

Variations in Course and Branching of Sciatic Nerve and it's Relation to Piriformis Syndrome

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ABSTRACT

Background: Sciatic nerve is a branch of sacral plexus. It passes below the piriformis and divides in the popliteal fossa. Higher division and relation of sciatic nerve to piriformis have been documented. Beaton and Anson have classified relation of sciatic nerve to piriformis. The aim of this study is to find incidence of variant anatomy of sciatic nerve as per Beaton and Anson classification.

Materials and methods: 48 formalin embalmed lower limbs used for regular anatomy teaching were used. Branching and course of sciatic nerve was observed in gluteal region, thigh and popliteal fossa.

Observations: As per Beaton and Anson classification, we found 81.2% showed type A or normal arrangement. Type B variation was seen in 14.6% while 4.2% showed type D variation.

Conclusion: Variations in branching of sciatic nerve and it's relation to piriformis muscle are important from point of view of Surgeons and Anaesthetists. Knowledge of these variations will help reducing block failures in cases of sciatica, piriformis syndrome and hip replacement surgeries.

KEY WORDS: Sciatic nerve, Sacral plexus, Piriformis Syndrome, Hip replacement.

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INTRODUCTION

Sciatic nerve is the largest and thickest branch of the sacral plexus. It passes below the Piriformis muscle and leaves the pelvis through greater sciatic foramen. It divides into Tibial and common peroneal branches. Sciatic nerve is also called the nervus ischiadicus in latin. Tibial and common peroneal are the terminal branches of sciatic nerve. The tibial component is derived from ventral branch of ventral rami of L4 to S3 while the common peroneal nerve is derived from dorsal branch of ventral rami of L4 TO S2. The normal location of division of sciatic nerve into terminal branches is at the apex of popliteal fossa.

Higher division in the pelvis has been documented more commonly while lower division is considered a rare finding. Iatrogenic reasons, injury during hip replacement surgeries and misplaced therapeutic injections in gluteus maximus can damage the nerve [1].

Lumbosacral radicular syndrome or Sciatica is shooting pain felt from lower back and directed to the leg. Pain is felt at the hip, back of thigh, anterior and back of leg. Disc herniation pressing on lumbar and spinal roots is the most common cause for sciatica. Spondylolisthesis, gestation and piriformis syndrome are other common causes [2].

Piriformis syndrome is due to abnormal relation with piriformis muscle causing compression of sciatic nerve. This term was coined by Robinson in 1947 [3]. Normally sciatic nerve passes below the piriformis and branches into tibial and common peroneal nerve in the popliteal fossa. Variations in branching and course of Sciatic nerve form the basis of unsuccessful sciatic nerve blocks [4]. Beaton and Anson [5] have been pioneers in study of sciatic nerve variations and their relation to Piriformis muscle. They came up with a classification in 1938 which divided the variations in six types. This study is undertaken to find incidence of variant branching of sciatic nerve and it's relation with piriformis syndrome.

MATERIALS AND METHODS

STUDY TYPE: Observational cadaveric study with 48 lower limbs from 24 formalin embalmed cadavers were used for this study. The cadavers were formalin embalmed for use of 1st MBBS Anatomy dissection classes.

During routine anatomy dissection, gluteal region was meticulously dissection to observe the route of sciatic nerve. The relation of sciatic nerve to the piriformis muscle was observed. The branching of sciatic nerve was noted. The gluteal region, back of the thigh and popliteal fossa were considered to look for higher branching of sciatic nerve. All variations were noted and photographed. The results were statistically analysed.

OBSERVATIONS

During routine Anatomy dissection we found variations in branching and course of Sciatic nerve. Out of 48 dissected lower limbs, we found higher division of Sciatic nerve in 9 lower limbs. 2 cadavers showed the higher branching bilaterally. Sciatic nerve with unilateral higher division (Fig 1) was seen on right side in 4 and on left side in 1 lower limb. Sciatic nerve piercing Piriformis was seen in 7 lower limbs. In 2 right sided lower limbs Sciatic nerve piercing the piriformis and then branching (Fig 2) was seen. In 5 lower limbs, 3 right sided and 2 left sided the common peroneal nerve was seen piercing the piriformis while the



Fig. 1: Common peroneal nerve piercing piriformis.



Fig. 2: Sciatic nerve piercing Piriformis.



Fig. 3: Common peroneal nerve piercing piriformis and re-joining with tibial nerve to form sciatic nerve in thigh which divides in popliteal fossa. A- Piriformis, B- common peroneal nerve, C- Tibial nerve, D - re-joined sciatic nerve F - Sciatic nerve redividing.

tibial nerve was seen arising below the muscle. (Fig 3) In one cadaver left sided common peroneal nerve was seen piercing the piriformis and the tibial nerve passed below the piriformis. Both these nerves re-join in the thigh to form sciatic nerve and divide again in the popliteal fossa. (Fig 4) Table 1 demonstrates the variations we observed in branching and course of Sciatic nerve.

Table 1: Variations in branching of Sciatic nerve.

Variations of sciatic nerve seen	Number seen
Higher division of sciatic nerve	9
Piercing Piriformis	7
Sciatic nerve piercing piriformis	2
Common peroneal nerve	5
Common peroneal nerve piercing piriformis and re-joining to form sciatic nerve in thigh which again divided in popliteal fossa.	1

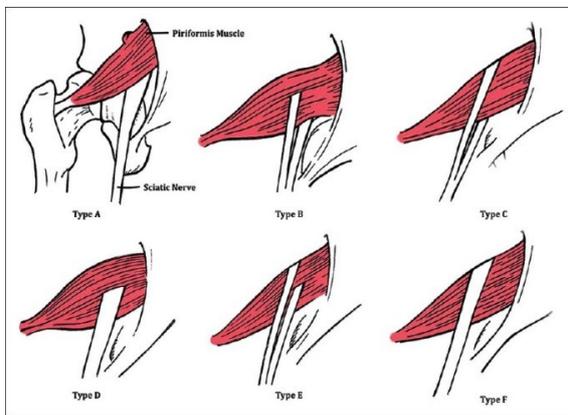


Fig. 4: Baeton and Anson classification of relation between Sciatic nerve and Piriformis muscle.

DISCUSSION

Variation in branching of sciatic nerve in the pelvis and before the popliteal fossa has been documented by many authors. Rare cases of trifurcation of sciatic nerve are also seen. Such variations contribute to cases of sciatica, piriformis syndrome and failed nerve blocks. Variations of course and branching of sciatic nerve should be definitely considered before hip surgeries and surgical intervention in vicinity of sciatic nerve [6].

Baeton and Anson [5] in 1938 made a classification of relation between sciatic nerve and piriformis muscle. They divided the course and division of sciatic nerve in relation to piriformis muscle into 6 types as shown in figure 4. Type A was sciatic nerve passing undivided below piriformis muscle. Type B was common peroneal nerve piercing piriformis and tibial nerve passing below the muscle. In

type C common peroneal nerve passes above piriformis and tibial nerve passed below the muscle. The sciatic nerve pierced the piriformis undivided in type D. In type E the common peroneal nerve passed above the piriformis and tibial nerve pierced the muscle. An undivided sciatic nerve passed above the piriformis muscle in type F. In our study we found 81.2% limbs showing type A, 14.6 % limbs showing type B and 4.2 % showed type D . The findings are shown in Table 2.

Lewis et al [7] found 11 % lower limbs showing variation of course and branching of Sciatic nerve. They mention that anatomical variations of sciatic nerve related to piriformis may play a role in pathologies like sciatica. Jha et al [4] found variations in branching of sciatic nerve in 3 out of 100 lower limbs. They found variation like higher division and common peroneal nerve piercing the Piriformis and passing above the muscle. The tibial nerve is seen passing below the piriformis in all three. In this study in Nepalese population, they mention that non-discogenic sciatica is seen in piriformis syndrome cases.

Patel S et al [8] did a study of division of sciatic nerve in 86 lower limbs. They reported sciatic nerve dividing in pelvis but below piriformis in 2 limbs. 3 lower limbs showed common peroneal nerve piercing piriformis. This finding corresponds to our study.

In a study done in Turkey, Z.Alsi Aktan Lkiz et al [3] 3.8% nerve piercing piriformis then dividing as type D . 7.69% showed type B variation. They conclude that the nerve can divide anywhere from the pelvis to popliteal fossa. Such variations can cause problems during administering nerve blocks. In their opinion inserting the needle 100 mm above the popliteal crease can be considered during post-operative pain blockage for below knee surgeries.

Barbosa et al [9] state that the common fibular nerve piercing the piriformis is the most commonly seen variation of sciatic nerve. This finding is also seen in our study. They correlate this finding with priformis syndrome. In a study of topographic variations of branches of sciatic nerve and it's relation to piriformis muscle by Pokorny et al [10], 14.3%

Beaton and Anson classification	Type A	Type B	Type C	Type D
Pokorny D et al [2006] [10]	79.10%	14.30%	2.20%	4.40%
Patel S et al [2011] [8]	91.80%	2.32%	5.81%	
Adibatti et al [2014] [11]	92%	2%	6%	
Z A A Lkiz et al [2018] [3]	84.62%	7.69%		3.80%
Lewis S et al [2018] [7]	89%	8.80%	2.90%	
Jha A K [2020] [4]	92.50%	2.50%	5%	
Current study [2021]	81.20%	14.60%		4.20%

Table 2: Comparison of Variations in various studies as per Beaton and Anson classification.

showed branching of sciatic nerve above piriformis. Common peroneal nerve was piercing piriformis and tibial nerve passed below it. In 2.2 % cases they found a unsplit nerve piercing the piriformis. In 4.4 % cases the sciatic nerve split before the piriformis. One branch passed above the muscle while second branch passed below the muscle. They mention that over stretching of nerves with variations can lead to injury during total hip arthroscopy.

Adibatti and Sangeetha [11] found normal anatomy in 92% cases during a study of sciatic nerve. Higher division in pelvis was seen in 6%, while 2% showed higher division in the thigh. Common peroneal nerve piercing the piriformis was seen in 2% cases. They also found trifurcation of sciatic nerve with a third branch to soleus was seen in 2%. Authors state that such variations should be considered by the surgeons during hip surgeries and anaesthetists during nerve blocks.

Variations in branching and course of sciatic nerve can be identified by imaging tools. MRI can determine higher division and piercing of piriformis causing Piriformis syndrome. Clinicians should consider these variations while performing hip surgeries and nerve blocks [12].

CONCLUSION

We conclude that variations in branching of sciatic nerve are common. We found Beaton and Anson type B as the most common variation. The relation of the Sciatic nerve to piriformis muscle should be considered to comprehend cases of Sciatica, Piriformis syndrome and other nerve compression cases. Knowledge of such variations will help reducing failure of sciatic nerve blocks.

Conflicts of Interests: None

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