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REVIEW ARTICLE

STUDY OF ANATOMICAL VARIATIONS OF THE SCIATIC NERVE AND IT'S IMPORTANCE TO CLINICIANS AND ANESTHETIST

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ABSTRACT

Sciatic nerve is the widest, thickest nerve of the body, arising from lumbosacral plexus. It is near about 2 cm wide. Sciatic nerve is formed by anterior and posterior divisions of spinal nerves L4, L5, S1, S2, S3. It has two components common peroneal and tibial components. It is formed in pelvic region, it emerges out from pelvis into gluteal region through greater sciatic foramena by passing below piriformis as a single nerve trunk. Then it courses in back of thigh and at the apex of popliteal fossa where it terminates into tibial nerve and common peroneal nerve. There are numerous variations in it's course. The main variation is in relation to it's exit from pelvis and division of sciatic nerve into terminal branches. These variations are of clinical importance and these may lead to compression of nerve called as sciatica. These variations are also important for anesthetist as this nerve commonly used for peripheral nerve block i.e. sciatic nerve block and variation in division and course may lead to failed block or sparing of block. The aims and objectives of present study are to find out variation in exit pattern of sciatic nerve and level of bifurcation of sciatic nerve and it's clinical correlation of above variations. In our study, we found that single trunk of sciatic nerve coming out in gluteal region below piriformis 75%, piercing piriformis 3.33% cases. Two divisions of sciatic nerve coming out in gluteal region common peroneal and tibial nerve passing below piriformis 11.67%, common peroneal piercing piriformis and tibial nerve passing below piriformis 6.67%, common peroneal passing above pyrifomis and tibial nerve passing below piriformis 3.33% cases. Terminal divisions of sciatic nerve in pelvis 21.67%, in upper part of thigh 5% and at apex of popliteal fossa 73.33%. These variations are of clinical importance and these may lead to compression of nerve called as sciatica. These variations are also important for anesthetist as this nerve commonly used for peripheral nerve block i.e. sciatic nerve block and variation in division and course may lead to failed block or sparing of block.

INTRODUCTION

Sciatic nerve is the widest, thickest nerve of the body, arising from lumbosacral plexus. It is near about 2 cm wide. Sciatic nerve is formed by anterior and posterior divisions of spinal nerves L4, L5, S1, S2, S3. It has two components common peroneal and tibial components. Common peroneal component arise from posterior division of spinal nerves L4, L5, S1, S2 and tibial component from anterior division of spinal nerves L4, L5, S1, S2, S3. It is formed in pelvic region, it emerges out from pelvis into gluteal region through greater sciatic foramena by passing below piriformis as a single nerve trunk. Then it courses in back of thigh and at the apex of popliteal fossa where it terminates into tibial nerve and common peroneal nerve. It supplies to muscles of back of thigh, leg and foot. It carries sensation from skin of leg except medial aspect of leg and foot. (Dutta 2004) There are numerous variations in it's course. The main variation is in relation to it's exit from pelvis and division of sciatic nerve into terminal branches. These variations are of clinical importance and these may lead to compression of nerve called as sciatica. These variations are also important for anesthetist as this nerve commonly used for peripheral nerve block i.e. sciatic nerve block and variation in division and course may lead to failed block or sparing of block. (Moore and Dalley 1999) This present study was to describe variation of exit of sciatic nerve from pelvis and variation of division of sciatic nerve the knowledge of variation of sciatic nerve is also important for surgical exploration. Previous studies done on variation of sciatic nerve were also discussed. Variation of sciatic nerve in this way is important for surgeons and anesthetist to avoid errors in treatment.

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AIMS AND OBJECTIVES

The aims and objectives of present study are

1. To find out variation in exit pattern of sciatic nerve

2. To find out variation in level of bifurcation of sciatic nerve
3. Clinical correlation of above variations.
4. To discuss present study findings with available literature.

MATERIALS AND METHODS

During routine cadaveric dissection in the department of anatomy, MVP's Dr Vasantrao Pawar Medical College, Nashik, 60 gluteal regions were examined in 3 yrs of 30 cadavers. Gluteus maximus was reflected and piriformis was exposed. Normally sciatic nerve divides at the level of superior angle of popliteal fossa.

The following variations of sciatic nerve were observed

1. Single trunk of sciatic nerve coming out in gluteal region
Below piriformis - ST1 (shown in Fig. no. 1)
Piercing piriformis - ST2 (shown in Fig. no. 2)
Above piriformis - ST3
2. Two divisions of sciatic nerve coming out in gluteal region
Common peroneal and tibial nerve passing below piriformis D1 (shown in Fig. no. 3)
Common peroneal piercing piriformis and tibial nerve passing below piriformis – D2 (shown in Fig. no. 4)
Common peroneal passing above pyrifomis and tibial nerve passing below piriformis –D3 (shown in Fig. no. 5)
3. Level of bifurcation of sciatic nerve –
In pelvis – B1 (shown in Fig. no. 3)
In upper part of thigh – B2 (shown in Fig. no. 6)
At apex of popliteal fossa – B3 (shown in Fig. no. 7)

Fig No 1- single trunk of sciatic nerve coming out in gluteal region below piriformis

Fig No 2- single trunk of sciatic nerve coming out in gluteal region piercing piriformis

Fig No 3-Common peroneal & Tibial nerve passing below piriformis

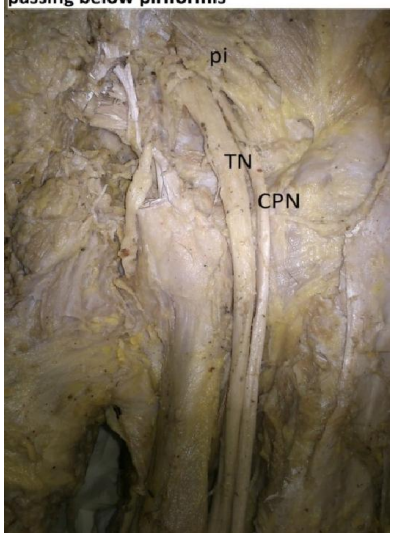


fig no 4- common peroneal N piercing piriformis & Tibial N passing below pirifirmis

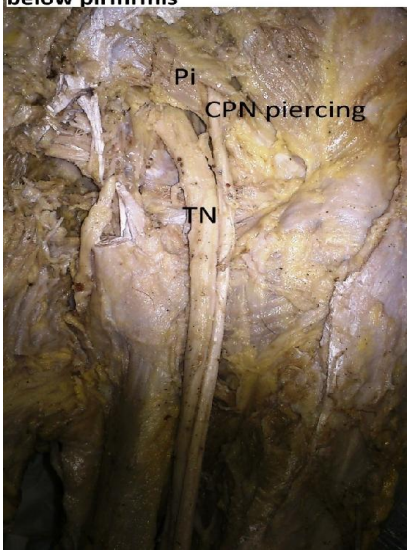


Fig No 5- common peroneal N passing above & tibial N below piriformis

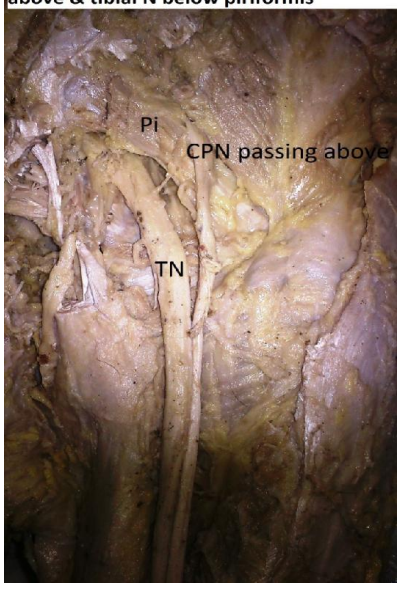


Fig No 6- bifurcation of sciatic nerve in upper part of thigh

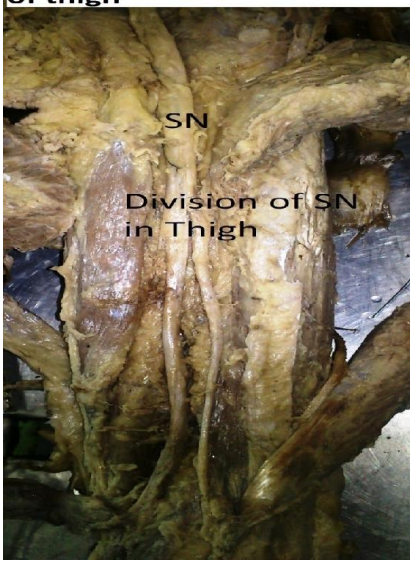
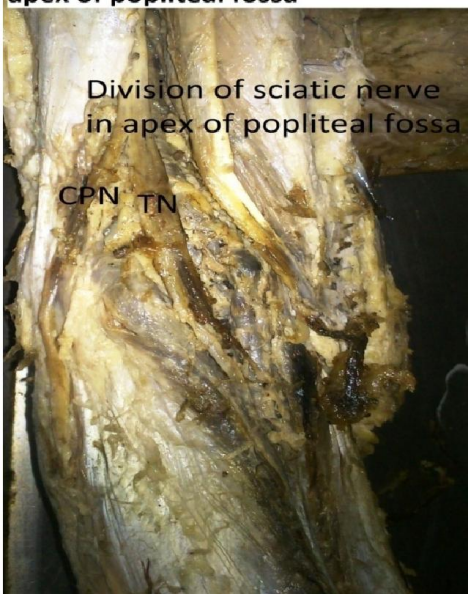


Fig No 7- bifurcation of sciatic N in apex of popliteal fossa



Observations and results

As shown in Table No 1 variation in the exit pattern of sciatic nerve following observations were found. Sciatic nerve exit from pelvis through greater sciatic foramena as a single trunk below piriformis muscle in 45 out of 60 cases (75%). In 2 cases (3.33%) single trunk of sciatic nerve comes out by piercing piriformis muscle, but in no case found in which single trunk of sciatic nerve comes out above piriformis. So from this it is concluded that sciatic nerve as a single trunk most commonly comes out through greater sciatic foramena below piriformis. In 13 cases (21.67%), sciatic nerve divides in two divisions, common peroneal nerve and tibial nerve in pelvic cavity, then these two divisions comes out through greater sciatic foramena. In this, 7 cases (11.67%) both divisions comes out below piriformis, in 4 cases (6.67%) common peroneal nerve pierces pyrifomis and tibial nerve passes below piriformis and in 2 cases (3.33%) common peroneal nerve passes above pirifomis and tibial nerve passes below piriformis. So from this it is concluded that if pelvis division of sciatic nerve occurs, then both divisions most commonly comes out below piriformis. Common peroneal nerve course variation is more frequent than tibial nerve. Variation of bifurcation of sciatic nerve is shown in Table No 2, from that it was found, in 13 cases (21.67%) sciatic nerve divides in pelvic cavity, in 3 cases (5%) sciatic nerve divides in upper part of thigh but in 44 cases (73.33%) sciatic nerve divides at apex of popliteal fossa. So most commom pattern is B3.

Table 1. showing variation in exit pattern of sciatic nerve

Single trunk of sciatic nerve coming out in gluteal region	No of cases & percentage	Two divisions of sciatic nerve coming out in gluteal region	No of cases & percentage
ST1	45 (75%)	D1	7 (11.67%)
ST2	2 (3.33%)	D2	4 (6.67%)
ST3	0 (0%)	D3	2 (3.33%)
Total	47 (78.33%)	Total	13 (21.67%)

Table 2. showing Level of Bifurcation of sciatic nerve

Level of Bifurcation	No of cases & percentage
B1	13 (21.67%)
B2	3 (5%)
B3	44 (73.33%)
Total	60 (100%)

DISCUSSION

The sciatic nerve is the largest branch of the lumbosacral plexus. It usually bifurcates at the upper angle of the popliteal fossa. The bifurcation levels are important in clinical and treatment aspect. Based on previous studies and literature, observations of present study are discussed. The pattern of bifurcation of sciatic nerve on right and left side & male and female were not significant in anatomy textbooks & journals, so not observed. The two terminal branches of the sciatic nerve may arise directly from the sacral plexus (Bergman *et al.,* 1988). During embryological development at the base of the limb bud, the nerves contributing to the lower limb form two plexuses, lumbar and sacral. Later as the elements from each of these plexuses grow out into the limb, they get subdivided into dorsal and ventral components for the dorsal and ventral musculature. The sciatic nerve is formed when the large dorsal component of the sacral plexus (common peroneal) and ventral component (tibial) move downwards close together (Demiryurek *et al.,* 2002). Hence depending upon the development it is possible that the common peroneal and tibial nerves separate from each other at different levels from their origins, in the gluteal region, the posterior compartment of the thigh or the popliteal fossa. (Bergman *et al.,* 1988; Demiryurek *et al.,* 2002; Shewale *et al.,* 2013) Various studies have reported the levels of division of sciatic nerve into tibial nerve and common peroneal nerve. Beaton and Anson (1937), have classified variations of the piriformis and sciatic nerve in 120 specimens in 1937 and in 240 specimens in 1938.

Their classification is known as the Beaton and Anson (1937) classification. It is as follows

Type I - Undivided nerve below undivided muscle
Type II - Divisions of nerve between and below the undivided muscle
Type III - Division above and below undivided muscle.
Type IV - Undivided nerve between heads of piriformis
Type V - Divisions between and above the heads
Type VI - Undivided nerve above undivided muscle

Table 3. showing comparison of present study with study by Beaton and Anson

Name of study	Type I	Type II	Type III	Type IV	Type V	Type VI
Beaton and Anson(6)	84.2%	11.7%	3.3%	0.8%	--	--
Present study	75%	--	2%	--	--	--

In present study, we found type 1 variation (75%) and type III (2%) of sciatic nerve from above 6 types. In study by Shailesh Patel *et al*. (2011), they found that Sciatic nerve already divided in pelvis and its two divisions comes out below piriformis in 2.32% cases and Sciatic nerve already divided in pelvis and its two divisions comes out differently from pelvis, one (Common Peroneal) comes out after piercing piriformis &

Other (Tibial) comes out below Piriformisin 5.81% cases and in our study it was 11.67% & 6.67% respectively. In our study the sciatic nerve has terminated in the upper part of thigh in 5% cases. In the study of Prakash *et al.* (2010) 16.3% of specimens have shown the division in the gluteal region. Guvencer *et al*. (2009) have examined 50 gluteal regions in 25 cadavers and observed that in 48 % of specimens sciatic nerve has been dividing in gluteal region. Ugrenovic *et al.* (2005) have found high division of sciatic nerve in 27.5% of the specimens in a study performed in 100 fetuses. When the nerve divides in the pelvis, the common peroneal nerve usually pierces the piriformis muscle. In our study common peroneal nerve pierce piriformis in 6.67% cases & sciatic nerve pierce piriformis in 3.33% caes. Mouret (1893) has concluded that in case of high division of sciatic nerve the common peroneal nerve passes through the piriformis muscle. Odijama and Kurihara (1963), have found the common peroneal nerve to pierce the piriformis muscle more commonly in males and on left side. Moore and Dalley (1999) have reported that common peroneal nerve passing through the piriformis and tibial nerve passing below piriformis is in 12.2% of specimens. Chiba (1992) has reported that common peroneal nerve passing through the piriformis is in 34% of cases in 514 extremities. Machado *et al*. (2003) have performed a dissection in 100 foetuses and have reported three types of variations

A) Type I - The common peroneal nerve penetrating the piriformis and tibial nerve passing under piriformis.
B) Type II - Common peroneal nerve passing above piriformis and tibial nerve below piriformis.
C) Type III - Sciatic nerve piercing piriformis muscle. The passage of sciatic nerve through the piriformis has also been reported by Pecina (1979) in 22% of 130 cadavers. It has included penetration of the piriformis by the sciatic nerve in 5% and piriformis piercing by common peroneal nerve in 17% specimens.

Ugrenovic *et al*. (2005) have found high division of the sciatic nerve in 27.5% of the specimens in a cadaveric study performed in 100 fetuses. The sciatic nerve has been seen leaving the pelvis below piriformis in 96% of 200 gluteal regions. The common peroneal nerve has been seen passing below the piriformis in 2.5% of specimens and common peroneal passing above piriformis and tibial nerve below piriformis in 1.5 % of cadavers. Pokorny *et al*. (2006) using 91 fresh cadavers have modified the Beaton and Anson [19] classification and stated that the first variation namely the undivided nerve below undivided muscle was the most common type and seen in 79.1% of the specimens. In our study it has been found in 75%. In study by Shewale *et al.* (2013), found a variation of rootlets of tibial nerve coming out separately below piriformis in 3.33% males and 6.66% females. Such a variation was not found in our study.

Conclusion

The knowledge of anatomical variations in the course of sciatic nerve is having great importance to surgeons, orthopedicians and anesthetist as it is frequently get operated site. By keeping in mind variations in the course and level of bifurcation of sciatic nerve helps anesthetist during sciatic block to improve clinical results. Variation in formation of sciatic nerve helps in treatment of sciatica. This study was done on cadavers during routine dissection for 1st MBBS students, to reveal variations of sciatic nerve.

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