

Variations of Sciatic Nerve Bifurcation: A Study

Research Article

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Abstract

Background: The sciatic nerve (SN) is the thickest nerve in the body. It is formed in the pelvis from the ventral rami of the fourth lumbar to the third sacral spinal nerves and leaves the pelvis via the greater sciatic foramen below piriformis and divides into Common Peroneal nerve (CPN) and Tibial nerve (TN) at the superior angle of popliteal fossa. High division of the sciatic nerve is the most common variation wherein the TN and the CPN may leave the pelvis through different routes. Such variations may lead to compression of the nerve, non discogenic sciatica, piriform syndrome and also to incomplete sciatic nerve block. Knowledge regarding this may help the surgeon to plan for various surgical intervention pertaining to the gluteal region.

Aim: To study the course and division of sciatic nerve.

Methodology: The study was conducted in the department of Anatomy, Subbaiah Institute of Medical Sciences over a period of 5 years. 70 lower extremities of 35 cadavers of both sexes were studied to see the variations in sciatic nerve bifurcation. Beaton and Anson classification has been followed for the classification of division of Sciatic nerve.

Results: In our study on 70 lower extremities of 35 cadavers, we observed 6 (8.6%) high division of SN. Among these, 2 (2.9%) lower extremities showed high division in the back of thigh and 4 (5.7%) showed within the pelvis. The remaining 64 (91.4%) lower extremities showed the division outside the pelvis.

Conclusion: Knowledge regarding the variation in the level of division of the sciatic nerve and its pelvic exit is of utmost importance in order to prevent inadvertent injury to the nerve during various surgical interventions in the gluteal region.

Keywords: Sciatic Nerve; Piriformis; Tibial Nerve; Common Peroneal Nerve.

Introduction

Sciatic is a Greek word derived from 'ischiadicus'. Sciatic nerve is also known as ischiadic nerve or ischiatic nerve, is a large nerve in humans and other animals [1]. The sciatic nerve is the thickest nerve in the human body formed in the pelvis by the ventral rami of L4-S3 spinal nerve roots. It is about 2cm wide and leaves the pelvis through the greater sciatic foramen below the piriformis and descends between the greater trochanter and ischial tuberosity in the gluteal region. The nerve divides subsequently into two terminal branches, Tibial and common peroneal nerve usually at the superior angle of popliteal fossa. It is a mixed nerve with the motor branches supplying the posterior group of thigh muscles as well as hip and knee joint. Its sensory component supplies the whole tibial and foot areas with the exception of the anteromedial tibial region and the medial margin of the foot [2].

Sciatic nerve presents a significant variation in its topography and division. Higher level of division of the sciatic nerve anywhere in the thigh or in the pelvis is commonly seen. In the pelvis, the whole nerve or its branches may emerge either below, above, or through the piriformis. High division of the sciatic nerve may be unilateral or bilateral usually leading to compression of nerve resulting in piriform syndrome and also incomplete block of sciatic nerve during popliteal block anaesthesia.

Variant course of sciatic nerve may lead to injury during operations in the gluteal region, non discogenic sciatica, coccygodynia. This causes paralysis or paresis of the thigh muscles with sensory disturbances. Hence present study was undertaken to know the level of sciatic nerve exit in relation to piriformis and the level of division of the nerve.

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Materials and Methods

The study was conducted in the department of anatomy, Subbaiah Institute of Medical Sciences, Shimoga on 70 lower extremities of 35 cadavers. The course and division of the sciatic nerve was observed and variations were minutely noted. The gluteal region, back of the thigh and popliteal fossa were exposed by dissection. The gluteus maximus muscle was cut from its insertion and reflected towards its origin. The biceps femoris muscle was retracted and the nerve was then exposed in the popliteal fossa. The exit of the nerve from pelvis, its relation to piriformis and level of division of the nerve were noted. In most of the specimens the sciatic nerve had a normal course. However in six cadavers, high division of sciatic nerve was observed and grouped according to Beaton and Anson classification [3, 4].

Observation and Results

In our study on 70 lower extremities of 35 cadavers, we observed that the sciatic nerve emerged as a single trunk below the piriformis in 64 lower extremities (Type 1- 91.4%). In two lower extremities, sciatic nerve emerged below the piriformis and had divided, the divisions later united with each other in the middle one third of the thigh and finally dividing into Tibial Nerve and Common Peroneal Nerve at superior angle of popliteal fossa (Type 2- 2.85 %). In two other lower extremities, the two components of sciatic nerve emerging above and below the piriformis (Type 3-2.85%).

In another specimen, Tibial nerve emerged below the piriformis and Common Peroneal Nerve emerged through the piriformis muscle (Type 5-1.4%). In one case we observed high division of SN in pelvis & the TN passing beneath the muscle and CPN

passed through the piriformis muscle was noted (1.4%). The results of the study are tabulated in Table 1-3 and shown in Figure 1-4.

Discussion

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 are subdivided into dorsal and ventral components, for the dorsal and ventral musculatures. The sciatic nerve is formed when the large dorsal component of the sacral plexus (common peroneal nerve) and the ventral component (tibial nerve) move downward close together [5]. Hence, based on their developmental formation, it is possible that the common peroneal and the tibial divisions of the sciatic nerve separate from each other at different levels from their origins: within pelvis, in the gluteal region, the posterior compartment of the thigh or the popliteal fossa.

High division of Sciatic nerve has been classified into different types by various authors. Beaton & Anson [3, 4] classified variations of the piriformis and SN in 120 specimens in 1937, and in 240 specimens in 1938. Their classification, known as the Beaton & Anson classification, is as follows:

- Type 1: Undivided nerve below undivided muscle
- Type 2: Divisions of nerve between and below undivided muscle
- Type 3: Divisions above and below undivided muscle
- Type 4: Undivided nerve between heads
- Type 5: Divisions between and above heads
- Type 6: Undivided nerve above undivided muscle

Table 1. Level of Division of Sciatic Nerve in the Present Study.

Level of division	No. of specimens	Percentage (%)
Normally at superior angle of popliteal fossa	64	91.4
High division within the pelvis	4	5.7
High division at the back of thigh	2	2.9

Table 2. Level of Division of Sciatic Nerve in Comparison with Other Studies.

Author	No. of specimens	Level of division in %	
		Before exiting pelvis	After exiting pelvis
Gabrielli et al., 1997 [10]	40	13.7	86.3
Ugrenovic et al., 2005 [11]	100	4	96
Pokorny et al., 2006 [12]	91	20.9	79.1
Prakash et al., 2010 [9]	43	16.3	83.7
Guvencer et al., 2010 [6]	25	48	52
Ogeng'o., 2011 [13]	164	20.1	79.9
Sabnis A S. 2012 [14]	140	9.28	90.7
Mallikarjun et al., 2014 [15]	50	8	92
Satyajit Sangram et al., 2015 [16]	50	18	82
S.Dhivya et al., 2016 [17]	64	6.25	93.75
Naveena Swargam et al., 2017 [18]	30	6.67	93.33
Present study	70	8.6	91.4

Table 3. Comparison of Present Study with Previous Studies.

Study	No of Specimens	Beaton and Anson classification Types (%)					
		1	2	3	4	5	6
Saritha S et al., (2012) [1]	50	92	2	2	-	-	-
Uluutku & Kurtoglu (1999) [19]	25 fetuses	74	16	10	-	-	-
M. Guvencer et al., (2009) [6]	50	52	16	8	-	-	-
Pokorny et al., (2006) [12]	91	79.1	14.3	4.4	2.2	-	-
Shailesh et al., (2011) [11]	86	91.8	2.32	5.81	-	-	-
AD Shewale et al., (2013) [20]	90	73.33	11.1	2.23	-	-	-
Mallikarjun et al., (2014) [15]	50	92	1.4	1.4	-	-	-
Present study	70	91.4	2.85	2.85	-	1.4	-

Figure 1. Division of SN below the undivided Muscle.



Figure 2. Division of TN & CPN below the Piriformis, High Division.



Figure 3. SN Pierces Piriformism and divides in to TN & CPN.



Figure 4. CPN Passing Through Piriformis, TN passing below the Piriformis.



In the present study, high division of SN in the back of thigh was noted in two specimen (2.9%) and high division of sciatic nerve in the pelvis was noted in 4 specimens (5.7%). These variations corresponded with type 1, type 2, type 3 and type 5 of above classification. In one case we observed high division of SN in pelvis & the TN passing beneath the muscle and CPN passed through the piriformis muscle (1.4%). This type of variations has been termed as Beaton and Anson type 6 [6, 7]. The variations in the course, division and distribution of SN have been reported in earlier literatures. The present study was compared with these studies and is depicted in Table 2, 3.

The level of division of the SN greatly influences the extent of neurological deficit in sciatic neuropathy. It may account for failure of SN block while performing popliteal block anesthesia. Piriformis syndrome is caused by an entrapment of SN as it exits the greater sciatic notch [7, 8]. Reunion of CPN and TN in the back of thigh, after dividing in the pelvis as seen in the present study may complicate the evaluation and interpretation of sciatic, common peroneal, tibial neuropathy and nerve block. It also provides the anatomical basis for spontaneous re-innervation of muscles following nerve injury [9]. Hence these variations have to be kept in mind during various operative procedures in the gluteal region.

Conclusion

High division of nerve can lead to nerve injury during deep intramuscular injections, failure of sciatic nerve block anesthesia during various surgical procedures, piriformis syndrome and damage to sciatic nerve during varicose vein stripping. Variations in the course of the nerve may complicate surgery and in the interpretation of sciatic neuropathy. Thus the knowledge of anatomical variation in the level of division of the sciatic nerve and its exit from the pelvis plays important clinical significance in preventing injury to the nerve and its subsequent complications during various surgical procedures.

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