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Case Report

A RARE CASE OF BILATERAL SUPRA PIRIFORMIS PELVIC EXIT OF COMMON PERONEAL NERVE: SIGNIFICANCE IN PELVIC AND HIP SURGERY

Cheryl-Melovitz Vasan *[1], Evan Goldman [2], Lauren Sysol [3], Nagaswami Vasan *[4].

*[1] Assistant Professor, Department of Biomedical Sciences, Cooper Medical School of Rowan University, Camden, New Jersey, USA.

[2] Evan Goldman, Assistant Professor, Department of Biomedical Sciences, Cooper Medical School of Rowan University, Camden, New Jersey, USA.

[3] Lauren Sysol, Anatomy Lab Technical Staff Member, Department of Biomedical Sciences, Cooper Medical School of Rowan University, Camden, New Jersey, USA.

*[4] Professor, Department of Biomedical Sciences, Copper Medical School of Rowan University, Camden, New Jersey 08103, USA.

ABSTRACT

Background: The tibial and common peroneal nerves unite to form the sciatic nerve, which may exit the pelvis in several different ways. Much of these differences involve the nerves relationship to the piriformis muscle.

Materials and Methods: We report here an anomaly found in a 70-year old Caucasian female who died of congestive heart failure and donated her body to the willed body program. As part of the cadaveric dissection of the donor, the medical students observed a variation in the pelvic exit of the common peroneal nerve.

Results and observations: Upon detailed dissection of the gluteal and pelvic region, we observed that bilaterally the common peroneal nerve exited the pelvis superolaterally and the tibial nerve exited inferomedially to the piriformis muscle. Intra- pelvic dissection further showed, that from the beginning, the two components of the sciatic nerve maintained an independent course.

Conclusions: The common peroneal and the tibial nerves, which unite to form the sciatic nerve normally, exit the pelvis inferior to the piriformis muscle. However, we observed an anomaly in the formation and exit of the two components of the sciatic nerve. The superolateral exit of the common peroneal nerve, especially, is a serious variation that is relevant in hip and pelvic surgery.

KEY WORDS: Common peroneal nerve, tibial nerve, sciatic nerve, piriformis, hip replacement surgery, pelvic surgery, patient risk.

Address for Correspondence: Prof. Dr. Nagaswami Vasan, D.V.M., M.V.Sc., Ph.D., Professor of Anatomy, Department of Biomedical Sciences, Cooper Medical School of Rowan University, 401 South Broadway, Camden, New Jersey 08103, USA. Phone: +1 (856) 361-2890
E-Mail: vasan@rowan.edu

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INTRODUCTION

The sciatic nerve consists of a laterally situated division, which eventually forms the common peroneal nerve (posterior postaxial), and a medially situated division, which forms the tibial nerve (anterior epaxial), that are enclosed in a

common connective tissue sheath (epineureal sheath) [1]. The sciatic nerve, after its formation, exits through the greater sciatic foramen inferomedial to the piriformis muscle accompanied by the posterior femoral cutaneous nerve, inferior gluteal neurovasculatures and the pudendal vessels. The sciatic nerve usually travels below the piriformis muscle, except in 10%–25% of cases, particularly when the peroneal division passes through or above the piriformis muscle [2]. The nerve travels between the greater trochanter laterally, and ischial tuberosity medially, and then descends into the subgluteal area.

The common peroneal nerve is comprised of nerve made of the dorsal division of L4 through S2 spinal segments that joins the tibial nerve that is made of ventral division of L4 through S3 spinal segments to form the sciatic nerve. The sciatic nerve exits the pelvis normally through the greater sciatic foramen inferior to the piriformis muscle [1]. Variations in the pelvic exit of the tibial, common peroneal and the sciatic nerve have been observed and classified into 6 types (Figure 1) [2-4]. Predominantly, the sciatic nerve, at the apex of the popliteal fossa, divides into the tibial and common peroneal nerves. Frequently, the sciatic nerve divides into its common peroneal and tibial nerve divisions soon after it exits the pelvic cavity (high division) and then unites to form the sciatic nerve as in a normal situation.

MATERIALS AND METHODS

In the present study, we utilized the donated cadaver, which had been dissected and studied by the medical students at Cooper Medical School of Rowan University. During the dissection of a 70-year-old Caucasian female, who died of congestive heart failure, we observed that bilaterally, the common peroneal nerve exited the pelvis superior and lateral to the piriformis muscle while the tibial nerve exited inferior and medial to the piriformis muscle (Figure 2). In order to expose the details of the gluteal region, we carefully elevated the gluteus maximus muscle, identified and dissected the piriformis, superior and inferior gemellus and quadratus femoris muscles, and the inferior gluteal neurovascular structures. Intra-pelvis dissection was hampered by extensive unknown pelvic pathology that needed careful dissection and clearing of the fibrous and fatty tissues. The cleared dissection field showed an intrapelvic formation and course of the common peroneal and tibial nerves.

Fig. 1: Shows the six types of commonly observed variations of the piriformis muscle, common peroneal, tibial and sciatic nerves. From: Smoll NR. Clinical Anatomy, 23: 8-17 (2010) with permission from the publishers.

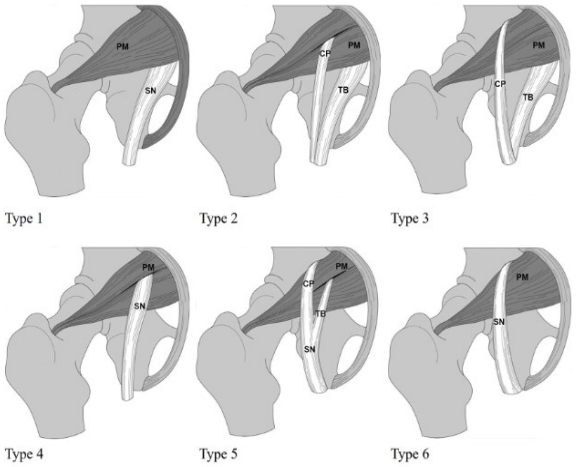
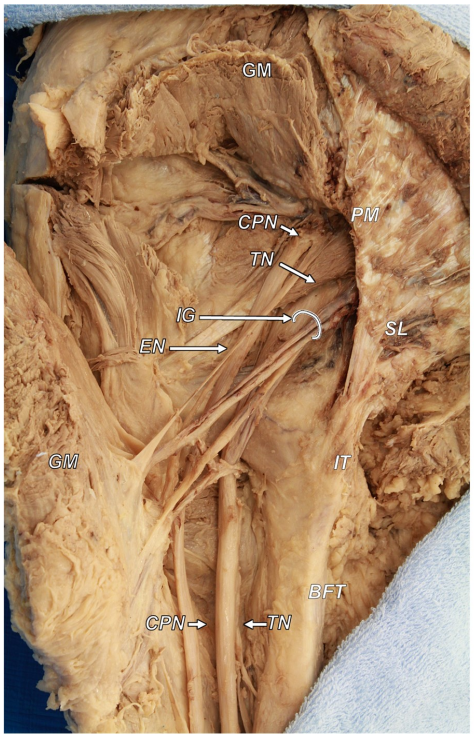


Fig. 2: Dissection of the gluteal region showing the pelvic exit of the common peroneal and tibial nerves as described in the text.

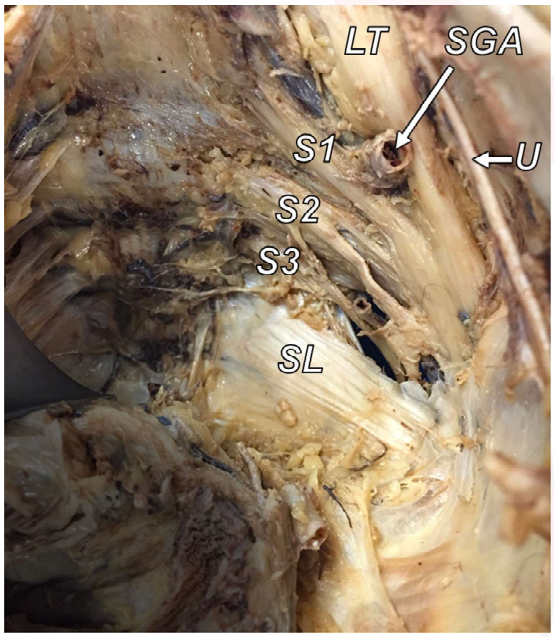


BFT- Biceps femoris tendon (long head); **CPN**-Common fibular nerve; **EN**- ectopic nerve to gluteus maximus; **GM**- gluteus maximus (reflected); **IG**-inferior gluteal neurovascular bundle; **IT**- ischial tuberosity; **PM**-piriformis muscle; **SL**- sacrotuberous ligament; **TN**- tibial nerve.

RESULTS AND DISCUSSION

The intrapelvic dissection revealed that the lumbosacral trunk (L4, L5) joined a smaller portion of S1 and S2 forming the common peroneal nerve that exited the pelvis superolateral to the piriformis muscle, while a smaller portion of S1 and larger part of S2-3 joined to form the tibial part of the sciatic nerve that exited the pelvis inferomedial to the piriformis muscle (Figure 3). In the extrapelvic gluteal region, the common peroneal nerve exited the pelvis superolateral to the piriformis muscle and the tibial nerve inferomedial to the muscle. Furthermore, without uniting to form the sciatic nerve, the two nerves followed an independent course. While the tibial nerve descended in the middle of the thigh, the common peroneal nerve pursued a lateral course in the gluteal, posterior thigh and knee regions. Other neurovascular structures in the gluteal region, were anatomically normal in their course and distribution.

Fig. 3: The intrapelvic dissection showing the formation of common peroneal and tibial nerves. The dissection field is marred by the unknown pelvic pathology (information about the pathology not available).



LT- Lumbosacral trunk; S1-S3- Posterior branches of sacral nerves 1-3; SGN- Superior gluteal nerve; SL- Sacrospinous ligament; U- Ureter.

Many of the observations regarding an aberrant pelvic exit of the sciatic, tibial and common peroneal nerves were made during the cadaveric dissection in teaching laboratories, while only a few Many of the observations regarding an aberrant pelvic exit of the sciatic, tibial and common peroneal nerves were made during the cadaveric dissection in teaching laboratories, while only a few were reported from performing hip surgery [4]. Atypical pelvic exit of the sciatic nerve was also observed in the dissection of a human fetus [5]. A detailed systematic review and meta-analysis of the occurrence of anomalous piriformis/sciatic nerve relationships that included 18 studies with over 6062 cadaveric specimens and 7 studies of 130 surgical cases [4] resulted in 6 types of sciatic nerve division (Table 1). In rare cases, the common peroneal and the tibial nerves are separated in their intrapelvic origin and follow an altered course. In the present study, the common peroneal nerve and tibial nerves followed the pattern of type "3", but they differed in that they did not join to form the typical sciatic nerve but followed an independent course (Figure 1). The type "3" variation occurred in approximately 1.5% of the cases observed [4]. In the present case, the tibial nerve descended in the middle of the thigh and the common peroneal nerve pursued a lateral course through the gluteal, posterior thigh and knee regions.

Table 1: Shows the classification of the variation of sciatic nerve division as described by Beaton and Anson (1937).

Type 1:	Undivided sciatic nerve (SN) below the undivided piriformis muscle.
Type 2:	Divisions of sciatic nerve (SN) components (PN and TN) between and below the undivided piriformis muscle.
Type 3:	Divisions of sciatic nerve (SN) components (PN and TN) above and below the undivided piriformis muscle.
Type 4:	Undivided sciatic nerve (SN) between the heads of the piriformis muscle.
Type 5:	Divisions of sciatic nerve (SN) components (PN and TN) between and above the heads of the piriformis muscle.
Type 6:	Undivided sciatic nerve (SN) above the undivided piriformis muscle.

SN- Sciatic nerve; **PN**- Peroneal nerve; **TN**- Tibial nerve.

During embryological development, the nerves contributing to the lower limb form two plexuses, the lumbar and sacral. Subsequently, as the components from each of these plexuses grow out into the limb, they are subdivided into dorsal and ventral components, for the dorsal and ventral musculature [4A]. The sciatic nerve is formed when the large dorsal component of the sacral plexus, the common peroneal nerve, and the ventral component, the tibial nerve, migrate inferiorly and come closer together. Upon exit from the pelvis, an epineureal

connective tissue sheath wraps around these two components. The common peroneal and the tibial divisions of the sciatic nerve detach from each other at different levels. The detachment can occur within pelvis (as observed in the present case), in the gluteal region (high division), the posterior compartment of the thigh (frequent site) or the popliteal fossa (normal site.

It has long been observed that the lateral division of the sciatic nerve (i.e. common peroneal nerve) is injured more severely than the medial division (i.e. tibial nerve) [6-8]. It has been suggested that this is possibly due to: 1) The difference in the fascicular pattern and cushioning effect of the epineurium between the two divisions; the tibial nerve has many fascicles distributed between elastic epineural tissue, whereas the common peroneal nerve is composed of fewer fascicles with limited supportive tissues. 2) The difference in the anatomical course between these two nerves: the tibial nerve is loosely fixed posteriorly, whereas the common peroneal nerve is taut and secured at the sciatic notch proximally, and the fibular neck distally. Consequently, traction of the sciatic nerve results in more damage to the common peroneal nerve than to the tibial nerve in the thigh [6, 7].

The pelvic exit of the common peroneal nerve superior or posterolateral to the piriformis muscle (Figure 2) places the patient at greater risk of common peroneal nerve injury especially when the surgeon makes a lateral approach to the hip joint.

Knowledge regarding the aberrant intrapelvic formation and extrapelvic course of the tibial, common peroneal and sciatic nerves, and their relationship to the piriformis muscle is essential for surgery for the pelvic pathology and various surgery of the hip. The atypical formation and course of the common peroneal nerve is significant in performing surgical procedures such as hip arthroplasty, piriformis tendon release or piriformis tenonectomy for piriformis syndrome treatment, sciatic anesthesia in the popliteal fossa for foot and ankle surgery etc. Common causes associated with the sciatic neuropathies following hip replacement, hip fracture or dislocation or femur fracture is due to abnormal formation and course of sciatic nerve [7, 9-11]. Acute compression of sciatic nerve is also possible in coma, labor and delivery, and penetrating wound, intramuscular gluteal injection, piriformis syndrome and pelvic pathology [7, 9-11]. The common peroneal nerve injury is more likely when a lateral approach is taken in hip replacement surgery [12]. Earlier study also showed common peroneal nerve palsy associated with pelvic surgery for colorectal, gynecological and urologic oncology [13]. Additionally, high division of the sciatic nerve could result in an ineffective sciatic nerve block (popliteal block) when performing foot and ankle surgeries (e.g. Achilles tendon repair, foot debridement). This block is one of the most useful blocks in surgical practice of the foot and ankle [14].

CONCLUSION

The aberrant behavior of the common peroneal and tibial nerves has consequences for individuals undergoing hip replacement surgery or treatment of the pelvic or femoral neck fracture. This is also significant in performing clinical procedures such as hip arthroplasty, piriformis tendon release or piriformis tenonectomy for piriformis syndrome treatment, sciatic anesthesia in the popliteal fossa for foot and ankle surgery etc. Additionally, high division could result in ineffective sciatic nerve block when performing surgery on the foot and ankle. Knowledge of how sciatic nerve and its components exit pelvis is important in hip surgery since their close proximity to the joint.

This study was presented as a poster in the session on “Anatomical Variations”, American Association of Anatomists, EB Annual Meeting, April 2016, San Diego, CA

ABBREVIATIONS

SN- Sciatic nerve
CPN- Common Peroneal Nerve
TN- Tibial nerve
PN- Peroneal nerve.

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Conflicts of Interests: **None**

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