

Distribution of the sciatic nerve and its branches in cadavers

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Abstract

Aim: The aim of this study was to determine whether the sciatic nerve and cutaneous branches originating from the nerve show any difference from the pattern described in textbooks.

Material and Methods: For this purpose, six cadavers four males and two females were provided School of Medicine of Firat University.

Results: The cadavers were dissected starting from formation of the sacral plexus and the sciatic nerve. Their portions in gluteal region and extensions in thigh area were examined. The diversion points of the common peroneal (fibular) nerve and the tibial nerve were determined and their lengths and thicknesses were measured. Diversion point of the sural nerve, which is a cutaneous nerve, was determined. The common peroneal nerve and the tibial nerve were followed up to their terminals. In this study, it is observed that the sciatic nerve was formed of the spinal nerves originating from the L 4-5 – S 1-2. The sural nerve formations were various in cadavers.

Conclusion: This study demonstrated that the sciatic nerve formed from the spinal nerves originating from the L 4-5 – S 1-2. The sural nerve formations were various in cadavers and it was understood that a certain formation of the sural nerve could not be described.

Keywords: Sciatic Nerve; Sural Nerve; Common Peroneal (Fibular) Nerve; Anatomy.

INTRODUCTION

Sciatica is defined as irritation or compression of the sciatic nerve that causes pain in the buttock area with radiation to the lower leg. The vast majority of cases have a spinal cause, such as disc herniation or reupture causing impingement of L5 or S1 nerve roots (1). The sciatic nerve blockage is used as a method of reducing the pain during unilateral arteriography of the lower extremity (2).

The sciatic nerve is formed by joining of lumbosacral trunk and 1st, 2nd and 3rd sacral rami. The sciatic nerve is 2 cm broad at its origin. It leaves the pelvis below the piriformis muscle and through the greater sciatic foramen. It extends downwards between the greater trochanter and ischial tuberosity, and along the back of the thigh. It divides into the tibial and the common peroneal (fibular) nerves proximal to the knee joint (3,4).

MATERIAL and METHODS

Data for this study was collected from six human cadavers which were used for teaching purposes in Medical School of Firat University. At first, formations of the sacral plexus

and the sciatic nerve were studied. Then the pelvic cavity was opened and the splanchnic structures were emptied and the body of the vertebrae was reached. Thus, the exit of the sciatic nerve and the point where intervertebral foramen were extended and passed into the gluteal region, was determined. Surrounding tissues, thicknesses, main branches and terminal branches of the sciatic nerve were studied comparatively in both lower extremities in each cadaver. The lengths and thicknesses of the nerves were measured with caliper compass.

RESULTS

In order to reach the vertebrae, firstly the pelvic regions and the cavities of the cadavers were opened and small and large intestines and other structures were emptied. Then, the sacral plexus was examined and it was observed that the sacral plexus of the dissected cadavers had been formed by the connection of the lumbosacral trunk and the anterior rami of the spinal nerves from S 1 and S 2 (Figure 1).

The lumbosacral trunk was formed by merging of a thin branch from L 4 and the ventral ramus of L5.

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Figure 1. The forming of the roots of the sciatic nerve is shown. LT:Lumbosacral truncus, 1:Fourth lumbal nerve, 2:Fifth lumbal nerve, 3:First sacral nerve, 4:Second sacral nerve

The sciatic nerve, on the other hand, was formed by the merging of the ventral rami of L 4-5 – S 1-2 spinal nerves in the pelvic cavity. These nerve fibers passed through the greater sciatic foramen and reached the gluteal region. The nerve fibers were measured with a caliper compass in their original position in the pelvis (Table 1).

| Table 1. The thicknesses at the exits of the intervertebral foramen of spinal nerves which form sciatic nerve (as mm) | | | | |
|---|----------------|----------------|----------------|----------------|
| | L ₄ | L ₅ | S ₁ | S ₂ |
| 1 st cadaver | 0.1 | 7.5 | 8.0 | 4.5 |
| 2 nd cadaver | 0.5 | 4.8 | 6.0 | 3.0 |
| 3 rd cadaver | 0.8 | 6.9 | 7.7 | 4.2 |
| 4 th cadaver | 0.9 | 7.0 | 7.5 | 4.1 |
| 5 th cadaver | 0.8 | 6.8 | 7.2 | 3.8 |
| 6 th cadaver | 0.6 | 5.2 | 6.5 | 3.4 |

The sciatic nerve was accompanied by the inferior gluteal artery and vein, the inferior gluteal nerve, the posterior femoral cutaneous nerve, the internal pudendal artery and vein and the pudendal nerve in the infrapiriform foramen area. They advanced towards the thigh region, passing between the ischial tuberosity and the greater trochanter in the gluteal area. The sciatic nerve gave motor fibers to

the biceps femoris, semitendinosus, semimembranosus and the part of the adductor magnus muscles in the thigh region.

The sciatic nerve was divided into the tibial and the common peroneal (fibular) nerves at the proximal level of the popliteal fossa. The branching points and thickness measurements are provided in Table 2. The common peroneal nerve passed anteriorly to the leg by circling around the neck of the fibula. This nerve gave a branch, called the lateral sural cutaneous nerve, posterior to the leg. The lateral sural cutaneous nerve merged with the medial sural cutaneous nerve which extended from the tibial nerve, together forming the sural nerve.

| Table 2. The branching points of the sciatic nerve and the thickness measurements of the tibial and common peroneal nerves | | | |
|--|---|--------------------------------|---|
| Number of cadaver | The region divided of ischiadic nerve distance from popliteal fossa (cm proximal) | Thickness of tibial nerve (mm) | Thickness of common peroneal nerve (mm) |
| 1 st cadaver | 17.5 | 6.5 | 4.8 |
| 2 nd cadaver | 10 | 6.0 | 4.5 |
| 3 rd cadaver | 0 | 5.8 | 4.0 |
| 4 th cadaver | 11 | 7.0 | 6.0 |
| 5 th cadaver | 5 | 6.0 | 4.0 |
| 6 th cadaver | 1 | 5.0 | 4.5 |

The common peroneal nerve was divided into the superficial peroneal and deep peroneal nerves, among starting fibers of the peroneus longus muscle and anterior to the leg. The deep peroneal nerve descended between the tibialis anterior and the extensor digitorum longus muscles in the supero-lateral part of the leg. In the infero-medial part of the leg (20 cm distal to the tibial tuberosity), it extended downward piercing through the extensor hallucis longus muscle. Then it extended further down and reached the dorsal part of the foot and crossed under the extensor hallucis brevis muscle, innervated skin between first and second toes and terminated there. The superficial peroneal nerve surfaced antero-laterally and in approximately 1/3 distal part of the leg. It branched into the medial dorsal cutaneous and the intermediate dorsal cutaneous nerves close to the ankle (Figure 2).

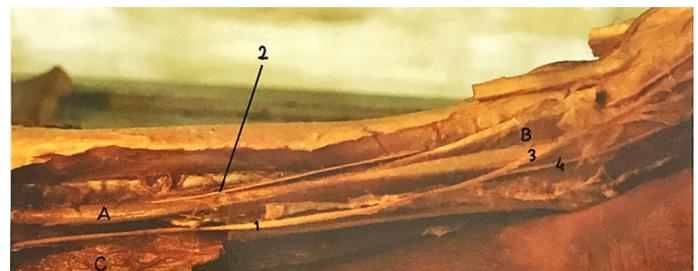


Figure 2. The deep and superficial peroneal nerve passing is seen. 1: Superficial peroneal nerve, 2: Deep peroneal nerve, 3: Medial dorsal cutaneous nerve, 4: Intermediate dorsal cutaneous nerve, A: M.tibialis anterior, B: M.extensor hallucis longus, C: M. peroneus longus

The medial dorsal cutaneous nerve terminated after innervating the medial side of the big toe and the adjacent sides of the second and third toes. The intermediate dorsal cutaneous nerve terminated after innervating the region between third and fourth toes.

The tibial nerve left the sciatic nerve in the proximal part of the popliteal fossa and gave fibers sensitively innervating the knee joint, periosteum of the tibia and tibiofibular joint. The tibial nerve continued to descend, passing through the arch of soleus muscle. Here it gave muscular branches to the back of the leg. In only two cadavers, the tibial nerve gave the sural nerve singularly (Figure 3). In these cadavers; the sural nerves advanced in the postero-lateral of the leg, passed behind the lateral malleolus and terminated towards the most lateral side of the foot dorsum and little toe (fifth toe).



Figure 3. Sural nerve is seen. 1: sural nerve, A: m. gastrocnemius, C: calcaneal tendon

The tibial nerve reached the foot sole via passing through the back of the medial malleolus and divided into the medial plantar and lateral plantar nerves at the sole. The thicknesses of these two branches were measured and in one cadaver the lateral plantar nerve was thicker than the medial plantar. In the remaining five cadavers

medial plantar nerves were thicker. The medial plantar nerves were ending in the first, second and third toes on the plantar side of the foot. The posterior tibial artery accompanied the lateral plantar nerve at the sole of the foot and the lateral plantar nerve was divided into deep and superficial two branches in the vicinity of the fifth metatarsal. The superficial branch gave its branches to the flexor digiti minimi brevis and the interosseal muscles and then terminated. The deep branch extended into the concavity of plantar arch and lasted after sinking into the oblique head of the abductor hallucis muscle.

DISCUSSION

In this study, it was observed that the sciatic nerve was formed in pelvis by the merger of ventral branches of spinal nerves originating from the L 4-5 – S 1-2. In none of the dissected cadavers, nerve fibers originating S 3 contributed the formation of the sciatic nerve. Previous studies suggest that sciatic nerve is formed by the merger of spinal nerves extending from L 4-5 – S 1-3 (2,3). It is reported that sciatic nerve originated from upper, middle and lower roots (5). In one of the previous studies, Kikuchi mentioned a furcal nerve originating from L 4 level. It was also stated that the space around the nervous tissue was narrower in males than in females (6). The Same authors have demonstrated that lumbosacral radicular symptoms with atypical neurologic findings are frequently due to furcal nerve compression (7).

It was reported that the sciatic nerve gave a perineal branch (8). Shehab et al. observed that motor fibers in the sciatic nerves originated from the L 4- 6 ventral horns and sensory fibers originated from dorsal roots of the same level (9). Aldskogius and Risling studied in kittens and found that in 7- days old kittens, 50 % of ipsilateral dorsal root ganglion neurons disappeared after the sciatic nerve was extracted (10). The sciatic nerve reached the gluteal region by passing through the infrapiriform foramen in all of the studied cadavers. It was stated that the piriformis muscle formed of two segments and the tibial nerve passed under the lower part of the piriformis while the common peroneal nerve passed between the two segments (11).

In all of the studied cadavers, the sciatic nerve was branching into the tibial nerve and the common peroneal (fibular) nerve in the proximal of the popliteal fossa. In one previous study the tibial nerve and the common peroneal nerve originated from two separate regions (11).

In one cadaver, the common peroneal nerve did not give any cutaneous branch at all at the back of the leg. In that cadaver, the tibial nerve itself was given the sural nerve branch. In another cadaver, the sural nerve was a branch of the tibial nerve. However, in that cadaver the common peroneal nerve was giving the cutaneous branch, called the lateral sural cutaneous nerve. That branch was terminating freely at the back of the leg. In the remaining cadavers, the cutaneous branches (one of the tibial nerve and the other one of the common peroneal nerve) were

emerging and, thus, forming the sural nerve. No record of the sural nerve originating singularly from the tibial nerve is present in previous studies. Bent et al. showed that if neurolymphomatosis is suspected, a nerve biopsy must be considered. They also emphasized that usually the sural nerve biopsy is necessary in order to demonstrate tumor cells (12).

CONCLUSION

As a result, with this study it is discovered that the sciatic nerve formed from the spinal nerves originating from the L 4-5 – S 1-2. The sural nerve formations were various in cadavers and it was understood that a certain formation of the sural nerve could not be described.

Competing interests: The authors declare that they have no competing interest.

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Ethical approval: The study is a graduate study and was done 25 years ago so the ethic approval was not needed

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