Anatomical Variation Course of the Lateral Femoral Cutaneous Nerve as It Exits the Pelvis in Thais from the Central Region

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Abstract : **The aim of this study was to examine in detail the course and location of lateral femoral cutaneous nerve (LFCN) as it emerges from the pelvis in Thais. The anatomy of the LFCN was studied through the dissection of 107 halves of formalin-embalmed Thai cadavers ranging in age from 37 to 94 years. The LFCN is formed by the union of posterior divisions of ventral rami of the second and third lumbar spinal nerves (L_2-L_3). The site at which the nerve exits the pelvis is quite variable. Depending on the anatomical location which varies from superficial and posterior, to medial and deep, to anterior superior iliac spine (ASIS) and origin of the sartorius muscle, five different types as identified by Aszman et al[1] were confirmed : type A, posterior to the anterior superior iliac spine across the iliac crest (1.86%); type B, medial to the anterior superior iliac spine and ensheathed in the inguinal ligament (9.34%); type C, medial to the anterior superior iliac spine and ensheathed in the tendinous origin of the sartorius muscle (46.72%); type D, medial to the anterior superior iliac spine located in the interval between sartorius muscle and iliopsoas muscle deep to the inguinal ligament (40.18%); type E, medial to the anterior superior iliac spine, deep to the inguinal ligament, overlying the iliopsoas fascia, and contributing the femoral branch of genitofemoral nerve (1.86%). The majority of the LFCN course and location as it exits the pelvis are type C (46.72%), and type D (40.18%). There is no statistical difference with regard to either gender or side of thigh.**

Key words : Lateral femoral cutaneous nerve, Anatomy, Thais

เรื่องย่อ : กายวิภาคศาสตร์ของประสาทเลเทอรัล ฟีมอรัล คิวแทเนียส ที่ทอดออกจากช่องเชิงกรานในคนไทยภาคกลาง

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ศึกษาความหลากหลายของทางเดินและตำแหน่งของเส้นประสาท lateral femoral cutaneous nerve (LFCN) ที่ทอดออกจากเชิงกรานในคนไทย โดยดูลักษณะทางกายวิภาคศาสตร์ของเส้นประสาท lateral femoral cutaneous nerve จำนวน 107 ข้างในอาจารย์ใหญ่ที่มีอายุระหว่าง 37 ถึง 94 ปี ผลการศึกษาพบว่าเส้นประสาท LFCN กำเนิดจากการรวมกันของ posterior divisions of L2-L3 ventral rami บริเวณที่ LFCN ทอดออกจากเชิงกรานมีความหลากหลายขึ้นอยู่กับตำแหน่ง เช่นที่สัมพันธ์กับ anterior superior iliac spine (ASIS) โดยอาจอยู่ posterior ต่อ ASIS, medial ต่อ ASIS, อยู่บน ASIS หรืออยู่ตรงที่เกาะต้นของกล้ามเนื้อ sartorius ดังนั้นสามารถจำแนกเส้นประสาท lateral femoral cutaneous nerve ได้ 5 แบบตามที่เสนอไว้โดย Aszman et al[1] คือ แบบ A อยู่หลังต่อ ASIS พบร้อยละ 1.86, แบบ B อยู่ medial ต่อ ASIS และแทรกใน inguinal ligament พบร้อยละ 9.34, แบบ C อยู่ medial ต่อ ASIS และแทรกใน tendinous origin ของกล้ามเนื้อ sartorius พบร้อยละ 46.72, แบบ D อยู่ medial ต่อ ASIS ระหว่างกล้ามเนื้อ sartorius และ iliopsoas ลึกต่อ inguinal ligament พบร้อยละ 40.18, และแบบ E อยู่ medial ต่อ ASIS ลึกต่อ inguinal ligament แต่เหนือต่อ iliopsoas fascia และได้รับ femoral branch จาก genitofemoral nerve พบร้อยละ1.86 ทางเดินและตำแหน่งของ LFCN ที่ทอดออกจากเชิงกรานแบบที่พบมากคือแบบ C (ร้อยละ 46.72) และแบบ D (พบร้อยละ 40.18) และไม่พบว่ามีความแตกต่างทางสถิติของความหลากหลายของทางเดินและตำแหน่งของ LFCN ทั้งระหว่างเพศชายและหญิงและระหว่างข้างซ้ายและข้างขวา

INTRODUCTION

The lateral femoral cutaneous nerve (LFCN), which is a sensory nerve, is formed by the union of posterior divisions of the ventral rami of the second and third lumbar spinal nerves (L_2-L_3). It emerges from the lateral border of psoas major anterior to the iliac crest, and passes between the iliacus and the iliac fascia. It runs towards the anterior superior iliac spine (ASIS), passing behind or through the inguinal ligament, which extends from the anterior superior iliac spine to the pubic tubercle. This nerve supplies skin and fascia of the anterolateral surface of thigh to the knee, the gluteal region and the greater trochanter to about the mid thigh[2,3].

Because of the variability of the course and location of the nerve as it emerges from the pelvis, the lateral femoral cutaneuous nerve may be compressed under the inguinal ligament, also known as meralgia paresthetica, which is an entrapment neuropathy from compression of the lateral femoral cutaneous nerve as it passes under the inguinal ligament. The entrapment produces pain, paresthesia, and sensory loss over the anterolateral aspect of the thigh, without motor loss[4]. This occurs in many disorders such as compression of the nerve by disc hernia, retroperitoneal tumors[5], pelvic inflammatory disease[6,7], hypothyroidism[8], iliac graft removal[9], inguinal herniorrhaphy[10], abdominal hysterectomy[11], laparoscopic cholecystectomy[12], diabetes mellitus, alcoholism, toxic neuropathies, obesity, pregnancy, tight clothing and abdominal tumors[13].

The knowledge of exact point at which the lateral femoral cutaneous nerve enters the thigh is essential for a successful decompression, local injection or protection of the LFCN during various operations. However, the studies on the course and variations of the LFCN are not conclusive and still controversial. The objective of this study was to examine in detail the course and the location of the LFCN as it emerges from the pelvis in Thais. The influences of gender and side difference were also taken into consideration.

MATERIALS AND METHODS

Anatomical dissections were conducted on 107 halves of formalin-embalmed cadavers at the Department of Anatomy, Faculty of Medicine Siriraj Hospital, Mahidol University. All preserved cadavers were Thais from the central region, ranging in

age from 37 to 94 years. The approach to dissection was first removal of the skin and subcutaneous fat of the entire abdomen and thigh. The abdomen was then opened and the visceral organs and retroperitoneal fat were removed. The psoas major muscle was carefully removed and the course of the root of the LFCN was determined. The LFCN was dissected distally as it proceeded across the iliac muscle. The deep circumflex iliac vessels were transected and the detailed relationship of the nerve and its passage were studied. Finally, the distance from the midpoint of ASIS to the LFCN along the line of the inguinal ligament or along the line of iliac crest was measured.

RESULTS

From dissection, the site at which the LFCN exited the abdomen was found to be quite variable. Depending on the anatomical location, which varied from superficial and posterior, to medial and deep, to anterior superior iliac spine (ASIS) and at the origin of sartorius muscle, five different types of course and location of the nerve as identified by Aszman et al[1] were confirmed. The anatomical distribution is summarized in Table 1 and described in detail as follows.

Type A. The lateral femoral cutaneous nerve (LFCN) exited the abdominal wall superficial and posterior to the anterior superior iliac spine (ASIS) across the iliac crest (Figure 1a). This was found in 2 cases (1.86%). Its course was the most superficial of all five types. The point where the nerve passed across the iliac crest was 3.46 ± 1.82 cm from the anterior superior iliac spine.

Type B. The nerve (LFCN) exited the abdominal wall and was ensheathed in the inguinal ligament medial to the anterior superior iliac spine (ASIS). Its course was superficial to the origin of the sartorius muscle (Figure 1b). This was found in 10 cases (9.34%, and the point where the nerve was ensheathed in the inguinal ligament was 1.93 ± 0.84 cm from the anterior superior iliac spine.

Type C. The nerve (LFCN) was located medial to the anterior superior iliac spine just beneath the inguinal ligament, and ensheathed in the tendinous origin of the sartorius muscle (Figure 1c). This was found in 50 cases (46.72%) and the point where the nerve was ensheathed in the tendinous origin of the sartorius muscle was 0.81 ± 0.35 cm from the anterior superior iliac spine.

Type D. The lateral femoral cutaneous nerve (LFCN) exited the abdominal wall medial to the anterior superior iliac spine (ASIS). Its course was found to be in the interval between sartorius muscle and iliopsoas muscle deep to the inguinal ligament (Figure 1d). This was found in 43 cases (40.18%). The point where the nerve passed under the ligament was 1.45 ± 0.85 cm medial to the anterior superior iliac spine.

Type E. The nerve (LFCN) exited the abdominal wall medial to the anterior superior iliac spine (ASIS). Its course was found to be in the most medial position on top of the iliopsoas muscle, and contributed the femoral branch to the genitofemoral nerve (Figure 1e). The inguinal ligament traversed the nerve a distance from and had no relation to the LFCN. This type was found in 2 cases (1.68%). The point where the nerve passed under the ligament was on average 3.43 ± 0.19 cm medial to the anterior superior iliac spine.

This study suggests that the LFCN is most commonly found medial to the anterior superior iliac spine (types B to E). The majority of the courses and locations of the LFCN exiting the abdomen are of type C (46.72%) and type D (40.18%). The LFCN of both types are located medial and close (about 0.81-1.45 cm) to the ASIS. There is no significant difference in the course of the LFCN with regard to either gender or side.

DISCUSSION

The study demonstrates that the lateral femoral cutaneous nerve arises from the fusion of posterior divisions of the ventral rami of the second and third lumbar spinal nerves (L_2-L_3). Accurate localization of the lateral femoral cutaneous nerve as it passes through or under the inguinal ligament is important as this is the point where it is most angulated and subject to injury[15]. It can be injured in many frequently performed operations such as inguinal herniorrhaphy, laparoscopic cholecystectomy and abdominal hysterectomy[14-16]. Meralgia paresthetica is also encountered in condition such as

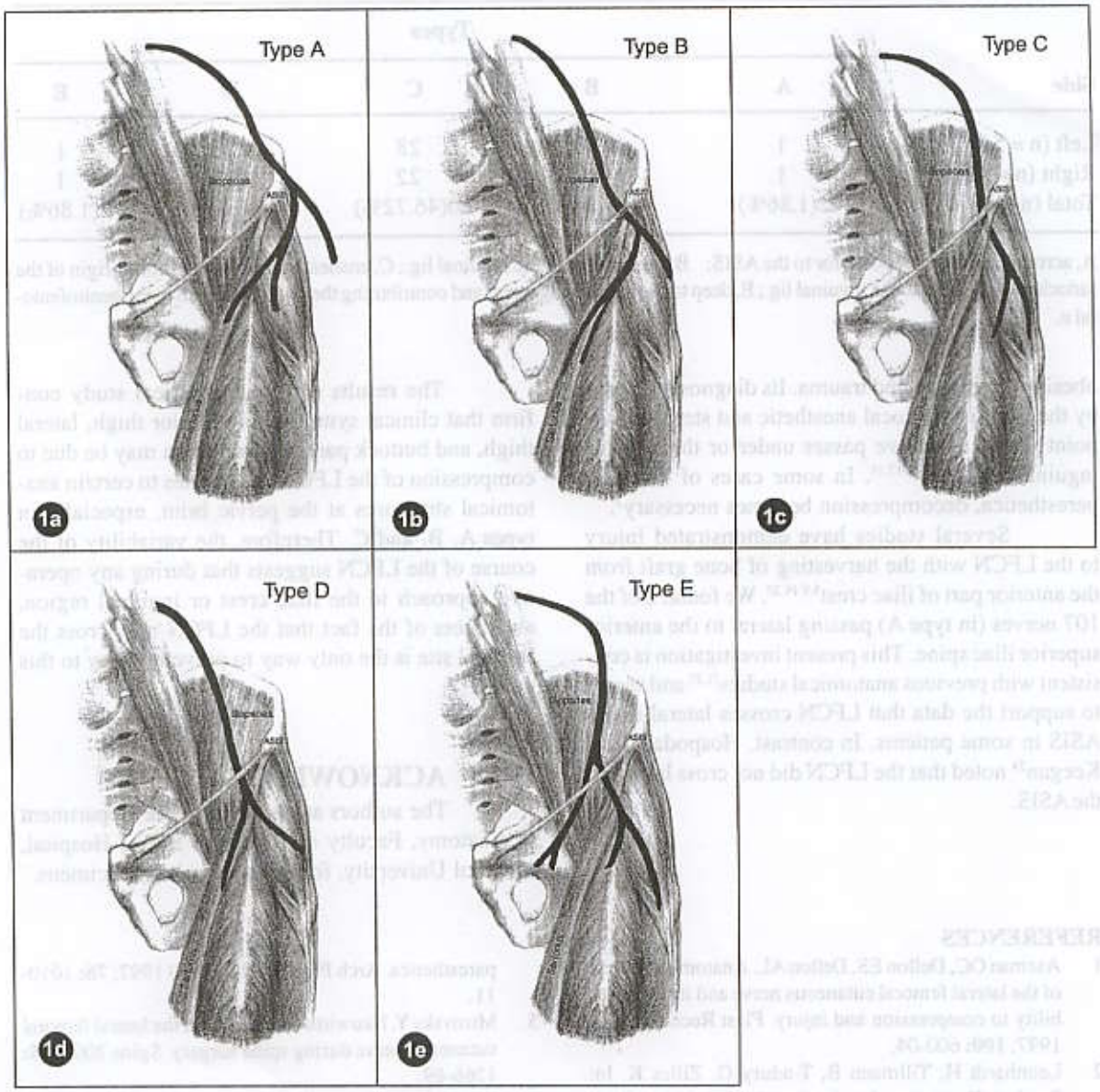

Figure 1. Diagram showing the variation in the course and location of the lateral femoral cutaneous nerve (LFCN) as it exits the abdomen. The nerve crosses the iliac crest posterior to the ASIS (type A); is ensheathed in the inguinal ligament (type B); is ensheathed in the tendinous origin of the sartorius muscle (type C); is deep to the inguinal ligament (type D); and is deep to the inguinal ligament and contributing the femoral branch to the genitofemoral nerve (type E). ASIS = anterior superior iliac spine.

Table 1. The anatomical distribution of five different types of Lateral femoral cutaneous nerve (LFCN) in Thais.

Side	Types				
	A	B	C	D	E
Left (n = 54)	1	4	28	20	1
Right (n = 53)	1	6	22	23	1
Total (n = 107)	2(1.86%)	10(9.34%)	50(46.72%)	43(40.18%)	2(1.86%)

A, across the iliac crest posterior to the ASIS; B, ensheathed in the inguinal lig.; C, ensheathed in the tendinous origin of the sartorius m.; D, deep to the inguinal lig.; E, deep to the inguinal ligament and contributing the femoral branch to the genitofemoral n.

obesity, pregnancy and trauma. Its diagnosis is made by the injection of local anesthetic and steroid at the point where the nerve passes under or through the inguinal ligament[14,17,18]. In some cases of meralgia paresthetica, decompression becomes necessary[3].

Several studies have demonstrated injury to the LFCN with the harvesting of bone graft from the anterior part of iliac crest[5,9,19,20]. We found 2 of the 107 nerves (in type A) passing lateral to the anterior superior iliac spine. This present investigation is consistent with previous anatomical studies[21,22] and seems to support the data that LFCN crosses lateral to the ASIS in some patients. In contrast, Hospodar[23] and Keegan[24] noted that the LFCN did not cross lateral to the ASIS.

The results of this anatomical study confirm that clinical symptom of anterior thigh, lateral thigh, and buttock paresthesia or pain may be due to compression of the LFCN as it relates to certain anatomical structures at the pelvic brim, especially in types A, B, and C. Therefore, the variability of the course of the LFCN suggests that during any operative approach to the iliac crest or inguinal region, awareness of the fact that the LFCN may cross the surgical site is the only way to prevent injury to this nerve.

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