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Research Article

A Cadaveric Based Morphometric Analysis of Sciatic nerve with clinical significance

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Abstract: Background: The sciatic nerve is the largest nerve in the human body, as well as in many other animals. There are two reasons for this; one being that there are numerous neural fibres that gather to produce this nerve, and secondly, due to the extensive size of the gluteal region and lower limb, in other words, the regions innervated by this nerve. The sciatic nerve develops from the lumbo-sacral plexus, from the fourth lumbar to the third sacral (L4-L5 and S1-S3) spinal nerves. The nerve often has a maximum width of two centimetres (cm) or more, and can reach a diameter of over 0.5 cm, as it passes posterior and inferior to piriformis. The sciatic nerve is described as the nerve with the largest diameter in the body. **Materials and Methods:** This is a Prospective, observational study and Conventional Routine dissection method. 800 Embalmed human adult cadavers lower limb specimens. Adult lower limb specimens were obtained from the embalmed cadavers allotted for routine dissection to the first year MBBS students at the Department of Anatomy, Index Medical college. Both right and left lower limbs were used from all 800 cadavers. Therefore, every right lower limb has a corresponding left lower limb. Specimens where damage to piriformis or the sciatic nerve observed was excluded. **Results:** In our study the SN exited inferior to the PM in 736 lower limbs (92%); between the fascicles of the PM and inferior to the PM in two lower limbs (6%); and in one thigh, between the fascicles of the PM and superior to the PM (2%). The anatomical variations that are always unilateral occurred more frequently in the left side (11%) compared to the right side (6%). **Conclusion:** The goal of this project was to identify the anatomical variations of the sciatic nerve divisions in relation to the piriformis muscle and provide awareness of additional sciatic nerve entrapments that are possible within the subgluteal space. While piriformis syndrome was once the "catch-all" diagnosis for posterior hip and buttock pain, there are many potential causes that need to be explored, including sciatic nerve entrapment within the subgluteal space.

Keywords: Morphometric; Sciatic Nerve; Subgluteal space

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1. Introduction

The sciatic nerve is the largest nerve in the human body, as well as in many other animals.[9] There are two reasons for this; one being that there are numerous neural fibres that gather to produce this nerve, and secondly, due to the extensive size of the gluteal region and lower limb, in other words, the regions innervated by this nerve. [2] The sciatic nerve develops from the lumbo-sacral plexus, from the fourth lumbar to the third sacral (L4-L5 and S1-S3) spinal nerves. [3] The nerve often has a maximum width of two centimetres (cm) or more, and can reach a diameter of over 0.5 cm, as it passes posterior and inferior to piriformis. The sciatic nerve is described as the nerve with the largest diameter in the body. [4]

The nerve carries both motor and sensory fibres. The sciatic nerve enters the gluteal region, through the lower part of the greater sciatic foramen, below piriformis, as a single nerve encompassed by a single epineural sheath, and thereafter continues into the lower limb. [5] The sciatic nerve is the chief innervator of the posterior compartment of the thigh, the anterior, lateral and posterior compartments of the lower leg, and dorsal and

plantar regions of the foot. [6] Generally, this nerve terminates in approximately the distal third of the posterior compartment of the thigh, to branch into the common fibular and tibial nerves. These two terminal branches are important innervators for normal functioning of the foot. [**?**]

This intricately long course makes the nerve vulnerable to injury from various medical causes. Another reason for injury could be related to an inadequate knowledge regarding anatomical variations of the nerve. [13] Therefore, knowledge of the nerve, and its variations, are of vital concern in clinical science. The anatomy of the sciatic nerve has been described extensively in literature. [14] However, this is not the case for the variations of the sciatic nerve, as well as the subsequent variations of structures closely related to, and innervated by this nerve, within the gluteal region. [15]

2. Material and methods

This is a Prospective, observational study and Conventional Routine dissection method.

Study Materials: 800 Embalmed human adult cadavers lower limb specimens. Adult lower limb specimens were obtained from the embalmed cadavers allotted for routine dissection to the first year MBBS students at the Department of Anatomy, Index Medical college.

Inclusion Criteria: Both right and left lower limbs were used from all 300 cadavers. Therefore, every right lower limb has a corresponding left lower limb.

Exclusion Criteria: Specimens where damage to piriformis or the sciatic nerve observed was excluded.

Documentation of the Variations: The parameters of the sciatic nerve and piriformis was measured for every cadaver in the sample group, regardless of whether a variation is present or not. Images were only taken of the lower limb if the specimens presenting anatomical variations. A Canon 600D 18.0-megapixel camera was used for capturing all the images. The lens has four-stop image stabilizer technology, which improves performance during low-light conditions, as can be expected in an artificially lighted dissection hall.

Statistical Analysis: For statistical analysis, a biostatistician, was consulted for quantitative and descriptive statistics of the study data. Statistical analysis was conducted with Statistica version 13.2 software. Comparisons were made between the left and right sides of the lower limbs, sex, and population groups.

3. Results

Table 1. Anatomical variations of the Sciatic nerve exit from the pelvis

Variation of the nerve according to side	Frequency	Percentage (%)
Inferior to the piriformis muscle (PM)	736	92
Between the fascicles of the PM and inferior to the PM	48	6
Between the fascicles of the PM and superior to the PM	16	2

In our study the SN exited inferior to the PM in 736 lower limbs (92%); between the fascicles of the PM and inferior to the PM in two lower limbs (6%); and in one thigh, between the fascicles of the PM and superior to the PM (2%) in table 1.

Table 2. Anatomical variation of the Sciatic nerve according to the side of the body in Percentage

Variation of the nerve according to side	Frequency	Percentage (%)
Right Side	48	6
Left Side	88	11

The anatomical variations that are always unilateral occurred more frequently in the left side (11%) compared to the right side (6%) in Table 2.

Table 3. Region of division of the SN into tibial nerve and the common peroneal trunk in Percentage

Region	Frequency	Percentage (%)
Gluteal region	248	31
Middle third of the thigh	72	9
Proximal part of the popliteal fossa	480	60

4. Discussion

In our study, the Sciatic nerve exited inferior to the PM in 736 lower limbs (92%), and anatomical variations occur in 8% of cases. To detect the variable relationship between SN and PM, Berihu et al., dissecting 56 lower limbs, reported that 75% of lower limbs showed normal anatomy of SN, whereas 25% of cases showed variations in relation to PM with trifurcation of the SN in 5% of cases. [16] Monte De Oca reported that the frequency of anatomical variations in the exit of the SN in relation with the PM was 10%, and the most common level at which the SN divided in the terminal branches was at proximal part of the popliteal fossa (75%). [17]

Barbosa et al. [18] conducted a systematic review and showed that the most prevalent anatomical variation was that the common fibular nerve passed through the piriformis muscle fibers (33.3%) and pointed to a possible association of this condition with piriformis syndrome. Similarly, Poutoglidou and colleagues [19] wrote a comprehensive systematic review with a meta-analysis of the SN variants relative to the PM and compared those variants' prevalence among different geographical populations with respect to gender and laterality, reporting that SN variants were more common among East Asians (with a 31% pooled prevalence of total variants), and no statistically significant differences with respect to gender and laterality.

All these variations should be considered during the semiology of disorders involving parts of the lower limbs. Given these differences, we believe that large-scale research should be carried out in a bigger multiethnic population group to confirm the associations of this anatomical variation in relation with the PM, which would also provide more information on the frequency of the variations. Although, in recent years, the development of new neurosurgical techniques and 3D devices have helped surgeons to improve their knowledge of surgical anatomy, real laboratory anatomical dissections are needed to safely perform surgeries. [20]

The exact position of the SN during surgical procedures around the hip and the variability that has been described may reduce the risk of iatrogenic injury. As the position of the SN is highly variable in its course and bifurcation, ultrasound should be used to identify the position of the nerve and its bifurcation point prior to nerve blocks. The use of ultrasound may increase the success rate, and reduce complications associated with sciatic or popliteal blocks.

5. Conclusion

The goal of this project was to identify the anatomical variations of the sciatic nerve divisions in relation to the piriformis muscle and provide awareness of additional sciatic nerve entrapments that are possible within the subgluteal space. While piriformis syndrome was once the "catch-all" diagnosis for posterior hip and buttock pain, there are many potential causes that need to be explored, including sciatic nerve entrapment within the subgluteal space.

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