



Anatomical variations of the sciatic nerve, in relation to the piriformis muscle



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ABSTRACT

Anatomical variations can be seen in any part of the body and unless they are identified through imaging, during surgery, or on autopsy most of them will never be detected. Anatomical variations of the sciatic nerve in relation to the piriformis have been described for many years and so has possible implications these variations might play in certain pathologies, such as sciatica. Identifying the frequency of anatomical variations in the population is relevant to identify patients that might not be treated effectively with standard medical care. These patients might require specialized care due to their unique anatomy. In this study 51 cadavers were examined for anatomical variations in the relation of the sciatic nerve to the piriformis muscle. We found that out of 102 lower limbs examined, 90 contained normal anatomy (89%). We identified two distinct variations of anatomy in the cadavers examined: one variation showing the common fibular branch of the sciatic nerve passing through the piriformis (occurring in 9 out of 102 or 8.8% of lower limbs examined); the second variation was the common fibular branch passing over the piriformis (found in 3 out of the 102 limbs or 2.9%).

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1. Introduction

The sciatic nerve is the largest nerve in the human body, branching from the sacral plexus with origins of L4–S4 spinal nerves carrying sensory and motor function. The sciatic nerve tracts through the pelvis and projects through the greater sciatic foramen, providing innervation for the lower extremities [16]. The sciatic nerve usually terminates into two branches above the popliteal region forming the common fibular nerve and the tibial nerve. The tibial division innervates the hamstring muscle of the posterior thigh, the muscles of the posterior compartments of the leg, and the muscles of the sole of the foot. The common fibular division innervates the short head of biceps femoris, and the muscle of the lateral and anterior compartments of the leg and the dorsum of the foot. As for the sensory portion of the nerve, innervation of the leg and foot are provided [16]. It was believed that after the branching of these two nerves occurs there was no further communication between these two branches, but a recent paper found that 75% of the sciatic nerves examined in their cadaver population showed some variation of connection between these two nerves [15]. This

leads to the conclusion that the division of the sensory and motor innervation of these two nerves may not be a clearly divided as once believed. Within the gluteal region, anatomical variations have been noted involving divisions of the nerve and the nerves relation to the piriformis muscle. The piriformis muscle is one of a group of muscles that allows for range of motion in the hip. It forms a canal with the gemellus superior through which the sciatic nerve passes. The piriformis originates on the pelvic aspect of the sacrum between the second and fourth foramina and attaches at the greater trochanter [16]. In the majority of the population, the sciatic nerve passes completely under the piriformis muscle, but in a small portion of cases one of the divisions of the sciatic passes through or over the muscle. The different anatomical variations of the sciatic nerve have been studied in association with gluteal surgeries and have been suggested as a possible trigger for piriformis syndrome [7]. This study was performed to determine how common each of the anatomical variations occurs in the general population.

2. Methods

51 cadavers, 102 lower limbs, in total were examined for the collection of data. 32 cadavers from Texas Tech Medical School in Lubbock were examined following their use in anatomy education and 19 from Paul L. Foster School of Medicine during their use for

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anatomy education. All cadavers were examined or further dissected in order to identify the anatomy of the sciatic nerve and its orientation to the piriformis muscle. For those cadavers whose gluteal regions were not already dissected, we exposed the gluteal region cutting through the gluteus maximus, exposing the underlying piriformis muscle and sciatic nerve. We then identified if the sciatic nerve was divided or whole and whether any portion of the nerve ran under, above, or between the two heads of the piriformis muscle and all variations were recorded.

3. Results

In this study, we found that 89%, of lower limbs examined contained normal anatomy with the sciatic nerve passing under the piriformis muscle. The most common variation identified consisted of a division of the sciatic nerve with the common fibular portion of the nerve passing through the piriformis muscle. This variation has also been described as Type 2 according to Beatons and Anson's classification [8]. In our study, 8.8% of the lower extremities were found to have this form of variation, with 5 being identified in the left lower limb and 4 identified in the right lower limb. The only other variation identified in the cadavers in this study, included a division of the sciatic nerve with the common fibular division passing over an intact piriformis muscle. This variation was labeled Type 3 according to Beatons and Anson's classification [8]. 2.9% of the lower limbs examined in this study were found to have this anatomical variation with 2 being identified in the left lower limb and 1 being identified in the right lower limb. All anatomical variations were identified in only one lower limb of each cadaver with the exception of one. In one 86 year old female, the Type 2 variation was identified in both the right and lower limb, but in all other cadavers variations occurred in one lower limb with the other lower limb showing normal anatomy [8]. (see Figs. 1–3)

4. Discussion

Sciatica is a painful condition that can result in chronic pain for patients, if the correct cause is not identified. Sciatica can be due to spinal degenerative disc disorders or spinal radiculopathies, but piriformis syndrome has been identified to account for up to 6–8% of sciatica [3]. The piriformis muscle inserts at the sacrum and terminates at the femoral greater trochanter, providing hip mobility through lateral rotation and abduction [4,5]. Piriformis syndrome results from the sciatic nerve being compressed by the piriformis muscle. This syndrome is clinically diagnosed through isolation of the source of pain and elimination of any other identifiable cause [1]. Michel et al. describe in their article multiple maneuvers designed to recreate sciatic pain due to piriformis entrapment through manipulation of the hip stabilization and mobility muscles. They purposed a 3 step process to clinically identify piriformis syndrome; first a passive stretch either Freiberg, FAIR (Flexion-Adduction-Internal Rotation) or HCLK (hell-contralateral knee) maneuvers, followed by an active maneuver, either Beatty, Pace and Nagle, or the FAIR test, and finally palpation of the piriformis muscle itself. They found that these techniques could be used to reproduce sciatic pain in non-discogenic causes of the sciatica, suggesting piriformis entrapment as the likely etiology. Michel et al. in a study of 250 patients diagnosed with piriformis syndrome purposed a clinical scoring system allowing clinicians to score patients on their description of their pain. Scores of 8 or more, most likely indicates piriformis syndrome, with 96.4% of the patients in the study with piriformis syndrome scoring an 8 or higher [4,5]. The criteria used in the scoring system are based on the alleviating and aggravating factors of the pain, with pain due to stretching or contraction of the piriformis being one of the criteria. This supports the idea that manipulation of the anatomy of the piriformis in relation to the sciatic nerve plays a crucial role in the pain provoked in piriformis syndrome. The etiology of piriformis syndrome is not completely understood, but anatomical variations

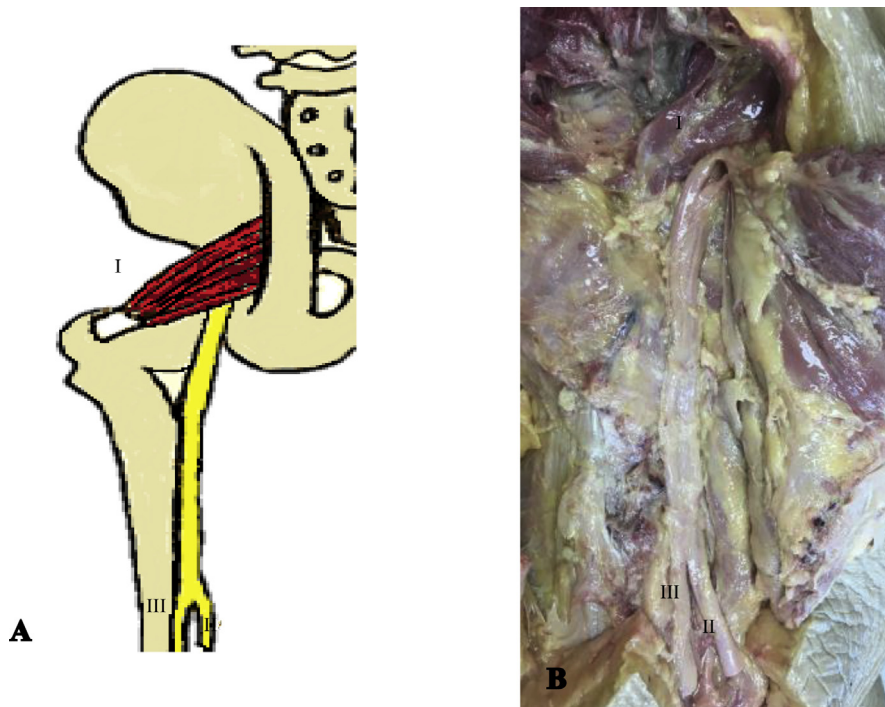


Fig. 1. A) A comparative illustration of normal anatomy. B) A picture of normal anatomy of dissected cadaver where II and III are the branches of the sciatic nerve. All images tagged as follows: I) Piriformis muscle, II) Tibial Division, and III) Common Fibular Division.

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