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Study of Variations in the Course and Distribution of Sciatic Nerve in the Gluteal Region and Back of Thigh in Adult Human Cadavers

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Abstract

Variations in the course and distribution of the sciatic nerve in the gluteal region and back of the thigh are clinically significant for surgical interventions and management of sciatic nerve-related conditions. This study aims to document these variations in adult human cadavers. The study examined 34 extremities from adult human cadavers to observe the typical and atypical divisions of the sciatic nerve, its relationship with the piriformis muscle the topographical variations. The levels of sciatic nerve division into terminal branches were also recorded. Out of 34 extremities, 76.47% exhibited typical divisions of the sciatic nerve, while 23.53% showed atypical patterns. The relationship between the sciatic nerve and the piriformis muscle was predominantly Type 1 (91.18%), with less common occurrences of Type 2 (5.88%) and Type 3 (2.94%) relationships. No Type 4 relationships were observed. Topographical variations showed that Group I (typical patterns) accounted for 94.12% of the cases, with 91.18% falling under subcategory I A. Group II (atypical patterns) was observed in 5.88% of the cases. The division of the sciatic nerve into terminal branches occurred at low levels in 76.48% of the cases, intermediate levels in 14.7% high levels in 8.82%. The study highlights the predominance of typical sciatic nerve divisions and relationships with the piriformis muscle in the examined cadavers. These findings enhance the anatomical understanding necessary for clinical and surgical practices involving the sciatic nerve. Awareness of these variations can aid in reducing surgical complications and improving patient outcomes.

INTRODUCTION

The sciatic nerve, the largest nerve in the human body, is essential for the function and innervation of the lower limb muscles and skin, extending from the lower spine through the gluteal region and down the back of the thigh^[1,2]. Given its extensive course and critical role, variations in the anatomy of the sciatic nerve are of significant clinical importance, particularly in the context of surgical interventions and the management of sciatic nerve-related conditions^[3].

Understanding the typical and atypical anatomical variations of the sciatic nerve is crucial for clinicians, especially surgeons and anesthesiologists who operate in the gluteal and thigh regions^[4]. These variations can influence the outcomes of surgeries such as hip replacements, posterior approaches to the acetabulum sciatic nerve blockades. Additionally, knowledge of these anatomical differences is vital for diagnosing and treating conditions like piriformis syndrome, where the relationship between the sciatic nerve and the piriformis muscle can impact the patient's symptoms and the effectiveness of treatments^[5,6].

Previous studies have documented various patterns of the sciatic nerve's division and its relationship with the piriformis muscle^[7,8]. However, continuous research is necessary to refine anatomical knowledge and its application in clinical settings. This study aims to explore the course and distribution of the sciatic nerve in the gluteal region and back of the thigh in adult human cadavers. By examining typical and atypical divisions, the relationship with the piriformis muscle topographical variations, this research seeks to enhance the existing body of knowledge and improve clinical outcomes.

MATERIALS AND METHODS

Place of Study: The study was conducted at the Department of Anatomy, Sri Venkateswara Medical College, Tirupatindra Pradesh, India.

Study Period: The research was carried out over a period of three years, from May 2018-May 2021.

Study Design: This was an observational, descriptive study conducted on adult human cadavers to examine the variations in the course and distribution of the sciatic nerve in the gluteal region and back of the thigh.

Sample Selection: A total of 34 extremities from adult human cadavers (17 right and 17 left extremities) were included in the study. The cadavers were sourced from the Department of Anatomy, following ethical guidelines and necessary approvals.

Dissection Procedure

Preparation of Specimens:

- The cadavers were preserved using standard embalming techniques.
- The gluteal region and back of the thigh were exposed through careful dissection.

Dissection Steps:

- The skin and superficial fascia were incised and reflected to expose the underlying muscles and nerves.
- The gluteus maximus muscle was retracted to reveal the course of the sciatic nerve.
- The sciatic nerve was traced from its origin at the greater sciatic foramen through the gluteal region to its division into terminal branches in the thigh.

Identification of Variations:

- The course and division of the sciatic nerve were observed and documented.
- The relationship of the sciatic nerve with the piriformis muscle was noted, classifying the types of anatomical variations.
- Topographical variations in the sciatic nerve were categorized based on their anatomical course and branching patterns.

Data Collection:

- Detailed notes and photographs were taken to record the anatomical variations.
- Measurements were made using calipers to ensure precision in documenting the nerve's course and branching levels.

Data Analysis: The collected data were analyzed to determine the prevalence of typical and atypical divisions of the sciatic nerve, its relationship with the piriformis muscle the topographical variations. Statistical analysis was performed to correlate the variations between the right and left lower limbs.

Ethical Considerations: Ethical approval for the study was obtained from the Institutional Ethics Committee of Sri Venkateswara Medical College. The cadavers used were treated with respect and dignity all procedures adhered to ethical guidelines for anatomical research.

RESULTS AND DISCUSSIONS

The study examined variations in the course and distribution of the sciatic nerve in the gluteal region

and back of the thigh in adult human cadavers. The findings are detailed as follows.

Typical and Atypical Divisions of Sciatic Nerve: The division of the sciatic nerve was categorized as typical or atypical. Out of the 34 extremities studied, 76.47% exhibited a typical division, while 23.53% showed atypical division patterns (Table 1). This distribution indicates a predominant presence of typical nerve divisions in the sample population.

Relationship Between Sciatic Nerve and Piriformis: The relationship between the sciatic nerve and the piriformis muscle was classified into four types. The majority of the extremities (91.18%) exhibited a Type 1 relationship, where the sciatic nerve passes below the piriformis muscle. Type 2, Type 3 Type 4 relationships were less common, observed in 5.88%, 2.94% 0% of the extremities, respectively (Table 2).

Variations in Sciatic Nerve Topography: The study identified variations in the topography of the sciatic nerve, categorized into Group I (typical topographical patterns) and Group II (atypical topographical patterns). Group I accounted for 94.12% of the cases, with subcategory I A being the most prevalent at 91.18%. Group II, representing atypical patterns, was observed in 5.88% of the cases (Table 3).

Division of the Sciatic Nerve into Terminal Branches: The levels at which the sciatic nerve divided into its terminal branches were documented as high, intermediate low. The majority of the divisions occurred at a low level (76.48%), followed by intermediate (14.7%) and high levels (8.82%) (Table 4). These results provide a comprehensive overview of the variations in the course and distribution of the sciatic nerve, highlighting the predominance of typical patterns and the specific relationships with anatomical landmarks such as the piriformis muscle. The findings have significant implications for clinical and surgical practices, aiding in the understanding and management of sciatic nerve-related conditions.

The present study provides a comprehensive analysis of the variations in the course and distribution of the sciatic nerve in the gluteal region and back of the thigh, based on observations from 34 extremities of adult human cadavers. The findings have significant clinical implications, particularly for surgical interventions and the management of sciatic nerve-related conditions.

Typical and Atypical Divisions of the Sciatic Nerve: The results indicate that typical divisions of the sciatic

nerve are present in 76.47% of cases, while atypical divisions are observed in 23.53% of cases. This aligns with existing literature, which reports similar frequencies of typical and atypical sciatic nerve divisions. The identification of atypical divisions is crucial for surgeons, as these variations can influence the approach and success of surgical procedures, such as hip replacements and sciatic nerve blockades^[9,10].

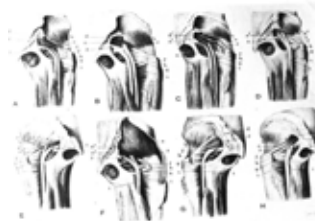


Fig. 1: Variations in the Sciatic Nerve



Fig. 2: Sciatic Nerve dividing at a distance of 34 cm from its emergence



Fig. 3: Sciatic Nerve divided with in the pelvis tibial and common peroneal nerves passes below the piriformis

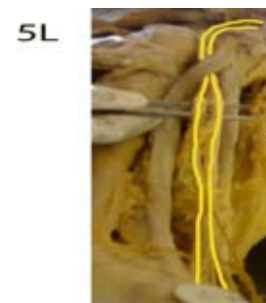


Fig. 4: Common peroneal nerve piercing the piriformis muscle ,tibial nerve emerging from the lower border of piriformis

Table 1: Typical and Atypical Divisions of Sciatic Nerve

| Type | Right | Left | Total | Percentage |
|----------|-------|------|-------|------------|
| Typical | 13 | 13 | 26 | 76.47% |
| Atypical | 4 | 4 | 8 | 23.53% |
| Total | 17 | 17 | 34 | 100% |

Table 2: Relationship Between Sciatic Nerve and Piriformis

| Type | Type 1 | Type 2 | Type 3 | Type 4 |
|------------------------------------|--------|--------|--------|--------|
| The present study (34 extremities) | 91.18% | 5.88% | 2.94% | nil |

Table 3: Variations in Sciatic Nerve Topography

| Group | Present Study (n=34) | Percentage |
|----------|----------------------|------------|
| I A | 31 | 91.18% |
| I B | 0 | 0% |
| I C | 1 | 2.94% |
| Group I | 32 | 94.12% |
| II A | 0 | 0% |
| II B | 2 | 5.88% |
| II C | 0 | 0% |
| Others | 0 | 0% |
| Group II | 2 | 5.88% |

Table 4: Division of the Sciatic Nerve into Terminal Branches

| Level | No. of Specimens | Percentage |
|--------------------|------------------|------------|
| High Level | 3 | 8.82% |
| Intermediate Level | 5 | 14.7% |
| Low Level | 26 | 76.48% |
| Total | 34 | 100% |

Relationship Between Sciatic Nerve and Piriformis Muscle:

The study found that the majority of the extremities (91.18%) exhibited a Type 1 relationship between the sciatic nerve and the piriformis muscle, where the nerve passes below the muscle. This is consistent with previous studies, such as those by Beaton and Anson^[11], which also reported a high prevalence of Type 1 relationships. The less common Type 2 (5.88%) and Type 3 (2.94%) relationships observed in this study highlight the importance of preoperative imaging and careful surgical planning to avoid inadvertent nerve injury, particularly in patients presenting with piriformis syndrome.

Variations in Sciatic Nerve Topography:

The topographical variations of the sciatic nerve were predominantly typical (94.12%), with atypical patterns observed in 5.88% of the cases. Group IA, representing the most common topographical pattern, accounted for 91.18% of the extremities. This high prevalence of typical patterns provides reassurance for clinicians, although the presence of atypical patterns underlines the need for vigilance during surgical procedures. The results are comparable to previous studies, such as those by Adibatti^[9], which also reported a high frequency of typical topographical patterns.

Division of the Sciatic Nerve into Terminal Branches:

The division of the sciatic nerve into its terminal branches occurred at a low level in 76.48% of the cases, intermediate level in 14.7% high level in 8.82%. These findings are in agreement with other anatomical studies, suggesting that the majority of sciatic nerve divisions occur at a low level, which is clinically relevant for surgeries involving the lower limb^[12].

Clinical Implications:

The variations in the sciatic nerve's anatomy have direct implications for clinical practice. Understanding these variations can aid in reducing the risk of surgical complications, improving the accuracy of sciatic nerve blockades enhancing the diagnosis and management of conditions such as piriformis syndrome and sciatica. Surgeons and anesthesiologists should be aware of these anatomical differences and consider them during preoperative planning and intra operative procedures.

CONCLUSION

This study highlights the importance of detailed anatomical knowledge of the sciatic nerve and its variations. The findings provide valuable insights that can improve surgical outcomes and patient care. Further research, including larger sample sizes and advanced imaging techniques, is recommended to continue refining our understanding of sciatic nerve anatomy and its clinical applications.

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