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Surgical anatomy of the lateral femoral cutaneous nerve in the groin region

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Summary

The lateral femoral cutaneous nerve (LFCN) is a sensitive collateral branch of the lumbar plexus that innervates the anterolateral region of the thigh. Its compression at the level of the groin originates a particular syndrome called meralgia paresthetica. Treatment of this neuropathy may involve sectioning or freeing of the nerve, both of which require an appropriate knowledge of its anatomy.

Sixty-four groin regions of formaldehyde-fixed adult cadavers were dissected, recording the relationships of the LFCN to the anterior superior iliac spine (ASIS).

The LFCN was identified in all cases; in one case, it originated as a collateral branch of the femoral nerve. The horizontal distance from the ASIS to the LFCN varied from 0 to 45 mm (mean 10.8 mm). 85.9% of LFCN were located at a distance of 20 mm or less from the ASIS. The vertical distance ranged from 0 to 47 mm, with a mean of 17 mm. We did not find significant differences between the distances upon attempting to correlate them with the individual's height or interiliac distance.

The relationship between the LFCN and the ASIS is variable. In most cases, the LFCN is found within a distance of 20 mm or less from the ASIS in both the lateral and cephalocaudal directions, although it may be located as far as 4 cm or more from it. In addition to this, the LFCN may enter the groin region already divided into more than one branch, or may also course through the inguinal ligament.

Key words: Meralgia paresthetica – Lateral femoral cutaneous nerve – Entrapment neuropathy

Introduction

The lateral femoral cutaneous nerve is a sensitive collateral branch of the lumbar plexus. From its origin, it courses in the retroperitoneum to enter the thigh, passing underneath the inguinal ligament, medial to the anterior superior iliac spine.

Owing to its pelvic and extra-pelvic relationships, it may be compromised by tumors or pelvic inflammatory processes, haematomas of the psoas muscle, or trauma to the groin, although the most frequent alteration is its compression at the abdominal-femoral passage (Haim et al., 2006; Korkmaz and Ozcakar, 2004; Martínez et al., 2007; Rengachary, 1994; Shapiro and Presta, 2003; Sinson and

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Zager, 1985; Thoma and Levis, 2003; Tindall, 2000).

Compromise of the LFCN elicits a clinical syndrome called *meralgia paresthetica (meros:* thigh, *algos:* pain). This syndrome is characterized by pain and paresthesia in the anterolateral aspect of the thigh (Ivins, 2000; Martínez et al., 2007; Rengachary, 1994; Tindall, 2000).

Some authors have stated that failure in the surgical treatment of meralgia paresthetica is due to variations in the disposition of the nerve in a high number of cases (Aldrich and van der Heever, 1989; Siu and Chandran, 2005). Moreover, reports have been made suggesting that some anatomical variants of the nerve might make it more susceptible to trauma in the groin region (Tejwani et al., 2006).

In the present paper, the relationships of the nerve in the upper portion of the thigh are studied.

Material and Methods

Sixty-four groin regions of formaldehyde-fixed adult cadavers belonging to the Anatomy Department of the Montevideo Medical School, Uruguay, were studied by macroscopic dissection.

We performed a golf club-shaped incision on them that included a horizontal cut over the topography of the inguinal ligament and a vertical cut beginning at its middle third. The skin flap was reclined laterally and the superficial planes were dissected in search of the LFCN.

Both the horizontal and vertical distances from the anterior superior iliac spine (ASIS) to the LFCN were measured in all specimens.

In 22 cases of those reported here, we also measured the height of the cadaver and its interiliac distance in order to determine whether the position of the nerve in the region varies according to these data.

Results

In 63 cases we found the LFCN originating as a collateral branch of the lumbar plexus; in one case it was found to originate from the femoral nerve (anterior external femoral cutaneous nerve or Valentin's ramus- 1.6% of cases).

Regarding the relationships between the LFCN and the ASIS, the distance on the horizontal plane was 0 to 45 mm (average 10.8 mm). In 23 cases, the nerve contacted the ASIS (35.9%); in 32 cases the distance was 1 to 20 mm (50%), and in 9 cases it was greater than 20 mm (14.1%).

The vertical distance between the LFCN and the ASIS ranged from 0 to 47 mm (average 17 mm).

In the cases in which we compared the distance from the nerve to the ASIS with the height of the individual and the interiliac distance, no statistically significant differences were found.

In none of our cases did the nerve pass through the inguinal ligament or lateral to the anterior superior iliac spine. Figure 1 shows the relationships of LFCN: ASIS, sartorius muscle and femoral artery, vein and nerve.

Discussion

The lateral femoral cutaneous nerve (LFCN) is a collateral branch of the lumbar plexus that receives the sensitivity of the anterior lateral part of the thigh.

Compression of the nerve at any point of its trajectory produces a typical and well known syndrome called *meralgia paresthetica.* Given the anatomical features of the LFCN, its compression usually occurs at the point where it reaches the groin (Dias Filho et al., 2003). Anatomical variants concerning its radicular composition, the origin from the lumbar plexus or its branches, its course in relation to the inguinal ligament and the ASIS, or its arrival at the groin as a single trunk or divided in two or more rami, can be found in the literature (Aldrich and van der Heever, 1989; Erbil et al., 2002; Hovelacque, 1927; Tejwani et al., 2006; Williams and Trizl, 1991).

Commonly, the LFCN is composed of fibers that mainly originate from L2. It transits through the retroperitoneum into the fascia of the psoas-iliac muscle and enters the groin region, coursing under the inguinal ligament, medial to the ASIS. Our study focused on the relationships of the LFCN with the ASIS, considering that this anatomical point is regarded as a landmark to approach the nerve in the surgical treatment of *meralgia paresthetica* (MP).

In all of our cases, the LFCN entered the groin region under the inguinal ligament and medial to the ASIS. However, some authors have reported its location between the fibers of

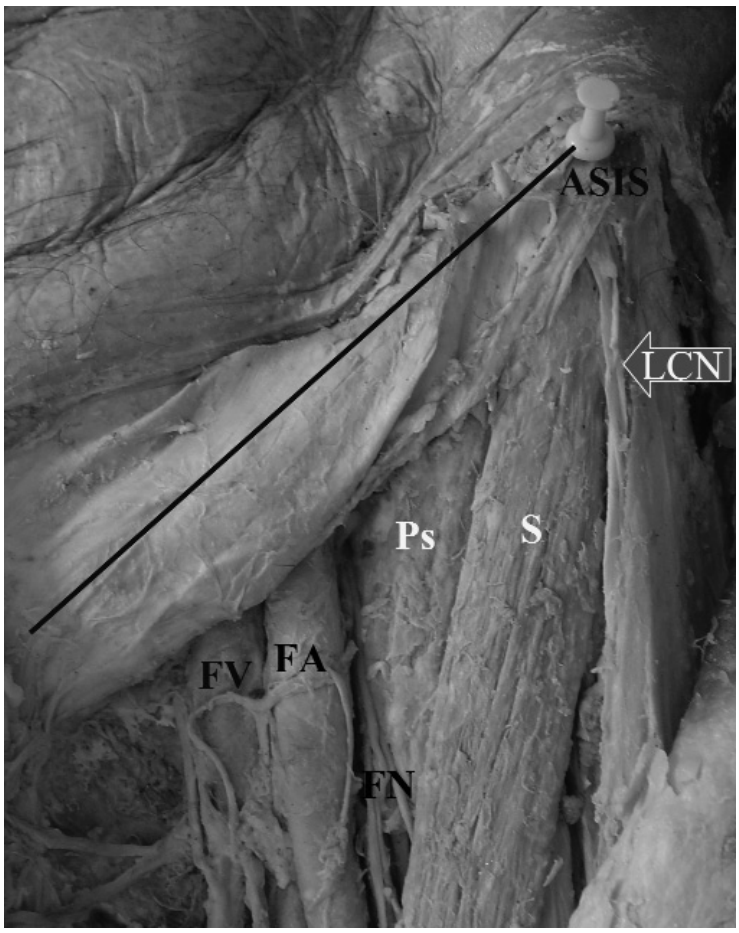

Figure 1. Groin region of an anatomical specimen, left side. The femoral vessels (FA y FV) lie in inner position with respect to femoral nerve (FN). In an external position, the femorocutaneous nerve (LCN), pass close to the antero superior iliac spine. The black line represents the inguinal ligament. ASIS = Anterior superior iliac spine; S = Sartorius muscle; Ps = Psoas muscle.

the ligament (27% of cases), over the ASIS (4%) or even lateral to it (Erbil et al., 2002; Hovelacque, 1927; Keegan and Holyoke, 1962; Tejwani et al., 2006). These variants expose the LFCN to trauma of the region or to injuries during surgical approaches seeking bone from the iliac crest for grafts (Tejwani et al., 2006).

Furthermore, the mere fact of positioning the patient in ventral decubitus over rolls is a cause of MP, due to compression of the nerve (Tejwani et al., 2006; Winfree and Kline, 2005).

According to our results, in almost 86% of cases the LFCN can be located at a distance of 2 cm or less from the ASIS in the horizontal plane. This information is very useful not only to plan surgical approaches to the nerve but also to arrive at a diagnosis of MP. Such a diagnosis is based on clinical criteria and on the injection of anesthetics and corticoids about 2 cm below and medial to the ASIS. According to our findings, this is a good point to accurately infiltrate most of the LFCN. If one also takes into account the fact that anesthetics diffuse through the different planes, the effectiveness of the test is further increased (Martínez, 2003; Martínez et al., 2007). Also from an anesthetic point of view, 3:1 Winnie's regional blockage is performed in this area. In this procedure, the perineural sheath of the femoral nerve is canalized and thus the femoral, obturator, and lateral femoral cutaneous nerves are anesthetized. Although it was thought that anesthetic agents reached the LFCN in a retrograde way through the perineural sheaths, recent studies have argued that diffusion occurs via the superficial planes (Martínez, 2003; Reilly et al., 2004).

Regarding the relationships between the LFCN and the ASIS, most authors agree that the trajectory of the LFCN is either very close to the ASIS or between the ASIS and the anterior inferior iliac spine (horizontal distances). This is corroborated by our findings, although it should be recalled that as many as 15% of LFCN are located at a distance greater than 2 cm from the ASIS. Williams and Trzil (1991)

describe a case where the LFCN was found 6 cm medial to the ASIS.

Considering the relationships on the vertical plane, it is also seen that the distance between the nerve (aponeurotic traversing point) and the iliac spine is two to three centimeters. Aldrich and van der Heeven (1989) mention that this point is located 4 to 6 cm below the ASIS. Mirovsky and Neuwirth (2000) affirm that the passage point through the aponeurosis is located 10cm away from the ASIS. Our data are comparable to those reported by classic authors, since the LFCN traversed the aponeurosis at an average distance of less than 2 cm from the ASIS, with a maximal distance of 47 mm.

Some authors have reported the LFCN to pass above the ASIS (4% of cases), a relationship that puts the nerve at high risk of injury due to trauma of the groin region or even during trauma surgery (Tejwani et al., 2006). Williams and Trzil (1991) have found the LFCN passing 4 cm *behind* the ASIS, over the iliac crest. In our series, we did not find any cases with such characteristics.

Regarding the origin of the nerve, despite the fact that our study was not centered on this we found only one case where the LFCN originated as a collateral branch of the femoral nerve. This variant is denominated anterior external femoral cutaneous nerve or Valentin's nerve (Hovelacque, 1927; Tejwani et al., 2006). Hovelacque (1927) states that it may be present in up to 20% of cases, which is a much higher figure than the one found by us (1.6%). Taking into consideration that both nerves have a similar trajectory, and complementary territories in the skin of the thigh, that author proposed that they should be considerate a "nervous complex", or even that in conceptual terms the LFCN could be considered a collateral branch of the femoral nerve. Other authors also mention the genitofemoral nerve as another possible origin for the LFCN and affirm that the LFCN can originate as a collateral branch of another nerve in as many as 30% of the cases (Keegan and Holyoke, 1962).

When addressing the dissection of our last 22 cases, we hypothesized that the interiliac distance or the height of the individual might influence the position of the LFCN with respect to the ASIS. We considered the possibility that the distance between the ASIS and the LFCN might become larger or smaller in short or tall individuals respectively. These differences could have also appear between males and females owing to the distinct disposition of their pelvises. We did not find any significant differences in the relationships of the LFCN and the ASIS when height and interiliac distance varied. According to the literature analyzed for this and other works by one of the authors (FM), this aspect had not been previously assessed and, although we did not find any differences, we feel it to be an original contribution of this article.

The clinical applications of our work can be summarized in three areas: the importance for the surgical treatment of MP; in traumatologic surgery involving the iliac crest, and in any other surgery that requires a ventral decubitus position where the patient will lean on the ASIS (Mc Gillicudy and Harrigan, 2000; Yang et al., 2005).

Regarding the treatment of MP, almost 90% of the patients improve with medical treatment, although some may require later surgery. Such surgery includes the performance of neurolysis (freeing of the nerve) or neurectomy (sectioning of the nerve) (Eerten et al., 1995; Greenberg, 2006; Siu and Chandran, 2005). In order to choose the correct surgical treatment, the surgeon must have a good knowledge of the anatomy of the LFCN, in particular concerning the point where it traverses the aponeurosis and of its relationships with the inguinal ligament. Positive surgical outcomes for MP are reduced in comparison with those addressing other entrapment neuropathies. Siu et al. (2005) state that in most cases failure in surgical treatment is due to mistakes when attempting to locate the nerve because of its anatomical variants or to the sectioning of peripheral branches of the nerve when it arrives at the groin already divided (Aldrich and van der Heever, 1989). This was already reported by classic anatomists, such as Hovelacque (1927), who remarked that the LFCN may arrive in two or three trunks when it divides within the pelvis.

In traumatologic surgery it is frequent to use auto-bone-grafts taken from the iliac crest, which also makes knowledge of the relationships of the nerve with the ASIS useful (Boone, 2003). Mirovsky and Neuwirth (2000) recommend taking grafts from the iliac crest distant from the ASIS in order to avoid injury of the nerve. Such injuries can be classified in two types: neuropraxia due to surgical manipulation, or postoperative haematomas or sectioning of the nerve. Usually, in the first case there

is a progressive and total disappearance of symptoms in the territory of the LFCN, while in the second the symptoms persist.

Regarding patient's positioning during surgery, we recommend a good cushioning of the ASIS and bending of the hip in order to avoid trauma to the nerve.

References

Aldrich EF and van den Heever CM (1989). Suprainguinal ligament approach for surgical tratment of meralgia paresthetica. *J Neurosurg,* 70: 492-494.

Boone DW (2003). Complications of iliac crest graft and bone grafting alternatives in foot and ankle surgery. *Foot Ankle Clin N Am,* 8: 1-14.

Dias Filho LC, Valença MM, Guimaraes Filho FAV, Medeiros RC, Silva RAM, Morais MGV, Valente FP and França SML (2003). Lateral femoral cutaneous nerve neuralgia: an anatomical insight. *Clin Anat*, 16: 309-316.

Eerten PV, Polder TW and Broere CAJ (1995). Operative treatment of meralgia paresthetica: transection versus neurolysis. *Neurosurgery,* 37: 63-65.

Erbil KM, Sargon FM, Sem F, Ozturk H, Tascioglu B, Yener N and Ozozan O (2002). Examination of variations of lateral femoral cutaneous nerves: reporto of two cases. *Anat Sci Int,* 77: 247-249.

Greenberg MS (2006). Handbook of Neurosurgery. 6th edition, Thieme, New York, pp 573-574.

Haim A, Pritsch T, Ben-Galim P and Dekel S (2006). Meralgia paresthetica. A retrospective analysis of 79 patients evaluated and treated according to a standard algorithm. *Acta Ortop,* 77: 482-486.

Hovelacque A (1927). Anatomie des nerfs craniens et rachidiens et du systéme grand sympathiqye chez l´Homme. Octave Doin, Paris.

Ivins GK (2000). Meralgia paresthetica, the elusive diagnosis. Clinical experience with 14 adult patients. *Ann Surg,* 232: 281-286.

Keegan JJ and Holyoke EA (1962). Meralgia paresthetica. An anatomical and surgical study. *J Neurosurg,* 19: 341-345.

Korkmaz N and Ozcakar L (2004). Meralgia paresthetica in a policeman: the belt or the gun. *Plast Reconst Surg,* 114: 1012-1013.

Martínez F (2003). Anatomía clínica de los miembros inferiores y sus aplicaciones a la anestesia regional. En: XIV Congreso Uruguayo de Anestesiología. Reunión Científica de LASRA (Asociación Latinoamericana de Anestesia Regional). Montevideo, Uruguay.

Martínez F, Lyford-Pyke P, Rodriguez C, Sergio P and Rega I (2007). Meralgia parestésica. *Rev Mex Neurocien,* 8: 205-210.

Mc Gillicudy JE and Harrigan MR (2000). Meralgia paresthetica. *Techn Neurosurg,* 6: 50-56.

Mirovsky Y and Neurwith M (2000). Injuries to the lateral femoral cutaneous nerve during spine surgery. *Spine,* 25: 1266-1269.

Reilley TE, Terebuh VD and Gerhardt MA (2004). Regional anesthesia techniques for the lower extremity. *Foot Ankle Clin NA,* 9: 349-372.

Rengachary SS (1994). Entrapment neuropathies. In: Rengachary SS, Wilkins RH (eds.). *Principles of Neurosurgery*. Mosby Wolfe, Hong Kong, pp 23.1-23.12.

Shapiro BE and Preston DC (2003). Entrapment and compressive neuropathies. *Med Clin N Am,* 87: 663-696.

Sinson G and Zager EL (1985). Entrapment neuropathies. In: Tindall GT, Cooper PR, Barrow DL (eds). *The practice of Neurosurgery*. Williams and Wilkins, Philadelphia, pp 2923-2946.

Siu TLT and Chandran KN (2005). Neurolysis for meralgia paresthetica: an operative series of 45 cases. *Surg Neurol,* 63: 19-23.

Thoma A and Levis C (2003). Compression neuropathies of the lower extremity. *Clin Plastic Surg,* 30: 189-201.

Tindall SC (2000). Surgical management of thoracic outlet syndrome and peripheral entrapment neuropathies. In: Schmidek HH (ed). *Operative neurosurgical techniques. Indications, methods and results*. WB Saunders, Philadelphia, pp 2377-2387.

Tejwani SG, Scaduto AA and Bowen RE (2006). Transient meralgia paresthetica after pediatric posterior spine fusion. *J Pediatr Orthop,* 26: 530-533.

Williams PH and Trzil KP (1991). Management of meralgia paresthetica. *J Neurosurg*, 74: 76-80.

Winfree CJ and Kline DG (2005). Intraoperative positioning nerve injuries. *Surg Neurol,* 63: 5-18.

Yang SH, Wu CC and Chen PQ (2005). Postoperative meralgia paresthetica after posterior spine surgery. Incidence, risk factors and clinical outcomes. *Spine,* 30: E547-E550.