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THE VARIATIONS IN THE BIFURCATION OF THE SCIATIC NERVE

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ABSTRACT

***Background*:** The sciatic nerve is largest and thickest nerve in the human body which is a branch of the sacral plexus. It has a long course in the pelvic region and in the lower extremity. It leaves the pelvis and enters the gluteal region via the greater sciatic foramen. Usually in the popliteal fossa, it divides into tibial and common peroneal nerve. The division of the sciatic nerve varies in different individuals so therefore, its point of bifurcation is of clinical importance. The compression of the sciatic nerve along its course can cause pain in the lower extremity and it can also be severed during surgery. Its unusual bifurcation can lead to piriformis syndrome or coccygodynia.

***Aim*:** the study is aimed at studying the variations in the bifurcation of the sciatic nerve.

***Methodology*:** 40 lower extremities of 20 cadavers (17 males and 3 females) properly embalmed with formaline were studied to see the variations in the bifurcation and course of the sciatic nerve. The gluteal real region was properly dissected and point of bifurcation noted and recorded.

***Result*:** A high and bilateral bifurcation was found in the very first cadaver that prompted further studies on other cadavers. The high bifurcation of the right lower extremity had a normal course and the divisions into tibial and common peroneal nerve of closely marginal size. On the other hand however, the high bifurcation of the left lower extremity presented with a smaller tibial diameter with an unusual course while the common peroneal nerve was normal.

***Conclusion*:** Though a unilateral unusual bifurcation is a natural phenomenon, some individuals may present a bilateral unusual bifurcation like the case report of this study. It is surgically important to know the possibility of a high bifurcation, an unusual course and their relation to piriformis, obturator internus, gamelli muscle as it helps to avoid any accidental damage of the sciatic nerve during surgery or any clinical work along the course of the sciatic nerve.

***Key words*:** sciatic nerve, tibial nerve, common peroneal nerve, piriformis syndrome.

INTRODUCTION

The sciatic nerve (also known as the ischiatic nerve) is the thickest nerve in the human body which is a branch of the sacral plexus (L4, L5, S1, S2, and S3). Variations are seen in the point of bifurcation, unilaterally or bilaterally [1].
In higher bifurcation (i.e. tibial nerve and common Peroneal nerve) may get spared in a case of injury to sciatic nerve [1].
Though complete palsy of sciatic nerve is rare to occur, it results into flail foot and severe difficulty in walking. Anatomical variations may contribute to piriformis syndrome, sciatic coccygodynia and muscle atrophy [1].
Awareness of the higher or lower bifurcation carries clinical significances [1].

The sciatic nerve is the most frequently injured nerve of the lower extremity. It is commonly injured in the posterior disiocation of the hip and fractures of the hip joint. It can also be injured during total replacement of the hip during hip surgery and hermiarthoplasty of the hip. It is one of the nerves commonly injured during intramuscular injection, also during positioning of an individual for gynecological surgeries. Peroneal divisions are more prone to injuries from injections. Patients will present with drop foot secondary to loss of dorsoflexion and eversion of foot as well as inability to extend foot. Injury to the tibial division of sciatic nerve produces loss of plantar flexion and inversion of the foot as well as loss of flexion of the ankle [2].

Several authors have reported variations of divisions of the sciatic nerve into tibial and common peroneal nerves from the sacral plexus to the lower part of the popliteal fossa.

It is therefore important for clinicians to know that its variations into divisions have specific clinical importance [3].

REVIEW OF RELATED LITERATURE

Sharadkumar Pralhad Sawant carried out a case report on the bilateral trifurcation on the sciatic nerve and its clinical significance which was carried out under the Department of Anatomy, K. J. Somaiya Medical College, SomaiyaAyurvihar, Eastern Express Highway, Sion, Mumbai. During routine dissection for the first MBBS students, we observed an unusual trifurcation of the sciatic nerve on the back of both the thighs in the middle of the popliteal fossa of a 70 years old, donated embalmed male cadaver. The sciatic nerve terminated in the middle of the popliteal fossa by giving three branches. The three branches given were tibial, superficial and deep peroneal nerves. The superficial peroneal nerve was almost as thick as the deep peroneal nerve. There is high division of superficial peroneal nerve intomedial and lateral branches. The medial branch arose from the superficial peroneal nerve at the proximal calf beneath the crural fascia and pierced the anterior intermuscular septum to enter the superficial fascia of anterior compartment [4].
The lateral branch descended in the anterior intermuscular septum in a peroneal tunnel, pierced the deep fascia of lateral compartment and gave cutaneous branches to the adjacent skin of front of leg. The sural nerve was formed by the

peroneal communicating branch of the deep peroneal nerve in the popliteal fossa, and descends on the posterior surface of the gastrocnemius to enter the superficial fascia about the middle of the back of the leg [4].

Dr. Satheesha Nayak B from the Department of Anatomy, Meleka Manipal Medical College (Manipal Campus), Madhav Nagar, ManipalUdupi District, Karnataka–INDIA did a case report on the topic, An unusual case of trifurcation of the sciatic nerve. Trifurcation of the sciatic nerve is extremely rare. Here, one such unusual type of trifurcation of sciatic has been reported. The sciatic nerve gave an abnormal trunk in addition to the tibial and common peroneal nerve. The abnormal trunk divided into lateral cutaneous nerve of the calf and the peroneal communicating nerve. Since the point of trifurcation was in the middle of the popliteal fossa, it is of clinical and surgical importance. During the routine dissection class for medical undergraduates, a trifurcation of the sciatic nerve was noticed. 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 abnormal trunk. The abnormal trunk divided into lateral cutaneous nerve of the calf and peroneal communicating nerve. The common peroneal nerve was reduced in size due to the presence of the abnormal trunk [5].

In 2011, Muthu K. t. et al. carried out a cadaveric study of sciatic nerve and its level of bifurcation. The aim of the study was to focus on the frequency of the level of bifurcation of sciatic nerve. The material of the study involved about fifty free lower limbs available in the department of anatomy, Sri Ramachandra Medical College, Sri Ramachandra University were utilized for the study. Sciatic nerve is dissected and the level of bifurcation is recorded. The result showed that in the present study the division of sciatic nerve is observed maximum in the middle of the thigh at 38% and in the popliteal fossa in 32% [2].

In 2011, Brooks J.B.B, et al. Carried out a research on Anatomical variations of the sciatic nerve in a group of brazilian cadavers. The objective of the present study was to evaluate the characteristics of the sciatic nerve and its relationship to the piriformis muscle in a group of Brazilian cadavers. The method of data collection was by anatomical dissection of 40 human limbs with detailed studies of the sciatic nerve and the piriformis muscle. The results showed anatomical variations of the relationship between the sciatic nerve and the piriformis muscle were rare. Data on the sciatic nerve length and width showed similar results to those from the literature [6].

In 2012 Sabnis A.S, carried out a research on anatomical variations of sciatic nerve bifurcation in human cadavers. In the course of his research, 140 lower extremities of 70 cadavers of age 50-70 years of both sexes during 5 years were studied to see the variations in sciatic nerve bifurcation. All cadavers were embalmed with 10% of formalin. The gluteal region was dissected well and sciatic nerve course was studied by noting the point of bifurcation. The result showed that in the first type higher bifurcation of sciatic nerve below piriformis found in 7% of cases while in second type we found bilateral higher bifurcation was in one cadaver. He concluded that though sciatic bifurcation at lower level either in popliteal fossa or upper 1/3 of thigh is common [1].

In 2013, Shewale A.D, et al. carried out a research on the Study of Variations in the Divisions, Course and Termination of the Sciatic Nerve. The study was performed on cadavers. The inferior extremities of 45 cadavers were examined and variations of division of sciatic nerve were noted and classified. The results of the study showed the highest incidence of sciatic nerve variation was observed in its termination. In 11.11% of cases the sciatic nerve was found to be divided in the gluteal region. In 11.11% specimens, the common peroneal nerve pierced the piriformis muscle. He concluded that the higher division of sciatic nerve can result in the involvement of only one out of the two divisions for the sciatic neuropathy[3].

MACROSCOPIC ANATOMY OF THE SCIATIC NERVE

The sciatic nerve (L4, 5, S1–3) is the largest nerve in the body. It is broad and flat at its origin, although peripherally it becomes rounded. The nerve emerges from the greater sciatic foramen distal to piriformis and under cover of gluteus maximus, crosses the posterior surface of the ischium, crosses obturator internus, with its gemelli, quadratus femoris and descends on adductor magnus. Here it lies deep to the hamstrings and is crossed only by the long head of biceps. The sciatic nerve terminates by dividing into the *tibial* and *common peroneal nerves*. The level of this division is variable usually it is at the mid-thigh, but the two nerves may be separate even at their origins from the sacral plexus.

Branches

The trunk of the sciatic nerve supplies the hamstring muscles (biceps, semi membranosus, semitendinosus) and also the adductor magnus, the latter being innervated also by the obturator nerve.
All the muscle branches apart from the one to the short head of biceps arise on the medial side of the nerve [8].

CASE REPORT

During a routine medical dissection of formaline-fixed cadavers by 400 level anatomy students of Nnamdi Azikiwe University, Anambra state, a male cadaver presented with a case of bilateral high sciatic nerve bifurcation. This observation thus prompted further research of which seventeen (17 males and 3 females) were also dissected (during the lower extremity class). The piriformis, gamelli, quadrates femoris, obturator intermus and sciatic nerve were identified, and the point of sciatic nerve bifurcation noted. Any abnormal observations were snapped and recorded.
On the right leg, the size of both the common peroneal and tibial nerves is closely proportional, and of normal courses to their termination.

The higher bifurcation of the left leg on the other hand, the common peroneal nerve is larger than the tibial nerve and entered the gluteal region by piercing through obturator internus muscle.

DISCUSSION

The origin of the word sciatic is of Latin origin from Greek word 'ischiadikos' which means subject to trouble in the hip or loins [1]. As earlier mentioned, it is the thickest nerve of the body and nerve of the posterior thigh. Various studies have reported different level of bifurcation. Some studies have also reported cases of trifurcation of the sciatic nerve. Higher level of sciatic nerve bifurcation is a relatively frequent phenomenon [9].

Bilateral neuropathy or trauma of sciatic nerve is rare to occur but unilateral lesion of sciatic nerve is common due to compression, trauma & injury during hip replacement procedure [1]. Bifurcation into its two major branches (common peroneal and tibial divisions) may occur anywhere between the sacral plexus and the lower part of the thigh [9]. In the present study, 20 specimens were studied after an unusual observation of high bilateral bifurcation of the sciatic nerve of which that of the left lower extremity has an unusual course.

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Any case of abnormal bifurcation and course of the sciatic nerve may cause pain sensation in the lower limb. Such cases of high bifurcation motivate radiologists to repeat MRI examinations on the other side. Awareness of the presence, location and course of the sciatic nerve will be of clinical significance to doctors, especially during surgery [1].

Fig 2.1.1 diagram showing the high bifurcation of the sciatic nerve in the right leg

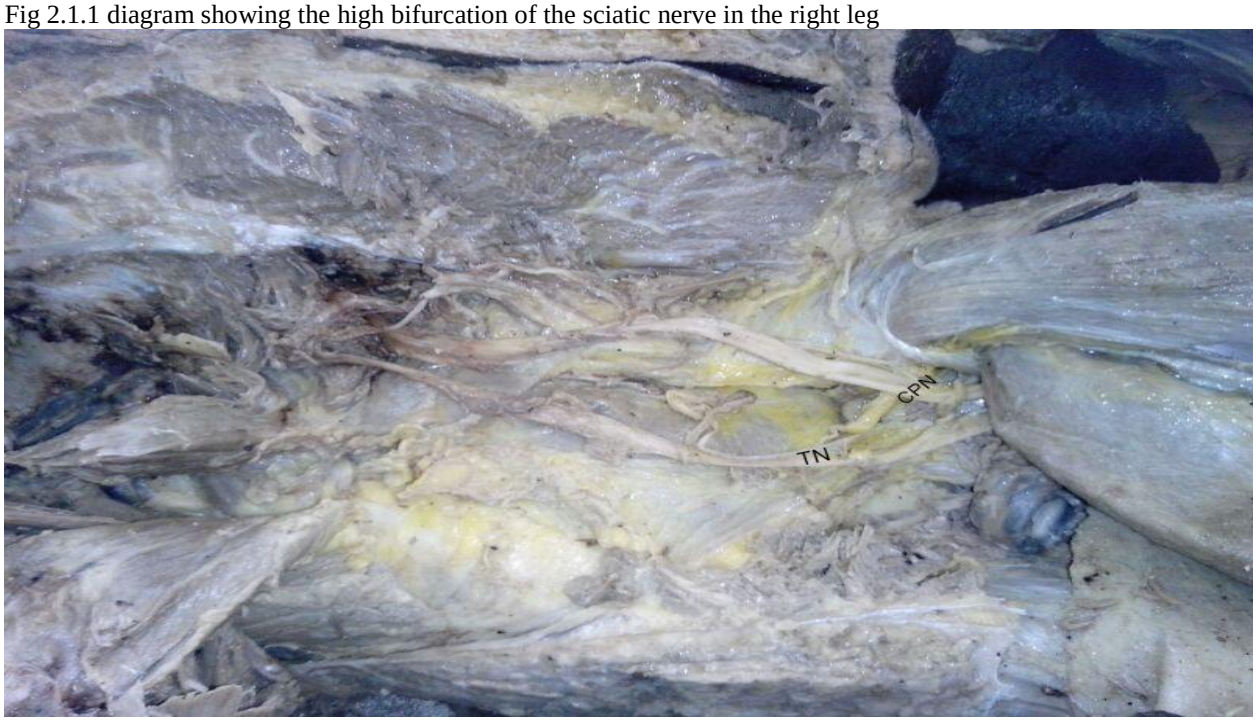

Fig 2.1.2 diagram showing the high bifurcation of the sciatic nerve in the left leg with tibial nerve smaller in size

a. .b

Fig 2.2 showing high bifurcation of sciatic nerve on both legs with smaller tibial nerve in the left leg (b)

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