ANATOMICAL STUDY OF WIDTH AND THICKNESS OF SCIATIC NERVE IN THE GLUTEAL REGION

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Abstract: Sciatic nerve is the largest nerve in the body originating from the sacral plexus and it supplies the lower limb through its branches. It leaves the pelvic cavity and enters the gluteal region usually through the greater sciatic foramen below the piriformis. It divides into its terminal branches at various levels which determine the length of sciatic nerve. The present study is undertaken to measure the width and thickness of sciatic nerve in the gluteal region as well as to measure the length of sciatic nerve till its terminal division. A detailed knowledge of anatomy of sciatic nerve and gluteal region whether normal or varied will not only help surgeon to be cautious, but plan accordingly during various surgical interventions in this region. Lower limb surgeries frequently involve sciatic nerve block. Therefore data obtained in the present study about the dimensions and course of SN in the gluteal region as well as the level of its division may serve as a guide for a successful surgery in this region.

I. INTRODUCTION

Sciatic nerves (SN) is the thickest nerve in human body. It is the largest branch of sacral plexus (L4,5 S1,2,3) formed in the pelvis anterior to piriformis (PM) muscle.[1]It usually leaves the pelvic cavity and enters the gluteal region through the greater sciatic foramen below the piriformis. It has two components, tibial and common peroneal, which are enclosed in a common connective tissue covering. Tibial component is medial and formed by ventral division of L4, L5, S1, S2 and S3 and common peroneal component is lateral and formed by dorsal division of L4, L5, S1 and S2. Finally, it ends by dividing into its terminal branches tibial and common peroneal usually at the upper angle of popliteal fossa. However, there are several reports of variations of sciatic nerve, both in its course and its level of termination.[2-4]Compression or irritation of the sciatic nerve is causes sciatica. The sciatica symptoms include nerve pain, numbness, tingling, and weakness. It may include inability to walk depending upon the where the pressure of the sciatic nerve occurs.[5]The present is undertaken to measure the width and thickness of sciatic nerve in the gluteal region as well as to measure the length of sciatic nerve till its terminal division. The study of these parameters is an attempt in better understanding the symptoms caused by compression of SN.

II. MATERIALS AND METHODS

Fifteen formalin fixed lower limbs (5 right and 10 left) were dissected in the department of Anatomy, KMC, Mangalore. After reflecting the gluteus maximus, and muscles of the back of thigh, the location of the SN and its exit from pelvis and the level of the SN division as shown in Figure 1 were noted. Whether longest sciatic nerve (figure 1) and shortest sciatic nerve (Figure 2) were selected and photographed. The following measurements were taken using vernier caliper and the measuring scale.

1. Distance between greater trochanter (GT) and ischial tuberosity (IT) in cm
2. Distance between medial border of SN and lateral border of IT in cm
3. Distance between lateral border of SN and medial border of GT in cm
4. Width of SN in mm
5. Thickness of SN between IT and GT in mm
6. Length of SN from the lower border of PM till its division in cm

The parameters were tabulated and Statistical analysis was performed using SPSS for Windows Version 13. The average, maximum and minimum values are calculated.

III. RESULTS

In the present study the SN was emerging below the piriformis in all the lower limbs. Sciatic nerve divided into common peroneal and tibial nerve at different levels as shown in Table 1. Both higher and lower division of sciatic nerve was observed on the left side. The maximum length of SN was 39cm and minimum was 2.5cm. However on the right side the division of SN was at a lower level with maximum length being 36.5cm and minimum 10.1cm. Thickness of SN did not show much difference on both the side as depicted in table 1. It was observed that the distance between medial border of SN and lateral border of IT was less on left side with the average distance being 1.4cm.

Whereas the distance between lateral border of SN and medial border of GT was almost same on both the side as shown in Table 1.

Table 1: Measurements taken for different parameters of sciatic nerve in both right and left lower limb

Parameters	Right lower limb			Left lower limb		
	Max	Min	Average	Max	Min	Average
Distance between GT and IT (cm)	6.4	5.5	5.8	5.8	5	5.3
Distance between medial border of SN and lateral border of IT (cm)	3.3	1.4	2	1.6	1.1	1.4
Distance between lateral border of SN and medial border of GT (cm)	3.7	1.8	3	3.4	2	2.8
Width of SN (mm)	13.5	9	10.6	13	7.84	9.7
Thickness of SN between IT and GT (mm)	1.9	1.4	1.7	2.5	1.4	1.9
Length of SN from the lower border of PM till its division (cm)	36.5	10.1	25.2	39	2.5	23.5

IV. DISCUSSION

Sciatic nerve block (SNB) is often used most of the lower limb surgery. There are several procedures or approaches for SNB. Therefore anatomical knowledge about the dimensions and course of SN in the gluteal region as well as the level of its division become surgically important. In their report Karmaker et al [6]have suggested that local anaesthetic injected into the subgluteal space (space below gluteus maximus where sciatic nerve is located) under ultrasound guidance is effective in producing SNB. Therefore the surface landmark for the topographic relation of sciatic nerve becomes important. Most of the classical text books of anatomy state that the SN passes out through greater sciatic foramen usually below piriformis and divides at the superior angle of the popliteal fossa into tibial and common peroneal nerves.[1]These two components represent two portions, inside the sciatic nerve, which are expressed at the origin of this nerve during the early stages of the embryonic development and maintain their identity throughout their course.[7] The separation that occurs during the early stages of development may remain in the adult, influencing the topographic relationships between the sciatic nerve and the piriformis muscle at the gluteal region. In the present study the SN was emerging below the piriformis in all the lower limbs (100%) studied. This finding is in accordance with the earlier studies which reports the passage of the entire nerve below the piriformis in 80 to 90% of the cases.[8-12]Variations like divisions of SN between and below PM was found by Beaton & Anson[13] in 17% of specimens, Pecina[14] in 6.15%, Beaton[15] in 7.1%, Moore & Dalley[16] in 12.2% of the specimens they studied. Division of the SN above and below PM was found by Beaton & Anson[13] in 3.3%, Beaton[15] in 2.1%, Moore & Dalley[16] in 0.5% of their study. Undivided sciatic nerve between two heads of PM was found in few studies like Beaton & Anson[13] in 0.8%, Beaton[15] in 0.8% of specimens. However these types of variations were not found in our study.

According to most of the studies when SN is dividing at a higher level it usually pierces the piriformis. Level of SN bifurcation levels are important in clinical and treatment aspects. Divided piriformis is said to be a very important cause of piriformis syndrome (when present), as common peroneal nerve passes between two divisions of piriformis it is usually compressed and irritated resulting in the specific symptoms. [17]Papadopoulos et al[18] mention that incidence of piriformis syndrome is six times more frequent in females Machado et al. [19] did not find even a single divided piriformis in their study series. The present study is in accordance with the above results since in our study also sciatic nerve divided at a higher level in the gluteal region but below the level of piriformis, the minimum level being 2.5cm below the piriformis in the left lower limb.

In the present study, the average length of SN was 24.3 cm with the maximum length being 39cm and minimum 2.5cm and both were recorded on the left side. The maximum thickness of SN between IT and GT was 2.5mm (left side) and minimum was 1.4mm (both sides) with an average of 1.8mm in our study. The average width of SN between IT and GT was 10.6 (Right side) and 9.7mm (left side). Statistically there was not much difference in the thickness on right and left side. In the study by Vicente et al[11] the width of SN at the level of inferior border of PM was 18.85mm on the right side and 22.32 mm on the left side. However, Williams et al[1] attributed the width of 20.0 mm to the sciatic nerve at its origin. In the present study, the mean distances between the medial margin of the SN and the lateral border of the IT were 2cm and 1.4cm on the right and left sides respectively. And the mean distance between lateral border of SN and medial border of GT were 3cm and 2.8cm respectively on right and left sides. This shows that in the present study on both sides the sciatic

nerve was descending with an inclination towards the medial side because the distance between IT and sciatic nerve was lesser on the medialside. However Vicente et al[11] observed the mean distance between the medial margin of the sciatic nerve and the lateral border of the sacro- tuberous ligament as 17.27 mm and 17.83 mm in the right and left lower limbs respectively. The nerve's lateral border was located at a 32.66 mm distance from the apex of the greater trochanter, on the right side, and at a 33.22 mm distance, on the left side. Knowing the high division of the sciatic nerve as well as its course is important for surgical approaches, in cases of lesions which affect its gluteal or femoral portions.[20] The high division may result in sciatica, nerve injury during deep intramuscular injections in gluteal region, failed sciatic nerve block in anesthesia and injury during posterior hip operations.[12]

CONCLUSION

A detailed knowledge of anatomy of sciatic nerve or gluteal region whether normal or varied will not only help surgeon to be cautious, but plan accordingly during various surgical interventions in this region. The present data could serve as a guide to prevent deep intramuscular injection hazards in gluteal region.

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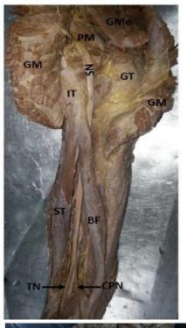

Figure 1: Gluteal region and back of thigh of right lower limb showing the division of sciatic nerve into common peroneal and sciatic nerve at popliteal fossa
SN- Sciatic nerve, TN- Tibial nerve, CPN- Common peroneal nerve, PM- Piriformis muscle, GM- Gluteus maximus, Gme- Gluteus medius, ST- Semitendonosus, BF- Biceps femoris, IT- Ischial tuberosity, GT- Greater trochanter

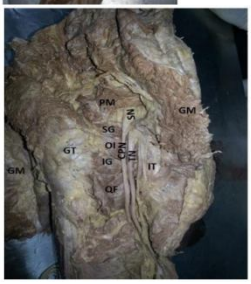

Figure 1: Left gluteal region showing the higher division of sciatic nerve into common peroneal and tibial nerve at upper border of superior gemillus muscle.
SN- Sciatic nerve, TN- Tibial nerve, CPN- Common peroneal nerve, PM- Piriformis muscle, GM- Gluteus maximus, SG- Superior gemillus, OI- Obturator internus, IG- Inferior gemillus, QF- Quardratus femoris, IT- Ischial tuberosity, GT- Greater trochanter

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