

The Study of Sciatic Nerve Based on Its Morphometric Measurements And It's Variations In Rayalaseema Region.

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Abstract

Introduction: Sciatic nerve is the thickest and longest nerve in the human body, consists mostly of lumbosacral fibres consisting L4, L5, S1, S2, S3, they are both sensory and motor. Sciatica has been torturing mankind for hundred if not thousands of years. Sciatica refers to a burning, stinging and numbing pain that is felt in the buttock, thigh, leg and foot which not be associated with low back pain. The sciatic nerve is frequently involved in daily medical practice of neurology, orthopedics, rehabilitation of anesthesia. Sciatic nerve present significant variability concerning its topography and division into terminal branches (common peroneal nerve and tibial nerve).

Methods: In the present study, 100 lower limbs of 50 embalmed adult cadavers which were formalin fixed from the Department of Anatomy of Sri Venkateswara Medical College, Tirupati, and Rajiv Gandhi Institute of Medical Sciences, Kadapa, Rayalaseema region, A.P, were dissected and the width, length, exit, course, relations and level of division of sciatic nerve were studied and compared with the previous studies.

Observations: The length, width, level of division of sciatic nerve and it's variations below the piriformis muscle in both right & left lower limbs were observed.

Results: The length of the sciatic nerve on the right side from the lower border of the piriformis muscle to its division into Tibial & Common Peroneal Nerves is about 2 cms. to 39.1 cms. with an average of 29 cms. While the left sciatic nerves is about 3 cms. to 39 cms. with an average of 29 cms. Width on right side is as 1.2 cms to 2.4 with an average 1.88 cms and on left side it is 1.2 cms. to 2.4 cms. with an average 1.9 cms. 78% had typical division at the Superior angle of popliteal fossa, 12% are had high level division in the gluteal region with 50% on the right side and 50% on the left side and two cadavers showed bilateral variations one in male and another in the female cadaver, 6% are having intermediate division in the back of the thigh above the popliteal fossa, 4% are having low level division below the superior angle of the popliteal fossa (in the middle of the popliteal fossa) both on the right side and on the left side.

Key Words: Sciatic nerve, piriformis muscle, tibial nerve, common peroneal nerve, division.

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I. Introduction

The Sciatic nerve (Ischiadic nerve or n.ischiadicus) is the thickest, widest and largest amongst all peripheral nerves in the human body. "Sciatic" is derived from the Greek word 'ischiadikos' which means pertaining to ischium and is the chief nerve of the lower limb.

The sciatic nerve is 2 cm wide at its origin and is the thickest nerve in the body. It leaves the pelvis via the greater sciatic foramen below piriformis and descends between the greater trochanter and ischial tuberosity, along the back of the thigh, dividing into the tibial and common fibular nerves at a varying level proximal to the knee. Superiorly, it lies deep to gluteus maximus, resting first on the posterior ischial surface with the nerve to quadratus femoris between them. It then crosses posterior to obturator internus, the gemelli and quadratus femoris, separated by the latter from obturator externus and the hip joint. It is accompanied medially by the posterior femoral cutaneous nerve and the inferior gluteal artery. More distally, it lies behind adductor magnus and is crossed posteriorly by the long head of biceps femoris. Its course corresponds to a line drawn from just medial to the midpoint between the ischial tuberosity and greater trochanter to the apex of the popliteal fossa. Articular branches arise proximally to supply the hip joint through its posterior capsule; these are sometimes derived directly from the sacral plexus. Muscular branches are distributed to biceps femoris, semitendinosus, semimembranosus and the ischial part of adductor magnus. The point of division of the sciatic nerve into its tibial and common fibular components is very variable. The common site is at the junction of the middle and lower thirds of the thigh, near the apex of the popliteal fossa, but the division may occur at any level

above this point and, rarely, may occur below it. The nerve is vulnerable in posterior dislocation of the hip. As it leaves the pelvis, it passes either behind piriformis or sometimes through the muscle, and at that point it may very rarely become entrapped or tethered; the piriformis syndrome is a controversial condition in which an anomalous relationship between piriformis and the sciatic nerve is thought to cause pain in the buttocks and along the course of the sciatic nerve. External compression over the buttock, e.g. in patients who lie immobile on a hard surface for a considerable length of time, can injure the nerve. The nerve may be damaged in misplaced therapeutic injections into gluteus maximus. Sciatic nerve palsy occurs after total hip replacement or similar surgery in 1% of cases, and may be caused by sharp injury, burning from bone cement, traction from instruments, manipulation of the hip, inadvertent lengthening of the femur, or haematoma surrounding the nerve. For some reason, possibly anatomical, the common fibular component of the sciatic nerve is more usually affected; the patient has a foot drop and a high-stepping gait.⁽¹⁾

II. Materials & Methods

In the present study, 100 lower limbs of 50 embalmed adult cadavers which were formalin fixed from the Department of Anatomy of Sri Venkateswara Medical College, Tirupati, and Rajiv Gandhi Institute of Medical Sciences, Kadapa, Rayalaseema region, A.P were dissected, the width of sciatic nerve were measured using a sliding vernier calipers and the length is measured by using a twine thread, measuring tape and the exit, course, relations, level of division of sciatic nerve below the piriformis muscle were observed and compared with the previous studies.

III. Observations & Results

The length of the sciatic nerve on the right side from the lower border of the piriformis muscle to its division into Tibial & Common Peroneal Nerves is about 2 cms. to 39.1 cms. with an average of 29 cms. While the left sciatic nerves is about 3 cms. to 39 cms. with an average of 29 cms. Width on right side is as 1.2 cms to 2.4 with an average 1.88 cms and on left side it is 1.2 cms. to 2.4 cms. with an average 1.9 cm.

TABLE NO. 1: Showing Width & Length of Sciatic Nerves on both sides at lower border of Piriformis muscle

S.NO	SEX	WIDTH		LENGTH	
		RIGHT	LEFT	RIGHT	LEFT
1	Male	2 . 1	2 . 4	3 2 3	2
2	Male	2 . 0	1 . 8	3 1 3	4
3	Female	2 . 2	2 . 1	2 7 2	9
4	Male	2 . 2	2 . 0	2 9 2	6
5	Male	2 . 1	1 . 9	2 7 . 5	2 8 . 5
6	Male	1 . 9	2 . 1	3 1 3 1 . 5	
7	Male	1 . 8	1 . 6	3 0 2	8
8	Male	1 . 4	1 . 3	2 9 2	7
9	Male	1 . 7	1 . 3	3 5 3	3
1 0	Female	1 . 9	1 . 7	3 1 . 2 5	
1 1	Male	1 . 6	1 . 8	3 0 . 5 3 . 3	
1 2	Male	2 . 2	2 . 3	2 8 2 6 . 5	
1 3	Male	2 . 2	2 . 4	2 9 2 9 . 5	
1 4	Male	2 . 1	2 . 3	2 7 . 5 2 6 . 5	
1 5	Male	1 . 9	1 . 7	2 . 3 3 0 . 5	
1 6	Male	1 . 8	1 . 9	3 3 3 2 . 5	
1 7	Male	1 . 8	2 . 0	3 4 3 3 . 7 5	
1 8	Male	1 . 6	2 . 4	2 8 2 . 5	
1 9	Male	1 . 9	1 . 7	3 1 2 9 . 5	
2 0	Male	1 . 5	1 . 7	3 0 3 . 2	
2 1	Male	2 . 2	2 . 1	3 4 3 . 6	
2 2	Male	2 . 4	2 . 1	3 0 3 . 1	
2 3	Male	1 . 6	1 . 5	2 9 2 7 . 5	
2 4	Male	2 . 3	2 . 0	3 0 2 8 . 5	
2 5	Female	1 . 7	2 . 1	3 4 3 2 . 5	
2 6	Male	2 . 1	2 . 3	3 7 . 5 3 . 9	
2 7	Male	2 . 3	2 . 0	2 8 . 5 3 . 0	
2 8	Male	2 . 0	2 . 2	2 7 2 . 9	
2 9	Male	2 . 1	2 . 3	3 1 . 5 3 . 3	
3 0	Male	1 . 8	1 . 7	2 9 3 . 5	
3 1	Male	1 . 8	1 . 6	1 5 1 7 . 5	
3 2	Male	1 . 6	1 . 9	2 6 2 . 8	
3 3	Male	1 . 5	1 . 5	2 . 5 3 . 3	
3 4	Male	1 . 8	1 . 7	1 8 1 5 . 5	

3 5	Male	2 . 0	1 . 8	3 2 . 5	3 4 . 5
3 6	Female	2 . 3	2 . 8	2 . 5	3 . 5
3 7	Male	1 . 4	1 . 5	3 9 . 1	3 8 . 5
3 8	Male	1 . 7	1 . 6	3 . 1	3 2 . 5
3 9	Male	2 . 0	1 . 8	3 . 2	3 1 . 5
4 0	Male	2 . 1	2 . 1	2 9 . 1	2 9 . 5
4 1	Male	2 . 2	2 . 2	2 8 . 2	2 8 . 5
4 2	Male	2 . 4	2 . 1	3 . 5	3 . 1
4 3	Male	1 . 8	1 . 5	3 1 . 5	3 0 . 5
4 4	Male	1 . 9	1 . 7	3 1 . 5	3 . 1
4 5	Male	1 . 7	1 . 2	3 . 5	2 8 . 5
4 6	Female	1 . 8	1 . 5	3 0 . 7 5	3 0 . 3 5
4 7	Male	2 . 4	2 . 2	3 1 . 5	3 . 1
4 8	Male	2 . 2	2 . 1	2 9 . 5	4 . 5
4 9	Male	1 . 5	1 . 7	1 6 . 5	1 . 8
5 0	Female	1 . 6	1 . 5	3 0 . 5	2 9 . 5

FIGURE 1:Shows Measuring The Width Of Sciatic Nerve:



FIGURES 2 & 3: SHOWS MEASURING THE LENGTH OF SCIATIC NERVE



FIGURE 4: Showing Course Of S.N Below Piriformis And It's Typical Divisionat Superior Angle Of Popliteal Fossa.

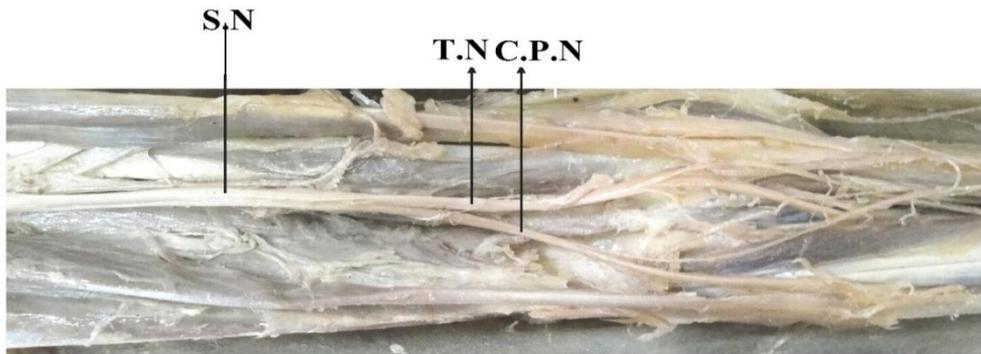


FIGURE 5: Showing High Level Of Division Of S.N In Gluteal Region Below Piriformis.

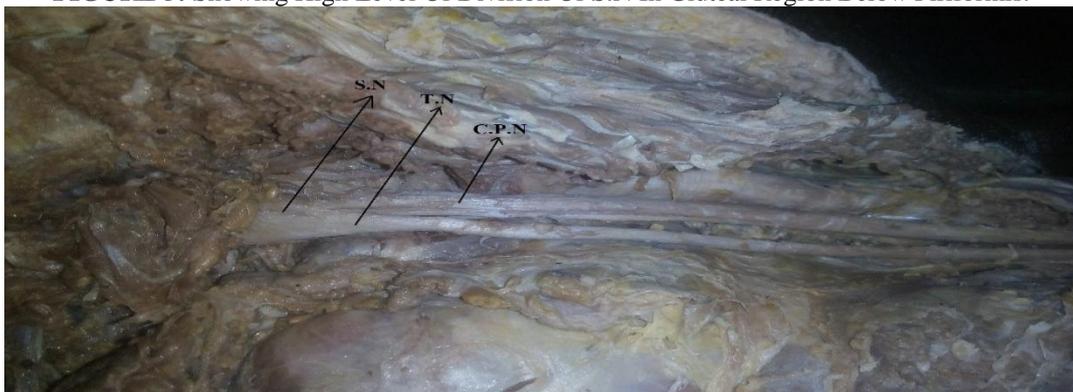


FIGURE 6: Showing Intermediate Level Of Division In Back Of Thigh

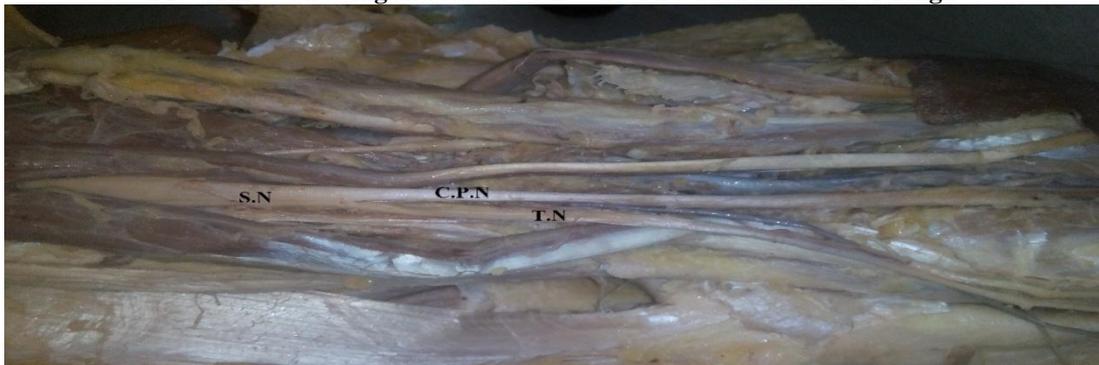


FIGURE 7: Showing Lowel Level Division Of Sciatic Nerve In Middle Of Popliteal Fossa



TABLE NO. 2 SHOWING LEVEL OF DIVISION OF SN INTO TN & CPN IN BOTH SIDES.

S.NO	Sex	Division - Right Side		Division - Left side	
		Level	Type	Level	Type
1	Male	Proximal angle of popliteal fossa	Typical	Proximal angle of popliteal fossa	Typical
2	Male	Proximal angle of popliteal fossa	Typical	Proximal angle of popliteal fossa	Typical
3	Female	Proximal angle of popliteal fossa	Typical	Proximal angle of popliteal fossa	Typical
4	Male	Proximal angle of popliteal fossa	Typical	Proximal angle of popliteal fossa	Typical
5	Male	Proximal angle of popliteal fossa	Typical	Proximal angle of popliteal fossa	Typical
6	Male	Proximal angle of popliteal fossa	Typical	Proximal angle of popliteal fossa	Typical
7	Male	Proximal angle of popliteal fossa	Typical	Proximal angle of popliteal fossa	Typical
8	Male	Proximal angle of popliteal fossa	Typical	Proximal angle of popliteal fossa	Typical
9	Male	Proximal angle of popliteal fossa	Typical	Proximal angle of popliteal fossa	Typical
10	Female	In gluteal region	High level	Proximal angle of popliteal fossa	Typical
11	Male	Proximal angle of popliteal fossa	Typical	In gluteal region	High level
12	Male	Proximal angle of popliteal fossa	Typical	Proximal angle of popliteal fossa	Typical
13	Male	Proximal angle of popliteal fossa	Typical	Proximal angle of popliteal fossa	Typical
14	Male	Proximal angle of popliteal fossa	Typical	Proximal angle of popliteal fossa	Typical
15	Male	Proximal angle of popliteal fossa	Typical	In gluteal region	High level
16	Male	Proximal angle of popliteal fossa	Typical	Proximal angle of popliteal fossa	Typical
17	Male	Proximal angle of popliteal fossa	Typical	Proximal angle of popliteal fossa	Typical
18	Male	In gluteal region	High level	Proximal angle of popliteal fossa	Typical
19	Male	Proximal angle of popliteal fossa	Typical	Proximal angle of popliteal fossa	Typical
20	Male	Proximal angle of popliteal fossa	Typical	Proximal angle of popliteal fossa	Typical
21	Male	Proximal angle of popliteal fossa	Typical	Proximal angle of popliteal fossa	Typical
22	Male	Proximal angle of popliteal fossa	Typical	Proximal angle of popliteal fossa	Typical
23	Male	Proximal angle of popliteal fossa	Typical	Proximal angle of popliteal fossa	Typical
24	Male	Proximal angle of popliteal fossa	Typical	Proximal angle of popliteal fossa	Typical
25	Female	Proximal angle of popliteal fossa	Typical	Proximal angle of popliteal fossa	Typical
26	Male	Middle of the popliteal fossa	Low Level	Middle of the popliteal fossa	Low Level
27	Male	Proximal angle of popliteal fossa	Typical	Proximal angle of popliteal fossa	Typical
28	Male	Proximal angle of popliteal fossa	Typical	Proximal angle of popliteal fossa	Typical
29	Male	Proximal angle of popliteal fossa	Typical	Proximal angle of popliteal fossa	Typical
30	Male	Proximal angle of popliteal fossa	Typical	In gluteal region	High level
31	Male	Back of thigh above the proximal angle of popliteal fossa	Intermediate level	Back of thigh above the proximal angle of popliteal fossa	Intermediate level
32	Male	Proximal angle of popliteal fossa	Typical	Proximal angle of popliteal fossa	Typical
33	Male	In gluteal region	High level	Proximal angle of popliteal fossa	Typical
34	Male	Back of thigh above the proximal angle of popliteal fossa	Intermediate level	Back of thigh above the proximal angle of popliteal fossa	Intermediate level
35	Male	Proximal angle of popliteal fossa	Typical	Proximal angle of popliteal fossa	Typical
36	Female	In gluteal region	High level	In gluteal region	High level
37	Male	Middle of the popliteal fossa	Low Level	Middle of the popliteal fossa	Low Level
38	Male	Proximal angle of popliteal fossa	Typical	Proximal angle of popliteal fossa	Typical
39	Male	Proximal angle of popliteal fossa	Typical	Proximal angle of popliteal fossa	Typical
40	Male	Proximal angle of popliteal fossa	Typical	Proximal angle of popliteal fossa	Typical
41	Male	Proximal angle of popliteal fossa	Typical	Proximal angle of popliteal fossa	Typical
42	Male	In gluteal region	High level	In gluteal region	High level
43	Male	Proximal angle of popliteal fossa	Typical	Proximal angle of popliteal fossa	Typical
44	Male	Proximal angle of popliteal fossa	Typical	Proximal angle of popliteal fossa	Typical
45	Male	In gluteal region	High level	Proximal angle of popliteal fossa	Typical
46	Female	Proximal angle of popliteal fossa	Typical	Proximal angle of popliteal fossa	Typical
47	Male	Proximal angle of popliteal fossa	Typical	Proximal angle of popliteal fossa	Typical
48	Male	Proximal angle of popliteal fossa	Typical	In gluteal region	High level
49	Male	Back of thigh above the proximal angle of popliteal fossa	Intermediate level	Back of thigh above the proximal angle of popliteal fossa	Intermediate level
50	Female	Proximal angle of popliteal fossa	Typical	Proximal angle of popliteal fossa	Typical

Out of 100 limbs, 78% had typical division at the proximal (Superior) angle of popliteal fossa, 12% are had high level division in the gluteal region with 50% on the right side and 50% on the left side and two cadavers showed bilateral variations one in male and another in the female cadaver, 6% are having intermediate division in the back of the thigh above the popliteal fossa, 4% are having low level division below the superior angle of the popliteal fossa (in the middle of the popliteal fossa) on both the right side and on the left side.

IV. Discussion

According to W.Henry Hollinshead⁽²⁾ the sciatic or ischiadic nerve in relation with the piriformis muscle holds in approximately 85 percent of cases, while in the remainder part or all of the sciatic nerve courses through, or a part courses into the buttock, and that the piriformis muscle may be divided into two parts by one or both components of the sciatic nerve. Since the nerve may be divided or undivided, and either one of the two parts or both may conceivably course below, through, or above the piriformis muscles. The variations from the

normal usually reported are only three: passage of the entire nerve through the muscle; passage of a part of it through and the other part below the muscle; and passage of the part below and the other above the muscle.

P Diogo et al⁽³⁾ stated there are numerous reports in the literature of terminal division of the sciatic nerve that, it can be divided at any point from its origin to termination. According to Brooks JBB et.al⁽⁴⁾ the level of division of nerve can be classified into different groups. Group A consists of sciatic nerve division proximally to its exit in the gluteal region. In Group B, it divides in the gluteal region. In Group C, D and E it divides in the upper, middle and lower region of the thigh respectively. In Group F the nerve divides in the popliteal fossa. Beaton and Anson⁽⁵⁾ classified variations of the piriformis muscle and the sciatic nerve in 240 specimens in 1938 into different types. The classification is known as Beaton and Anson classification, is as follows.

Type 1: Undivided nerve below undivided muscle

Type 2: Division of nerve between and below undivided muscle

Type 3: Division above and below undivided muscle

Type 4: Undivided nerve between heads

Type 5: Division between and above heads

Type 6: Undivided nerve above undivided muscle.

Sanjay Kumar Yadav⁽⁶⁾ observed that in 33 specimens the sciatic nerve emerged through the greater sciatic foramen below the piriformis muscle as a single nerve without division (78.57%), in 2.38% both the components of sciatic nerve were separated below piriformis (E3) - Separate tibial and common peroneal nerve components below piriformis and also observed that most common site of division of sciatic nerve is in the popliteal fossa in both sexes (D5); 2nd most common site of division was observed near the superior angle of popliteal fossa in both sexes (D4).; In six specimens showed division of the sciatic nerve was at the upper part of the thigh; In eight specimens sciatic nerve was divided in the gluteal region; In six specimens sciatic nerve divided in the middle of the thigh (D3); It shows that more common length (35 – 42.5 cm) in males whereas (35 – 38.5 cm) in females from lower margin of piriformis to the popliteal fossa. 2nd common length (32 – 34.5 cm) in males whereas (29.5 – 34.5 cm) in female up to near the superior angle of popliteal fossa. Mallikarjun adibatti et.al⁽⁷⁾, studied 50 lower limbs and observed sciatic nerve emerged as a single trunk below the piriformis in 46 specimens (92%). High division of Sciatic Nerve in the back of thigh was noted in one specimen (2%).

Mustafa Guvencer et.al⁽⁸⁾ Sciatic Nerve exited the pelvis through the infrapiriform portion of greater sciatic foramen (IP) with no variation in 38 of the 50 gluteal regions (76%). The SN exited the pelvis as an undivided nerve in 26 gluteal regions (52%). There was evidence of high division of the SN in 24 gluteal regions (48%). The TN and the CPN leave the pelvis through the infrapiriform portion of greater sciatic foramen (IP) together within the different sheath in 12 out of 24 gluteal regions with high division in 24%.

Prakash et.al⁽⁹⁾ in a study observed two (one male and female each) out of 86 (2.3%) extremities, the sciatic nerve made tibial and common peroneal divisions in the gluteal region (Group B). In three (two male and 1 female) out of 86 (3.5%) extremities, it divided at the upper part of the posterior compartment of the thigh (Group C). 2.3% of the extremities (one male and one female) showed a division of the sciatic nerve at the middle part of the back of the thigh (Group D). Group E reported the highest incidence of sciatic nerve division; in 35 (24 male and 11 female) out of 86 extremities (40.7%), the sciatic nerve divided at the lower part of the posterior compartment of the thigh. 30 (21 male and nine female) out of 86 extremities (34.9%) were classified under Group F, as they showed division of the sciatic nerve into tibial and common peroneal nerves in the popliteal fossa.

Sabnis A.S⁽¹⁰⁾ observed majority (90.7%) of lower limbs (LL) show bifurcation of sciatic nerve at lower level and 9.28% of LL show at higher level. In only one cadaver bilateral higher bifurcation was seen, one side shows division below piriformis and other side shows piriformis in between CPN & TN and also found bifurcation in popliteal fossa in 24% of lower extremities unilaterally, 34% bilaterally & in upper 1/3rd of thigh in 16% unilaterally &, 15% bilaterally.

Saritha S et.al⁽¹¹⁾, observed a male cadaver showed bilateral variation in which Sciatic nerve on the right side 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. Shivaji B Sukre⁽¹²⁾ observed the sciatic nerve exited the pelvis below the piriformis and divided at the superior angle of popliteal fossa in 25 cadavers (83.33%). In four out of the 30 cadavers (13.33%), the sciatic nerve was seen to leave the pelvis below the undivided piriformis with its two components together but in separate sheaths.

Ugrenovic et al⁽¹³⁾ found high division of the sciatic nerve either in the posterior femoral region or in the gluteal region in 27.5% of the specimens in a cadaveric study in 2005 performed on 100 fetuses. They have also highlighted that high division of sciatic nerve may cause an incomplete sciatic nerve block during the popliteal block anaesthesia. R. R. Karambelkar et al⁽¹⁴⁾ observed the sciatic nerve exited the pelvis through the greater sciatic foramen below piriformis as a single nerve without division in 66 of the 90

gluteal regions (73.33%). In 2 specimens (2.22%) both the nerves were separate and the tibial nerve was in separate rootlet form. In 10 specimens (11.11%) both the components were in the infrapiriform compartment but separately emerging and found level of division was 11.11% at gluteal region (D1), 6.67% at upper part of thigh (D2), 4.44% at middle part of thigh (D3), 70.00% at lower part of thigh near superior angle of popliteal fossa (D4), 7.78% at lowermost, in the popliteal fossa posterior to knee joint (D5).

In the present study, all the lower limbs showed course of sciatic nerve below the piriformis muscle and the level of divisions of sciatic nerve below the piriformis were considered in the present study. Out of 100 limbs, 78% had typical division at the proximal (Superior) angle of popliteal fossa, 12% are had high level division in the gluteal region with 50% on the right side and 50% on the left side and two cadavers showed bilateral variations one in male and another in the female cadaver, 6% are having intermediate division in the back of the thigh above the popliteal fossa, 4% are having low level division below the superior angle of the popliteal fossa (in the middle of the popliteal fossa) on both the right side and on the left side. The present study is nearly in correlation with the studies of Sanjay Kumar Yadav ⁽⁶⁾, Prakash et.al ⁽⁹⁾, Sabnis A.S ⁽¹⁰⁾, with Shivaji B Sukre ⁽¹⁴⁾, Ugrenovic et al ⁽¹⁵⁾, R. R. Karambelkar et al ⁽¹⁶⁾.

V. Summary & Conclusion

The present study has been carried out in 100 lower limbs of 50 cadavers which were dissected and observed for morphometry and variations of sciatic nerve and found 78% of limbs had typical course and division into tibial nerve and common peroneal nerve at the superior angle of popliteal fossa, 12% had high level of division in the gluteal region below the piriformis muscle and 6% had intermediate level of division in the back of thigh above the popliteal fossa and 4% were dividing within the popliteal fossa as low level division. The observations made in the study is useful for enlightening the knowledge of morphometry and variations of sciatic nerve which prevents the complications during interventions made by anaesthetics and surgeons and to prevent the iatrogenic causes related to sciatic nerve damage.

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