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Anatomical variation of sciatic nerve: a case report of high division and unusual anastomosis with the posterior femoral cutaneous nerve

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SUMMARY

The posterior femoral cutaneous nerve is a sensitive nerve that rises from S1-S3, usually giving off cutaneous branches for the gluteal region, perineum, the posterior region of the thigh and leg. The sciatic nerve is the largest nerve in the human body, rising from L4-S3, and divides into the tibial and common fibular nerves, innervating the muscles from the posterior compartment of the thigh. Anastomosis between the sciatic nerve and the posterior femoral cutaneous nerve is rare. During dissection of the right gluteal region on a male cadaver fixed with 10% formalin, we observed an anastomosis between both nerves, while the common fibular nerve perforated the piriformis muscle, dividing it in two muscle slips. Both nerves trajectories were within the regular pattern after this communication. Our aims were to describe this unusual case of anastomosis and perform a literature review on the variations of the sciatic nerve, while also discussing their clinical significance.

Keywords: Anatomic variation – Nervous anastomosis – Sciatic nerve – Posterior femoral cutaneous nerve – Piriformis muscle

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INTRODUCTION

The sciatic nerve (SN) is the largest nerve in the human body. It rises from the lumbosacral plexus (ventral roots of L4-S3) in the pelvis, reaching the gluteal region through the greater sciatic foramen, below the piriformis muscle (PM), anterior to the gluteus maximus muscle and posteriorly to the superior gemellus muscle (SGM). It is followed proximally by the inferior gluteal artery and the posterior femoral cutaneous nerve (PFCN). Distally, the SN rests posteriorly to the adductor magnus muscle and it is crossed anteriorly by the long portion of the biceps femoris muscle (Testut & Jacob, 1944; Goss, 1973; Nayak et al., 2014; Berihu et al., 2015; Tomaszewski et al., 2016).

It gives origin to the tibial nerve (TN) and the common fibular nerve (CFN), usually on the proximal angle of the popliteal fossa (Testut & Jacob, 1944; Goss, 1977; Shewale et al., 2013; Berihu et al., 2015). The TN is formed by the ventral branches of L4-S3 roots, while the CFN is composed by the dorsal branches of L4-S2 roots (Testut & Jacob, 1944; Goss, 1973).

The PFCN is formed by the dorsal branches of S1 and S2 roots, and the ventral branches of the S2 and S3 roots. It leaves the pelvis through the same pathway as the SN. It runs together with the SN until the inferior border of the gluteus maximus muscle, where it turns superficial to the long portion of the biceps femoris muscle although deep to

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the fascia lata, innervating the skin of the posterior region of the thigh. It emits gluteal, perineal, femoral and sural branches, also innervating the posterior region of the leg. It is a sensory nerve (Testut & Jacob, 1944; Goss, 1977; Meng et al., 2015).

Many variations regarding these nerves have been reported and discussed in the literature, usually with their relation with the PM and their clinical significance (Beaton and Anson, 1938; Testut & Jacob, 1944; Goss, 1977; Bergman et al., 1988; Meng et al., 2015; Dellon, 2015; Tomaszewski et al., 2016).

We report a rare anatomic variation of the SN and the PFCN in the gluteal region, in which they presented an unusual anastomosis. To our knowledge, this communication was only described once in the literature, by Tunali et al. (2011).

CASE REPORT

A cadaver fixed with a 10% formalin solution was dissected in an anatomy class. When the right gluteal region was dissected, we observed a high division of the SN in which the CFN pierced the PM and divided it into two slips, whilst the TN ran blow the inferior border of the lower slip (Fig. 1). We also observed an anastomosis between the SN and PFCN around the lower slip of the PM (Fig. 1). Afterwards, all nerves had its regular trajectories. The left gluteal region showed no variations.

DISCUSSION

The nerves of the lumbosacral plexus are derived together with the bones and muscles from the 5 lumbar and 5 sacral somites. At the end of the fourth week, motor nerve fibers begin to appear in the spinal cord, and they develop in conjunction with the limb bud. The brachial and lumbosacral plexus are formed by ventral primary rami of the spinal cord, and at the base of the limb bud they are subdivided into dorsal and ventral components, in order to provide innervation for the muscles compartment. (Demiryürek et al., 2002; Moore et al., 2015).

The main patterns of SN variations proposed by Beaton and Anson (1938) and modified by Tomaszewski et al. (2016) are depicted in Table 1.

According to the literature, the Type A is the usual description of the SN, ranging from 66.7% to 93.6% of cases (Bergman et al., 1988; Machado et al., 2003; Patel et al., 2011; Pokorný et al., 2006; Delabie et al., 2013; Adibatti et al., 2014; Natsis et al., 2014; Sinha et al., 2014; Berihu et al., 2015; Haładaj et al., 2015; Tomaszewski et al., 2016).

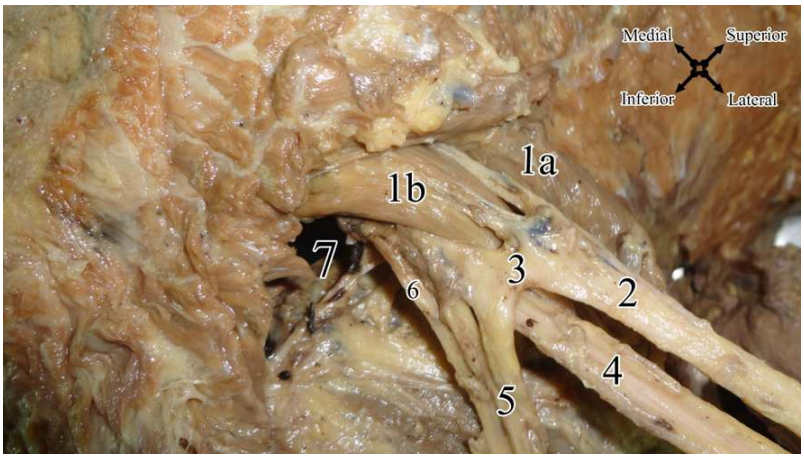

Fig. 1. Lateral traction of the nerves to exhibit the anastomotic arch on the lower slip of the piriformis muscle. 1a = Upper slip of the piriformis muscle; 1b = lower slip of the Piriformis muscle; 2 = Common fibular nerve; 3 = Anastomosis; 4 = Tibial nerve; 5 = Posterior cutaneous femoral nerve; 6 = Inferior gluteal vessels; 7 = Infrapiriformis space of the greater sciatic foramen.

Table 1. Common variations of the sciatic nerve based on its relation to the piriformis muscle [as proposed by Beaton and Anson (1938) and modified by Tomaszewski et al. (2016)]

Type	Description
Type A)	The SN passes below the PM (most common)
Type B)	The SN divides in the pelvis, the CFN pierces the PM and the TN passes below the PM.
Type C)	The SN divides in the pelvis, the CFN passes above the PM, while the TN runs below.
Type D)	The SN pierces the PM.
Type E)	The SN divides in the pelvis, the CFN runs over the PM, and the TN pierces the PM.
Type F)	The SN exits the pelvis undivided above the PM.
Type G)	The SN divides in the pelvis, the CFN and the TN courses separately below the PM.

SN = Sciatic nerve; PM = Piriformis muscle; CFN = Common fibular nerve; TN = Tibial nerve.

Type B has been reported in 2% to 13.63% of cases (Bergman et al., 1988; Machado et al., 2003; Ugrenović et al., 2005; Patel et al., 2011; Delabie et al., 2013; Natsis et al., 2014; Sinha et al., 2014; Tomaszewski, et al., 2016). Our variation presented this pattern. Type C has been reported in 0.3% to 3.3% of cases (Chiba et al., 1992; Moore and Dalley, 1999; Machado et al., 2003; Ugrenović et al., 2005; Delabie et al., 2013; Natsis et al., 2014; Sinha et al., 2014; Haładaj et al., 2015; Tomaszewski et al., 2016). Type D has been reported in 0.3% to 3% of cases (Pokorný et al., 2006; Delabie et al., 2013; Natsis et al., 2014; Sinha et al., 2014). Type F was found in 0.3% of cases (Natsis et al., 2014). Type G was reported in 9% of cases by Berihu et al. (2015), albeit the terminal branches emerged below the PM and followed their trajectory separately, furthermore, Patel et al. (2011) reported this type in 9.09% of cases. According to Tomaszewski et al. (2016) meta-analysis, types D, E, F and G have been described in less than 1% of the overall population. These numbers are detailed in Table 2.

Only one similar case to ours has been described by Tunali et al. (2011), in which there was a communicating branch of 3 cm between the PCFN and the SN, 11 cm after their passage on the infrapiriformis space of the greater sciatic foramen.

Piriformis syndrome (PS) is a clinical condition caused by compression of the SN due to the PM, and it has been vastly described in the literature - often associated with anatomical variations of the SN or the PM, muscular hypertrophy (in athletes), contraction of the PM, inflammatory process, and muscle spasms. This syndrome causes pain, paresis of the gluteal region, leading to a posture alteration and more severely, movement incapacity. Its diagnosis is hard, since its symptoms are unspecific, although it is habitually unilateral (Arifoglu et al., 1997; Babinski et al., 2003; Machado et al., 2003; Carare and Goodwin, 2008 et al., 2008; Delabie et al., 2013; Haładaj et al., 2015). The B and D types are more susceptible for developing PS, as the SN pierces the muscle and by result can suffer compression (Sinha et al., 2014).

Awareness of these many variations are important to the surgeon, as procedures such as total hip arthroplasties can cause severe damage to the SN, causing patients to experience intense and permanent pain. The SN can also be subject to compression by bone cement, thermal damage during cement polymerization, compression by hematoma, bone prominence or an implanted acetabular component. Some variations can also lead to an ineffective anesthetic block of the SN (Pokorný, 2006; Carare and Goodwin, 2008; Reinoso-Barbero et al., 2014; Berihu et al., 2015; Tomaszewski et al., 2016). Pokorný et al. (2006) hypothesized that the B, D, and E types are riskier candidates for total hip arthroplasty, although studies with patients suffering from nerve palsy due to this procedure are needed.

The PFCN and its branches can also be a target during total hip replacement, erroneous injections on the nerve, and procedures of gluteal and thigh flaps for reconstruction, causing symptoms such as numbness and paresthesias. It can also be compressed due to hematomas, tumors, prolonged cycling, entrapment in the fascia lata, abnormal veins, and it can even be compressed against the sciatic tuberosity. Neuropathy of the PFCN, although rare, has been described in the

Table 2. Detailed prevalence of Sciatic Nerve variations, according to the literature

Author	Type A	Type B	Type C	Type D	Type F	Type G
Beaton and Anson (1937)	84.%	11.7%	3.3%	0.8%	-	-
Bergman et al. (1988)	87.5%	12%	0.5%	2.25%	-	-
Chiba et al. (1992)	-	34%	-	-	-	-
Moore and Dalley (1999)	-	12.2%	0.5%	-	-	-
Machado et al. (2003)	80%	2%	16%	2%	-	-
Ugrenović et al. (2005)	96%	2.5%	1.5%	-	-	-
Pokorný et al. (2006)	79.1%	14.3%	4.4%	2.2%	-	-
Patel et al. (2011)	91.8%	5.81%	-	-	-	2.32%
Delabie et al. (2013)	90%	7.1%	2.1%	0.8%	-	-
Natsis et al. (2014)	89.8%	6.1%	0.7%	0.7%	0.7%	-
Sinha et al. (2014)	85%	9%	9%	3%	-	-
Berihu et al. (2015)	75%	-	2%	-	-	9%
Haładaj et al. (2015)	66.7%	20%	3.3%	-	-	-
Tomaszewski, et al. (2016)	85.2%	9.8%	1.9%	<1%	<1%	<1%

literature. Another increasing clinically relevant aspect of the PFCN is the fact that free inferior gluteal flap has been performed in surgeries of breast reconstruction. Thus, knowing the anatomic landmarks of the nerve in this region is vital, as it has been shown that there could be a chance of nerve damage during this particular procedure (Tunali et al., 2011; Dellon, 2015; Meng et al., 2015).

The anastomosis presented here may be injured during these various procedures, and thus could cause symptoms of PS and symptoms of numbness and sensory loss of the posterior region of the thigh skin, due to a possible exchange in motor and sensitive fibers during this anastomosis. We also believe that our case report could be a vulnerable target for nerve compression, as this anastomosis presented around the lower slip of the PM.

CONCLUSIONS

Given the sciatic and the posterior femoral cutaneous nerves' clinical significance, it is vital to study the many patterns of variations regarding these structures. We believe that further researches are needed in order to clarify the embryological aspects of how the piriformis muscle varies in relation with the sciatic nerve, since they develop together as the lower limb bud elongates. Further studies of fibers exchange between sensitive and motor nerves are also needed in order to accurately predict symptoms caused by possible iatrogenic lesions regarding nervous anastomosis. Our work contributed to the literature in the sense of exposing a very rare variation of the sciatic nerve in which there is exchange of fibers with the posterior femoral cutaneous nerve, a purely sensitive nerve.

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