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The Study of Division of Sciatic Nerve in 100 Specimens with Its Clinical Significance

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ABSTRACT

Aim: To study the division of Sciatic nerve. Materials & Methods: This study on division of sciatic nerve was performed on 50 (100 specimens of Inferior Extremities) embalmed donated cadavers (45 males & 5 females) in the department of Anatomy of K.J.Somaiya Medical College, Sion, Mumbai, India. In order to study the level of division of the sciatic nerve the 100 specimens were classified into six groups depending on the level of sciatic nerve division in the gluteal region, the upper, middle and lower parts of the back of the thigh, and the popliteal fossa. Observations: The highest incidence of sciatic nerve division (53%) was observed in the lower part of the back of the thigh. In 22% of the specimens, the sciatic nerve was dividing proximal to its entrance in the gluteal region. In 12% of the specimens, the sciatic nerve was dividing into the tibial and common peroneal nerves in the middle part of the back of the thigh. In 8% of the specimens, the sciatic nerve was dividing into the tibial and common peroneal nerves in the popliteal fossa. In 3% of the specimens, the sciatic nerve was dividing into the tibial and common peroneal nerves in the upper part of the back of the thigh. The lowest incidence of the sciatic nerve division (only 2%) was observed in the gluteal region. Conclusion: In sciatic nerve neuropathies, the extent of neurological deficits depends on the level of the sciatic nerve division. Sciatic nerve division into the tibial and common peroneal components at a higher level can result in the involvement of only one out of the two divisions in sciatic neuropathy. It can also result in a failure of the sciatic nerve block while performing popliteal block anaesthesia. These anatomical variations may contribute to clinical conditions such as piriformis syndrome, sciatica and coccygodynia.

Introduction:

The sciatic nerve (also known as the ischiadic nerve and the ischiatic nerve) is 2 cm wide at its origin and is the thickest nerve in the body. It leaves the pelvis via the greater sciatic foramen below piriformis and descends between the greater trochanter and ischial tuberosity, along the back of the thigh, dividing into the tibial and common peroneal (fibular) nerves at a varying level proximal to the knee. Superiorly it lies deep to the gluteus maximus, resting first on the posterior ischial surface with the nerve to quadratus femoris between them. It then crosses posterior to obturator internus, the gemelli and quadratus femoris, separated by the latter from obturator externus and the hip joint. It is accompanied medially by the posterior femoral cutaneous nerve and the inferior gluteal artery. More distally it lies behind the adductor magnus and is crossed posteriorly by the long head of the biceps femoris. It corresponds to a line drawn from just medial to the midpoint between the ischial tuberosity and greater trochanter to the apex of the popliteal fossa .

Articular branches arise proximally to supply the hip joint through its posterior capsule, these are sometimes derived directly from the sacral plexus. Muscular branches are distributed to biceps femoris, semitendinosus, semimembranosus and the ischial part of adductor magnus.

The point of division of the sciatic nerve into its major components (tibial and common peroneal) is very variable. The common site is at the junction of the middle and lower thirds of the thigh, near the apex of the popliteal fossa. The division may occur at any level above this, though rarely below it. It is not uncommon for the major components to leave the sacral plexus separately, in which case the common peroneal component usually passes through piriformis at the greater sciatic notch while the tibial component passes below the muscle (1).

The sciatic nerve supplies the knee flexors and all the muscles below the knee, so that a complete palsy of the sciatic nerve results in a flail foot and severe difficulty in walking. This is rare and usually related to trauma. The nerve is vulnerable in the posterior dislocation of the hip. As it leaves the pelvis it passes either behind piriformis or sometimes through the muscle and at that point it may become entrapped (the piriformis syndrome; this is a common anatomical variant but an extremely rare entrapment neuropathy). External compression over the buttock (e.g. in patients who lie immobile on a hard surface for a considerable length of time) can injure the nerve. The commonest cause of serious sciatic nerve injury is iatrogenic. It may be damaged in misplaced therapeutic injections into gluteus maximus. The safe zone for deep intramuscular injections here is the upper outer quadrant of the buttock. Perhaps safer still is to inject into the quadriceps, though this can produce problems of its own, e.g. haemorrhage, leading to contracture of the muscle, which limits knee movement. Sciatic nerve palsy occurs after total hip replacements or similar sureries in 1% of cases. This can be due to sharp injury, burning from bone cement, traction from instruments, manipulation of the hip, inadvertent lengthening of the femur, or haematoma surrounding the nerve or within its soft tissue coverings. Haematoma is characterised by the development of severe pain in the immediate post operative period. Early surgical exploration and evacuation of haematoma can reverse the nerve lesion. Unfortunately the other causes may not be reversed. The majority are temporary. Complete sciatic nerve palsy is very rare. For some reason, possibly anatomical, the common peroneal part is more usually affected. The patient has a foot drop and a high stepping gait (1).

The sciatic nerve bifurcates into two major divisions (tibial and common peroneal), most commonly at the lower part of the posterior compartment of the thigh (1 to 6). Several authors have reported variations in its division into the tibial and common peroneal nerve from the sacral plexus to the lower part of the popliteal space(3 to10). These anatomical variations may contribute to piriformis syndrome, sciatica, coccygodynia and muscle atrophy(12). This should be taken into account by clinicians who are planning interventions around the sciatic nerve and its division in the lower extremity.

Materials & Methods:

This study on division of the sciatic nerve was performed on 50 (100 specimens of Inferior Extremities) embalmed donated cadavers (45 males & 5 females) in the department of Anatomy of K.J.Somaiya Medical College, Sion, Mumbai, India. In order to study the level of division of the sciatic nerve the 100 specimens were classified into six groups depending on the level of sciatic nerve division in the gluteal region, the upper, middle and lower parts of the back of the thigh, and the popliteal fossa.

In the specimens in Group A, the sciatic nerve divided proximal to its exit in the gluteal region. In Group B, it divided in the gluteal region. In Groups C, D and E, it divided in the upper, middle and lower region of the back of the thigh, respectively. In Group F, the sciatic nerve divided in the popliteal fossa.

The photographs were taken for proper documentation.

Observations:

In Group A, 22 (19 males & 1female) of the 100 (22%) specimens, the sciatic nerve divided proximal to its exit in the gluteal region. In Group B, 2 (2 males) out of 100 (2%) specimens, the sciatic nerve divided in the gluteal region. In Group C, 3 (2 males and 1

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female) out of 100 (3%) specimens, the sciatic nerve divided at the upper part of the back of the thigh. In Group D, 12 (all males) out of 100 (12%) specimens, the sciatic nerve divided at the middle part of the back of the thigh. In Group E, 53(47 males and 8 females) out of 100 (53%) specimens, the sciatic nerve divided at the lower part of the back of the thigh. In Group F, 8 (all males) out of 100 (8%) specimens, the sciatic nerve divided into the tibial and common peroneal nerves in the popliteal fossa.



Fig. - 1 : The photographic presentation of normal course of the sciatic nerve.

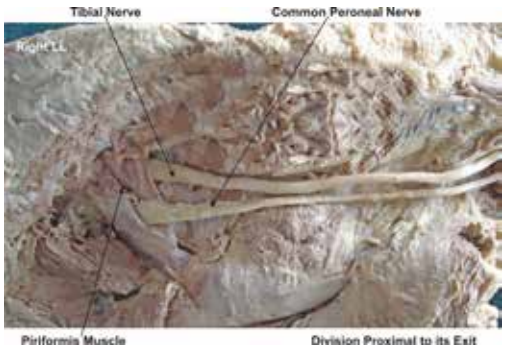


Fig. - 2 : The photographic presentation of division of sciatic nerve proximal to its exit, belonging to Group A.

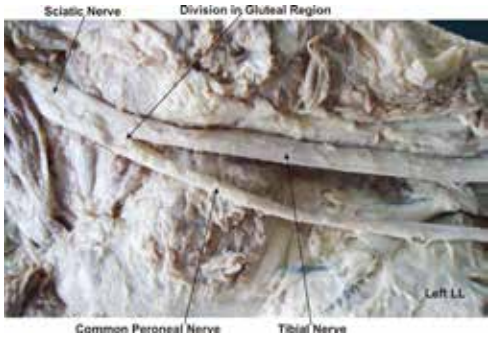


Fig. - 3 : The photographic presentation of division of sciatic nerve in the gluteal region belonging to Group B.

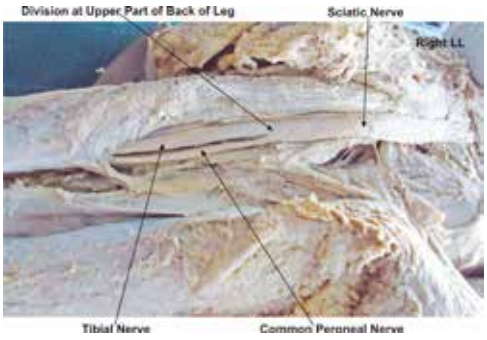


Fig. - 4 : The photographic presentation of division of sciatic nerve at the upper part of the back of the leg belonging to Group C.



Fig. - 5 : The photographic presentation of division of sciatic nerve at the middle part of the back of the leg belonging to Group D.

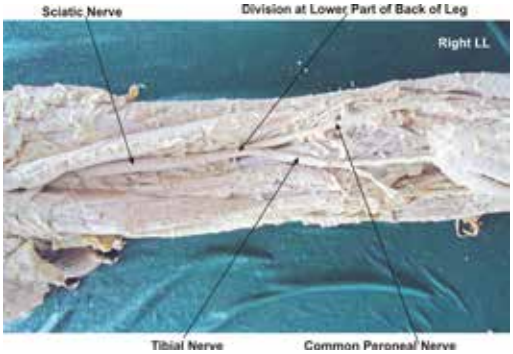


Fig. - 6 : The photographic presentation of division of sciatic nerve at the lower part of the back of the leg belonging to Group E.

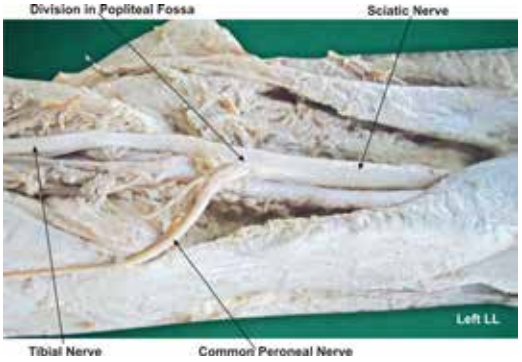


Fig. - 7 : The photographic presentation of division of sciatic nerve in the popliteal fossa belonging to Group F.

Table 1.The level of division of sciatic nerve observed in present study

Groups	Level of division	No.of specimens	Total No.of specimens	%
I	proximal to its exit	22	100	22
II	gluteal region	2	100	2
III	upper part of back of thigh	3	100	3
IV	middle part of back of thigh	12	100	12
V	lower part of back of thigh	53	100	53
VI	popliteal fossa	8	100	8

Comparison with previous studies:

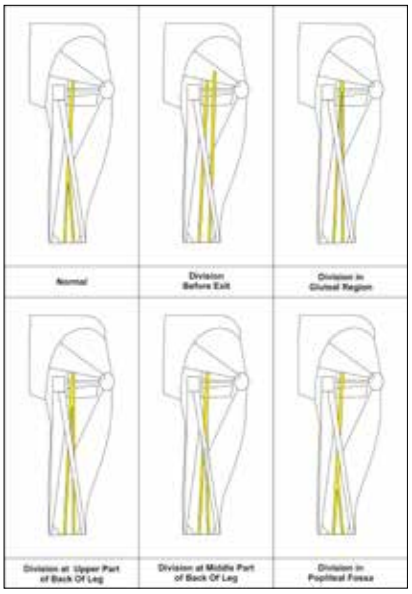
The division of the sciatic nerve is compared with previous studies and it has been found, that the incidence of divison of the sciatic nerve before its exit is found more frequently in our study except the study of Guvencer et al18 (Table 2).

Table 2. A comparison of the level of sciatic nerve division documented in various studies

Study	Year	No. of specimens	Before exit	After exit
Pokomy et al (13)	2006	91; 182	20.9%	79.1%
Ugrenovic et al(14)	2005	100; 200	4.0%	96.0%
Gabrielli et al (15)	1997	40;80	13.7%	86.3%
Guvencer et al(18)	2009	25;50	48.0%	52.0%
Present study (Sawant et al)	2012	50;100	22 .0%	78.0%

Discussion:

During embryological development at the base of the limb bud, the nerves contributing to the lower limb forms two plexuses (lumbar and sacral)(13). Later, as the elements from each of these plexuses grow out into the limb, they are subdivided into the dorsal and ventral components, for the dorsal and ventral musculatures(13). The sciatic nerve is formed when the large dorsal component of the sacral plexus (common fibular nerve) and the ventral component (tibial nerve) move downward close together(13). Hence, based on their previously mentioned developmental formation, it is possible that the common fibular and the tibial divisions of the sciatic nerve separate from each other at different levels from their origins; in the gluteal region, the posterior compartment of the thigh or the popliteal fossa, as observed in this study. Various studies have reported on the level of sciatic nerve division into tibial and common peroneal nerves (Table 2). The incidence of sciatic nerve division before its exit in the gluteal region in our study was 22%, which was higher than that found in a study conducted by Pokorný et al (20.9%), Ugrenović et al (4.0%) and Gabrielli et al (13.7%) (14,15,16). Saleh et al studied the level of division of the sciatic nerve into the tibial nerve and common peroneal nerve above the knee in 30 cadavers, and reported that the sciatic nerve divided at a distance of 50–180 mm above the popliteal fossa crease(17). Güvençer et al(18) examined 50 gluteal regions in 25 cadavers and observed that in 52% of the cases, the sciatic nerve exited the pelvis as a whole nerve without any division, whereas in 48% of the cases, a high division of sciatic nerve was recorded (Table 2) (18). Suresh et al recorded the measurements from the magnetic resonance images of 59 patients and proposed a formula for determining the point of bifurcation of the sciatic nerve in the posterior



thigh using a linear regression model(19). Acute sciatic neuropathies commonly result from hip arthroplasty, hip fracture or dislocation(2). On the other hand, causes such as coma, which result in prolonged compression, are relatively rare(2). The extent of involvement and neurological deficits vary depending on the level of division of the sciatic nerve. A high division of the sciatic nerve into the tibial and common peroneal nerves can result in the escape of either the tibial or the common peroneal nerve from one of the aforementioned causes, which would finally result in a decrease in neurological deficits as compared to the low division of the sciatic nerve. One important consequence of the high division of the sciatic nerve that has been reported by various authors is that it may lead to failure of popliteal block anaesthesia(20,21).

Clinical significance:

A high division of the sciatic nerve into the tibial and common peroneal nerves can result in the escape of either the tibial or the common peroneal nerve, which would finally result in a decrease in neurological deficits as compared to the low division of the sciatic nerve. One important consequence of the high division of the Sciatic Nerve is that it may lead to the failure of popliteal block anaesthesia.

Conclusion:

The awareness of high division of the sciatic nerve into the tibial and common peroneal nerves is clinically important for surgeons dealing with entrapment or compressive neuropathies, orthopaedicians operating on the fractures of femur, anaesthetist performing pain management therapies on the lower limb and physiotherapist doing electromyography for evaluating and recording the electrical activity produced by skeletal muscles. A lack of knowledge of such type of variations might complicate surgical repair.

Competing interests:

The author declare that he has no competing interests.

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