CASE REPORT

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Bilateral variant hamstring musculature with unilateral variant sciatic nerve

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SUMMARY

Anatomic variation of lower limb innervation and musculature significantly impacts the structure and function of nearby musculature and vasculature. This case report details the findings of a rare unilateral sciatic nerve variation, as well as bilateral muscular slips within the lower limbs. The left sciatic nerve was found to emerge as its common peroneal and tibial divisions at the superior and inferior borders of the piriformis, respectively. The muscular slips were found to extend from the long head of the biceps femoris to the semitendinosus muscles bilaterally. Research suggests that the presence of sciatic nerve variation and accessory muscular slips within the same subject is an uncommon finding. These findings are significant due to their potential implications in both surgical and clinical specialties. Surgeons should be aware of anatomical variation in the gluteal and hamstring regions for procedures such as total hip replacements, while clinicians should be aware of such variation for diagnostic and nerve block purposes.

Key words: Sciatic nerve variation – Muscular slip – Hamstring variation – Piriformis syndrome – Common peroneal nerve – Tibial nerve

INTRODUCTION

The sciatic nerve innervates the posterior compartment of the thigh and the major portion of the leg and foot. It normally emerges in one epineural sheath from the ventral rami of spinal nerves L4-S3. It courses through the greater sciatic foramen, under the piriformis muscle with other nervous and vascular tissue such as the posterior cutaneous, pudendal, and inferior gluteal nerves, and the inferior gluteal and internal pudendal arteries and veins. The sciatic nerve maintains the common peroneal and tibial divisions in one epineural sheath until splitting into two separate divisions in the popliteal region (Schuenke et al., 2016).

A study performed by Beaton and Anson (1938) described sciatic nerve variation in four subtypes. Type A demonstrates normal anatomy with the entire sciatic nerve coursing deep to the piriformis muscle. Type B, found in 11% of lower limbs, shows the common peroneal division piercing through the piriformis muscle, with the tibial division coursing deep to the piriformis. Type C, found in 0.86% of lower limbs, shows the common peroneal division coursing superficial to the piriformis, with the tibial division coursing deep to the piriformis. The final classification, Type D, found in 0.13% of limbs, describes the entire sciatic nerve piercing through the piriformis muscle (Beaton and Anson, 1938). Another recent study found a normal relationship between the sciatic nerve and piriformis muscle in 93.6% of lower limbs, while 0.3% of lower limbs demonstrated the tibial nerve coursing deep to the piriformis with the common peroneal nerve coursing superficial to the piriformis, as seen in this case report (Natsis et al., 2014).

The hamstring muscle group is made up of three muscles: semimembranosus, semitendinosus, and biceps femoris. These muscles function in concert to flex the knee and extend the leg at the hip (Cetkin, 2017). Variation within these muscles is uncommon, but has been documented. Le Double (1897) discusses findings of a belly from the long

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head of the biceps femoris muscle attaching to the semitendinosus muscle, similar to findings discussed in this report. It has been hypothesized that the presence of a muscular slip could be a result of defective migration of muscle precursor during embryogenesis (Schnorrer and Dickson, 2004; Cetkin, 2017).

This case is being reported to document a rare combination of sciatic nerve and hamstring musculature variations within the same cadaver. Such findings should be made aware to medical providers due to their implications in clinical and surgical medicine, as well as their relationship to embryology.

CASE REPORT

During the routine dissection of a seventy-eight year old Caucasian male cadaver at Marian University College of Osteopathic Medicine in Indianapolis, Indiana, multiple lower limb variations were found:

The left gluteal region showed the common peroneal and tibial divisions of the sciatic nerve emerging at the superior and inferior borders of the piriformis, respectively (Fig. 1). The nerves were traced into the pelvis and the pelvic plexus was examined. The two components of the sciatic nerve arose directly from the dorsal and ventral divisions of their lumbosacral nerves. The right sciatic nerve had a normal course and branching pattern.

A variant muscular slip was found in the hamstring region on both sides. The muscle fibers coursed from the long head of the biceps femoris to the semitendinosus in the mid-thigh. The sciatic nerve on the right side and the common peroneal and the tibial nerve on the left coursed deep to the variant muscular slip (Fig. 2).

The variant muscular slips did not have a distinct innervation of their own; hence they were likely innervated by the nerves supplying the long head of biceps femoris or semitendinosus.

COMMENTS

Multiple lower limb variations were discovered during the dissection of the cadaver in this case report. Unilateral variation of the sciatic nerve is less common than bilateral anomalies. A systematic review of six studies regarding variations of the piriformis and sciatic nerve found that 63.6% of anomalies occurred bilaterally (Smoll, 2009). Type C of Beaton and Anson's classification is the type of variation found in this case, and is among the less common variants at a prevalence of 1.5% (Ugrenovic et al., 2005; Tomaszewski et al., 2017). This specific finding of the tibial nerve coursing deep to the piriformis, with the common peroneal nerve coursing superficial to the piriformis, has implications in the diagnosis of sciatic nerve pain related to piriformis syndrome. An individual with such variation might present with piriformis syndrome atypically, complaining of only tibial nerve-related compression, such that anterior compartment paresthesia related to the common peroneal branch of the sciatic nerve would be spared. A study by Pires et al. (2016) reported a case with anastomosis between the sciatic nerve and posterior femoral cutaneous nerve around the lower slip of the piriformis muscle. This finding may lead to an uncharacteristic pain distribution in the posterior thigh compared to the typical sciatic nerve pain pattern complaint by patients. Diagnosis of piriformis syndrome can be affected by the position of the sciatic nerve at the time of diagnosis. The Freiberg test is commonly used in diagnosis of piriformis syndrome, and involves manipulation of anatomy such that the sciatic nerve is prone to entrapment, which elicits pain. Variation within the sciatic nerve can influence physical exam findings such as a positive Freiberg test (Guvencer et al., 2008). Clinicians must be aware of such variations so as not to misdiagnose such pain with peripheral etiology.

Sciatic nerve variation must also be made aware to physicians performing procedures such as sciatic nerve block and total hip replacement surgeries. A study performed by Ugrenovic et al. (2005) reports high terminal division of the sciatic nerve in 1/3 of cases, which should be taken into consideration when performing popliteal block anesthesia. The popliteal approach to nerve block is often used in ankle and foot surgery. Normally, the posterior popliteal approach is used to numb the sciatic nerve, with insertion of the needle 7 cm above the popliteal fossa (Hadzik et al., 2002). This approach to sciatic nerve block may fail due to variation in the level of the division of the nerve. Saleh et al. (2009) found that, when inserting a needle 50 - 100 mm above the popliteal crease, local anesthetic may be injected in the vicinity of the tibial or common peroneal nerve, but not both. However, insertion of the needle 160 mm above the popliteal crease ensures placement of the needle in the vicinity of, or proximal to, the division of the sciatic nerve (Saleh et al., 2009). High division of the sciatic nerve must be considered in such a procedure so as to avoid a partial block.

Additionally, as in the case of this cadaver, the bilateral muscular slip between biceps femoris and semitendinosus could cause difficulty with popliteal sciatic nerve block, as the slip exists at the level in which the needle for anesthesia is inserted and should be further investigated.

A meta-analysis performed by Tomaszewski et al. (2016) found that the sciatic nerve deviates from its normal course in 15% of cases. Thus, it is recommended that "a thorough assessment needs to be considered when performing procedures in the pelvic and gluteal regions in order to reduce the risk of iatrogenic injury". The two most common causes of iatrogenic sciatic neuropathies are due to gluteal injection injuries first, with hip replacement surgery as the second most common cause. A study revealed that botox injections of the piriformis muscle are of the most efficient adjunct to physical therapy for the treatment of piriformis

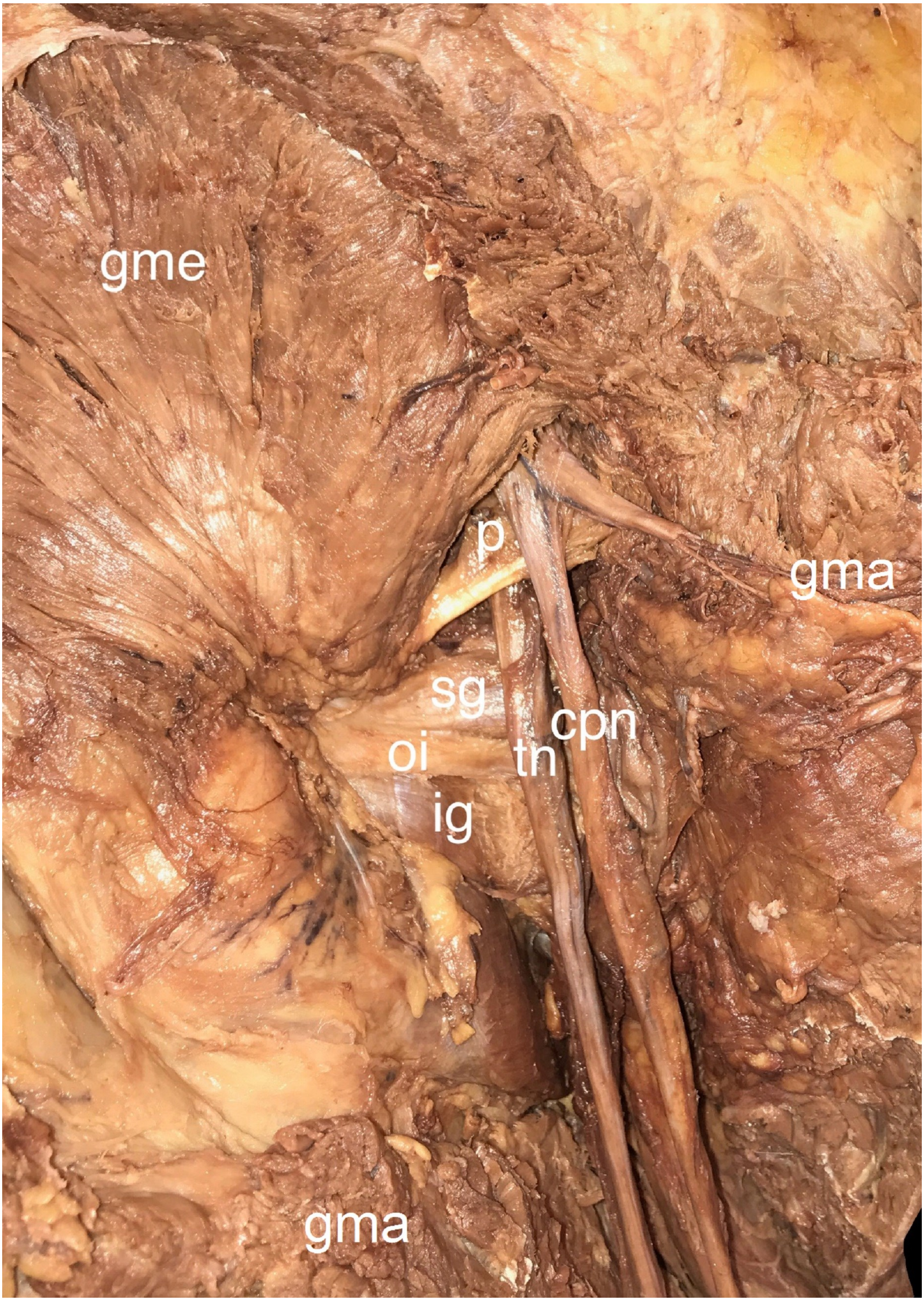

Fig 1. Left Gluteal Region. gma: Gluteus maximus; gme: Gluteus medius; p: Piriformis muscle; sg: Superior gemellus; oi: Obturator internus; ig: Inferior gemellus; cpn: Common peroneal nerve; tn: Tibial nerve.

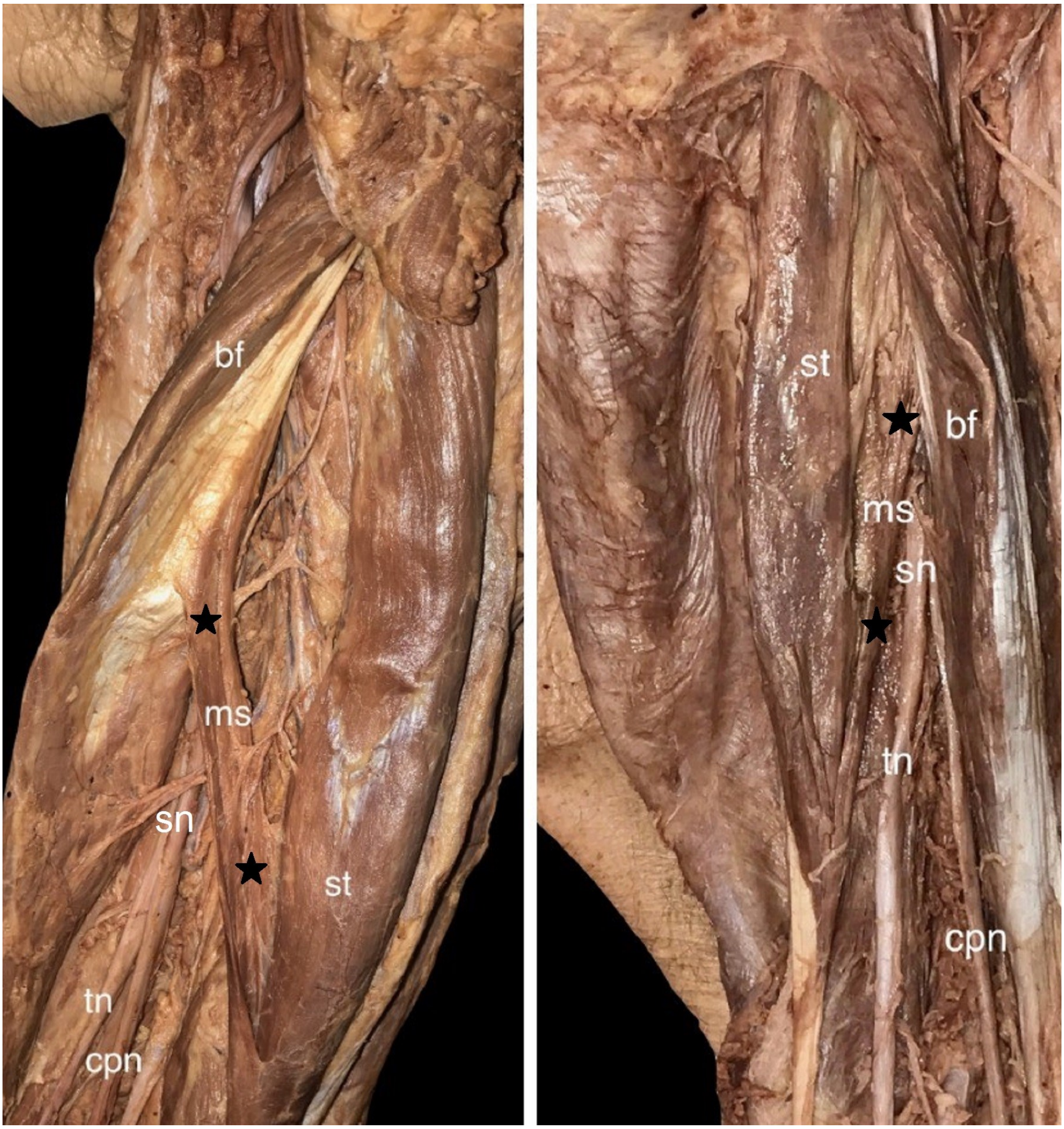

Fig 2. Left and right posterior thigh. bf: Biceps femoris; ms: Muscle slip; st: Semitendinosus; tn: Tibial nerve; cpn: Common peroneal nerve. Asterisks indicate the muscular slip connecting biceps femoris and semitendinosus.

syndrome (Fishman et al., 1991). In performing such an injection, sciatic nerve variation must be considered such that superficially coursing or piercing branches are avoided so as to avoid further injury or failed nerve block attempts (Adibatti, 2014).

When performing total hip replacement surgery, sciatic nerve variation must also be considered. Several intraoperative sources have the potential to cause sciatic nerve injury including direct trauma, compression by surgical material, or vascular compromise (Wolf et al., 2014). A study performed by Schmalzreid et al. (1991) found that neuropathies presented post-operatively in the ipsilateral lower extremity of 53% of total arthroplasties. Another study suggested that sciatic nerve variation is more closely associated with surgically related nerve injury than to the surgical approach alone (Navarro et al., 1995).

Surgeons must be cognizant of sciatic nerve variation so as to remain diligent in avoiding surgically related injury.

A detailed observation on muscular anomalies provided by Macalister (1875) illustrated multiple variations of the hamstring musculature. Some of the reported variations include: two variations involving semitendinosus, a slip covering the sciatic nerve from biceps femoris, and the short head of biceps femoris receiving an accessory fascicle from the vastus externus. However, none of these reported variations correspond to the findings presented in this manuscript. Tubbs RS et al. (2016) reported the occurrence of a tendinous intersection found near the midpoint of the muscle, which may receive a muscular slip from biceps femoris. Accessory slips were noted to arise from the coccyx, sacrotuberous ligament, or ischial tuberosity to join the belly of semitendinosus. Furthermore, while muscular slips in the hamstrings region have been reported unilaterally, a review of literature failed to report bilateral hamstring muscular slips. Chakravarthi (2013) reported a finding of a muscular slip in the hamstring region that was innervated by a branch of the tibial nerve. In this case however, there was no distinct innervation to the muscular slips and they are assumed to be innervated by the tibial nerve that innervates the semitendinosus or biceps femoris. This additional muscle is hypothesized to improve the strength of medial rotation of the semi-flexed knee. It should also be considered that a muscular slip between biceps femoris and semitendinosus could potentiate sciatic nerve pain as the sciatic nerve was found to course below the slip. Additionally, it is reasonable to believe the muscular slip could alter the biomechanics of the muscle (Chakravarthi, 2013). Failure of muscle primordia to regress or migrate appropriately could be responsible for the accessory muscular slip found in this cadaver (Schnorrer and Dickson, 2004).

This rare combination of variations is significant due to potential implications in both surgical and clinical specialties. Clinicians should be aware of anatomical variation in the gluteal and hamstring regions for procedures such as total hip replacements, and also for diagnostic and nerve block purposes.

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