

Original Research Article

Anatomical study on sciatic nerve variations in Andhra Pradesh, India

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ABSTRACT

Background: The sciatic nerve is the largest and widest nerve in the body and is derived from ventral rami of spinal nerves L2 to S3. Sciatic nerve appears in the Gluteal region below Piriformis from Pelvic cavity by passing through Greater Sciatic foramen. In between the Ischial tuberosity and greater trochanter of Femur, it reaches the back of the thigh. At the superior angle of Popliteal fossa, it divides into Tibial and common Peroneal (fibular) nerves. The division varies, and it may occur within the pelvis, Gluteal, upper, mid and lower part of thigh. The anatomical variations of the level at which the Sciatic nerve divides is considered important by Neurosurgeons, Anaesthetists, Orthopaedicians and Surgeons.

Methods: This study was conducted on 52 lower limbs to determine the level of sciatic nerve bifurcation and its variations on 26 embalmed human cadavers. The data was analyzed manually using numbers, frequencies and percentages.

Results: The findings of this study states that in 2 limbs (3.84%) the nerve divided in the gluteal region; in 4 limbs (7.69%) in the pelvic region; in 10 limbs (19.23%) at the junction between upper and middle thigh. The highest incidence of division occurs in 36 limbs (69.23%) at the superior angle of the popliteal fossa.

Conclusions: The findings of this study revealed that the majority of sciatic nerve divisions occur at the superior angle of popliteal fossa while some divided into other regions such as Pelvis, Gluteal and thigh regions.

Keywords: Bifurcation, Division, Sciatic nerve, Trifurcation, Variations

INTRODUCTION

Sciatic nerve is the longest and widest nerve in the human body. It is 2 cm wide at its origin and is the thickest throughout its course. It leaves the pelvis via the Greater sciatic foramen below Piriformis and descends between greater trochanter and Ischial tuberosity, along the back of the thigh, dividing into the Tibial and common Peroneal (Fibular) nerve at a varying level proximal to the knee.¹

The point of division of the Sciatic nerve into its major components is variable. The common site is at the

junction of the middle and lower third of the thigh, near the apex of the Popliteal fossa. The division may occur at any level above its normal division and it is the most frequently injured nerve.² Many Studies declared that most of the variations exist at the level of sciatic nerve bifurcation.^{3,4} The anatomical variations of the level at which the sciatic nerve divides is considered important by clinicians.⁵ Sciatic nerve is also known as the 'Ischiadic nerve.'

It runs from each side of the lower spine, deep in the gluteal region, back of the thigh all the way down to the foot via its branches, connecting the spinal cord with the

leg and foot supplies nearly the whole of the skin of the leg, the muscles of the back of the thigh, and those of the leg and the foot. Commonly at the apex of popliteal fossa the Sciatic nerve bifurcates (85-89%) into Tibial nerve and Common Peroneal nerve.

A good knowledge about the anatomical variations in the formation, course and division of Sciatic nerve is important for Surgeons, Orthopedicians, Anaesthetists and other medical professionals to avoid surgical complications, to prevent failure of Sciatic block, to prevent Sciatic nerve injury during deep intramuscular injections etc.

METHODS

This study was conducted on 52 embalmed and intact Gluteal regions in 26 cadavers with no pathology, which were used for routine dissection for undergraduates over a period of three years i.e. from November 2015 to 2018, at Department of Anatomy, Andhra Medical College, Vishakhapatnam, Andhra Pradesh, India. Nineteen of the cadavers were male and seven were female.

The Gluteus maximus was elevated to explore the structures under cover of it. Piriformis was identified and the sciatic nerve emerging below it was identified and dissected to clear the sheath around it. Connective tissue sheaths surrounding the Tibial and Common peroneal nerves is also dissected. Following the proper exposure, the location and its exit from pelvis and the level of the Sciatic nerve bifurcation was observed in all dissected specimens (Figure 1).⁶



Figure 1: Exposure of sciatic nerve.

Normally sciatic nerve bifurcates at the superior angle of popliteal fossa in 80-90% of individuals. The data was analyzed manually using numbers, frequencies and percentages.

Inclusion criteria

Cadavers with intact musculature, and no fractured lower limbs.

Exclusion criteria

Limbs with fractured hip joint and femur, limbs with distorted musculature and any damages around sciatic nerve.

RESULTS

Variations in sciatic nerve bifurcation were seen in seventeen limbs. That is in fourteen limbs belonging to twelve male cadavers and three limbs belonging to two female cadavers. One Female and two male cadavers had variations in both limbs. On one side, sciatic nerve divided at Gluteal region and on the other side, Sciatic nerve divided in pelvis.

In this study authors found that in 4 limbs (7.69%) the nerve divided in the pelvic region i.e. in between ischial tuberosity and greater trochanter (Figure 2).



Figure 2: Division in pelvic region.

In 2 limbs (3.84%) sciatic nerve divided in the gluteal region below the lower border of piriformis muscle, (Figure 3).



Figure 3: Division in gluteal region.

In 10 limbs (19.23%) sciatic nerve divided at the junction between upper and middle thigh, where it is crossed by long head of Biceps muscle (Figure 4).



Figure 4: Division in thigh region.

The highest incidence of division occurred in 36 limbs (69.23%) i.e. at the superior angle of the popliteal fossa (Figure 5) (Table 1).



Figure 5: Division in popliteal fossa.



Figure 6: Trifurcation of sciatic nerve.

Table 1: Levels of bifurcation and percentage.

Level of bifurcation	Percentage
Pelvis	7.69%
Gluteal region	3.84%
Mid-thigh	19.23%
Popliteal fossa	69.23%

In this study authors found trifurcation of sciatic nerve in one limb (0.49%) (Figure 6).

DISCUSSION

Most of the textbooks of human anatomy, orthopedics and surgery state that the sciatic nerve bifurcation levels are important in clinical and treatment aspects. Just proximal to the popliteal fossa the Sciatic nerve divides into its large branches. The smaller common peroneal nerve, which deviates laterally and the larger Tibial nerve which continue distally in the midline of the limb. Compression caused by anatomical variations in the relationship of nerve to the Gluteal and Piriformis may cause Sciatic pain. In the thigh penetrating wounds and fractures of femoral shaft injures Sciatic nerve.⁷ Bifurcation into its two major divisions (common peroneal and tibial nerves) may occur anywhere between the sacral plexus and the lower part of the thigh.⁸ Identification of variations of level of bifurcation makes surgical procedures more effective and accurate. Pelvic division of Sciatic nerve in other similar studies, the magnitudes varies 19%, 48%, 17%, 20.1% of higher observation in Poland, Turkey, and Kenya respectively.⁹⁻¹¹

Chiba has studied 514 extremities for the variations of Sciatic nerve, and he found one rare variation, in 34% common peroneal nerve is piercing through Piriformis which is not seen in this study.¹² In this study in one cadaver on the right side sciatic nerve divided about 50 mm above the popliteal crease (0-150 mm) but below the superior angle of popliteal fossa. On the left side Sciatic nerve divided at the level of the popliteal crease.

One study has reported 11.11% of sciatic nerve division in the Gluteal region. Prakash et al, has reported 16.3% sciatic nerve division in Gluteal region. Other studies have reported that 48% of sciatic nerve divides in the Gluteal region.¹³⁻¹⁵ Ugrenovic et al, has reported 27.5% of high division of sciatic nerve.¹⁶ In the present study, high division of Sciatic nerve is found in 11.53% of specimens. The study Anbumani T.L et al, observed 16% showed bilateral variations and one cadaver 4% showed unilateral variation of sciatic nerve.¹⁷

Brooks et al, classified the level of division into 6 groups as follows:¹⁸

- Group A - Division of Sciatic nerve in Pelvis,

- Group B - Division of Sciatic nerve in Gluteal region,
- Group C - Division of Sciatic nerve in Upper region of thigh,
- Group D - Division of Sciatic nerve in Middle region of thigh,
- Group E - Division of Sciatic nerve in Lower region of thigh,
- Group F - Division of Sciatic nerve in Popliteal fossa.

In present study authors found 69.23% belonging to Group F -Division of Sciatic nerve in Popliteal fossa.

Kiros and Woldeyes found Sciatic nerve bifurcating in lower 1/3rd of thigh in 40.7% and 8% respectively and at popliteal fossa in 34.9% and 64% respectively.¹⁹ The findings of this study revealed that the division of sciatic nerve in the pelvic region, was observed in 8.33%. This result was different from other similar studies where the magnitudes were 19% of higher observation in Poland.⁹

Sciatic nerve bifurcation in the Gluteal region was observed in 3.84%. This result was in agreement with 2.3% observations reported on similar studies by Prakash et al.¹⁴ On the other hand, it is differing with the findings like 8%, 14% were reported in India and Poland respectively.^{2,9} Middle thigh Sciatic nerve bifurcation was observed in 19.23% in the current study. This result was nearer to 38 % observed in Kenyan population. Popliteal fossa division is seen highest in 69.23% in present study. This is correlated with study which observed 67.1% in a study by Ogengo et al.¹¹

Regional anaesthesia, which has become increasingly popular for lower limb procedures, improves the quality of postoperative pain relief.²⁰ Among regional Anaesthesia techniques for the lower limb, Sciatic nerve block is a well-established procedure that is widely used either alone or in association with other nerve blocks.²¹ The sciatic nerve is the thickest nerve in the human body. This is important to bear in mind when Sciatic nerve block is performed in the Popliteal fossa. During Popliteal block anaesthesia for surgeries of foot and ankle region the Sciatic nerve is approached 5-7 cm above the transverse popliteal crease. In such procedures, the high division of nerve leads to complete failure of Sciatic nerve block or an incomplete block of Sciatic nerve.²²

Sciatica is the term applied to the condition of pain in the area of distribution of Sciatic nerve. It is due to a longest course i.e. intraspinal, intrapelvic and extra pelvic course of sciatic nerve. Therefore, knowledge of the Anatomy is a necessary prerequisite to make differential diagnosis in disease.²³ Anatomical variations in the level at which the Sciatic Nerve divides into the Tibial nerve and Common peroneal nerve have been suspected as a possible cause for incomplete block of the Sciatic Nerve in the popliteal fossa.²⁴ In the present study, the division of the Sciatic

nerve occurs at variable distances from the Popliteal crease, ranging from 50 to 180 mm.

Sharadkumar Pralhad Sawant reported trifurcation of sciatic nerve into Tibial, superficial and deep peroneal nerves.²⁵ In another study they have observed 2 cases of sciatic nerve trifurcation out of 20 cadavers.²⁶ In this study authors found one single limb with trifurcation.

CONCLUSION

The Sciatic nerve divides into the Tibial nerve and Common peroneal nerve at variable distances above the popliteal fossa superior angle. To know the variations in the bifurcation is very important for Orthopaedicians, Surgeons and Anaesthesiologists.

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