



CADAVERIC STUDY FOR LEVEL OF DIVISION OF SCIATIC NERVE AND ITS CLINICAL IMPLICATIONS.

Anatomy

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ABSTRACT

The Sciatic nerve (SN) is the nerve of posterior compartment of thigh. It is the thickest nerve of human body and formed in pelvis from ventral rami of 4th lumbar to 3rd sacral spinal nerves. It enters the lower limb via the greater sciatic foramen below piriformis. The nerve passes along the back of the thigh, and divides into the tibial and common fibular nerves proximal to the knee. The actual level of division is variable since both nerves are structurally separate and only loosely connected throughout their proximal course. For this study 26 Lower limbs of 13 cadavers, dissected and examined. Results are divisions at pelvic region (7.69%), upper third region (3.85%), in middle third region (19.23%), superior angle of popliteal fossa (7.69%) and in lower third region (61.54%). Purpose of this study is to identify variations in level of division of the sciatic nerve with clinical.

KEYWORDS

INTRODUCTION:-

Sciatic nerve is thickest nerve composed of Tibial nerve and Common fibular nerve, both emerges as common trunk from lumbosacral plexus. Tibial nerve is a ventral branch of ventral rami of L4 to S3 spinal nerves. Common fibular nerve forms from dorsal branches of ventral rami of L4 to S2 spinal nerves. Sciatic nerve leaves greater sciatic foramen below Piriformis muscle and descends between the Greater trochanter and Ischial tuberosity. At the back of thigh it divides into Tibial and Common fibular nerves at a varying level proximal to knee. Superiorly, it lies deep to Gluteus Maximus muscle with the nerve to the Quadratus Femoris. It crosses posterior to the Obturator Internus muscle, the Gemeli muscles and Quadratus femoris muscle. Medially, it is accompanied by posterior femoral cutaneous nerve and the inferior gluteal artery. Distally, it lies behind Adductor Magnus and is crossed posteriorly by the long head of Biceps femoris. It corresponds to a line from medial to the midpoint between the ischial tuberosity and greater trochanter to the apex of the popliteal fossa. Articular branches from Sciatic nerve arise proximally to supply hip joint through its posterior capsule. These articular branches are sometimes derived directly from the sacral plexus. Muscular branches are given to Biceps femoris muscle, Semitendinosus muscle, Semimembranosus muscle and Ischial part of Adductor magnus muscle [1]. The point of division of Sciatic nerve is variable. **The common site is at the junction of the middle and lower thirds of the thigh, near the apex of the popliteal fossa as documented [1].** The sciatic nerve supplies the knee flexors and all the muscles below the knee, so complete palsy of this nerve results in a flail foot and severe difficulty in walking. The nerve is vulnerable to injury in posterior dislocation of the hip. This study aims at observing the course and variations in the branching pattern of the sciatic nerve.

MATERIALS AND METHODS:-

26 sciatic nerves from 13 Formalin fixed cadavers were examined during routine cadaveric dissection for the purpose of undergraduate teaching in Department Of Anatomy, Gandhi Medical College, Bhopal. Sciatic nerve bifurcation at the superior angle of popliteal fossa was considered as normal [1].

Dissection of gluteal region was done by exposing and cleaning of the gluteus maximus muscle to show the structures covered under it. Sciatic nerve was exposed in the left and right lower limbs of the cadavers by the standard dissection technique which we use regularly for teaching [2]. Piriformis muscle and its relation to the sciatic nerve and its branches were observed. Dissection of the posterior compartment of the thigh was also done to observe the origin, course, branching pattern and variations of bifurcation of Sciatic nerve.

Classification, followed for identifying and grouping pattern of bifurcation of Sciatic nerve [3].

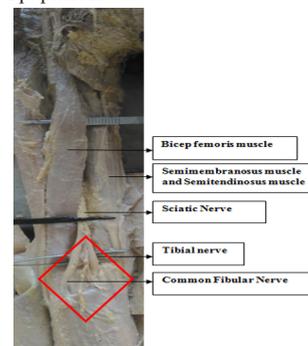
1. **Group A-** Division of SN in the pelvis and its two divisions (CPN and TN) emerging in different relations with piriformis.
 - a. **Type 1:** Both CPN and TN infrapiriformis
 - b. **Type 2:** CPN through piriformis and TN infrapiriformis .
 - c. **Type 3:** Both CPN and TN through piriformis.
 - d. **Type 4:** CPN suprapiriformis and TN infrapiriformis.
 - e. **Type 5:** CPN suprapiriformis and TN through piriformis .

2. **Group B-** Division of SN after its exit from Greater sciatic foramen: This group may be first divided into three **subgroups B1, B2 and B3** depending upon the relation of the main trunk of the SN with piriformis.
 - A) **B1-** SN emerging below Piriformis
 - B) **B2-** SN emerging through piriformis
 - C) **B3-** SN emerging above piriformis

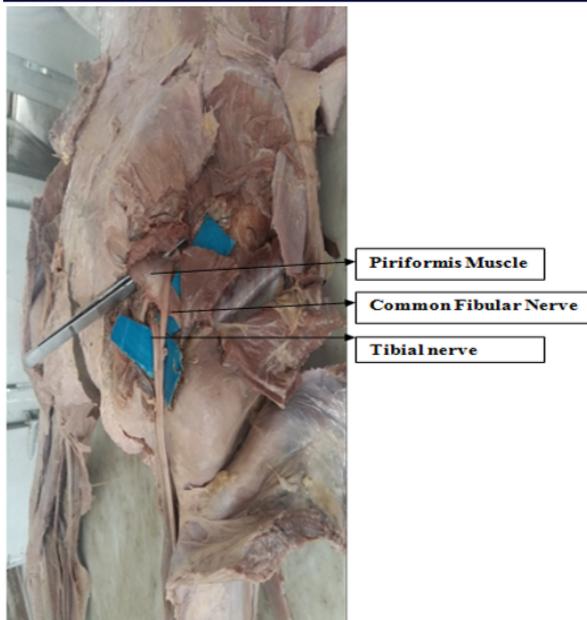
- A) **B1-** SN emerging below Piriformis
- B) **B2-** SN emerging through piriformis
- C) **B3-** SN emerging above piriformis

Now all these subgroups may be classified into different types depending upon the level of division of SN after its exit from Greater sciatic foramen.

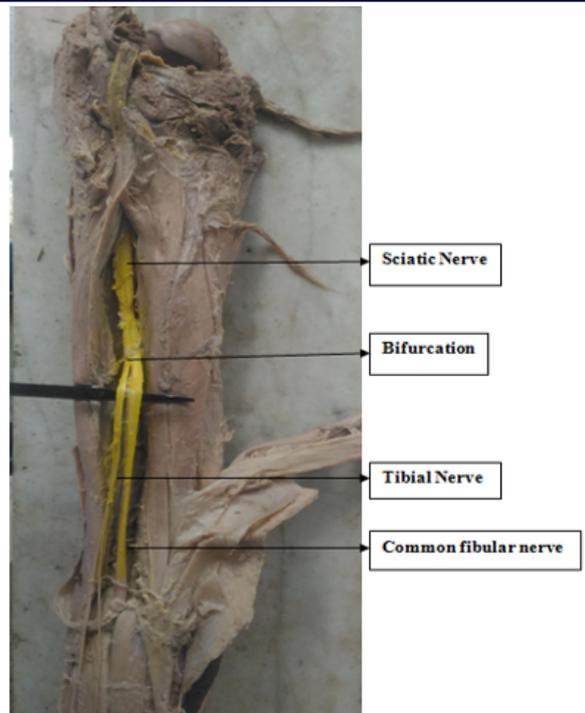
- a. **Type 1-** Division of SN in gluteal region i.e. between its exit from GSF and gluteal fold.
- b. **Type 2-** Division at the junction of gluteal region and upper 1/3rd of thigh
- c. **Type 3-** Division in the upper 1/3rd of the thigh
- d. **Type 4-** Division at junction of upper and middle 1/3rd of thigh
- e. **Type 5-** Division in the middle 1/3rd of thigh
- f. **Type 6-** Division at the junction of middle and lower 1/3rd of thigh which is also the superior angle of popliteal fossa.
- g. **Type 7-** Division in lower 1/3rd of thigh which is equivalent to upper half of popliteal fossa.



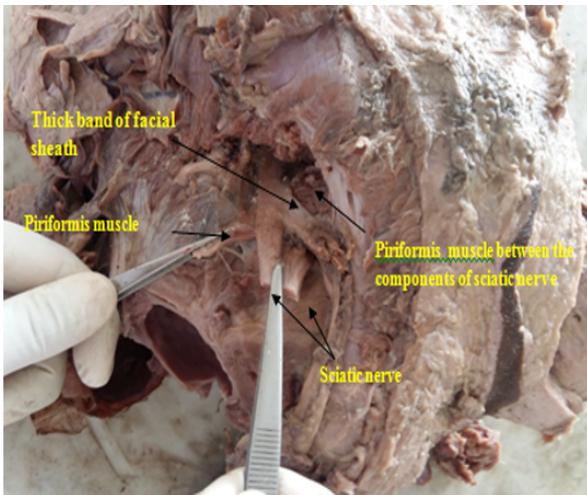
[Fig. 1] Normal, Division at the junction of middle and lower 1/3. Group B Subgroup B1 Type 6



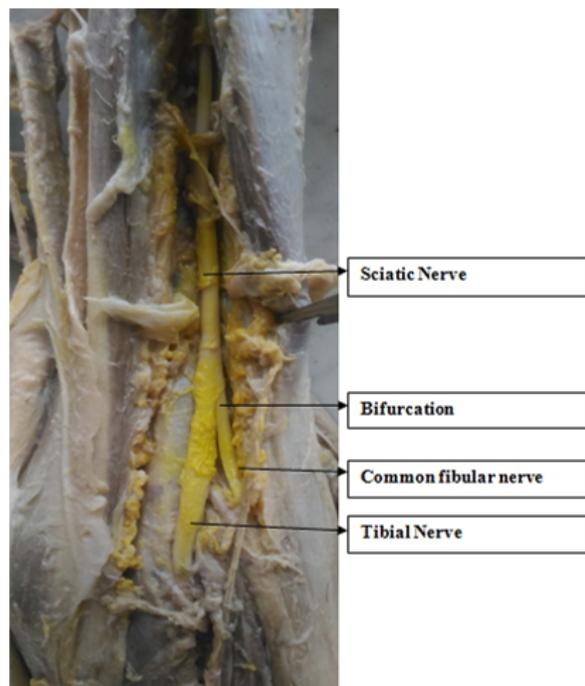
[Fig. 2]CPN suprapiriformis and TN infrapiriformis and both enclosed in fascial sheath to form sciatic nerve and further divide in mid third of posterior compartment. Group A Type 4



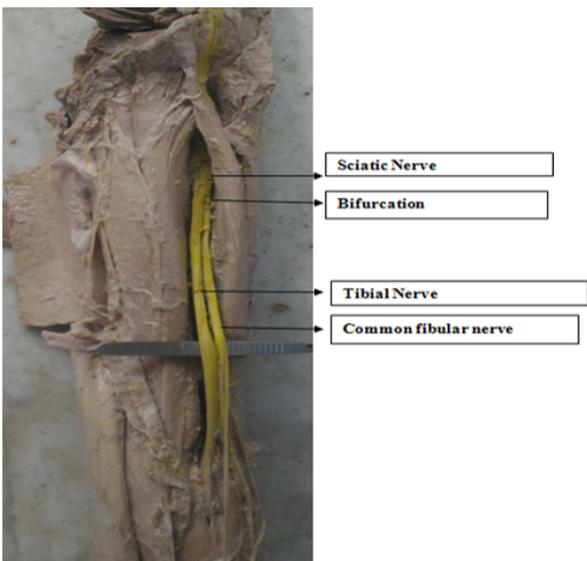
[Fig 5] Bifurcation at middle 1/3 rd Group B Subgroup B1 Type 5



[Fig 3] TN and CPN above and below piriformis muscle Group A Type 4



[Fig 6] Bifurcation at lower 1/3 rd Group B Subgroup B1 Type 7



[Fig 4] Bifurcation at upper 1/3 rd. Group B Subgroup B1 Type 3

Results:- In this study, 26 limbs from 12 male cadavers and 1 female were studied.

Table 1: Levels of Bifurcation of SN. [3]

Sr. no	Group	Subgroup	Type	Incidence		
				Rt	Lt	Total
1	A	-	Type 4	1(3.85%)	1(3.85%)	2(7.69%)
2		B1	Type 3	1(3.85%)	0	1(3.85%)
3	B	B1	Type 5	3(11.55%)	2(7.69%)	5(19.23%)
4		B1	Type 6	1(3.85%)	1(3.85%)	2(7.69%)
5		B1	Type 7	8(30.77%)	8(30.77%)	16(61.54%)
	Total			14(53.84%)	12(46.16%)	26(100%)

The findings of this study states that in 2 limbs (7.69%) sciatic nerve divides in pelvis into CPN and TN enters gluteal region above and

below piriformis and then enclose in sheath [Figure 2, 3] there we found a thick fascial band which crosses over piriformis from CPN to superior gemellus muscle, then SN continue up to the lower 3rd and separates in CPN and TN. In 1 limb (3.85%), according to classification given sciatic nerve emerges below piriformis and divide in the upper third region [Figure 4]. In 5 limbs (19.23%), sciatic nerve emerges below piriformis and divides in the middle third region [Figure 5]. In 2 limbs (7.69%), sciatic nerve emerges below piriformis and nerves divided at the junction of middle and lower one-third region [Figure 1]. In 16 limbs (61.54%), sciatic nerve emerges below piriformis and nerves divided at the lower third region [Figure 6].

Table 2: Symmetry in bifurcation of paired SN.

S. No.	Group	Subgroup	Type	Rt	Lt	Symmetry in paired limbs
1.	A	-	Type 4	1	1	Symmetrical
2.		B1	Type 3	1	0	Asymmetrical pair
3.	B	B1	Type 5	3	2	Asymmetrical one pair
4.		B1	Type 6	1	1	Symmetrical
5.		B1	Type 7	9	9	Symmetrical

The highest incidence of sciatic nerve division occurs in 16 limbs (61.54%) in the lower third part of the posterior compartment of the thigh. Beside this, 2 pairs of SN were asymmetrical in the level of its bifurcation.

DISCUSSION:-

Different researchers have given different results in their studies of sciatic nerve depending upon its level of bifurcation.

Harsimran Grewal et al (2016) - In the present study, the elaborated classification, followed was given by them. In their study, the highest incidence of SN bifurcation was observed at superior angle of popliteal fossa (63.3%) followed by division at junction of upper and middle 1/3rd of thigh (20%), in the pelvis (10%) and in middle 1/3rd of thigh (6.7%). **Mengstu Desalegn Kiros et al (2015)** in their study states, highest incidence of division occurs in 32 limbs in the popliteal fossa (64%), in 12 limbs, at upper, middle and lower part of the posterior compartment (24%), in 4 limbs, the nerve divided in the pelvis region (8%), in 2 limbs in the gluteal region (4%). In addition 8 (32%) of the 25 cadavers were asymmetrical between right and left sides. **Birhane Alem Berihu et al.** In their study 56 lower limbs were used. Among these 42 lower limbs showed a normal anatomy of the sciatic nerve (75 %) whereas 14 lower limbs showed variations in the sciatic nerve (25 %). Of these 14 lower limbs, the 6 lower limbs show variations of the sciatic nerve in relation to piriformis muscle (11 %), whereas in 5 lower

limbs, Common fibular nerve and Tibial nerve arises separated below the Piriformis and rejoin posterior to quadratus femoris muscle and bifurcate at the superior angle of popliteal fossa 9 %). The rest one lower limb, the Common fibular emerges above the Piriformis and Tibial nerve emerges below the Piriformis and descends separately along their course (2 %). The rest 8 of 14, lower limbs, shows variations of the sciatic nerve in relation to popliteal region of the thigh (14 %). Of these 8 lower limbs, the 3 lower limbs showed trifurcation of sciatic nerve into three major divisions (Tibial nerve, Common fibular nerve and an unusual trunk) in the middle of the popliteal fossa on the right side of the male lower limb (5 %). The unusual trunk divides into the lateral cutaneous nerve of the calf and fibular communicating nerve and in one female lower limb, trifurcation of sciatic nerve into tibial, superficial and deep fibular nerves were observed on the left side at the superior angle of popliteal fossa. **Saritha et al (2012)** found, the highest incidence of SN bifurcation at superior angle of popliteal fossa (92%), followed by division in gluteal region (2%) and in pelvis (2%). **Parkash et al (2010)** - the highest incidence of SN bifurcation was observed at Lower 1/3rd of thigh (75.6%), followed by division Common peroneal nerve suprapiriformis and Tibial nerve infrapiriformis (17.4 %). In the upper 1/3rd of thigh gluteal (3.5%) and in middle 1/3rd of thigh (6.7%).

In comparison to above researchers, our findings states that in 2 limbs (7.69%) sciatic nerve divides in pelvis into Common peroneal nerve and Tibial nerve enters gluteal region above and below piriformis and then enclose in sheath [Figure 2]. In 1 limb (3.85%), the sciatic nerve, divide in the upper third region [Figure 3]. In 5 limbs (19.23%), it divides in the middle third region [Figure 4]. In 2 limbs (7.69%), the nerve divided at the junction of middle and lower one-third region [Figure 1] In 16 limbs (61.54%), the nerve divided at the lower third region [Figure 5]. The highest incidence of sciatic nerve division occurs in 16 limbs (61.54%) in the lower third part of the posterior compartment of the thigh.

Our study coincides in observation of sciatic nerve division in pelvis and lower third region, with study of Kiros & Woldeyes, Upper 1/3rd of thigh with Parkash et al.

In present study observations deviates with some previous studies because different researchers had classified the sciatic nerve division in different manner and many criteria which have been followed in this study are coinciding.

Reason for such observation may be nutritional, regional occupational, racial, or hereditary cause.

Sr. No.	Authors (Race)	Level of Division of SN (Group/Type as per Grewal et al classification)								
		In the Pelvis			Gluteal region	Upper 1/3rd of thigh	Junction of upper & middle 1/3rd of thigh	Middle 1/3rd of thigh	Superior angle of popliteal fossa	Lower 1/3rd of thigh (upper 1/2 of popliteal fossa)
		Group A Type 1 (Both IP)	Group A Type 2	Group A Type 4 (CPN-SP & TN - IP)	Group B1 Type 1	Group B1 Type 3	Group B1 Type 4	Group B1 Type 5	Group B1 Type 6	Group B1 Type 7
1	Prakash et al (Indian) (2010) [11]			17.40%	2.30%	3.50%		2.30%		40.7%+ 34.9%
2	Muthu Kumar et al (Indian) (2011) [10]				8%	14%		38%		32%+8%
3	Ogeng'o et al (Kenyan) (2011) [9]	9.80%		2.40%	2.40%			10.40%	67.10%	
4	Saritha et al (Indian) (2012) [8]	2%	2%	2%	2%				92%	
5	Desalegn & Tesfay (2014) [7]	2.80%		5.50%				92%		
6	Berihu and Debeb (2015) [5]	9%		2%						
7	Kiros & Woldeyes (Ethiopian) (2015) [4]			8%	4%	12%		4%		8%+ 64%
8	Harsimran et al (2016) [3]	6.70%		3.30%		20%		6.70%	63.30%	
9	Present study			7.69%		3.85%		19.23%	7.69%	61.54%

Clinical implications:

The anatomical variations of the Sciatic nerve have important clinical implications and are reported in different races and populations with a variable frequency. Neuromuscular condition known as Piriformis muscle syndrome or Non- Discogenic sciatica is related with Compression of SN between piriformis and superior gemellus that is characterized by sensitivity, motor and trophic disturbances in the region of distribution of trapped component of SN. It may have similar symptoms for which the differential diagnosis is necessary from Intervertebral discitis, Lumbar radiculopathy, Primary Sacral dysfunction, Sacroiliitis, Sciatica and Trochanteric bursitis.

External compression over the buttock as in patients who lie immobile on a hard surface for long time can cause injury to the nerve. The most common cause of serious sciatic nerve injury is iatrogenic. Sciatic nerve palsy also occurs after total hip replacement or similar surgery in 1% of cases.

CONCLUSION:-

In this study, the majority of sciatic nerve divisions occur in the lower 1/3rd of thigh and popliteal fossa, while some divided into other regions of thigh. In line with observations of earlier researchers these variations in the levels of bifurcation must be more specific in the region and affected by race, nutrition, genetic making, type of pelvis and differential geographical distribution. Further regional studies needs to be done on large number of samples so that generalization for specific population will be more accurate and helps in region specific data that can be used for orthopedic surgery and physiotherapy purpose.

Conflicts of Interests: None

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