

Anatomical Variation in Trifurcation of the Sciatic Nerve Cadaveric Study and Its Clinical Implications

¹Birhane Alem Berihu, ²Yared Godefa Debeb

¹Lecturer, Department of Anatomy and Histology, Institute of Bio-Medical Sciences, College of Health Sciences, Mekelle University, P.O. Box: 1168, Mekelle, Ethiopia

²Assistant professor, Department of physiology, Institute of Bio-Medical Sciences, College of Health Sciences, Mekelle University, Mekelle, Ethiopia

Abstract: Descriptions in set of connections Neuropathaties involving the peripheral nerves are relatively common, especially in Sciatic nerve. Sciatic nerve is the largest nerve in the body which arises from the sacral plexus. The sciatic nerve anatomy is broadly studied in man, because of its clinical importance. The aim of the paper is to present study of variation in trifurcation of sciatic nerve and review of literature related to this case. It usually divides at the upper angle of the popliteal fossa but one of its common variations is high division into tibial and common peroneal nerves. Here in our study, we observed an unusual trifurcation of the sciatic nerve on the back of the thighs in the middle of the popliteal fossa during cadaveric study by routine dissection. The photographs of the trifurcation of the sciatic nerve were taken for proper documentation and for ready reference. The trifurcation of the sciatic nerve is very rare. The sciatic nerve gave an unusual trunk in addition to the tibial and common peroneal nerves at middle of the popliteal fossa. The unusual trunk divided into lateral cutaneous nerve of the calf and the peroneal communicating nerve. The knowledge of low level of termination of sciatic nerve is important for clinicians and surgeons. Clinically, the sciatic nerve is widely used for both diagnostic (nerve conduction velocity studies) and therapeutic purposes (nerve grafting). Thus, a detailed knowledge of the anatomy of the sciatic nerve and its contributing nerves are important in carrying out these and other procedures.

Keywords: Tibial and common peroneal nerves, Anatomical Variation in Trifurcation of the Sciatic nerve Cadaveric Study and its Clinical Implications.

1. INTRODUCTION

The sciatic nerve, a branch of the sacral plexus (L4 and 5; S1, 2, and 3), emerges from the pelvis through the lower part of the greater sciatic foramen. It is the largest nerve in the body and consists of the tibial and common peroneal nerves bound together with fascia. The nerve appears below the piriformis muscle and curves downward and laterally, lying successively on the root of the ischial spine, the superior gemellus, the obturator internus, the inferior gemellus, and the quadratus femoris to reach the back of the adductor magnus muscle. It is related posteriorly to the posterior cutaneous nerve of the thigh and the gluteus maximus. It leaves the buttock region by passing deep to the long head of the biceps femoris to enter the back of the thigh. Occasionally, the common peroneal nerve leaves the sciatic nerve high in the pelvis and appears in the gluteal region by passing above or through the piriformis muscle [1]. It is a mixed nerve contains both motor and sensory fibers. The motor branches supply the posterior compartment of thigh muscles as well as hip and knee joint, however sensory branches supply the whole tibial and foot areas with the exception of the anteromedial tibial region and medial margin of the foot. The point of division of the sciatic nerve into the tibial and the common peroneal nerve 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. The sciatic nerve bifurcates into two major divisions (tibial and common peroneal), most commonly at the lower part of the posterior compartment of the thigh [1, 2, 3].

Several authors have reported variations on its division into the tibial and common peroneal nerve from the sacral plexus to the lower part of the popliteal space [1, 4, 6, 7, 8, 9, and 10]. These anatomical variations may contribute to piriformis syndrome, sciatica, coccygodynia and muscle atrophy [5]. This should be taken into account by clinicians who are planning interventions around the sciatic nerve and its division in the lower extremity. Higher level of the sciatic nerve division is a relatively frequent phenomenon. Variant course of sciatic nerve may lead to inadvertent injury during operative procedures in the gluteal region, popliteal region coccygodynia etc. Inadvertent injury or compression of sciatic nerve causes paralysis or paresis of the thigh muscles and adequate sensory disturbances. Each anatomical variation reflects a different and case specific presentation which requires a detailed description of various forms of anatomical variations. Hence, present study is undertaken to know the level of variation in division in relation to popliteal region and variations in the branching pattern of sciatic nerve.

2. MATERIALS AND METHODS

40 popliteal regions were examined in 20 formalin fixed cadavers with no pathology during the period of 1 year and 6 months. Fifteen of the cadavers were male and five were female. The gluteal region, posterior region of thigh, popliteal region up to posterior region of the leg was properly dissected by the investigator together with medical student to explore the sciatic nerve and its branches during teaching and learning processes. Anatomical variation of sciatic nerve starting from its origin is studied. Emphasis is also included on determining the extent of anatomical variation in any encountered discrepancy in distribution of sciatic nerve. Cadavers with traumatic injury are excluded except those with intact gluteal, thigh, popliteal and leg regions. Following the proper exposure the location of the sciatic nerve and its exit from pelvis and the level of the sciatic nerve division were all recorded. Normally Sciatic nerve bifurcates at the superior angle of popliteal fossa in 80-90% of individuals.

3. RESULT /OBSERVATION

In our study, variations in sciatic nerve trifurcation were seen in 5 cadavers that are in four males and one female. Totally five lower limbs showed variation in the division of sciatic nerve. Among them 40 specimens (87.5%) the sciatic nerve had a normal course after its exit below the piriformis and divided into TN and CPN at the superior angle of popliteal fossa, while in 2 specimens (5%) there was trifurcation in to three divisions and 7.5% division of sciatic nerve(tibial and common peroneal) gives directly sural nerve(table-1). In one male cadaver on the one right side lower limb showed that the sciatic nerve terminated in the middle of the popliteal fossa by giving 3 branches. The three branches given were the tibial nerve, common peroneal nerve and an unusual trunk (Fig- 1). The unusual trunk divided into lateral cutaneous nerve of the calf and peroneal communicating nerve. Additionally, in our study we found that the three male cadavers had variation on right and left side of the limbs the three branches showed tibial , common peroneal and sural nerves but origin of sural nerve on two cadaver is directly from tibial nerve only on the right and left side and on the other cadaver sural nerve originate directly from common peroneal nerve on right side(fig-3,4 and 2 respectively). Furthermore, in our study we found that the female cadavers showed variation in sciatic nerve on the right side, the three branches given are tibial, superficial and deep peroneal nerves unlike male cadavers (Fig- 5). Sciatic nerve on the right side divided about 50 mm above the popliteal crease but below the superior angle of popliteal fossa.

Table - 1: Depicting the level of division of sciatic nerve in the present study

Level of division	Normal at sup. Angle of popliteal fossa	%	Trifurcation of sciatic nerve in the back of thigh in to tibial common proneal and un usual trunk	%	furcation of sciatic nerve in the back of thigh, 2 tibial in to sural nerve and common proneal in to sural nerve	%	Total no of specime n/limbs	%
No of specimen/ limbs	35	87.5	2	5	3	7.5	40	100

4. DISCUSSION

According to the textbooks of anatomy, the nerves contributing to the lower limb form two plexuses (lumbar and sacral). The sciatic nerve is formed when the large dorsal component of the sacral plexus (common fibular nerve) and the ventral component (tibial nerve) move downward close together [1, 6, and 7]. It leaves the pelvis via the greater sciatic foramen below the piriformis and above the gemellus superior, descends between the greater trochanter and ischial tuberosity along the back of the thigh dividing into tibial and common peroneal (common fibular) nerves at a varying level proximal to the knee. Many variations in the course and distribution of the sciatic nerve have been reported. The sciatic nerve usually bifurcates at the lower level of thigh. These two nerves often arise separately from the sacral plexus, may be separated in the greater sciatic foramen by the piriformis muscle and pass into the thigh as contiguous but separate structures. When the nerve divides in the pelvis, the common peroneal nerve usually pierces the piriformis muscle [1, 6, and 7].

The trifurcation of sciatic nerve into tibial, common peroneal and lateral cutaneous nerve of calf has been observed but the trifurcation of sciatic nerve into tibial, superficial and deep peroneal nerves is also documented in literature (Sharadkumar Pralhad Sawant [11]). In our study on 20 cadavers (40 lower limbs) we have observed (87.5%) the sciatic nerve had a normal course after its exit below the piriformis and divided into TN and CPN at the superior angle of popliteal fossa, while in 2 specimens (5%) there was trifurcation into three divisions and 7.5% division of sciatic nerve (tibial and common peroneal) gives directly sural nerve. Each of the anatomical variations may reflect a different and case-specific clinical presentation of sciatic neuropathy. Such cases of trifurcation have been earlier reported with different branches by Sawant [13], Satheesh Nayak [14].

In our study, in one male cadaver on the one right side lower limb showed that the sciatic nerve terminated in the middle of the popliteal fossa by giving 3 branches. The three branches given were the tibial nerve, common peroneal nerve and an unusual trunk (Fig- 1). The unusual trunk divided into lateral cutaneous nerve of the calf and peroneal communicating nerve. Our study is similar with reported of [2] showed the sciatic nerve terminated in the middle of the popliteal fossa by giving 3 branches. Additionally, in our study we found that the two male cadavers had variation on one left side of the limbs the three branches showed tibial, common peroneal and sural nerves but origin of sural nerve on two cadavers is directly from tibial nerve only on the right and left side and on the other cadaver sural nerve originates directly from common peroneal nerve on left side (fig-3, 4 and 2 respectively). Our result is similar with that of Tanvi *et al* [12] who reported that the variant formation of sural nerve was found in the left leg of the 50 year old male cadaver. In this case, the medial sural cutaneous nerve and lateral sural cutaneous nerve, after respectively deriving from the tibial and common fibular nerve, were noticed to continue their course without any formation of a unique nerve trunk on the posterior side of left leg. A transverse communicating branch connecting these two nerves was present about 10 cm above the lateral malleolus. Both the branches continue their course in the foot separately on the lateral side of the foot and little toe supply the overlying skin. Both the nerves were normal in their size and course and gave out their respective other branches in normal way [12].

Furthermore, in our study we found that the female cadavers showed variation in sciatic nerve on the right side, the three branches given are tibial, superficial and deep peroneal nerves unlike male cadavers (Fig- 5). Sciatic nerve on the right side divided about 50 mm above the popliteal crease but below the superior angle of popliteal fossa. On the right side Sciatic nerve divided at the level of the popliteal crease (Fig- 5). The present case of low division and trifurcation of the sciatic nerve may be an advantage to surgeons who do the popliteal block for leg surgery, because high divisions of sciatic nerve may lead to failure of popliteal block anesthesia. The thick peroneal communicating nerve in this case is ideal for nerve grafts. Since the division of sciatic nerve is very low, its branches may interfere in knee surgery. Since trifurcation of the sciatic nerve has not been reported previously, this report is of extreme importance to surgeons dealing with popliteal aneurysms. The abnormal trunk mentioned here might surprise the surgeons because normally a nerve trunk of that thickness is not expected in the region. As the sural nerve is of significant diagnostic and therapeutic importance, detailed knowledge of the sural nerve's anatomy and its contributing nerve is also of great importance.

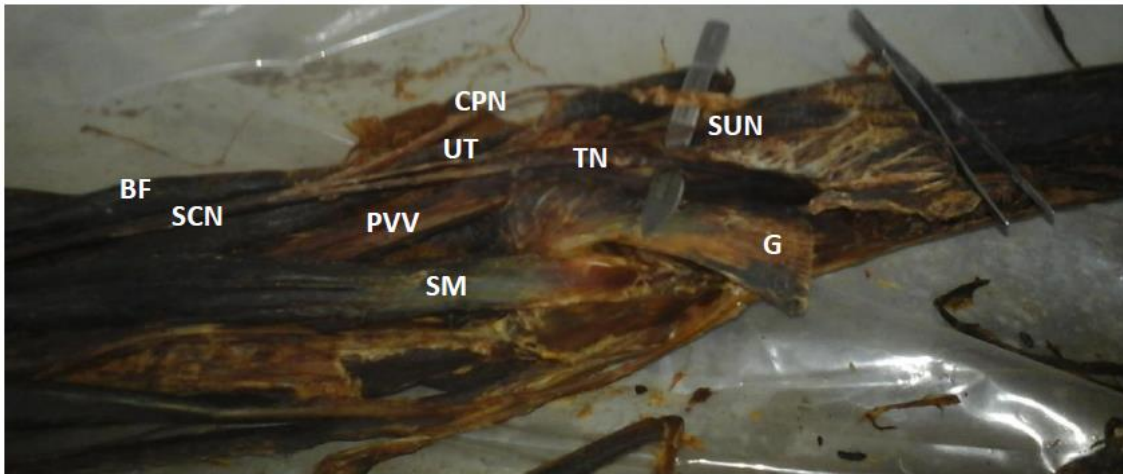


Figure: 1. Dissection of the right popliteal fossa showing trifurcation of the sciatic nerve (SCN: sciatic nerve dividing low in the popliteal fossa; TN: tibial nerve; CPN: common peroneal nerve; uT: unusual trunk SUN: sural nerve; PVV: popliteal vessel; G: two heads of gastrocnemius muscle; SM: semimembranosus; BF: Biceps Femoris

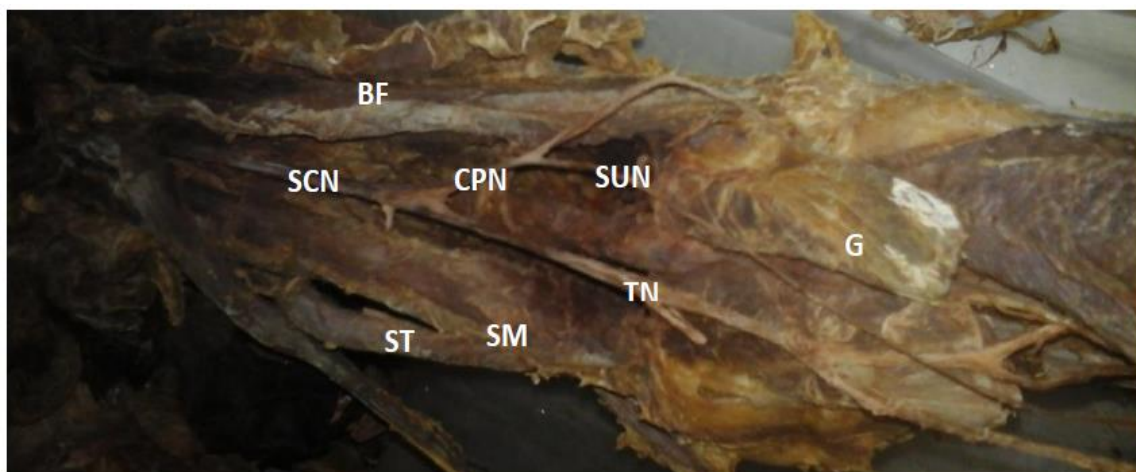


Figure: 2. Dissection of the right popliteal fossa showing furcation of the sciatic nerve (SCN: sciatic nerve dividing low in the popliteal fossa; TN: tibial nerve; CPN: common peroneal nerve - SUN: sural nerve; PVV: popliteal vessel; G: two heads of gastrocnemius muscle; SM: semimembranosus; BF: Biceps Femoris; ST:Semitendinosus.

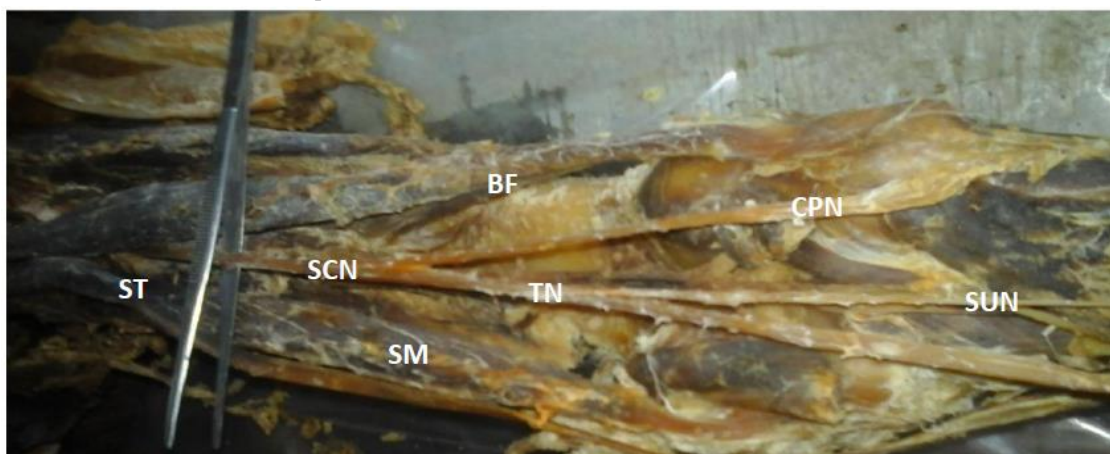


Figure 3. Dissection of the right popliteal fossa showing furcation of the sciatic nerve (SCN: sciatic nerve dividing low in the popliteal fossa; TN: tibial nerve - SUN: sural nerve; CPN: common peroneal nerve; PVV: popliteal vessel; SM: semimembranosus; BF: Biceps Femoris; ST:Semitendinosus

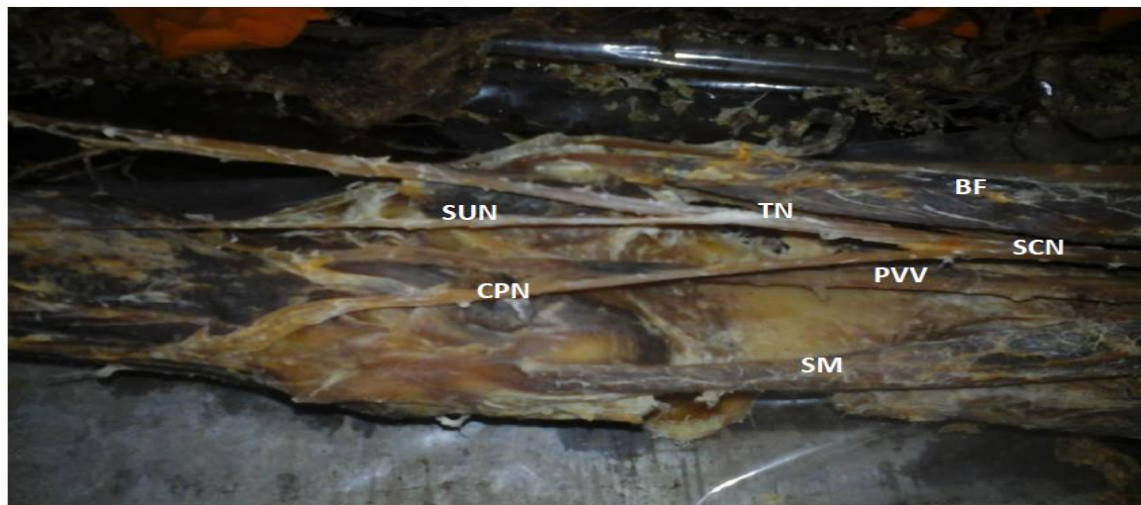


Figure: 4. Dissection of the left popliteal fossa showing furcation of the sciatic nerve (SCN: sciatic nerve dividing low in the popliteal fossa; TN: tibial nerve - SUN: sural nerve; CPN: common peroneal nerve; PVV: popliteal vessel; SM: semimembranosus; BF: Biceps Femoris; ST: Semitendinosus)

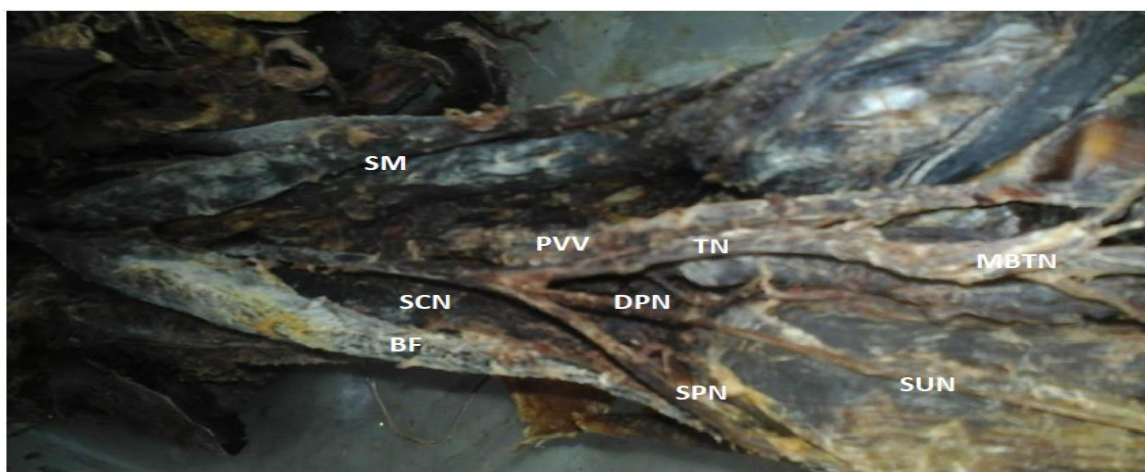


Figure: 5. Dissection of the female right popliteal fossa showing furcation of the sciatic nerve (SCN: sciatic nerve dividing low in the popliteal fossa; TN: tibial nerve DPN: deep peroneal nerve ; SPN: superficial peroneal nerve; MBTN: muscular branch of tibial nerve; PVV: popliteal vessel; SM: semimembranosus; BF: Biceps Femoris, SUN: sural nerve)

5. CONCLUSION

Data of prospective variation anatomy of the sciatic nerve and sural nerve should help surgeons in locating the nerves as well as avoiding potentially unnecessary complications. Knowledge of the unusual variant location of sciatic nerve in the present case will enable the surgeon to find and preserve the nerve during fasciotomy, neurolysis, neuroma resection, or bony and soft tissue reconstruction.

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