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Original Research Article

Anatomical Variations of the Sciatic Nerve in Relation to the Piriformis Muscle: A Retrospective Cadaveric Study

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Abstract:

Background: The sciatic nerve shows considerable anatomical variation in its relationship with the piriformis muscle and in its level of bifurcation. Such variations are clinically relevant during diagnosis, regional anesthesia, and gluteal or hip surgery.

Aim: To evaluate anatomical variations of the sciatic nerve in relation to the piriformis muscle and determine the pattern of sciatic nerve bifurcation.

Methodology: A retrospective cadaveric observational study was conducted in Darbhanga Medical College, Laheriasarai, Darbhanga, Bihar, India, over 3 months. A total of 58 adult human cadaveric specimens were examined. The sciatic nerve–piriformis relationship, anatomical variations, and bifurcation level were documented and classified according to the Beaton and Anson classification.

Result: The classical Type I relationship was observed in 52 specimens (89.7%), while variations occurred in 6 (10.3%). Normal bifurcation was present in 48 specimens (82.8%), whereas 10 (17.2%) showed early or high bifurcation.

Conclusion: The sciatic nerve predominantly follows the classical course; however, clinically important variations occur and should be considered during surgical and anaesthetic procedures.

Keywords: Sciatic Nerve; Piriformis Muscle; Anatomical Variation; Cadaveric Study; Bifurcation; Beaton and Anson Classification.

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Introduction

The sciatic nerve is the largest peripheral nerve in the human body and is a continuation of the anterior divisions of the lumbosacral nerve roots (L4-S3). Two large components, the tibial component (L4, L5, S1, S2 and S3) and common peroneal component (L4, L5, S1 and S2) [1]. In the normal position the sciatic nerve emerges from the pelvis via the greater sciatic foramen and enters the gluteal region below the piriformis muscle. It then passes down the back of the thigh and generally splits into two branches at the upper end of the popliteal fossa, the tibial nerve and common peroneal nerve [2]. This is a classic presentation but there is a lot of variability in the relationship of the sciatic nerve and the piriformis muscle and also the level at which the division of the sciatic nerve occurs. The piriformis is an anatomical landmark of the gluteal area, and it is strategic for the relationship with the greater sciatic foramen and the structures traversing it. The sciatic nerve may divide before leaving the pelvis, one or both parts may pass through the piriformis muscle, or the nerve may run between two heads of the piriformis muscle.

These variations were systematically described by Beaton and Anson, dividing them into six anatomical patterns, which are useful for describing the relationship between the sciatic nerve and piriformis muscle [3]. In the classical pattern, the sciatic nerve is not divided and passes inferior to the non-divided piriformis muscle, in other patterns, the relationships between the tibial component and common peroneal component and the piriformis muscle are different [4]. The classification is still used extensively in cadaveric anatomical studies of the area. A knowledge of the anatomical relationships of these structures is important clinically because the variations can cause compression or irritation of the sciatic nerve. Piriformis syndrome, which may cause buttock pain, posterior thigh pain and symptoms similar to normal sciatica, has been linked to abnormal passage of the sciatic nerve through or around the piriformis muscle [5]. It has been suggested that piriformis syndrome is an important extra-spinal mechanism responsible for sciatic symptoms, especially in the absence of a clear clinical history of a lumbar disc disease or nerve root compression [6].

Thus, knowledge of the relationship between the sciatic nerve and the piriformis muscle is helpful for the differentiation of discogenic from non-discogenic sciatic pain. The degree of sciatic nerve bifurcation is also of clinical significance. The sciatic nerve is usually not divided in the posterior thigh until it reaches the region of the popliteal fossa, where it splits into the tibial nerve and common peroneal nerve. Usually, however, a high division is found in the pelvis, gluteal region or proximal thigh. This early division can change the course of the individual nerves and can be important for regional anesthesia. Of special interest is variation in the sciatic nerve termination or division that could result in inadequate sciatic nerve blockade in popliteal nerve block (PNB) surgeries [7]. Understanding of these variations can then enhance the precision and efficiency of the regional anesthetic techniques. Another connection that's significant in surgical interventions in the hip and pelvis is between the sciatic nerve and the piriformis muscle. The sciatic nerve is susceptible to trauma during THA, posterior hip approaches, pelvic surgery, and any surgeries in the deep gluteal region [8].

There are variations in the anatomical position that can cause the nerve to shift from its normal position and therefore present a greater risk of inadvertent nerve damage during dissection. For instance, a cadaver study in Nepal studied 40 gluteal compartments and found differences in three of them, such as different patterns of nerve division in relation to the piriformis muscle [9]. Anatomical studies have shown that the variation of the sciatic nerves is common and occurs at different rates in different populations. A study of 28 formalin fixed male cadavers found normal anatomy of the sciatic nerve in 52 lower limbs (93%), with four (7.1%) lower limbs exhibiting variations, including a previously unreported variation related to the common peroneal nerve and a double head of the piriformis muscle [10]. The results show that even though the anatomical variants may be rare, they could be clinically relevant and highlight the need for having anatomical patterns recorded in the populations of interest. If it is relevant not only to anatomical education, but also to forensic anatomy, radiology, regional anesthesia, orthopedic surgery and neurosurgical practice, it is logical to classify and document these variants. Correct information regarding the location, direction and division of the sciatic nerve can aid in the understanding of non-standard distribution of sciatic pain, surgical planning and minimize risk of iatrogenic injury [11]. Moreover, cadaveric studies allow a direct visualization of the anatomic relationship and enable the documentation of variations to a greater degree than would be possible by routine clinical examination.

Considering these anatomical and clinical facts, the present study for the purpose of retrospective evaluation of the anatomical variations of the sciatic nerve in relation to the piriformis muscle was undertaken in Darbhanga Medical College, Laheriasarai, Darbhanga, Bihar, India. Special emphasis was placed on the pattern of sciatic nerve–piriformis relationship and the level of sciatic nerve bifurcation, with the Beaton and Anson classifications as the main two classification systems for the observed anatomic variations. The study should provide anatomical information for the region and enhance the knowledge of variations that could be of importance for the diagnosis of piriformis syndrome, regional anesthesia and surgical procedures in the gluteal and pelvic region.

Methodology

Study Design: The present study was designed as a retrospective observational cadaveric anatomical study to evaluate the anatomical variations of the sciatic nerve in relation to the piriformis muscle, including variations in the course, relationship, and level of division of the sciatic nerve.

Study Area: The study was conducted in Department of Anatomy, Darbhanga Medical College, Laheriasarai, Darbhanga, Bihar, India, using available adult human cadaveric specimens for anatomical examination and documentation of the sciatic nerve and piriformis muscle relationship.

Study Duration: The study was conducted over a period of 3 months.

Sample Size: A total of 58 adult human cadaveric specimens (N = 58) were included in the present study for evaluation of sciatic nerve anatomical variations and its relationship with the piriformis muscle.

Sample Population: The study population comprised adult human cadaveric specimens available in the study setting. The gluteal regions were examined to identify the normal and variant relationships between the sciatic nerve and piriformis muscle, including the level of sciatic nerve division and its relationship to the piriformis muscle.

Data Collection: Data were collected through systematic anatomical examination of the selected cadaveric specimens. The observations included the relationship of the sciatic nerve with the piriformis muscle, pattern of sciatic nerve division, level of bifurcation, laterality of the variation, and presence of any abnormal course or muscular variation. The observed patterns were documented and classified according to the Beaton and Anson classification system, which categorizes the anatomical relationship between the sciatic nerve and piriformis muscle into different patterns.

Inclusion Criteria

1. Adult human cadaveric specimens were included.
2. Specimens with adequately preserved gluteal regions were included.
3. Specimens in which the piriformis muscle and sciatic nerve could be clearly identified were included.
4. Specimens suitable for assessment of the sciatic nerve–piriformis relationship were included.
5. Specimens in which the course and division of the sciatic nerve could be adequately evaluated were included.

Exclusion Criteria

1. Cadavers with severe damage to the gluteal region were excluded.
2. Specimens with extensive surgical alteration of the gluteal or pelvic region were excluded.
3. Specimens with severe decomposition or inadequate preservation were excluded.
4. Specimens in which the sciatic nerve or piriformis muscle could not be clearly identified were excluded.
5. Specimens with pathological or traumatic alterations affecting the structures under investigation were excluded.

Procedure: The gluteal region of each selected cadaveric specimen was carefully dissected to expose the piriformis muscle and sciatic nerve. The gluteus maximus was retracted appropriately, followed by identification of the piriformis muscle and the sciatic nerve as it emerged through the greater sciatic foramen. The relationship between the sciatic nerve and piriformis muscle was examined and documented. The course and level of division of the sciatic nerve into its tibial and common peroneal components were also assessed. Any variation was recorded according to its side and anatomical pattern and classified using the Beaton and Anson classification. This approach is consistent with established cadaveric studies of the sciatic nerve–piriformis relationship.

Statistical Analysis: The collected observations were entered into Microsoft Excel and analyzed using IBM SPSS Statistics. Categorical variables, including the normal and variant sciatic nerve patterns, Beaton and Anson classification types, laterality, and level of nerve bifurcation, were expressed as frequencies and percentages. Where applicable, the distribution of anatomical variations between sides or categorical groups was compared using the Chi-square test or Fisher's exact test, with a P-value of <0.05 considered statistically significant. Cadaveric studies of sciatic nerve variation similarly report anatomical patterns primarily using frequencies and percentages".

Result

Table 1 shows the distribution of the 58 cadaveric specimens according to the side examined. An equal distribution was observed, with 29 right-sided (50.0%) and 29 left-sided (50.0%) specimens. Thus, both sides were equally represented in the study, allowing assessment of sciatic nerve variations without unequal side representation.

Table 1: Distribution of Cadaveric Specimens According to Side Examined

Side	Number of specimens	Percentage (%)
Right	29	50
Left	29	50
Total	**58**	**100**

Table 2 demonstrates the anatomical relationship between the sciatic nerve and piriformis muscle. The classical relationship, in which the undivided sciatic nerve passed inferior to the piriformis muscle, was observed in 52 specimens (89.7%). Anatomical variations were identified in 6 specimens (10.3%), including passage of the common peroneal nerve through or above the piriformis and other variant relationships. The findings indicate that although the classical arrangement was predominant, a measurable proportion of specimens demonstrated clinically relevant anatomical variations.

Table 2: Anatomical Relationship of the Sciatic Nerve with the Piriformis Muscle

Sciatic nerve–piriformis relationship	Number (n=58)	Percentage (%)
Undivided sciatic nerve passing inferior to piriformis	52	89.7
Common peroneal nerve passing through piriformis	2	3.4
Common peroneal nerve passing above piriformis	1	1.7
Tibial nerve passing below piriformis and common peroneal nerve passing through piriformis	2	3.4
Sciatic nerve passing through piriformis	1	1.7
Total	**58**	**100**

Table 3 presents the distribution of sciatic nerve–piriformis relationships according to the Beaton and Anson classification. Type I was the most frequently observed pattern, accounting for 52 specimens (89.7%). Type II and Type V were each observed in 2 specimens (3.4%), while Type III and Type IV occurred in 1 specimen (1.7%) each. Type VI was not observed in the present sample. Overall, the predominance of Type I indicates that the classical anatomical relationship was the most common pattern, whereas the remaining types represented relatively uncommon anatomical variations.

Table 3. Distribution of Sciatic Nerve Variations According to Beaton and Anson Classification

Beaton and Anson type	Anatomical pattern	Number (n=58)	Percentage (%)
Type I	Undivided nerve passes below piriformis	52	89.7
Type II	Common peroneal nerve passes through piriformis	2	3.4
Type III	Common peroneal nerve passes above piriformis	1	1.7
Type IV	Undivided nerve passes through piriformis	1	1.7
Type V	Tibial component passes below and common peroneal component passes through piriformis	2	3.4
Type VI	Undivided nerve passes above piriformis	0	0
Total		**58**	**100**

Table 4 shows the distribution of sciatic nerve bifurcation according to anatomical level. In the majority of specimens, 48 (82.8%) showed bifurcation at or near the upper part of the popliteal fossa, representing the usual level of division. Early or high bifurcation was observed in 10 specimens (17.2%), involving different levels of the posterior thigh and gluteal region. Thus, although normal bifurcation was predominant, early division of the sciatic nerve was identified in a notable proportion of the examined specimens.

Table 4: Distribution of Sciatic Nerve Bifurcation According to Anatomical Level

Level of sciatic nerve bifurcation	Number (n=58)	Percentage (%)
At/near upper part of popliteal fossa (usual level)	48	82.8
Lower third of posterior thigh	4	6.9
Middle third of posterior thigh	2	3.4
Upper third of posterior thigh	2	3.4
Gluteal region/proximal to greater sciatic foramen	2	3.4
Total	**58**	**100**

Table 5 provides an overall summary of the anatomical findings. A normal sciatic nerve–piriformis relationship was observed in 52 specimens (89.7%), whereas 6 specimens (10.3%) demonstrated anatomical variations. Similarly, the usual level of sciatic nerve bifurcation was observed in 48 specimens (82.8%), while 10 specimens (17.2%) showed high or early bifurcation. These findings demonstrate that the classical anatomy of the sciatic nerve was predominant in the present study, but variations in its relationship with the piriformis muscle and its level of bifurcation were also present and may have clinical significance during regional anaesthesia and surgical procedures involving the gluteal and posterior thigh regions.

Table 5: Overall Distribution of Normal and Variant Sciatic Nerve Anatomy

Anatomical finding	Number (n=58)	Percentage (%)
Normal sciatic nerve–piriformis relationship	52	89.7
Sciatic nerve anatomical variation	6	10.3
Normal bifurcation level	48	82.8
High/early bifurcation	10	17.2

Discussion

The present study analyzed 58 cadaveric specimens of adults to outline the relationship between the sciatic nerve and piriformis muscle and elucidate the different levels of sciatic nerve bifurcation. In this sample, classical sciatic nerve (passing below the piriformis muscle) was seen in 52 specimens (89.7%) and anatomical variations in 6 (10.3%). This is similar to the results of earlier cadaveric studies, with different populations showing different percentages of normal anatomy. Atoni et al. studied 56 lower limbs and found that 52 (92.9%) had normal sciatic nerve–piriformis anatomy while 4 (7.1%) showed variation [12]. The frequency of the anatomical variants thus was somewhat lower than the normal pattern (89.7%) and somewhat higher than the variation rate reported by Atoni et al. (10.3%), indicating a possible difference in frequency due to population".

Jha et al. [13] reported a similar situation in a cadaveric study in Nepal with 40 gluteal regions, where 37 (92.5%) exhibited the typical type-A relationship and three (7.5%) variations. They arrived at a result of nearly 90% normal anatomy which is similar to our present observation of 89.7% normal anatomy, but they did show a slightly higher percentage of variants. In addition to type-B and type-C relationships, (2.5% and 5%, respectively) as reported by Jha et al., a few additional relationships were identified in the present study, such as the passage of the common peroneal component through the piriformis. This difference could also be due to the relatively small subsample size and differences in population and classification of composite variants. Natsis et al. studied 147 cadavers with 294 limbs, corroborating the predominance of the classical arrangement in our study. The relationship between the typical sciatic nerve and piriformis was found in 275 limbs (93.6%) and the anatomical variations were found in 19 (6.4%) limbs [14].

The current level of normal anatomy (89.7%) is slightly lower than that reported by Natsis et al. (93.6%) but slightly higher than that reported by Natsis et al. (6.4%) for the variation rate. Importantly, Natsis et al. observed some rare variations: common peroneal nerve traversing through the piriformis, both parts passing through the piriformis, and varieties not classified. The present finding is consistent with the observations of the six classical Beaton and Anson categories, which do not necessarily capture all anatomical configurations found in cadaveric dissection. The sample in the present study is of the Darbhanga community in Uttar Pradesh, and it is particularly interesting to compare this with Indian studies. Adibatti and Sangeetha studied 50 lower limbs and found that the sciatic nerve divided in high percentage in 4 limbs (8%) of which 2% in the posterior thigh and 6% in the pelvis [15]. In the present study 10 of 58 specimens (17.2%) showed early or high bifurcation rate, which is much more than that of Adibatti and Sangeetha (8%).

The difference suggests that the degree of sciatic nerve division may vary significantly among different anatomic specimens and underscores the need to report the level of sciatic nerve division separately from nerve–piriformis relationships. Additional Indian data is available from Harsh et al that examined 64 gluteal regions, which included an absence of the sciatic nerve and piriformis anatomy in 50 cases (78%) and variations in 14 cases (22%) [16]. Using their Beaton and Anson classification, there were 78% type I, 12.5% type II, 3% type III and 1.56% type VI patterns. In comparison to these, the present study showed a significantly greater frequency of normal anatomy (89.7% vs. 78%) and a lower number of anatomical variations (10.3% vs. 22%). The difference in frequency between the two populations indicates that the frequency of the nerve variation is not homogenous even within geographically related populations and is affected by the composition of the sample, anatomical classification, and the characteristics of the specimens. The current results are also similar to the overall evidence in a systematic review and meta-analysis. The normal type-I relationship ranges between 85% and 100% of which 92% was obtained in Poutoglidou et al., 2020 study, 94% in Adibatti and Sangeetha study, 94.2% in Patel et al., and 99.3% in Sabnis [17] study in Indian studies included in that review.

The present value of 89.7% is within the wide range reported in the past for Indian populations. International studies also have shown significant differences, from 76.7% in Polish cadaver studies, to around 93% in Nepalese and Greek samples. Such variation highlights the idea that the anatomy of variation might be regional or population specific. As to the division of the sciatic nerve, our study revealed that in 48 specimens (82.8%) the sciatic nerve was bifurcated at or near the upper part of the popliteal fossa, while in 10 specimens (17.2%) it was divided early. Clinically important because early division could change the anticipated position of the tibial and common peroneal components during posterior thigh surgery or regional anaesthetic. A cadaveric study of 40 sciatic nerves performed in 2022 found the nerve to divide in the proximal area of the popliteal fossa (55%), in the gluteal region (35%), and in the middle third of the thigh (10%). The distribution is not the same as in the present study, but both investigations show that bifurcation of the sciatic nerve can be at a very high level other than the classical one. In conclusion, the present study confirms that the classical relationship between the piriformis and the sciatic nerve was predominant (89.7%), although variations with clinical relevance were found in 10.3% of the specimens and early or high bifurcation was found in 17.2% of the specimens.

The results obtained are broadly similar to those reported in the cadaveric studies carried out earlier in India and overseas but with different frequencies. These differences are significant as they can lead to entrapment of the sciatic nerve and piriformis-related symptoms and also may make the surgery for glute diseases or regional nerve block more difficult. So the anatomical observations at Darbhanga Medical College, Laheriasarai, Darbhanga, Bihar are helpful in the light of other regional observations and again reinforce the importance of the careful identification of the relationship of the sciatic nerve and piriformis in clinical and surgical procedures.

Conclusion

The present cadaveric study, which was retrospective, revealed that the classical sciatic nerve–piriformis relationship was most common, occurring in 52 of 58 cases (89.7%), and six cases (10.3%) showed different anatomical relationships. The most common pattern was type I (Beaton and Anson). In 48 specimens (82.8%), the typical sciatic nerve bifurcation was seen, while in 10 specimens (17.2%) early or high bifurcation of the sciatic nerve was observed. The results confirm the classical anatomy but also show that there are clinically relevant variations of the sciatic nerve. Awareness of these variations is crucial for the understanding of piriformis syndrome and sciatica and to help minimize potential nerve damage during regional anaesthetic, hip surgery and other surgery in the gluteal and posterior thigh regions.

References

1. Standring S, editor. Gray's Anatomy E-Book: Gray's Anatomy E-Book. Elsevier Health Sciences; 2021 May 22.
2. Agur AM, Dalley AF. Moore's essential clinical anatomy. Lippincott Williams & Wilkins; 2018 Dec 18.
3. Beaton LE, Anson BJ. The relation of the sciatic nerve and of its subdivisions to the piriformis muscle. The anatomical record. 1937 Dec;70(1):1-5.
4. Smoll NR. Variations of the piriformis and sciatic nerve with clinical consequence: a review. Clinical Anatomy: The Official Journal of the American Association of Clinical Anatomists and the British Association of Clinical Anatomists. 2010 Jan;23(1):8-17.
5. Boyajian-O'Neill LA, McClain RL, Coleman MK, Thomas PP. Diagnosis and management of piriformis syndrome: an osteopathic approach. Journal of Osteopathic Medicine. 2008 Nov 1;108(11):657-64.
6. Probst D, Stout A, Hunt D. Piriformis syndrome: a narrative review of the anatomy, diagnosis, and treatment. PM&R. 2019 Aug;11:S54-63.
7. Hopayian K, Song F, Riera R, Sambandan S. The clinical features of the piriformis syndrome: a systematic review. European Spine Journal. 2010 Dec;19(12):2095-109.
8. Vloka JD, Hadžic A, April E, Thys DM. The division of the sciatic nerve in the popliteal fossa: anatomical implications for popliteal nerve blockade. Anesthesia & Analgesia. 2001 Jan 1;92(1):215-7.
9. Pokorný D, Jahoda D, Veigl D, Pinskerová V, Sosna A. Topographic variations of the relationship of the sciatic nerve and the piriformis muscle and its relevance to palsy after total hip arthroplasty. Surgical and Radiologic Anatomy. 2006 Mar;28(1):88-91.
10. Natsis K, Totlis T, Konstantinidis GA, Paraskevas G, Piagkou M, Koebke J. Anatomical variations between the sciatic nerve and the piriformis muscle: a contribution to surgical anatomy in piriformis syndrome. Surgical and Radiologic Anatomy. 2014 Apr;36(3):273-80.
11. Nastoulis E, Karakasi MV, Pavlidis P, Thomaidis V, Fiska A. Anatomy and clinical significance of sacral variations: a systematic review. Folia Morphologica. 2019;78(4):651-67.
12. Atoni AD, Oyinbo CA, Francis DA, Tabowei UL. Anatomic variation of the sciatic nerve: a study on the prevalence, and bifurcation loci in relation to the piriformis and popliteal fossa. Acta medica academica. 2022;51(1):52.
13. Jha AK, Baral P. Composite anatomical variations between the sciatic nerve and the piriformis muscle: a Nepalese cadaveric study. Case Reports in Neurological Medicine. 2020;2020(1):7165818.
14. Natsis K, Totlis T, Konstantinidis GA, Paraskevas G, Piagkou M, Koebke J. Anatomical variations between the sciatic nerve and the piriformis muscle: a contribution to surgical anatomy in piriformis syndrome. Surgical and Radiologic Anatomy. 2014 Apr;36(3):273-80.
15. Adibatti M, Sangeetha V. Study on variant anatomy of sciatic nerve. Journal of clinical and diagnostic research: JCDR. 2014 Aug 20;8(8):AC07.
16. Kumar A, Harsh V, Barry JM, Jalal A, Patil S. Lower Extremity Injection Nerve Injury: Black, White, and Shades of Gray. Journal of Peripheral Nerve Surgery. 2019 Jul 15;3(1):08-18.
17. Poutoglidou F, Piagkou M, Totlis T, Tzika M, Natsis K, Poutoglidou F. Sciatic nerve variants and the piriformis muscle: a systematic review and meta-analysis. Cureus. 2020 Nov 17;12(11).