

Variations in Division of Sciatic Nerve and its Clinical Relevance: A Cadaveric Study

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Abstract

Introduction: The sciatic nerve emerges through the greater sciatic foramen, leaves pelvis and enters into gluteal region by passing below piriformis as a single nerve encompassed by a single epineural sheath. It descends along back of thigh and divides into tibial nerve and common peroneal nerve, usually at superior angle of popliteal fossa. Understanding of variations in the levels of division of sciatic nerve is important for the management of non-discogenic sciatica, posterior hip operations, failed sciatic nerve block. Objective: To study the variations in division of sciatic nerve and to define the level of its exit. **Subjects and Methods:** Seventeen cadavers (34 limbs) fixed in formalin were dissected and studied during routine dissection in department of Anatomy, Mysore Medical College and level of division of sciatic nerve were noted. **Results:** Out of 34 limbs, 5 cases (14.7%) were dividing at gluteal region, 2 cases (5.8%) at mid-thigh and 27 cases (79.4%) exited pelvis as a whole nerve and divided at superior angle of popliteal fossa. Type G was most common variation. **Conclusion:** The exit and level of division of sciatic nerve is important for surgeons as there is surgical maneuvering in this region during posterior hip operations and to avoid iatrogenic nerve injury during deep intramuscular injections in gluteal region.

Keywords: Sciatic nerve, Tibial nerve, common peroneal nerve.

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Introduction

The sciatic nerve 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.^[1] The common site of division of sciatic nerve is at the junction of the middle and lower thirds of the thigh, near the apex of the popliteal fossa, seen in 80%-90% of individuals but the division may occur at any level above this point, and it is variable. These variations may cause nerve compressions under other structures leading to non discogenic sciatica, piriformis syndrome,^[2] nerve injury during deep intramuscular injections in gluteal region,^[3] failed popliteal nerve block in anesthesia.^[4] The anatomical variations of the level at which the sciatic nerve divides is considered important by clinicians during neuromuscular diagnosis and treatments in lower limb. The present study is undertaken to know the incidence in variations of division of sciatic nerve in relation to piriformis in south Indian population.

Subjects and Methods

The study was carried out on 34 formalin fixed lower limbs (males: 24, females: 10) during routine dissection in department of Anatomy, Mysore Medical College for a period of three years. The division of sciatic nerve were evaluated for possible variations. The gluteal region, back of the thigh and popliteal fossa were exposed by dissection. The gluteus maximus muscle was cut from its insertion and reflected towards its origin. The biceps femoris muscle was retracted and the nerve was then exposed in popliteal fossa. The course of the nerve was delineated and looked for any possible variations. The exit of the nerve from pelvis, its relation to piriformis and level of division of the nerve were recorded under the following 1) at level of gluteal region (high division) in relation to piriformis, 2) intermediate division 3) at the level of superior angle of popliteal fossa.

Results

Among the 34 limbs studied, a total of 7 limbs showed variations in the division of the nerve. All the variations were seen in male cadavers. 5 cases (14.7%) were dividing at gluteal region of which 4 were of type G variety (2 bilateral and 2 unilateral) where the tibial nerve and common peroneal nerve passes below piriformis (FIG-1) and one of Type C was seen unilaterally where common peroneal nerve was seen to arise above the piriformis and

tibial nerve below (FIG-2). Intermediate division was seen bilaterally in 2 cases (5.8%) approximately at upper thigh (FIG-3) and 27 cases (79.4%) were of Type A variety which showed normal division at superior angle of popliteal fossa. Trifurcation of the nerve was not observed in any of the cases. [Table 1]

Table 1: Distribution of levels of division of sciatic nerve

Laterality	Level of division		
	Gluteal region	Intermediate	Superior angle of Popliteal fossa
Bilateral	Type G(2)	2	Type A (24)
Unilateral	Type C(1)	Nil	Type A(3)
	Type G(2)		

Table 2: Comparison of incidence of variations of sciatic nerve with previous studies.

SL. No	Authors	Type A	Type B	Type C	Type D	Type E	Type F	Type G
1	Beaton and Anson ^[8]	84.0%	11.7%	3.3%	0.8%	Nil	nil	Nil
2	Tomaszewski et al ^[9]	85.2%	9.8%	1.9%	<1%	Nil	<1%	<1%
3	Ugrenovic et al ^[10]	96%	2.5%	1.5%	nil	Nil	nil	Nil
4	Bergman et al ^[7]	87.5%	12%	0.5%	2.25%	Nil	nil	Nil
5	Pokorny et al ^[11]	79.1%	14.3%	4.4%	2.2%	Nil	nil	Nil
6	Natsis et al ^[13]	89.8%	6.1%	0.7%	0.7%	Nil	0.7%	Nil
7	Berihu et al ^[16]	75%	Nil	2%	nil	Nil	nil	9%
8	Sinha et al ^[12]	85%	9%	9%	3%	Nil	nil	Nil
9	Patel et al ^[17]	91.8%	5.81%	nil	nil	Nil	nil	2.32%
10	Present study	74.4%	Nil	2.9%	nil	Nil	nil	11.7%

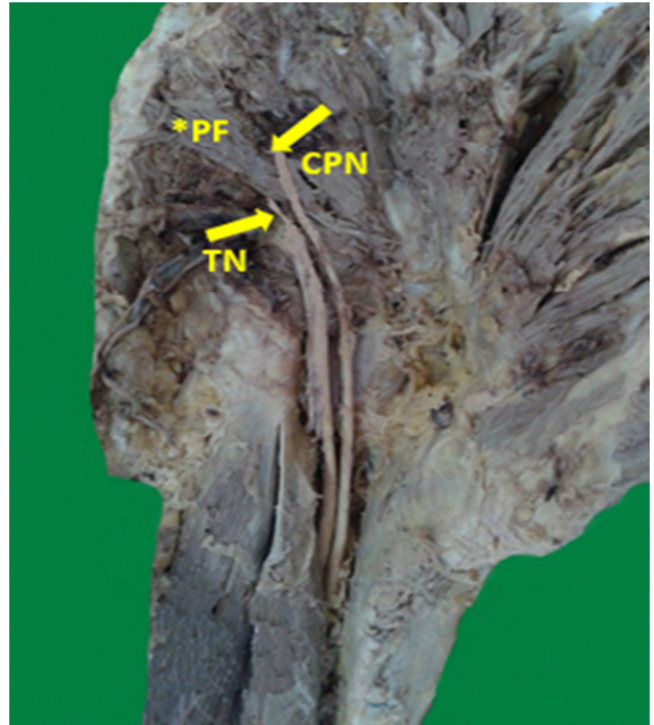


Figure 2: Type C variation showing CPN passes above the PF while the TN runs below

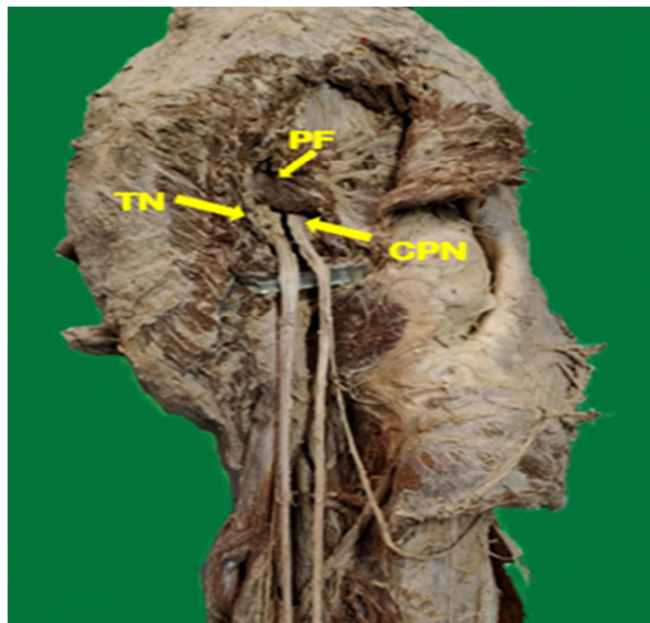


Figure 1: Type G variation showing TN and CPN dividing below Piriformis (PF)



Figure 3: Variation of Sciatic nerve showing Intermediate division

Discussion

Sciatic nerve is a mixed nerve and the largest branch of lumbosacral plexus. It is formed by ventral rami L4-S3 of the spinal nerves, and at the base of the limb bud they are subdivided into dorsal and ventral components, to provide

innervation for the appropriate muscle compartment as they follow the growth cones of the limb bud.^[5] Sciatic nerve presents significant variations concerning its division owing to its embryological basis as both components of the plexus move closely together downwards.^[6] The tibial and common peroneal nerve may directly arise from sacral plexus.^[7]

Based on the literature, Beaton and Anson,^[8] has classified the variation of sciatic nerve in relation with piriformis and it was modified by Tomaszewski et al.^[9] The present study was done according to modified classification and is as follows: Type A- The sciatic nerve(SN) passes below the piriformis(PF) (most common), Type B-The SN divides in the pelvis, the common peroneal nerve(CPN) pierces the PF and the tibial nerve(TN) passes below the PF ,Type C-The SN divides in the pelvis, the CFN passes above the PF, while the TN runs below. Type D-The SN pierces the PF. Type E-The SN divides in the pelvis, the CFN runs over the PF, and the TN pierces the PF. Type F-The SN exits the pelvis undivided above the PF. Type G-The SN divides in the pelvis, the CFN and the TN courses separately below the PF.

The different types of variations accounts for the early division of the nerves at their origins and their subsequent courses below. The variations with its frequency is shown in [Table 2]. In the present study, most commonly seen was type A (79.4%) where the sciatic nerve passes below piriformis and divided at the level of superior angle of popliteal fossa, it was in par with the literature although Chiba et al,^[14] and Moore and Dalley,^[15] mentioned type B as commonly seen, 34% and 12.2% respectively. The second most common variation noted in the gluteal region was type G (11.7%) which was similar to study of Berihu et al,^[16] whereas type B was reported in literature. It was followed by type C (2.9%) and the highest incidence of type C (16%) was reported by Machado et al.^[18] Babinski et al,^[25] described a rare variation in which the CPN passed superior and TN inferior to superior gemellus muscle. A case report of double superior gemellus and double piriformis muscles associated with SN dividing and passing between two piriformis has been described by Arifoglu et al,^[26] These variations make the nerve vulnerable to compression, leading to neurological defects like piriformis syndrome, coccygodynia and muscle atrophy.

Intermediate division of sciatic nerve was noted in 5.8% where the division was at upper thigh which was different with the study of Kumar et al,^[19] and Kiros et al,^[20] who reported 14% and 12% respectively. Prakash et al,^[21] has reported as low as 3.5%.In the present study, the high and intermediate divisions of sciatic nerve (20.5%) were seen in males which differed from the study of Patel et al,^[17] reported variations in 3.12% of males and 22.72% in females. Ewa Okraszewska,^[22] reported no correlation of sciatic nerve variation with the sex. The variations were found unilaterally in 3 cases and bilaterally in 2 cases. There is no significant difference in laterality.

The high division may account for failures in popliteal nerve block. Popliteal block is usually given by insertion of the needle at 100mm above the popliteal crease. Saleh et al,^[24] observed that SN division occurs at a variable level 50-180mm above the popliteal fossa and may account for failures with popliteal block anesthesia. The variation of

sciatic nerve can be the cause of iatrogenic nerve injury during intramuscular injections in gluteal region.^[3] It may also account to recurrent symptoms and refractory to treatment in patients with symptomatic lumbar disc herniation and sciatic neuropathy following total hip replacement.^[23]

Conclusion

The anatomic variations of the sciatic nerve should be considered during procedures of gluteal region and thigh flap reconstructive surgeries to avoid iatrogenic injuries. The present study recorded a higher percentage of Type G compared to other literature. Proper understanding of these variants allow surgeons and radiologists to provide early intervention and better treatment outcome in south Indian population.

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