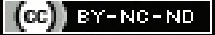


Variations in the Lateral Femoral Cutaneous Nerve of the Thigh in Cadavers: A Cross-sectional Study

PRATIMA JAISWAL¹, ANKUSH ASOPA², AARUSHI JAIN³, PRATIK PRATI HAR⁴

ABSTRACT

Introduction: The Lateral Femoral Cutaneous Nerve (LFCN) is formed by the union of the dorsal divisions of the ventral rami of the third and fourth lumbar spinal nerves. The nerve is a sensory branch of the lumbar plexus and supplies the upper lateral aspect of the thigh. It is often trapped between the inguinal ligament and the anterior superior iliac spine, causing paraesthesia in the supplied area, known as meralgia paraesthetica. The LFCN has been shown to exhibit significant variations in formation and course, which can affect the efficacy of nerve blocks administered in the affected area.

Aim: To study the variations in the formation of the LFCN in the pelvis of cadavers.

Materials and Methods: A cross-sectional study was conducted at Government Medical College, Kota, Rajasthan, from January 2021 to January 2023. The study involved 25 formalin-embalmed cadavers (20 male and 5 female) obtained from the anatomy

departments of various medical colleges in Rajasthan. All human cadaveric specimens with well-preserved lumbar plexus, regardless of gender, were included. The lumbar plexus was dissected bilaterally, and the formation and any variations of the LFCN were observed and recorded using digital photography. The obtained data was segregated by gender and side, and Chi-square test was applied to analyse the data using Statistical Package for Social Sciences (SPSS) version 25.0.

Results: The LFCN originated from L2 and L3 in 47 (94%) specimens. We observed the absence of the LFCN, double LFCN, and sole origin from L2 only in 1 (2%) case each. Additionally, the origin of the LFCN from the femoral nerve was observed in one specimen.

Conclusion: The variations noted in the present study would be valuable for surgeons and anaesthetists planning skin grafts and nerve blocks in the thigh area, as well as in transpsoas surgeries.

Keywords: Meralgia, Nerve block, Psoas major, Skin graft, Transpsoas

INTRODUCTION

The LFCN is a cutaneous nerve of the thigh. It usually originates from the ventral rami of the second and third lumbar nerves, but variable contributions from L1 to L3 have been described [1]. It emerges from the posterolateral border of the psoas major and crosses the iliacus obliquely to reach the anterior superior iliac spine. It carries sensations from the parietal peritoneum in the iliac fossa. On the left, the nerve passes behind the lower part of the descending colon. The right nerve passes posterolateral to the caecum, separated from it by the iliac fascia and peritoneum. Both nerves usually pass behind the inguinal ligament about 1-2 cm medial to the anterior superior iliac spine; sometimes, they pass through or, rarely, anterior to the ligament. Occasionally, the nerve may lie anterior or superior to the anterior superior iliac spine as it enters the thigh. Though rare, it may be absent, and in such instances, the femoral branch of the genital branch serves as its nerve supply [2]. Meralgia paresthetica, characterised by numbness, pain, and tingling sensation over the lateral aspect of the thigh, is due to compression of the LFCN by the inguinal ligament against the hip bone during iliac crest grafting and sometimes by tight-fitting outfits. Meralgia paresthetica due to compression of the LFCN at the inguinal ligament is common, as the nerve bends at an angle of about 90° to pass from the inguinal region to the thigh [3]. Knowledge of the variations is also essential in cases where a skin graft is taken from the lateral thigh to avoid undue iatrogenic injury to the nerve. The lateral cutaneous nerve of the thigh can be blocked with local anaesthetics. This nerve can be blocked using ultrasound guidance [4]. Lateral approaches in lumbar surgeries can cause structural nerve injury. Information on the disparities in the LFCN, particularly in its mediolateral course, is critical to avoid approach-related injuries [5].

The present study aimed to document the variations in the formation and course of the LFCN within the pelvis in the Rajasthani population.

MATERIALS AND METHODS

A cross-sectional study was conducted at Government Medical College in Kota, Rajasthan from January 2021 to January 2023. The study involved twenty-five formalin-embalmed cadavers, with 20 male and 5 female specimens obtained from the anatomy departments of various medical colleges in Rajasthan. Prior ethical approval was obtained from the Institutional Ethical Committee with consent number F3/Acad/IEC/2020/41.

Inclusion criteria: All human cadaveric specimens with well-preserved lumbar plexus, regardless of gender were included in the study.

Exclusion criteria:

- Autolysed human cadaveric specimens.
- Cadavers or postmortem bodies with damaged plexus during removal.
- Specimens showing evidence of surgical intervention involving the abdomen or lumbar region.
- Specimens with gross vertebral and skeletal anomalies.

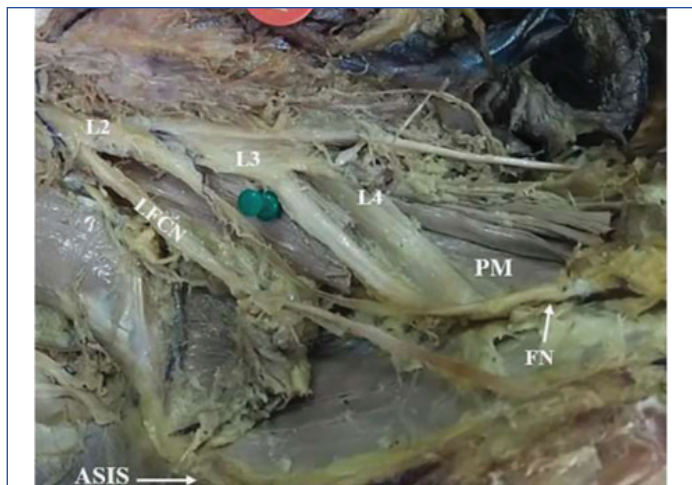
Bilateral dissection of the lumbar plexus was performed on the cadavers, following the guidelines and instructions provided by Cunningham's Manual of Practical Anatomy [6]. During the dissection, care was taken to avoid injury to vessels, nerves, and muscles. After a detailed dissection, the formation, branches, and relations of the LFCN (lateral femoral cutaneous nerve) were studied, and any variations, if present, were carefully noted and recorded in a tabulated format.

STATISTICAL ANALYSIS

The data was analysed using SPSS version 25.0. Chi-square test was applied to assess the association between the gender and the formation of LFCN.

RESULTS

LFCN is formed by the union of branches from the dorsal division of the second and third lumbar nerves [Table/Fig-1].

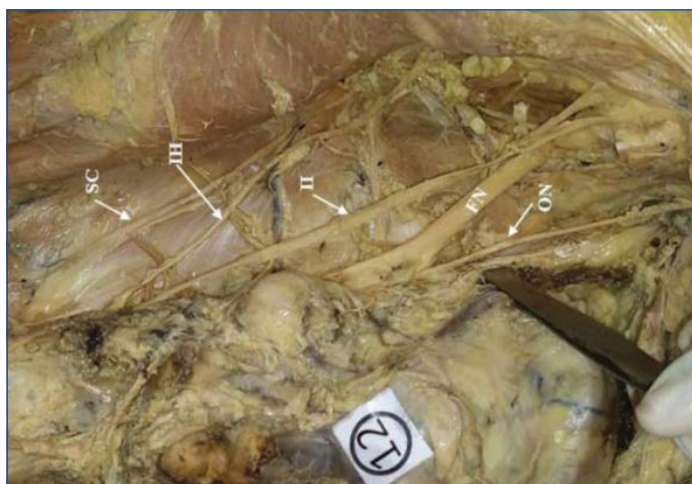


[Table/Fig-1]: Shows femoral (FN) nerve formation takes place outside the psoas major muscle (PM) from dorsal divisions of L2, L3 and L4. Also note that lateral femoral cutaneous nerve (LFCN) arises solely from L2. (ASIS: anterior superior iliac spine).

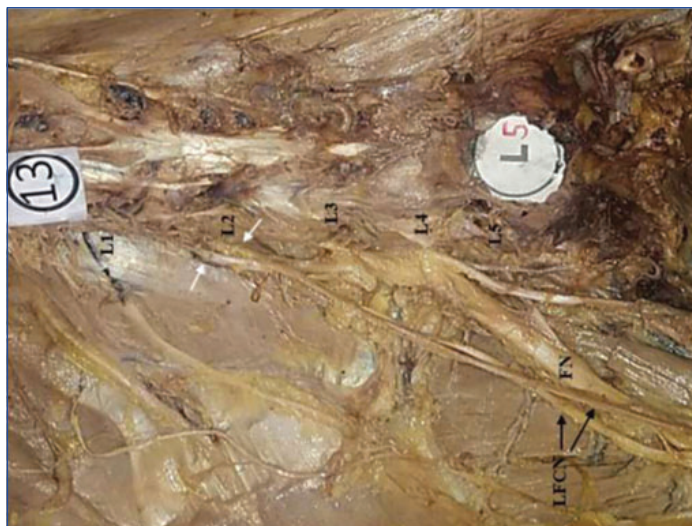
LFCN was not found in 2% of the specimens [Table/Fig-2] and [Table/Fig-3]. A rare variation was observed where the LFCN originated from the trunk of the femoral nerve just before the trunk received the contributing branch from the fourth lumbar nerve. As a result, the root value of the LFCN remained at L2, L3 in this observation. In 2% of the specimens, the nerve was found to originate from the second lumbar nerve root. Double LFCN was observed in 2% of the cases, as shown in [Table/Fig-4]. In such instances, one nerve originated from the L1 nerve, and the other took its origin from the L2 nerve.

Root value	Male (n=20)		Female (n=5)	
	Right (%)	Left (%)	Right (%)	Left (%)
L2L3	18 (36)	19 (38)	5 (10)	5 (10)
L2	1 (2)	-	-	-
Double LFCN	1 (2)	-	-	-
Arising from femoral nerve	-	1 (2)	-	-
Absent	-	1 (2)	-	-

[Table/Fig-2]: Formation of Lateral Femoral Cutaneous Nerve (LFCN). Calculated p-value 0.75; Chi-square: 10.12; df: 12



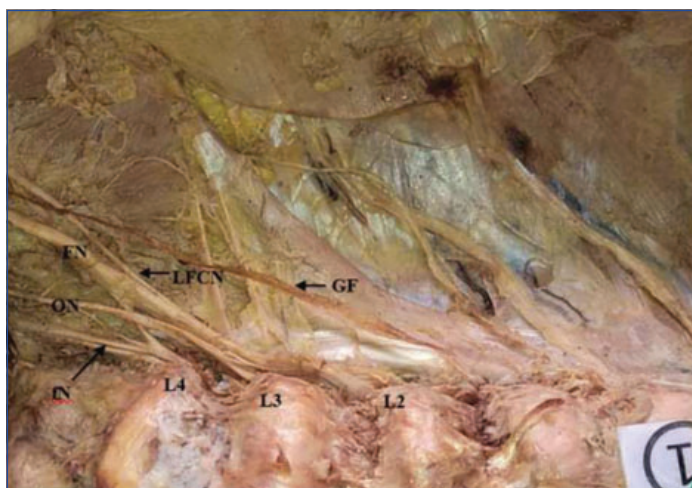
[Table/Fig-3]: Absent lateral femoral cutaneous on left-side. IH: Iliohypogastric nerve; SC: Subcostal nerve; FN: Femoral nerve; ON: Obturator nerve



[Table/Fig-4]: Double Lateral femoral cutaneous nerve (LFCN). White arrowheads indicate different origin of the two nerves (L1 and L2) in this specimen. (FN, femoral nerve; L1 to L5, lumbar spinal nerve roots).

The Chi-square test was applied to ascertain the association between gender and root value (formation of LFCN). The values were calculated and analysed to conclude that the data obtained, both gender-wise and sidewise, were independent of each other (p>0.75).

One specimen that showed the root value of LFCN as L2L3 also exhibited the emergence of the same from the femoral nerve. Therefore, one specimen/nerve was counted twice [Table/Fig-5].



[Table/Fig-5]: Lateral Femoral Cutaneous Nerve (LFCN) originates from lateral aspect of the Femoral Nerve (FN). fn: Furcal nerve; GF: Genitofemoral nerve; ON: Obturator nerve

DISCUSSION

The most common origin of the LFCN is from the dorsal division of the second and third lumbar ventral rami. The present study aligns with the observations of Nontasaen P et al., and Anloague P et al., whose incidences were 98.5% and 85.3%, respectively [Table/Fig-6] [1,7-12].

The second most common observation, as recorded by other authors, was the origin of the LFCN from the L1 and L2 roots. The highest incidence was recorded in the study by Sim IW and Webb T at 36.7% [9]. De Ridder VA et al., (12%), Anloague P and Huijbregts PP (11.8%), and Arora D et al., (13.3%) also made similar observations [1,8,10].

However, in the present study, the LFCN arose from L2 alone in 2% of specimens, which is similar to the findings of Sim IW and Webb T in 1.6% of cases [9]. Anloague P et al., reported the LFCN arising from the dorsal division of the L1 and L2 ventral rami and from L2 alone in 11.8% and 2.9%, respectively [8].

In the present study, double LFCN was seen in 2% of specimens. Sim IW and Webb T observed it in 10%, while Dias Filho LC et al.,

Author	Study place	Cases (n)	L2, L3	L2	L1, L2	Double LFCN	Absent
De Ridder VA et al., [1] (1999)	Netherland	400	55%	-	12%	-	-
Dias Filho LC et al., [11] (2003)	Brazil	52	-	-	-	30%	-
Sim IW and Webb T [9] (2004)	Melbourne	60	42.7%	1.6%	36.7%	10%	-
Anloague P et al., [8] (2009)	Ohio (US)	68	85.3%	2.9%	11.8%	-	-
Carai A et al., [12] (2009)	Italy	148	-	-	-	-	8.8%
Nontasaen P et al., [7] (2015)	Thailand	131	98.5%	0.8%	0.8%	-	-
Arora D et al., [10] (2015)	Punjab (India)	60	46.6%	-	13.3%	-	16.6%
Present study	Rajasthan (India)	50	94 %	2 %	-	2 %	2 %

[Table/Fig-6]: Comparison of origin of LFCN with other studies [1,7-12].

reported it in 30% of cases [9,11]. The absence of the LFCN was reported by Arora D et al., and Carai A et al., in 16.6% and 8.8% of specimens, and also in the current study as 2% [10,12].

The LFCN was found as a branch arising from the femoral nerve in 2% of the present study, which coincides with the observation by Mattera D, who reported it in 1.6%, and Dias Filho LC et al., who reported it in 1.92% of specimens [Table/Fig-7] [9-11,13,14]. Sim IW and Webb T, Arora D et al., and Astik RB and Dave UH observed higher incidences at 10%, 8.3%, and 6.2%, respectively [9,10,14]. In such instances, femoral nerve block would possibly also produce LFCN block, which may alter the clinical outcome of lumbar plexus blockade. Vice versa is also possible [15].

Authors	Study place	Case (n)	Incidence %
Dias Filho LC et al., [11] (2003)	Brazil	52	1.92%
Sim IW and Webb T [9] (2004)	Melbourne	60	10%
Astik RB and Dave UH [14] (2011)	Andhra Pradesh (India)	64	6.2%
Arora D et al., [10] (2015)	Punjab (India)	60	8.3%
Mattera D et al., [13] (2008)	Uruguay	128	1.6%
Present study	Rajasthan (India)	50	2%

[Table/Fig-7]: Comparison of origin of LFCN from femoral nerve [9-11,13,15].

Limitation(s)

The present study had the limitation of a limited sample size. Therefore, in order to generalise the findings and compare them with the existing literature, replication studies should be undertaken in a variety of settings with increased sample sizes. Variations related to the course of the nerve and its relationship with other structures in the region were also not considered in the study. Nowadays, MRI is a highly sensitive diagnostic tool prior to any surgical or neurosurgical intervention in the lumbar region. Therefore, introducing MRI-based morphometry to the present study could have been beneficial.

CONCLUSION(S)

The origin and course of the LFCN show significant variation, which should be considered when evaluating nerve lesions clinically and

performing surgery on the lumbar spine using transpoas techniques. Knowledge of the origin and course of the LFCN is crucial to avoid iatrogenic nerve injury. Understanding these variations is also important in cases where a skin graft is taken from the outer thigh.

REFERENCES

- [1] De Ridder VA, de Lange S, Popta JV. Anatomical variations of the lateral femoral cutaneous nerve and the consequences for surgery. *J Orthop Trauma*. 1999;13(3):207-11.
- [2] Gray AT, editor. Chapter 39-Lateral Femoral Cutaneous Nerve Block. In *Atlas of Ultrasound-Guided Regional Anesthesia*. 3rd ed.: Elsevier; 2019. Pp. 143-49.
- [3] Grossman MG, Ducey SA, Nadler SS, Levy AS. Meralgia paresthetica: Diagnosis and treatment. *J Am Acad Orthop Surg*. 2001;9(5):336-44.
- [4] Becciolini M, Pivec C, Riegler G. Ultrasound of the lateral femoral cutaneous nerve: A review of the literature and pictorial essay. *J Ultrasound Med*. 2022;41(5):1273-84.
- [5] Grunert P, Drazin D, Iwanaga J, Schmidt C, Alonso F, Moisi M, et al. Injury to the lumbar plexus and its branches after lateral fusion procedures: A cadaver study. *World Neurosurg*. 2017;105:509-25.
- [6] Koshi R. Chapter 13: The posterior abdominal wall. In *Cunningham's Manual of Practical Anatomy*. 16th ed.: Oxford University Press; 2017. Pp. 205-16.
- [7] Nontasaen P, Das S, Nisung C, Sinthubua A, Mahakkanukrauh P. A cadaveric study of the anatomical variations of the lumbar plexus with clinical implications. *Journal of the Anatomical Society of India*. 2016;65:24-28.
- [8] Anloague P, Huijbregts PP. Anatomical variations of the lumbar plexus: A descriptive anatomy study with proposed clinical implications. *J Man Manip 'Ter'*. 2009;17(4):107-14.
- [9] Sim IW, Webb T. Anatomy and anaesthesia of the lumbar somatic plexus. *Anaesth Intensive Care*. 2004;32(2):178-87.
- [10] Arora D, Kaushal S, Chhabra U. Morphology of Lateral Femoral Cutaneous Nerve (LFCN). *J Res Med Den Sci*. 2015;3(4):256-59.
- [11] Dias Filho LC, Valenc MM, Guimaraes FA, Medeiros RC, Silva RA, Morais MG, et al. Lateral femoral cutaneous neuralgia: An anatomical insight. *Clinical Anatomy*. 2003;16(4):309-16.
- [12] Carai A, Fenu G, Sechi E, Crotti FM, Montella A. Anatomical variability of the lateral femoral cutaneous nerve: Findings from a surgical series. *Clin Anat*. 2009;22(3):365-70.
- [13] Mattera D, Martínez F, Soria V, Verdier V, Salle F, Saibene A, et al. Surgical anatomy of the lateral femoral cutaneous nerve in the groin region. *European Journal of Anatomy*. 2008;12(1):33-37.
- [14] Astik RB, Dave UH. Variations in formulation and branching pattern of the femoral nerve in iliac fossa: A study in 64 Human Lumbar plexuses. *People's Journal of Scientific Research*. 2011;4(2):14-19.
- [15] Sharrock NE. Inadvertent 3-in-1 block following injection of the lateral cutaneous nerve of thigh. *Anesth Analg*. 1980;59(11):887-88.

PARTICULARS OF CONTRIBUTORS:

1. Senior Professor, Department of Anatomy, Government Medical College, Kota, Rajasthan, India.
2. Postgraduate Resident, Department of Anatomy, Government Medical College, Kota, Rajasthan, India.
3. Professor and Head, Department of Anatomy, Government Medical College, Kota, Rajasthan, India.
4. Postgraduate Resident, Department of Anatomy, Government Medical College, Kota, Rajasthan, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:

Dr. Pratima Jaiswal,
1-K-27, Vigyan Nagar, Kota-324005, Rajasthan, India.
E-mail: drpratimajaiswal@gmail.com

PLAGIARISM CHECKING METHODS: [Lain H et al.](#)

- Plagiarism X-checker: Mar 04, 2023
- Manual Googling: Jun 30, 2023
- iThenticate Software: Jul 05, 2023 (14%)

ETYMOLOGY: Author Origin

EMENDATIONS: 7

AUTHOR DECLARATION:

- Financial or Other Competing Interests: None
- Was Ethics Committee Approval Obtained for this study? Yes
- Was informed consent obtained from the subjects involved in the study? Yes
- For any images presented appropriate consent has been obtained from the subjects. Yes

Date of Submission: **Feb 23, 2023**

Date of Peer Review: **Mar 25, 2023**

Date of Acceptance: **Jul 06, 2023**

Date of Publishing: **Nov 01, 2023**