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A CADAVERIC STUDY ON CONUNDRUM IN HIGH BIFURCATION OF SCIATIC NERVE IN SOUTH INDIAN POPULATION

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ABSTRACT

Introduction: The Sciatic nerve is the thickest nerve in the body. It is made up of two components, namely the tibial and the common peroneal which are derived from the ventral rami of L4 to S3 spinal nerves of the lumbosacral plexus. It begins in the pelvis and terminates at the superior angle of the popliteal fossa by dividing into tibial and common peroneal nerves. **Aim of the study:** The aim of the present study was to identify the anatomical variations in the bifurcation pattern of the sciatic nerve related to piriformis muscle in the south Indian population. **Materials and Methods:** A total of about Twenty formalin fixed cadavers comprising of 40 lower limbs were collected from the department of anatomy at Panimalar medical college hospital and research institute. The dissection of gluteal region and posterior compartment of the thigh was done based on Cunningham's dissection manual to expose and study the sciatic nerve. The variations in the anatomical course of sciatic nerve, its relationship to Piriformis muscle and the level of bifurcation were observed, photographed and recorded. **Results:** Out of 40 lower limbs, 36 limbs (90 %) showed normal anatomy of sciatic nerve. The remaining 4 limbs (10%) showed high bifurcation of sciatic nerve and a variation in relation to piriformis muscle. Among 4 limbs, one limb (2.5%) showed sciatic nerve bifurcation at the level of superior gemelli. **Conclusion:** The knowledge regarding the anatomical variations in the high bifurcation of sciatic nerve may help the surgeons and anesthetist for their routine clinical practice. The cadaveric study of these types of variations may give a clear and proper guide for the surgeons to practice efficient surgical interchange and that may avoid surgical errors.

KEYWORDS: Sciatic nerve, common peroneal nerve, tibial nerve, piriformis muscle, popliteal fossa.

INTRODUCTION

The sciatic nerve is the thickest nerve in the human body, formed by the union of five nerve roots (L4-S3) arising from the lumbosacral plexus. It carries two nerve components, namely: the tibial component (L4, 5, S1, S2, and S3) and the common-peroneal component (L4, 5, S1, and S2). Normally this nerve enters the gluteal region from the pelvis through the greater sciatic foramen and emerges inferior to the piriformis muscle. It descends along the posterior compartment of thigh till the superior angle of the popliteal fossa, where it divides into its terminal branches: the tibial nerve and the common peroneal nerve.[1] This normal anatomy may vary in some persons at the level where the nerve divides is

considered as anatomical variation of sciatic nerve bifurcation.

The sciatica is a clinical condition that occurs due to compression of the sciatic nerve which results in the shooting pain along its distribution. The pain usually begins in the gluteal region and radiates along the back of the thigh and the lateral side of the leg to the dorsum of the foot.[2] Various studies have reported that the variations in the course of the sciatic nerve, as it emerges into the gluteal region, may cause compression of the nerve that can lead to sciatica.[3-5]

Similarly, the piriformis syndrome occurs were the sciatic nerve gets compressed by the piriformis muscle. It causes pain and numbness in the buttocks and the back of the leg. It includes the symptoms like buttock pain, sciatica-like pain, numbness, and tingling. The pain becomes worsen during prolonged sitting or exercise.[6-10]

Another increasingly recognized syndrome is the deep gluteal syndrome caused by the compression of the sciatic or pudendal nerve due to non-discogenic pelvic lesions. Park JW et al reported the concept of the deep gluteal syndrome which extended our understanding of posterior hip pain is due to nerve entrapment beyond the traditional model of the piriformis syndrome.[11,12]

Thereby, the purpose of the present study was to examine sciatic nerve variations with the piriformis muscle, its pattern and level of bifurcation, in the south Indian population. Beaton and Anson's classification method for sciatic nerve variation with the piriformis was followed in the study.[13]

MATERIALS AND METHODS

A total of 20 embalmed male cadavers were taken for the study from the department of anatomy at Panimalar medical college hospital and research institute Chennai. The cadavers are dissected by the undergraduate medical students in a routine dissection class. Any gross pathology observed in the cadaver were excluded from the study. The selected cadavers to be used for the study was tagged for identity and carefully dissected by a drained dissector and the variations were observed.

The dissection was done according to the method given in the Cunningham's manual of dissection. Accordingly, the gluteal regions of 40 lower limbs were dissected carefully and the gluteus maximus muscle was retracted to expose the piriformis muscle and sciatic nerve. Then the back of thigh was dissected the long head of the biceps femoris was traced and separated from the semitendinosus muscle to expose the sciatic nerve in that compartment. The descend of sciatic nerve was traced till the superior angle of popliteal fossa to observe their bifurcation.

The sciatic nerve variation pattern in relation to the piriformis muscle and its level of bifurcation was observed, noted and photographed. The sciatic nerve variations were classified according to the Beaton and Anson classification system[13], which categorizes into 6 types,

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.

RESULTS

In this study, 36 (90%) out of 40 dissected lower limbs of human cadavers showed normal anatomy of the sciatic nerve, piriformis muscle, and their relationship (Fig.1), which corresponds to type-1 according to Beaton and Anson's classification. Four limbs (10%) showed variations in the anatomy of the sciatic nerve.

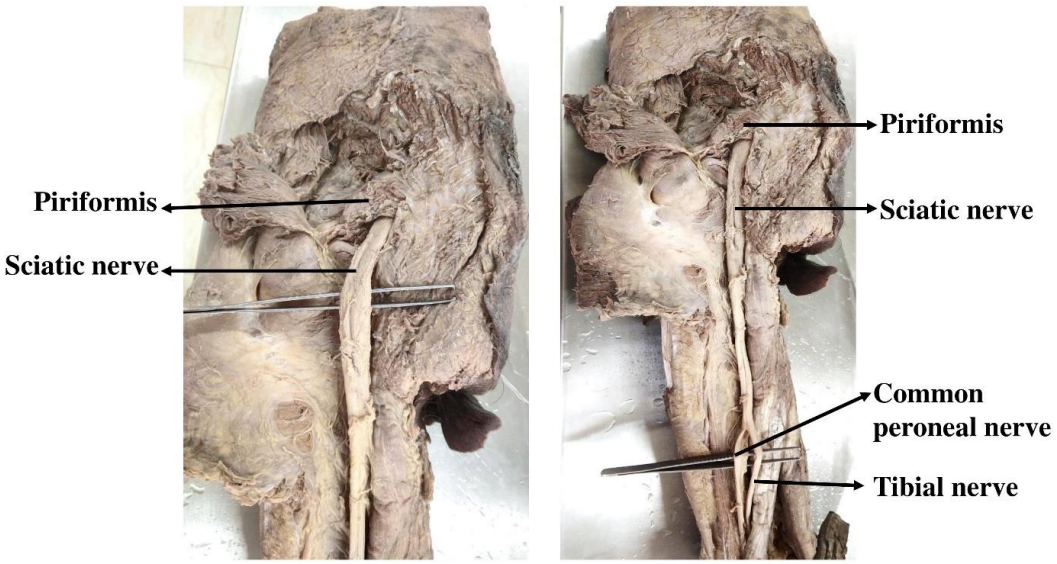

Fig. 1: Photograph shows the normal anatomy of sciatic nerve with piriformis muscle.

One cadaver showed bilateral variation of sciatic nerve with piriformis muscle: the common peroneal nerve emerged above the piriformis and tibial nerve pierced the muscle on both the sides of the limb (Fig.2). This variation is type-5 according to Beaton and Anson's classification.

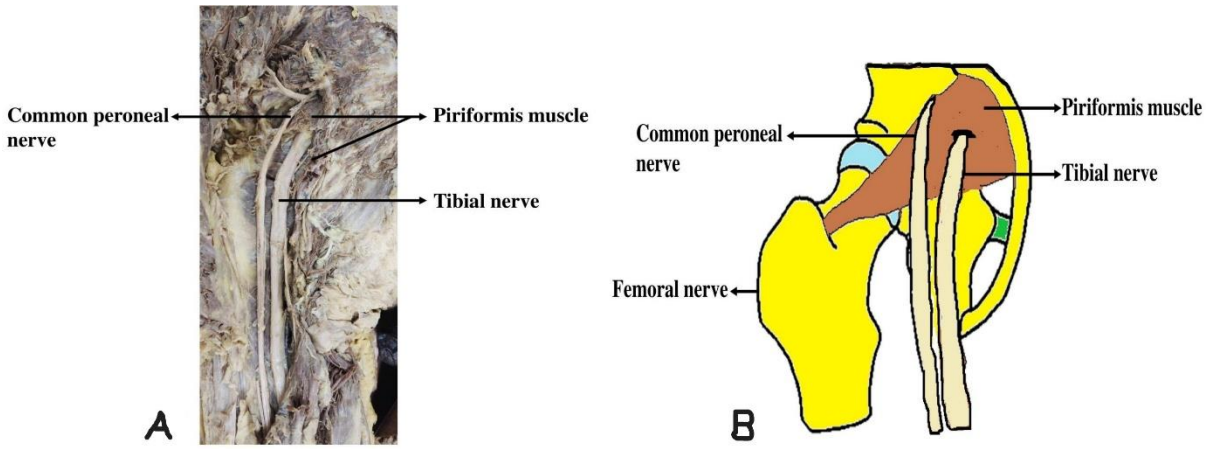

Fig. 2: A. Photograph of the dissected male cadaver showing the left gluteal region reveals the type-5 division of sciatic nerve. B. Diagrammatic representation of high bifurcation of the sciatic nerve.

The two lower limbs of a particular cadaver showed a bilateral variation of the sciatic nerve in relation to the piriformis muscle: on the right limb, the sciatic nerve emerged below the piriformis, just 5cm below, it bifurcated into two nerves at the level of superior gemelli (Fig.3). On the left limb, the common peroneal nerve emerged above the piriformis, while tibial nerve emerged between the heads of a double piriformis (double head piriformis) (Table.1).

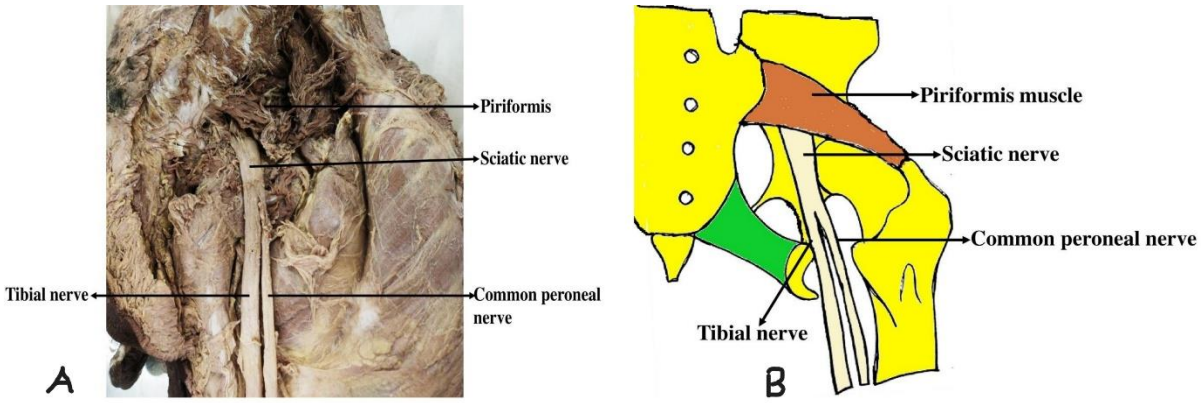

Fig. 3: A. Photograph of the dissected male cadaver showing the right gluteal region reveals the high bifurcation of the right sciatic nerve by 5cm below the lower border of piriformis muscle at the level of superior gemellus muscle and tendon of obturator internus. The nerve is divided into the tibial nerve and common peroneal nerve. B. Diagrammatic representation of high bifurcation of the nerve.

Table 1: Classification of types of high bifurcation of sciatic nerve.

Beatson classification	Percentage obtained from present study (40 limbs)	Variation reported in the present study
Type I	90%	-
Type II	-	-
Type III	-	-
Type IV	-	-
Type V	7.5%	-
Type VI	-	-
Present study	2.5%	Sciatic nerve divided just 5cm below piriformis at the level of superior gemelli.

DISCUSSION

The sciatic nerve is the largest branch of lumbosacral plexus that contains tibial and common peroneal components of ventral rami of L4 to S3 spinal nerves. It begins in the pelvis and terminates at the superior angle of the popliteal fossa by dividing into tibial and common peroneal nerves. This normal anatomy may vary in some persons. Such anatomical variation in the high bifurcation of sciatic nerve has been reported in various studies.[14-18] In the present study, according to Beaton and Anson's classification of the relation of sciatic nerve variation to Piriformis muscle, 36 (90%) out of 40 dissected lower limbs of human cadavers showed normal anatomy of the sciatic nerve, piriformis muscle, and their relationship, which corresponds to type-1 according to Beaton and Anson's classification. Four limbs (10%) showed variations in the anatomy of the sciatic nerve.

One cadaver showed bilateral variation of sciatic nerve with piriformis muscle: the common peroneal nerve emerged above the piriformis and tibial nerve pierced the muscle on both the sides of the limb. This variation is type-5 according to Beaton and Anson's classification. Specimens of type 2, type 3, type 4 and type 6 variety of Beaton and Anson's classification were not found in the present study.

Furthermore, a cadaver showed a bilateral variation of the sciatic nerve in relation to the piriformis muscle: on the right limb, the sciatic nerve emerged below the piriformis, just 5cm below, it bifurcated into two nerves at the level of superior gemelli. On the left limb, the common peroneal nerve emerged above the piriformis, while tibial nerve emerged between the heads of a double piriformis (double head piriformis). This finding was corroborated with the study reported by Berihu and Debeb that in a male cadaver on the right gluteal region it showed high bifurcation of the right sciatic nerve by 1 cm below the lower border of piriformis muscle and in a female cadaver on the left gluteal region showed 2 cm below the lower border of piriformis muscle.[19]

A similar study was conducted by Atoni AD et al, in their study they have identified 92.9% of lower limbs with normal anatomy of the sciatic nerve in relation to the piriformis muscle, which corresponds to type 1 classification. In two (3.6%) lower extremities of a particular cadaver, the common peroneal nerve and the tibial nerve were seen passing respectively through and below the piriformis muscle; this is a type-2 variant of the Beaton and Anson's classification and is the most widely reported variation, where the nerves descend separately throughout their course.[20]

However, there are regional variations in sciatic nerve anatomy. In Indians the type1 and 2 were prominent variations observed.[21,22] Prakash et al conducted study in 43 cadavers they found, the highest incidence of sciatic nerve division (40.7 percent) was observed in the lower part of the posterior compartment of the thigh. In 34.9 percent of the specimens, the sciatic nerve was divided into tibial and common peroneal nerves in the popliteal fossa. 16.3 percent of extremities showed sciatic nerve division proximal to its entrance in the gluteal region.[23] Chiba. S studied the positional relationships between the piriformis muscle and the nerves which arise from the sacral nerve plexus in 514 sides of 257 Japanese adults, found Type I variation in 309 (60%) of 514 sides.[24] A study conducted amongst the Ethiopians of sub-Saharan Africa suggested that types 4, 5, and 6 are rare.[25] But in the present study type 5 was found in 7.5 % of south Indian population.

The knowledge of the anatomical variations observed in the present study might be useful in choosing the correct treatment for patients with piriformis syndrome or sciatica. This study highlights sciatic nerve variations around the gluteal region in the south Indian population.

CONCLUSION

The anatomical variation of sciatic nerve observed in cadavers may be a useful guide for surgeons and anesthetist during their routine medical practice. The cadaveric study of these types of variations may give a clear and proper lead for the surgeons to practice efficient surgical recombination and avoid surgical errors.

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