample size, particularly in the cross-sectional studies evaluating cadaveric dissections. While this study provide valuable insights into the anatomical variations of the sciatic nerve, a larger cohort may yield more comprehensive data that could enhance the statistical reliability and generalizability of the findings. Future research with expanded sample sizes is warranted to further elucidate the complexities of sciatic nerve anatomy and its clinical implications.

CONCLUSION

Comprehending the variations in the course and branching of the sciatic nerve (SN) is vital for surgeons performing procedures in the gluteal region. These anatomical differences can lead to conditions like piriformis syndrome and may affect the efficacy of nerve blocks.

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