

Anatomical Variations in the Division and Innervation of the Sciatic Nerve with its Clinical Consequences

MOHD SALAHUDDIN ANSARI, MUKESH SINGLA, KUMAR SATISH RAVI, RAJNI SINGH

ABSTRACT

Introduction: Commonly encountered peripheral nerve in emergency, trauma, routine surgical medical practice and neurology is Sciatic Nerve (SN). Its vulnerability to injury is because of its thickness and long course. Its vast clinical involvement warrants a more definitive study. So the study was planned with the following aims and objectives.

Aim: To study the anatomical variations in the division and innervation of the sciatic nerve and to correlate these variations with the clinical consequences of the nerve.

Materials and Methods: This study was carried out on 30 lower limbs of human cadavers of Indian origin. The sciatic nerves of these cadavers were dissected, photographed, observed, analysed and interpreted in the Department of Anatomy.

Results: It was found that in 43% of cases division of

sciatic nerve was just below the lower border of piriformis, in 36%, between the piriformis and the mid of the thigh, in 14% near the mid of the thigh, in 7%, between midway of thigh and joint line of the knee and not even in a single case, the division was found to be, in the pelvis and below the knee joint line.

Conclusion: Most common site of exit and bifurcation of SN were found to be just below the piriformis which is in contradiction to the earlier reports which state apex of the popliteal fossa to be the most common site of SN bifurcation. So we emphasize that this fact should also be there in the mind of concerned surgeons, orthopedicians, anaesthesiologists and neurophysicians while dealing with and planning for the pathologies involving SN, not only for better diagnosis and treatment but also for avoidance of iatrogenic complications.

Keywords: Injury, Neuropathy, Peripheral Nerve, Piriformis, Sciatica, Surgery

INTRODUCTION

Commonly encountered peripheral nerve in emergency, trauma, routine surgical medical practice and neurology is Sciatic Nerve (SN) because of its long course and vulnerability to injury. The differences in the exit routes of two divisions of sciatic nerves are important in clarifying the clinical aetiology of non-discogenic sciatica. Due to clinical significance of the sciatic nerve and its division at various level, a more definitive study seems to be more appropriate and necessary to provide not only additional data to anatomical records and surgical literatures but also for the benefit of the surgeons as well as neuro-physicians.

The sciatic nerve is the most frequently injured lower extremity nerve [1]. It is commonly injured in posterior dislocation of the hip [2] and in the fracture of the hip joint [3]. Due to variation in the site of its division as well as its relation in the gluteal region, it is prone to entrapment neuropathy like piriformis syndrome. So it warrants the sound knowledge of its anatomy, course and relations in the concerned regions. The lower limb is frequently

the site of trauma and other pathology like frequent abscess formation and various joint disease, in the joints of lower limb which all require interventions that demand proper anatomical knowledge, especially of its innervation, blood vessels and lymphatic as well as their possible variations. Surgeons should make every effort to preserve and protect, among other structures, the sciatic nerve, the commonly encountered peripheral nerve, by neurophysicians in conditions like discogenic and nondiscogenic sciatica, by orthopaedicians in procedures like total hip replacement, hemiarthroplasty of hip, and rehabilitation and by anaesthesiologists during the procedure of nerve block [4]. Even during intramuscular injections one of the commonly injured nerves is SN [5]. Different gynaecological positioning during surgeries like hysterectomy, dilatation and curettage may involve SN [6]. A radical surgery is needed in SN with cicatricial change due to untreated endometriosis of SN [4]. Neurological defects are commonly observed in sciatic neuropathies which are usually the outcome of its injury. There is no replacement of cadaver as a best tool to study human anatomy even in this era [4].

So the primary requirement for the concerned physicians, surgeons, anaesthesiologists and concerned medical practitioners in general, is the sound knowledge of not only normal anatomy of SN but also its variant anatomy in order to arrive at its precise location, accurate diagnosis, for the best possible treatment, to prevent the unfortunate iatrogenic injuries during its interventional and surgical procedures.

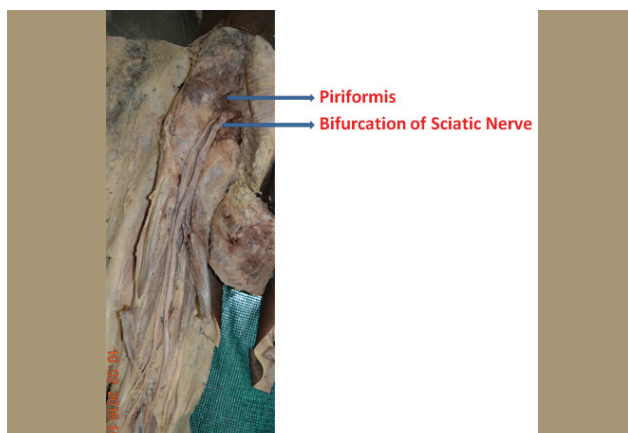
MATERIALS AND METHODS

This study was a cross sectional type of observational study, carried over a period of 2 years from March 2014 to March 2016. The study was conducted on 30 lower limbs of 15 adult male and female cadavers of Indian origin that were selected to be dissected for routine educational purposes in the Department of Anatomy AIIMS Rishikesh.

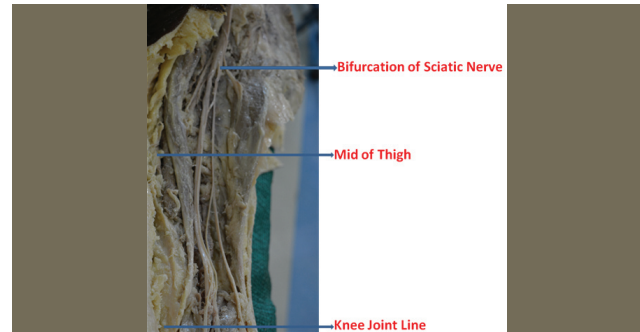
The lower limbs of the cadavers were labelled from 1 to 30, right and left limbs were labelled R and L, respectively. The limbs were dissected retaining their continuity with the trunk. Exposure of the sciatic nerve and its branches were achieved following classical incisions and dissection procedures as provided by Cunningham's Manual of Practical Anatomy [7], taking care to preserve all arteries, sacrificing venae comitantes and resecting the muscles that come in their way. For this study the required permissions were taken from institute, concerned ethical committee, and all the research methods followed were in-line with international ethics and values.

RESULT

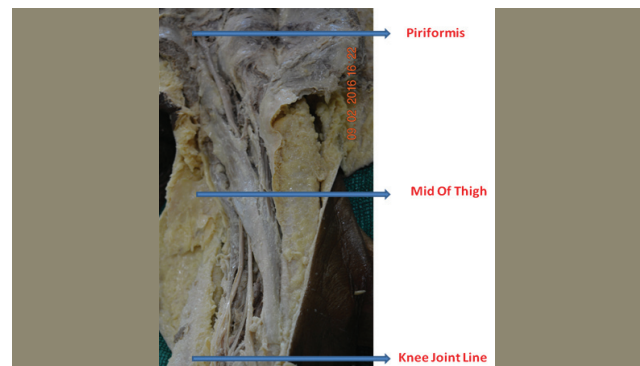
It was observed that there was no or negligible variation in the site of division of sciatic nerves of the limbs of the same cadavers. There was definite variation in the site of division of sciatic nerves of the limbs of the different cadavers [Table/Fig-1-5]. The different sites of variation found were just below the lower border of piriformis in 43% of the cases [Table/Fig-1 and 5], between the piriformis and the mid of the thigh in 36% [Table/Fig-2 and 5] of the cases, near the mid of the thigh in 14% [Table/Fig-3a,3b and 5] of the cases and in 7% [Table/Fig-4 and 5] of the cases between midway of thigh and knee



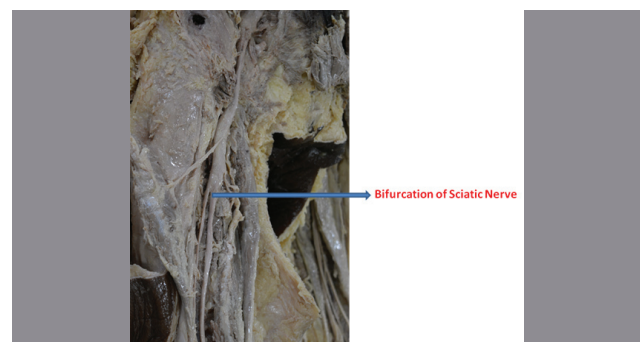
[Table/Fig-1]: Image showing exit and bifurcation of Sciatic Nerve below the lower border of piriformis.



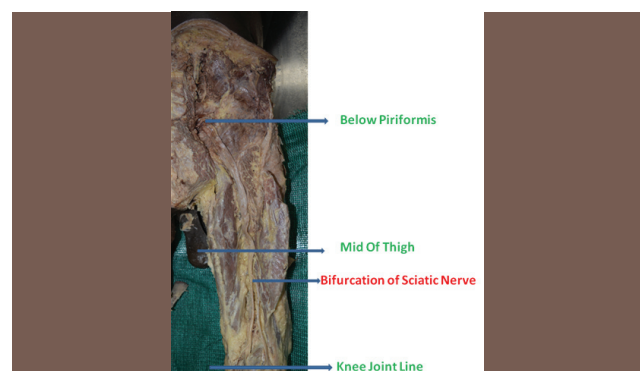
[Table/Fig-2]: Photograph showing bifurcation of the Sciatic Nerve above the mid of the thigh.



[Table/Fig-3a]: Photograph showing bifurcation of the Sciatic Nerve at the mid of the thigh covered by biceps femoris.



[Table/Fig-3b]: Photograph showing bifurcation of the Sciatic Nerve at the mid of the thigh after removal of biceps femoris.



[Table/Fig-4]: Photograph showing bifurcation of the Sciatic Nerve below the mid of the thigh.

joint line [Table/Fig-1-5]. No division was found to be, below the knee joint line and in the pelvis.

Lower limbs of the Cadavers in S. No	Bifurcation at the Lower border of Piriformis	Bifurcation between Piriformis and mid of the thigh	Bifurcation at or near the mid of the thigh	Bifurcation between mid of the thigh and the knee joint line	Bifurcation below the knee joint line
1	Y	-	-	-	-
2	Y	-	-	-	-
3	-	-	Y	-	-
4	-	Y	-	-	-
5	Y	-	-	-	-
6	Y	-	-	-	-
7	-	-	-	Y	-
8	-	-	Y	-	-
9	Y	-	-	-	-
10	Y	-	-	-	-
11	-	Y	-	-	-
12	-	Y	-	-	-
13	-	Y	-	-	-
14	-	Y	-	-	-
15	Y	-	-	-	-
16	Y	-	-	-	-
17	-	Y	-	-	-
18	-	Y	-	-	-
19	-	Y	-	-	-
20	-	Y	-	-	-
21	Y	-	-	-	-
22	Y	-	-	-	-
23	-	-	Y	-	-
24	-	-	Y	-	-
25	Y	-	-	-	-
26	Y	-	-	-	-
27	-	Y	-	-	-
28	-	Y	-	-	-
29	Y	-	-	-	-
30	-	-	-	Y	-
Total	13(43%)	11(36%)	4(14%)	2(7%)	0(0%)

[Table/Fig-5]: Showing the incidence of the different sites of bifurcation of sciatic nerve in this study.

*Note: - Y = Yes i.e. bifurcation present and - means absence of bifurcation at the corresponding sites.

DISCUSSION

There are references from different text books like that of from anatomy, orthopaedics and surgery which emphasises the clinical importance of the sites of bifurcation of SN. The normal division of undivided SN, in 85 to 89% of the cases is found to be the apex of the popliteal fossa [8]. Any explanation or

comment on the variation of the SN demands the knowledge of phylogeny and development of the sacral plexus. In some of the previous studies, the variation in the division of SN in the right and left limbs of the same individual and in male and female were found to be non significant as well as there was no relation between the height of the individual and the site of bifurcation of SN [9]. Pokorny et al., studied the variations in the anatomical relationship of SN and piriformis muscle [10]. During their study of 91 cadavers, they found an atypical relationship in 19 cadavers (20%). Further they reported that in 79.1% of the cases SN passes below the piriformis to enter into the thigh, in 14.3% of the cases the SN divides and one branch passes through the muscle and the other below the muscle, in 2.2% of the cases undivided nerve passes through the piriformis and the anatomical variation as a whole in SN and piriformis to be 15-30%.

In other study, in 96% of the cases the SN left the pelvis through infrapiriformis foramen and in 4% of the cases there was variable relation between SN and piriformis. In the same study it was also reported that in 2.5% cases Common Peroneal Nerve (CPN) penetrated the piriformis muscle and Tibial Nerve (TN) exit the pelvis through through infrapiriformis foramen, while in 1.5% of the cases the CPN was present above the piriformis and TN was below the piriformis [11]. Some workers reported the division of the SN in the gluteal region itself. CPN piercing the piriformis and TN was passing below the piriformis. This high division of the SN may account for the failure of the popliteal block [12]. Vloka et al., reported the site of division of SN, to be within the range of 0 to 115mm above the popliteal fossa and therefore advocated the ideal site for popliteal block to be 100mm above the popliteal crease which is proximal to the division of the SN [13]. In other study the site of the division of SN was found to be 50 to 180 mm above the knee and its variable level accounting for the frequent failures of the popliteal block [14]. Guvencer et al., reported in their study that in 52% of the cases the SN exited without division and in 48% of the cases they observed a high division of SN. Further they reported that in 24% of the cases the CPN passed above the piriformis and TN below it and in 24% of the cases they followed different route [15]. Some studies showed a high division of the SN in which the passage of CPN was above the gemellus superior and that of TN was below it, referring this anatomical relation for the cause of piriformis syndrome, coccygodynia and muscle atrophy [16]. There was a case report of double superior gemellus and double piriformis muscles with high division of SN with their exit between the two piriformis [17]. Some group of workers have reported the division sites of the SN to be 38%, 32%, 14%, 8%, 8% in the middle of the thigh, popliteal fossa, upper thigh, gluteal region and lower thigh respectively [18]. In another study it was reported that in 92% of the cases bifurcation of the SN was at the superior level of popliteal fossa

and in 8% of the cases there were high division of the SN in the pelvis [19]. In the present study the most common site of exit and division of SN were found to be, below the piriformis (43%) followed by the other sites. Beside the small sample size the findings of this study are relevant for the clinical and surgical practice dealing with SN.

CONCLUSION

Most common site of exit and bifurcation of SN were found to be just below the piriformis which is in contradiction to the earlier reports which state apex of the popliteal fossa to be the most common site of SN bifurcation. Though the sample size of the study was small facts of the study can't be ignored. So we emphasise that this fact should also be there in the mind of concerned surgeons, orthopedicians, anaesthesiologists and neurophysicians while dealing with and planning for the pathologies involving SN not only for better diagnosis and treatment but also for avoidance of iatrogenic complications.

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