

A CADAVERIC STUDY ON HIGH DIVISION OF SCIATIC NERVE IN RELATION TO PIRIFORMIS MUSCLE WITH CLINICAL SIGNIFICANCE IN SOUTH INDIAN POPULATION

S. Elavar Kuzhali¹, H.Geetha Sangeetha², P.Sivaranjani³, G Gohila^{4*}

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Corresponding Author:

Dr. G Gohila,
Email: drgohila@gmail.com

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¹Assistant Professor, Department of Anatomy, Govt Tiruvannamalai Medical College, Tiruvannamalai

²Assistant Professor, Institute of Anatomy, Madras Medical College, Chennai

³Assistant Professor, Department of Anatomy, Govt Medical College, The Nilgiris

⁴Assistant Professor, Department of Anatomy, K.A.P.Viswanatham Govt. Medical College, Trichy, Tamilnadu India

Abstract

Background: The sciatic nerve is formed in the pelvis by joining of ventral rami of L4-S3 Spinal Nerves. It leaves the pelvis through the Greater sciatic foramen below the piriformis muscle and descends between the Greater trochanter and Ischial Tuberosity, dividing into Tibial and Common fibular Nerves at the superior angle of popliteal fossa. The point of division of sciatic Nerve into Tibial and Common fibular is very variable. High division of the sciatic nerve is either unilateral or bilateral, and the components of sciatic nerve has variable relation with piriformis muscle. It leads to compression of the nerve resulting in piriformis syndrome. The commonest cause of sciatic nerve injury is posterior dislocation and fracture of hip joint. To know the anatomical variations in the sciatic nerve division and its relation with piriformis muscle have much clinical importance. **Materials and Methods:** This Descriptive type of Observational study was conducted during the routine cadaveric dissection of I MBBS Students in the Department of Anatomy, K.A.P. Viswanatham Govt Medical college, Trichy. 50 Gluteal regions were examined in 25 adult embalmed human cadavers. **Result:** Out of 50 lower limbs dissected High division of sciatic Nerve was found in 10%, Trifurcation in 2%. Sciatic Nerve in relation to piriformis variations Type B (2%), Type C(4%),Type G (4%) was also noted. **Conclusion:** Variations such as high division, its relation with piriformis can lead to nerve injury during deep intramuscular injections, failure of sciatic nerve block anaesthesia and piriformis syndrome.

INTRODUCTION

The sciatic nerve is 2cm wide and the thickest nerve in the body. It is formed in the pelvis by joining of ventral rami of L4-S3 Spinal Nerves. It leaves the pelvis through the Greater sciatic foramen below the piriformis muscle and descends between the Greater trochanter and Ischial Tuberosity, along the back of thigh dividing into Tibial and Common peroneal Nerves at the superior angle of popliteal fossa. Superiorly it lies deep to the Gluteus Maximus, resting first on the posterior ischial surface with the nerve to the quadratus femoris between them. It crosses posterior to the Obturator internus, the gemelli, quadratus femoris. It is related medially posterior femoral cutaneous nerve and inferior gluteal artery. More distally, it lies behind the Adductor magnus and crossed posteriorly by the long head of biceps femoris. It 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.

It is a mixed Nerve containing both motor and sensory fibres. Articular Branches to hip joint through its posterior capsule, Muscular branches to biceps femoris, semitendinosus, semimembranosus, and the ischial part of Adductor Magnus.

The level of division of sciatic Nerve into Tibial and Common peroneal is very variable. The commonest site is at the junction of middle and lower thirds of thigh, near the apex of popliteal fossa, but the division may occur at any level above this point and rarely may occur below it. It is not uncommon for the tibial and common peroneal nerve to leave the sacral plexus separately, in this variant the common peroneal nerve usually pierces the piriformis at the greater sciatic notch while the tibial nerve passes below the muscle.^[1]

High division of the sciatic nerve is either unilateral or bilateral, and both the components of sciatic nerve has variable relation with piriformis muscle. It leads to compression of the nerve resulting in piriformis syndrome. The compression of the nerve produce paralysis or paresis of respective muscles and sensory disturbances. The commonest cause of sciatic nerve injury is posterior dislocation and fracture of hip joint.^[2] The variation in the division of Sciatic Nerve Manifest as piriformis syndrome, sciatica, inadvertent nerve injury during deep intramuscular injections, failure of sciatic nerve block during popliteal block anaesthesia,^[3] External compression of sciatic nerve in buttock in immobile patients injure the sciatic nerve.^[4] The variations in the sciatic nerve and its relation with piriformis muscle have surgical importance for the posterior Para trochanteric portal during arthroscopic surgery.^[5] The present study describes the High division of sciatic nerve, and its relation with piriformis. The knowledge of the variations of Sciatic nerve could help Anesthetists, Neurosurgeons, orthopaedician to avoid surgical errors.

MATERIALS AND METHODS

This Descriptive type of Observational study was conducted during the routine cadaveric dissection of I MBBS Students in the Department of Anatomy, K.A.P. Viswanatham Govt Medical college, Trichy, India. 50 Gluteal regions were examined in 25 adult embalmed human cadavers for the period of three years from 2019 to 2022. All the cadavers available for study period were included. Fifteen of the cadavers were male and ten were female cadavers. Since it is a cadaveric study ethics committee approval not obtained.

Inclusion Criteria

The lower limbs of normal anatomical features of both the genders and sides were included in the study.

Exclusion Criteria

The lower limbs of trauma, deformity and contractures were excluded from the study. The course and division of the SN were noted to see any possible variations. The Gluteal region, back of 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 the popliteal fossa.^[6] The exit of the nerve from the pelvis, its relation to piriformis and the level of division were recorded. The entire course of the nerve was described and looked for any possible variations.

RESULTS

In the present study 44 out of 50 (88%) specimens showed the normal pattern of SN. i.e the SN comes

out of the pelvis by passing below the PM and enters in to the Gluteal region, then descends downwards in the back of thigh, finally it bifurcated into TN and CPN at the superior angle of popliteal fossa. Out of 50 specimens 6(12%) specimens showed variation in the bifurcation of SN. Out of 6 specimens 5(10%) showed high bifurcation of SN. In one specimen (2%) the SN trifurcated into TN, CPN and Sural Nerve.

High division of SN & SN in relation with PM [Table 1]

1. One male cadaver showed bilateral High bifurcation of SN in the pelvis

Right side- CPN pierced the PM, TN passed below the PM. (Type B) [Figure 1] Left side- Both the divided nerve TN and CPN passed below the PM in a separate sheath. (Type G)

2. One male Cadaver showed bilateral High bifurcation of SN in the pelvis

Right side- CPN and TN passed above and below the PM. (Type C)

Left side- CPN and TN passed above and below the PM. (Type C) [Figure 2]

3. One female cadaver showed unilateral high bifurcation of SN in the pelvis. Left side – CPN and TN passed below the PM in a separate sheath. (Type-G) [Figure 3]

Trifurcation of SN

4. One male cadaver showed trifurcation of SN into CPN, TN and Sural Nerve in the superior angle of Popliteal Fossa. [Figure 4]

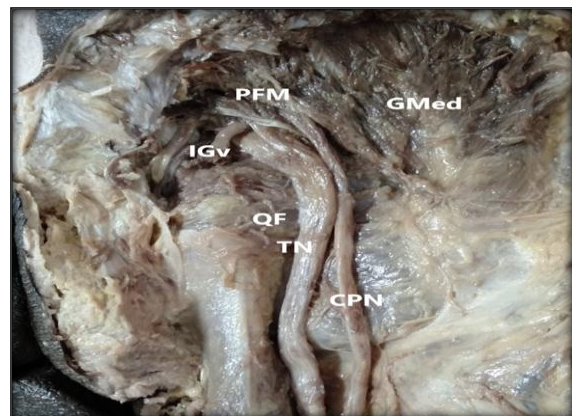


Figure 1: Type B – CPN pierced the PM and TN passed below the PM

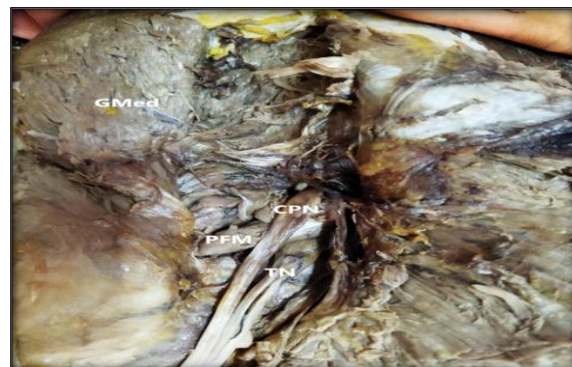


Figure 2: Type C – CPN & TN passed above and below the PM



Figure 3: Type G – CPN & TN passed below the PM in a separate sheath

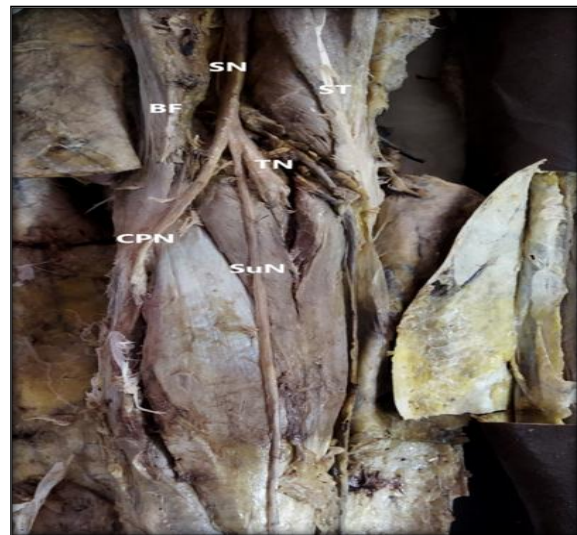


Figure 4: Trifurcation of SN into CPN, TN and Sural Nerve

Table 1: Relation of Sciatic Nerve with piriformis

Types of SN in relation to PM	Type A	Type B	Type C	Type D	Type E	Type F	Type G
No of Specimens (Total =50)	45	1	2	-	-	-	2
%	90%	2%	4%	-	-	-	4%

Table 2: SN in relation to PM compared with previous studies

Studies	No of specimens	Types of variations						
		A	B	C	D	E	F	G
Beaton &Anson BJ(1937), ^[18]	240	84.2%	11.7%	3.3%	0.8%	-	-	-
Beaton LE (1938), ^[24]	480	90%	7.1%	2.1%	0.8%	-	-	-
Guvencer et al(2010), ^[19]	50	52%	16%	8%	-	-	-	24%
Patel S et al (2011), ^[2]	86	91.8%	2.32%	5.81%	-	-	-	-
Saritha S et al (2012), ^[25]	50	92%	2%	2%	-	-	-	-
Prathibaseema et al (2013), ^[14]	100	92%	3%	4%	1%	-	-	-
Rupali shastrakar et al (2015), ^[27]	50	70%	16%	6%	-	-	-	-
Anbumani TL et al (2015), ^[28]	50	90%	4%	4%	-	-	-	-
Ameetkumar Jha et al (2020), ^[17]	40	92.5%	2.5%	5%	-	-	-	-
Present study	50	90%	2%	4%				4%

DISCUSSION

Piriformis syndrome is considered as an atypical, contentious neuromuscular disorder occur due to compression of the SN at the level of PM. The diagnosis of the exact cause of the pain is a major challenge due to paucity of confirmed clinical and definitive diagnostic criteria like radioimaging or electrodiagnostic testing.^[7,8]

Piriformis syndrome describes the presence of pain in the buttock and posterior hip region caused due to nondiscogenic and extrapelvic entrapment of the SN.^[9] The present study aims to explore the southindian cadavers to provide awareness and strengthen the findings of the SN variations and its

relation to the PM as a probable cause for the nondiscogenic sciatica as well as other pain etiologies.

In the present study, 90% SN divides normally at the level of superior angle of popliteal fossa into CPN and TN.10% of specimens it divides in the pelvis.

High division of SN (10%) in the present study was similar to some of the previous studies. Gabrielli et al,^[10] reported 13.7%, Pokorny et al,^[11] reported 20.9%, Prakash et al,^[12] 16.3%, Rashmi Deopujari et al,^[13] found 11.9%, Pratheebaseema et al,^[14] found 7%, Mallikarjun et al,^[15] reported 8% in 50 Lowerlimbs, A,A,Khan et al,^[16] reported 12.5%,

and Ameetkumarjha et al,^[17] reported 7.5% of High division of SN in 40 specimens.

Variant anatomy of SN in relation to piriformis was first classified by Beaton and Anson in 1937.^[18] This classification devised at that time was composed of six major classes, four of which were directly observed in their sample, The other two hypothetical variants have since been identified in subsequent studies. Most studies have adopted for or slightly modified Beaton and Anson original classification system, which is considered as the main basis for classification today.^[19,20]

The collected results of my study was similar to the one developed by Beaton and Anson.

Patterns of SN exit and relationship to the PM were classified as follows,

Type A- SN exits the pelvis undivided below the PM.

Type B- SN divides in the pelvis, CPN pierces the PM, and TN lies below the PM.

Type C- SN divides in the pelvis, CPN courses above the PM, and TN lies below the PM.

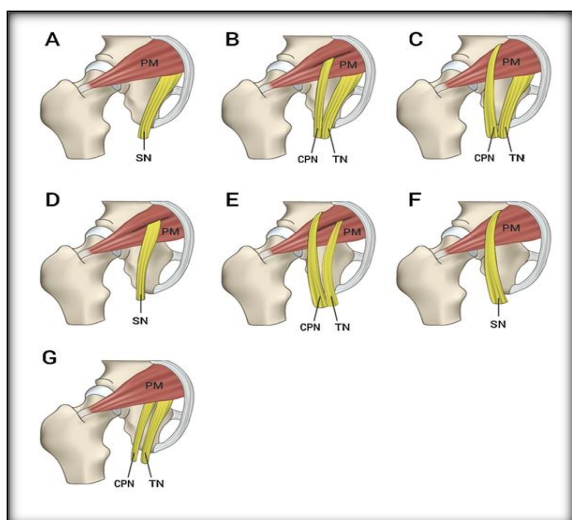
Type D- SN exits the pelvis undivided piercing the PM.

Type E- SN divides in the pelvis, CPN courses above the PM, and TN pierces the PM.

Type F- SN exits the pelvis undivided coursing above the PM.

Type G- SN divides in the pelvis, both CPN and TN coursing separately below the PM.

Out of these variations, type "A" is considered as normal relationship between the PM and the SN and type B to F are labelled as variant relationship. The type F variation defined hypothetically by Beaton and Anson was later reported by Ozaki et al,^[21] and Sayson et al.^[22] Similarly Babinski et al,^[23] reported a rare variation, in which CFN and TN emerged as separate branches through the IP but TN was passing anterior to the superior gemellus muscle. Though not reported by Beaton and Anson, Güvençer et al have referred to this variation as Beaton and Anson Type G.^[19,20]



Each of the anatomical variations may reflect a different and case-specific clinical presentation of sciatic neuropathy. A large number of variations in the course and distribution in the SN have been reported earlier in the literature. The nerve may divide into two major divisions, CPN and TN at varied levels extending from sacral plexus till the lowerpart of thigh.

In the present study we have encountered Type A (90%), Type B(2%), Type C(4%), Type G variant (4%) and it is similar to the previous studies in literature. [Table 2].

Among the 50 specimens, one specimen the SN trifurcates into CPN, TN and the Sural Nerve (2%) and it is reported in the previous studies Mallikarjun et al,^[15] (2%), Anbumani et al,^[28] (2%), Birhanealem et al (5%).^[29]

The fetal cadavers were not included due to unavailability. The probability of anatomical variation in cadavers makes it essential among clinicians, neurosurgeons and orthopaedic surgeons to be aware of the potential complications during medical or surgical interventions.

The sciatic nerve block in the popliteal fossa is frequently administered for anaesthesia and postoperative pain blockage for lower extremity surgery below the knee. The sciatic nerve division in the popliteal fossa and its depth have significant implications for popliteal block Anaesthesia. Consequently, the nerve may bifurcate into CPN and TN at variable levels extending from sacral plexus till the popliteal fossa. Recognizing these anatomical variations can help clinicians in performing nerve blocks.

CONCLUSION

High division of SN was found in 10% of specimens and trifurcation of SN in 2% of lowerlimbs. SN in relation to PM variations Type B (2%), Type C (4%), Type G (4%) were noted. Cadavers make the best means to see the anatomical variations of different structures of the body. SN injuries and entrapment neuropathy form a routine part of day-to-day medical practice. knowledge regarding the course, division and branching pattern and how it leaves the pelvis is of more importance in order to prevent inadvertent injury to the nerve during various surgical procedures in the gluteal region. Also while performing operations; a surgeon should be aware of the variations in the normal branching pattern and divisions of the SN. Variations such as high division and trifurcation of nerve can lead to nerve injury during deep intramuscular injections, failure of SN block anaesthesia during various surgical procedures or inadvertent damage to SN during varicose vein stripping. Variations in the course of SN may complicate surgery and in the interpretation of sciatic neuropathy.

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