

Anatomical Variation in the Division of Sciatic Nerve in Sudanese Subjects – Cadaveric Study form may 2016 to june 2017

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Abstract

Original Research Article

Background: The Sciatic nerve is the widest nerve of the body. It consists of two components, namely: the tibial and the common peroneal components derived from the ventral rami of L4 to S3 spinal nerves of the lumbosacral plexus. It exits the pelvis through the greater sciatic foramen below the Piriformis muscle and descends between the greater trochanter of the femur and ischial tuberosity of the pelvis to the knee. Higher division of the sciatic nerve is the most common variation where the TN and CPN may leave the pelvis through different routes which may lead to various clinical manifestations. Likewise, their adequate knowledge will help in increasing surgical precision and decreasing morbidity. **Material and methods:** The study is a descriptive cross-sectional study conducted at the department of anatomy of several medical faculties in Sudan from May 2016 to June 2017. In which 50 male cadaver (100 lower extremities) age ranges from 50 to 70 years were dissected to level the bifurcation. **Result:** In the 100 explored sciatic nerves we get five types of bifurcation; Inside the pelvis, High up in the gluteal region & upper third of the back of the thigh, The middle of the back of the thigh, The lower of the back of the thigh & At Popleteal fossa with the last one been the most frequently reported variant. One variant is the nerve exit the pelvis as two roots united at the gluteal region to divide again at the popliteal fossa. **Discussion:** According to the literature, the anatomical variant described in 50 cadavers is considered relatively not rare. **Conclusion:** The most frequent reported nerve is that nerve exiting the pelvis as sciatic nerve 79 % (78 – 80 %), passing anterior to piriformis 92% (90 – 94%), posterior to; superior gemelli 92%, obturator internus, inferior gemelli, quadratus femoris 100%. In the 20% of nerves (10 cadaver) with pelvic division the tibial component is keeping the anterior relation to piriformis in all cases & in both side, while the common peroneal division show three type of variation with the most frequent one of them 65% (60 – 70%) is that nerve pass between the two head of the piriformis.

Keywords: Sciatic Nerve, Tibial Nerve, Common Peroneal Nerve, Piriformis Muscle.

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INTRODUCTION

The sciatic nerve is the thickest and the longest nerve in the human body. Therefore, it is often approached in the clinical setting, either in the context of trauma, tumors, and vascular lesions in neighborhood structures, entrapment syndromes, and hip or femur surgery or percutaneously for lower limb anesthetic blocks. Hence, a detailed knowledge of the normal anatomy of this nerve, as well of its potential anatomical variants is of paramount importance[1].

Sciatic nerve is formed in the pelvis by joining of ventral division of anterior primary rami of L4- S3

spinal nerve roots. It is 2 cm wide at its origin from sacral plexus (Fig. 1). Normally it emerges through the greater sciatic foramen, leaves pelvis and enters into gluteal region by passing below piriformis as a single nerve encompassed by a single epineural sheath. It then crosses posterior to the obturator internus, gemelli & quadratus femoris muscle. It divides subsequently into two terminal nerves, tibial nerve and common peroneal nerve usually at the lower part of the posterior compartment of thigh. But sometimes it divides high. There is a close relationship between the sciatic nerve and the intrapelvic muscles (especially piriformis) along its course. The piriformis, one of the intrapelvic muscles, may compress the sciatic

nerve and cause the piriformis syndrome. Previous studies reported a variety of different anatomic relations between the sciatic nerve or its terminal branches and the piriformis [2, 3].

The undivided nerve may emerge above the piriformis or through the muscle. The major divisions

of the nerve may lie either side of the muscle, or (the most common variant) one division either above or below. The evidence of each variation may cause different clinical presentation. It is known that each anatomical variation may reflect a different and a case-

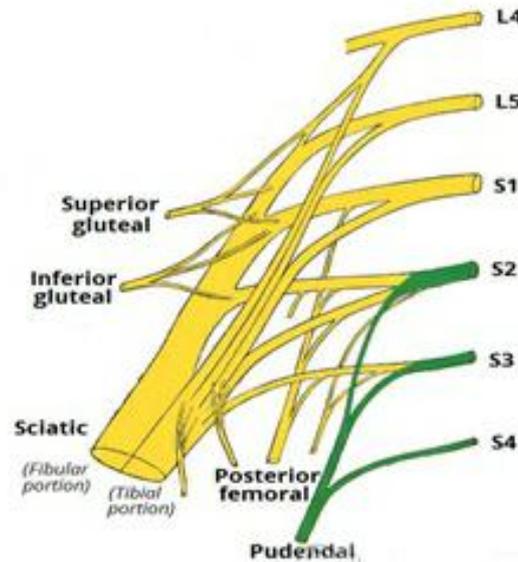


Fig-1: Sacral plexus

Specific clinical presentation

This requires a detailed description of anatomical variations [2]. Several studies declared that there are numerous variations both in the course and distribution of the sciatic nerve. The main variations were the relationship of sciatic nerve to piriformis muscle and its level of bifurcation. The relationships between the piriformis muscle and sciatic nerve have been classified by Beaton and Anson using a six category classification system. There are three types of variations characterized by the high division of the sciatic nerve, and a fourth type that does not occur. These variations are classified as types I, II, III and IV. In type I, the common peroneal nerve passes through the Piriformis muscle and the tibial nerve runs beneath its inferior margin. In type II variation, the common peroneal nerve extends over the superior margin and the tibial nerve passes under the inferior margin of piriformis. In type III variation the sciatic nerve does not divide and passes through piriformis. Rarely, the undivided sciatic nerve passes above piriformis the type IV[4].

These anatomical variations of sciatic nerve can contribute to piriformis Syndrome and sciatica. In addition to the position of the piriformis muscle there other causes for sciatica such as a posterior dislocation of the hip joint, herniated disc or pressure from the uterus during pregnancy may damage the nerve roots. Piriformis syndrome is an uncommon and often undiagnosed cause of buttock and leg pain. It may be

caused by anatomic abnormalities of the piriformis muscle and resulting in irritation of the sciatic nerve by the piriformis muscle. The abnormal passage of the sciatic nerve has been attributed to entrapment of sciatic nerve as it exits the greater sciatic notch in the gluteal region. Knowledge of such patterns is also important for surgeons dealing with Piriformis syndrome which affects 5-6% of patients referred for the treatment of back and leg pain [4].

MATERIAL AND METHODS

This was a cross-sectional descriptive study conducted at the department of anatomy of several medical faculties (Alzaeim Alazhari, Alahfad, Shandi & Africa International Universities) in Sudan. 100 lower extremities of 50 adult male cadavers, age ranges 50-70 years, during the period from May 2016 to June 2017. In which these 50 cadavers were dissected to report the level of division of sciatic nerve to its terminal branches; the tibial & the common peroneal and its relation to the short rotators muscles; the piriformis (PF), the superior gemellus (SG), the obturator internus (OI), the inferior gemellus (IG) and the quadratus femoris (QF). The gluteus maximum was elevated to explore the short rotators, following by proper exposure of the nerve as it emerge from greater sciatic notch, running on the back of the thigh & as it enter the popliteal fossa & divide to its terminal branches. During that we report; the level of division, the relation to short rotators, the relation between its terminal branches &

the piriformis (in high divided nerve), & any evidence of variation is recorded.

RESULTS

The dissection reports that the sciatic nerve as it exit from the pelvis shows variation in; its relation to short rotator muscles, & the level of bifurcation of the nerve into its terminal branches the tibial (TN) & common peroneal nerve (CPN). Even variation is reported in some cadavers between the right & left side.

Most of the nerve 92% (90 – 94%) are passing anterior or deep to piriformis while they emerging from the greater sciatic notch with (fig-2&3) only 8% (6 – 10

%) passing through piriformis & no one passing posterior or superficial to it (fig-4&5&6).

The 20% of nerves those divide inside the pelvis and exit as tibial branch & common peroneal branch in all of them the tibial branch keep its anterior or deep relation to piriformis muscle while the common peroneal branch show three variable with the most common one is that passing between piriformis two head 65% (7 right limb & 6 left limb out of 10), followed by that's run below it 20% (2 limb in each side), & the other which passing through the muscles 20% (1 right limb & 3 left limb out of 10), and no one passing superficial or posterior to it.

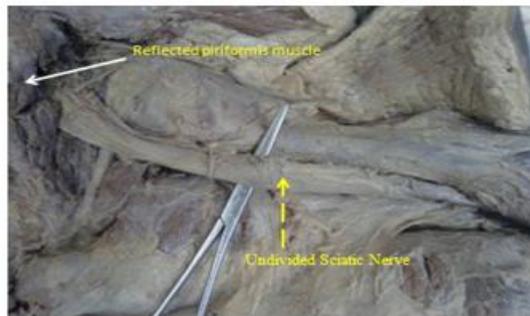


Fig-2: Right undivided sciatic nerve passes below piriformis



Fig-3: Left undivided sciatic nerve pass below piriformis

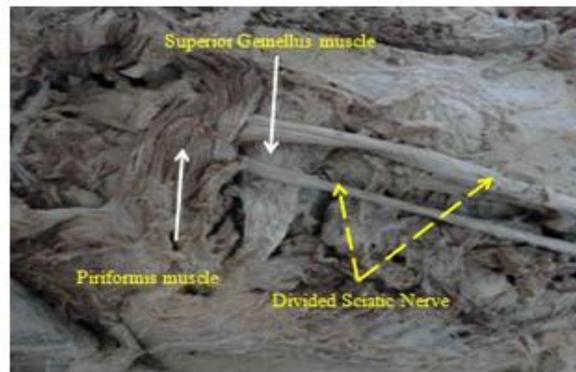


Fig-4: Right divided sciatic nerve pass below piriformis



Fig-5: Left divided sciatic nerve pass below piriformis

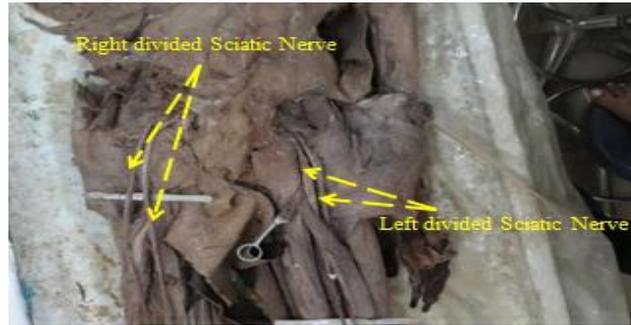


Fig-6: Bilateral divided sciatic nerve passes below piriformis

The level of division report six variable with division at the popliteal fossa level is the most frequent one 42% (40 – 44%) (Fig 7 & 8), followed by intra-pelvic division 21% (20 – 22%) (fig:11-14), then the

lower third of the posterior thigh 17% (16 – 18%) (Fig 15& 16), while the less frequent variant is the posterior thigh upper third division 6% (4 – 8%) followed by the middle third 12% (Fig 17& 18).



Fig-7: Left sciatic nerve divided with in popliteal fossa

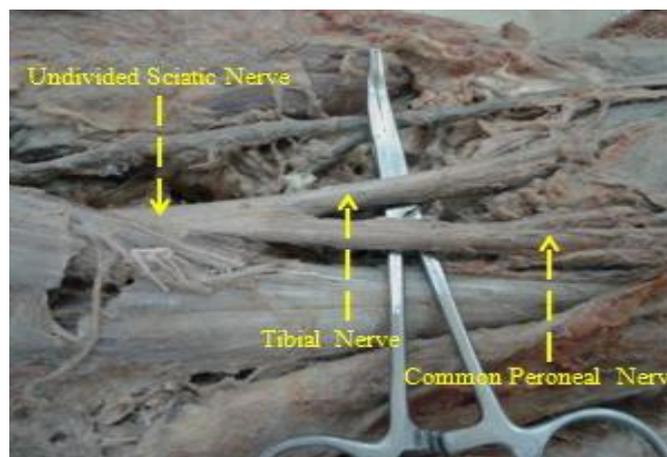


Fig-8: Right sciatic nerve divided with in popliteal fossa

The nerve is then pass posterior or superficial to all remaining short rotators (superior gemilli, obturator internus, inferior gemilli, quadrates femoris) in both side of cadaver except in 8% of them the nerve pass anterior to the superior gemilli only & is reported bilaterally in same cadaver (4 cadaver).

One of newly reported variant that the nerve exit the pelvis as two root that unite at the gluteal area & divided into its two terminal branches at popliteal fossa, this variant is reported bilaterally in the cadaver (Fig 9&10).

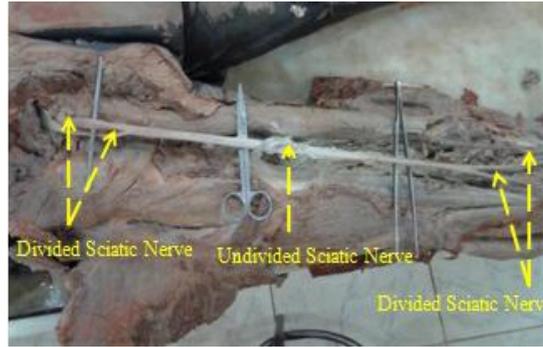


Fig-9: Right sciatic nerve exit as 2 saperat root fuse at gluteal then divided with in popliteal fossa



Fig-10: Left sciatic nerve exit as 2 saperat root fuse at gluteal then divided with in popliteal fossa

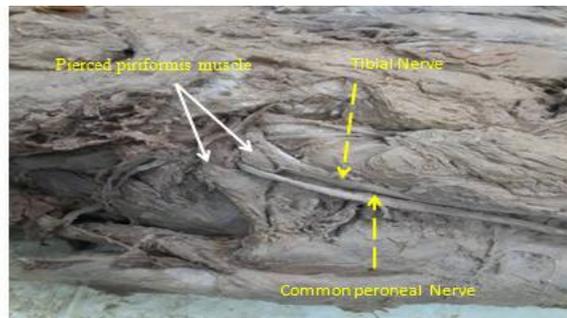


Fig-11: Right divided sciatic nerve with CPN piercing PF

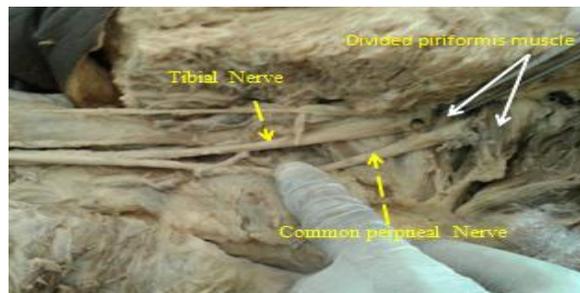


Fig-12: Left sciatic nerve divide within PF



Fig-13: Bilaterally sciatic nerve divided within the pelvis



Fig-14: Left sciatic nerve divided within the pelvis

DISCUSSION

According to the Beaton and Anson[19] classification, in our study the most frequent variant is type I, which is inconsistent with other study conducted by Mengistu Desalegn, Beaton, Shailesh & other [5, 7, 8, 9, 10, 11, 12,14]. However lower percentage (7%) was found by Sabnis. A. S [6]. The recorded 8% (6 – 10 %) passing through piriformis (fig-4&5&6) is also been reported by Pecina 1979 [18] & Chiba [8]. again the divided nerve with its TN & CPN have a deferent relation to piriformis is reported by Benzoni *et al.* [3], in one specimen out of 66 dissections, in it the piriformis was bipartite and two components of sciatic nerve were separate with tibial nerve passing below piriformis and common peroneal nerve passing between the two components of the muscle. Concerning the frequency of variant of level of bifurcation we found the most reported variants is the popliteal fossa level division, which is also described with higher frequency by Ugrenovic *et al.* [15], in 200 dissections but he report only 4% for intra-pelvic division variant which is albeit lower than our record (21%). Ewa *et al.* reports Sciatic nerve divides at lower third of thigh in 13.8% of cases

which is comparable to our record to the same variant 17% (16 – 18%), but a higher record of 13.8% for our less frequent variant; the upper third of thigh bifurcation, is reported by Sabin *et al.* [6]. the important things is that no reported nerve or even one of its component is passing posterior or superficial to piriformis in this study. These anatomical variations of sciatic nerve can contribute to piriformis Syndrome and sciatica. In addition to the position of the piriformis muscle there other causes for sciatica such as a posterior dislocation of the hip joint, herniated disc or pressure from the uterus during pregnancy may damage the nerve roots. Piriformis syndrome is an uncommon and often undiagnosed cause of buttock and leg pain. It may be caused by anatomic abnormalities of the piriformis muscle and resulting in irritation of the sciatic nerve by the piriformis muscle. The abnormal passage of the sciatic nerve has been attributed to entrapment of sciatic nerve as it exits the greater sciatic notch in the gluteal region. Knowledge of such patterns is also important for surgeons dealing with Piriformis syndrome which affects 5-6% of patients referred for the treatment of back and leg pain.

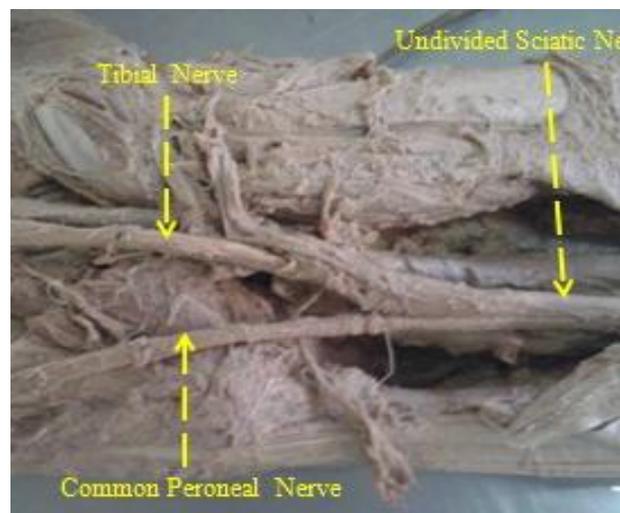


Fig-15: Left sciatic nerve divided in the lower of the back of the thigh



Fig-16: Right sciatic nerve divided in the lower of the back of the thigh

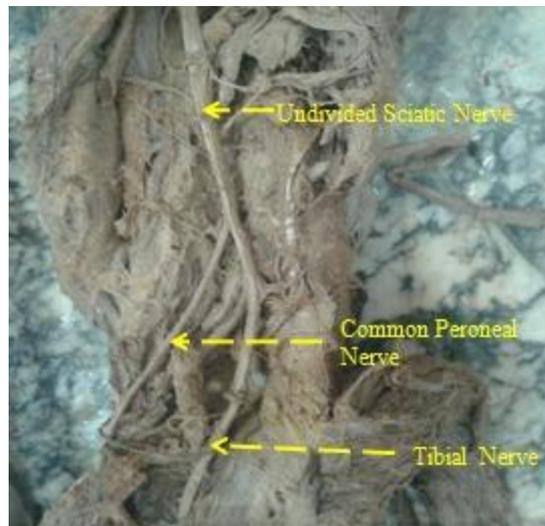


Fig-17: Right sciatic nerve divided in the middle of the back of the thigh



Fig-18: Left sciatic nerve divided in the middle of the back of the thigh

CONCLUSION

Knowledge of anatomical variations in gluteal region is imperative for surgeons, as this is the area of frequent surgical manipulation. A thorough knowledge of different variations will help surgeon to be careful and serve to plan various surgical.

The knowledge regarding the level of division of the sciatic nerve and the location where it leaves the

pelvis is of great importance. The abnormal passage of the sciatic, the common peroneal, and the tibial nerves, either through the piriform or below the superior gemellus may facilitate nerve injury during posterior hip surgery & the knowledge of that prevent morbidity.

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Conflict Of Interest

The authors declare that they do not have any conflicts of interest in concern to this article.

REFERENCES

- Diogo Paisi, Diogo Casal, Maria Alexandre Bettencourt Pires, Andrea Furtado, Tiago Bilhim, Maria Angelica- Almedida, João Goyri-O'neill, Sciatic nerve high Division: Two different anatomical variants, *Acta Med Port.* 2013 May-Jun;26(3):208-211.
- Shastrakar R, Nakhate M, Sawant VG. Study of variation in the high division of sciatic nerve and its relationship with the Piriformis muscle. *Med Res Chron.* 2015;2(3):359-65.
- Benzon HT, Katz JA, Benzon HA, Iqbal MS. Piriformis Syndrome Anatomic Considerations, a New Injection Technique, and a Review of the Literature. *Anesthesiology: The Journal of the American Society of Anesthesiologists.* 2003 Jun 1;98(6):1442-8.
- <https://teachmeanatomy.info/lower-limb/nerves/sacral-plexus>
- Desalegn M, Tesfay A. Variations of sciatic nerve its exit in relation to piriformis muscle in the Northern Ethiopia. *International Journal of Pharma Sciences and Research.* 2014 Dec 5;5(12):953-6.
- Andersen HL, Andersen SL, Tranum-Jensen J. Injection inside the paraneural sheath of the sciatic nerve: direct comparison among ultrasound imaging, macroscopic anatomy, and histologic analysis. 2012.
- Beaton LE, Anson BJ. The sciatic nerve and the piriformis muscle: their interrelation a possible cause of coccygodynia. *JBJS.* 1938 Jul 1;20(3):686-8.
- Patel S, Shah M, Vora R, Zalawadia A, Rathod SP. A variation in the high division of the sciatic nerve and its relation with piriformis muscle. *Natl J Med Res.* 2011 Oct;1(2):27-30.
- 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 1;28(1):88-91.
- Okraszewska E, Migdalski Ł, Jędrzejewski KS, Bolanowski W. Sciatic nerve variations in some studies on the Polish population and its statistical significance. *Folia morphologica.* 2002;61(4):277-82.
- Vicente EJ, Viotto MJ, Barbosa CA, Vicente PC. Study on anatomical relationships and variations between the sciatic nerve and piriformis muscle. *Rev Bras Fisioter.* 2007;11(3):197-202.
- Divizyon SS. Variations in the high division of the sciatic nerve and relationship between the sciatic nerve and the piriformis. *Turkish neurosurgery.* 2009;19(2):139-44.
- Jaja O, Hhel B, Mwika P, Khanbhai M, J J M. Variant anatomy of sciatic nerve in a black Kenyan population. *Folia Morphol (Warsz).* 2011;70(3):175-9.
- Muthu K, Srimathi, Ananda R, Sumathi L.A. Cadaveric Study of Sciatic Nerve and It's Level of Bifurcation. *Journal of Clinical and Diagnostic Research.* 2011;5(8).
- Ugrenović S, Jovanović I, Krstić V, Stojanović V, Vasović L. The level of the sciatic nerve division and its relations to the piriform muscle. *Vojnosanit Pregl.* 2005; 62(1):45-9.
- Sharma S, Ahmad M, Khullar M. Direct origin of tibial nerve and common peroneal nerve from lumbosacral plexus. *JK-Practitioner.* 2012 Jan;17(1-3):54-7.
- Pećina M. Contribution to the etiological explanation of the piriformis syndrome. *Cells Tissues Organs.* 1979;105(2):181-7.
- Chiba S. Multiple positional relationships of nerves arising from the sacral plexus to the piriformis muscle in humans. *Kaibogaku Zasshi.* 67(6): 691-724, 1992
- Machado FA, Babinski MA, Brasil FB, Favorito LA, Abidu- Figureiedo M, Costa MG: Anatomical variations between sciatic nerve and piriform muscle during fetal period in human. *Int J Morphol.* 21(1): 29-35, 2003.