

Anatomical Variations in the Course and Level of Termination of Superficial Peroneal Nerve- A Cadaveric Study

B SHWETHA¹, MS PUSHPA²

ABSTRACT

Introduction: Several variations in the course and branching pattern of the Superficial Peroneal Nerve (SPN) have been reported. Knowledge of the different course of SPN is essential in reducing the risk of iatrogenic injury during the orthopaedic foot and ankle surgery and various other procedures.

Aim: To observe any variations in the course, and level of termination of SPN.

Materials and Methods: This descriptive analytical study was conducted on 50 lower limb specimens in the Department of Anatomy, Bangalore Medical College and Research Institute Bengaluru from January 2013 to January 2016. Dissection kit was used for dissection, digital camera was used for photography of specimens, measuring tape was used to measure the distance at which the SPN became cutaneous with respect to the tip of lateral malleolus and the distance at which SPN terminated into medial and Intermediate Dorsal Cutaneous Nerve (IDCN) with reference to the tip of lateral malleolus. Descriptive statistics was used and results were expressed as Mean \pm SD.

Results: It was observed that the distance at which SPN became cutaneous with respect to tip of lateral malleolus was 10 \pm 2.82 cm. The level of termination of SPN into Medial Dorsal Cutaneous Nerve (MDCN) and IDCN with reference to tip of lateral malleolus was 4.7 \pm 2.08 cm. In 5 (10%) of 50 specimens the SPN terminated at a higher level before piercing the deep fascia. Out of these 5 specimens, it was observed that in one specimen the SPN terminated above the head of fibula before piercing Peroneus Longus (PL) muscle. In another specimen, the SPN terminated near the head of fibula before piercing PL muscle. In one of the specimens SPN terminated near head of fibula after piercing PL, in two specimens SPN terminated in upper third of the leg after piercing PL muscle and their terminal branches pierced the deep fascia and emerged out at different level with respect to tip of lateral malleolus.

Conclusion: SPN became cutaneous and terminated in the distal third of the leg in most cases. This knowledge is very helpful to surgeons and orthopaedists in performing fasciotomy, and ankle arthroscopy to prevent iatrogenic injury to the nerve.

Keywords: Ankle arthroscopy, Intermediate dorsal cutaneous nerve, Medial dorsal cutaneous nerve

INTRODUCTION

The SPN is a nerve in the lateral compartment of the leg. It is a terminal branch of the Common Peroneal Nerve (CPN) and arises at the neck of the fibula deep to the PL muscle, passes between the PL and peroneus brevis. It supplies both of these muscles and pierces the deep fascia in the distal third of the leg and divides into MDCN and IDCN. Skin over the dorsum of foot is supplied by MDCN and IDCN, except for the skin over the cleft between first and second toe and medial margin of dorsum of foot, which is supplied by Deep Peroneal Nerve (DPN) and saphenous nerve, respectively [1]. The SPN exhibits a highly variable anatomical course on the anterolateral surface of the leg and its terminal branches on the dorsal surface of the foot. In clinical conditions like compartment syndrome, fasciotomy needs to be performed, during this procedure the deep fascia of the leg is incised to relieve pressure, so care should be taken to prevent damage to the SPN which becomes cutaneous in the distal third of the leg. Chances of injury to this nerve are also high during the procedures like anterior arthroscopy, in which an anteromedial portal is made medial to the tendon of tibialis anterior, where SPN lies in proximity.

So, a thorough knowledge of the anatomical relationship and variation of SPN is necessary to prevent its injury. This study aims to provide a detailed description of SPN regarding its origin, course, termination and variations in the level of termination of SPN.

MATERIALS AND METHODS

A descriptive analytical study was conducted in the Department of Anatomy, Bangalore Medical College and Research Institute Bengaluru, Karnataka, India from January 2013 to January 2016. Institutional Ethical Clearance was obtained (BMC/IEC/Proc. No.03/2013). A total of 50 lower limb specimens from 25 embalmed cadavers were used for this study.

Inclusion criteria: Lower limbs from adult cadavers of both sexes without any deformity were included in the study.

Exclusion criteria: Cadavers with congenital, acquired deformities and fractures of the lower limb were excluded from the study.

Procedure

A horizontal incision was made just below the level of the tibial tuberosity and across the leg at its junction with the foot. A vertical incision was made from just below the tibial tuberosity onto the dorsum of the foot till the middle of second toe. The skin flap was reflected laterally till peroneal muscles were seen. The level at which the SPN became cutaneous, and in specimens with a higher division of the nerve, the level at which the terminal branches of SPN pierced the deep fascia and became cutaneous was measured with the tip of lateral malleolus as a reference point [2]. Digital camera was used to take pictures of the specimens.

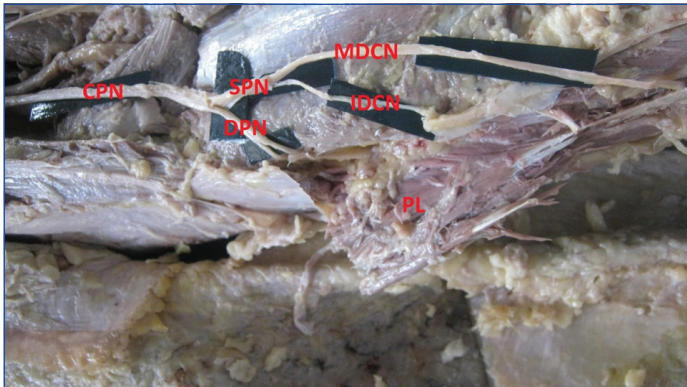
STATISTICAL ANALYSIS

Descriptive statistical analysis was performed using and data was tabulated on Microsoft Excel for further analysis.

RESULTS

In present study it was observed that in 5 (10%) of 50 specimens, the SPN terminated at a higher level before piercing the deep fascia. And in 45 specimens, the nerve terminated after piercing the deep fascia.

In one specimen, the SPN terminated above the head of fibula before piercing the PL muscle and in this specimen it was noted that the terminal branches MDCN and IDCN pierced the deep fascia 8 cm and 5 cm, respectively above the tip of lateral malleolus [Table/Fig-1,2].



[Table/Fig-1]: High termination of Superficial Peroneal Nerve (SPN) into Medial Dorsal Cutaneous Nerve (MDCN) and Intermediate Dorsal Cutaneous Nerve (IDCN) above head of fibula, before piercing Peroneus Longus (PL), Common Peroneal Nerve (CPN), Deep Peroneal Nerve (DPN).



[Table/Fig-2]: Medial Dorsal Cutaneous Nerve (MDCN) and Intermediate Dorsal Cutaneous Nerve (IDCN) pierced the deep fascia 8 cm and 5 cm above tip of lateral malleolus, respectively.

In one specimen, it was noted that the SPN terminated near the head of fibula before piercing PL and the terminal branches MDCN and IDCN pierced the deep fascia 4 cm and 4.5 cm above the tip of Lateral malleolus, respectively [Table/Fig-3,4].



[Table/Fig-3]: High termination of Superficial Peroneal Nerve (SPN) into Medial Dorsal Cutaneous Nerve (MDCN) and Intermediate Dorsal Cutaneous Nerve (IDCN) near head of fibula before piercing Peroneus Longus (PL), Common Peroneal Nerve (CPN), Deep Peroneal Nerve (DPN), Peroneus Longus (PL).



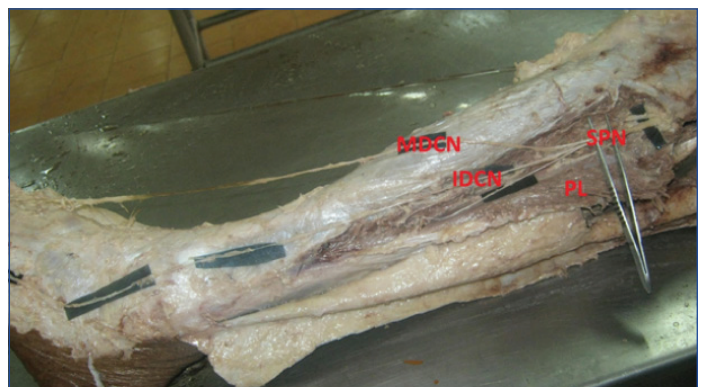
[Table/Fig-4]: Medial Dorsal Cutaneous Nerve (MDCN) and Intermediate Dorsal Cutaneous Nerve (IDCN) piercing deep fascia 4 cm and 4.5 cm above the tip of lateral malleolus, respectively.

In one specimen it was noted that the SPN terminated near the head of fibula after piercing PL and the terminal branches Medial Branch (MB) and Lateral Branch (LB) pierced the deep fascia 14 cm and 8 cm above the tip of Lateral malleolus, respectively [Table/Fig-5].



[Table/Fig-5]: High termination of Superficial Peroneal Nerve (SPN) near head of fibula after piercing Peroneus Longus (PL) Medial branch (MB) Lateral Branch (LB) Sural Nerve (SN).

In two specimens, SPN terminated in upper third of the leg after piercing PL into MDCN and IDCN [Table/Fig-6].



[Table/Fig-6]: High termination of Superficial Peroneal Nerve (SPN) into Medial Dorsal Cutaneous Nerve (MDCN) and Intermediate Dorsal Cutaneous Nerve (IDCN) in upper third of the leg after piercing Peroneus Longus (PL).

On average, the level at which the SPN pierced the deep fascia in 50 specimens recorded with reference to the tip of lateral malleolus was $10 \text{ cm} \pm 2.82 \text{ cm}$. The level of termination of SPN into MDCN and IDCN with reference to the tip of lateral malleolus was $4.7 \text{ cm} \pm 2.08 \text{ cm}$. The course of SPN in all the 50 specimens was normal within the lateral compartment of the leg.

DISCUSSION

The present study involved dissection of 50 lower limb, and it was observed that in 5 (10%) of the specimens SPN terminated into MDCN and IDCN at higher level before piercing the deep fascia.

Biswas S et al., studied 50 lower limb specimens, they found that in 92%, the SPN became subcutaneous as single trunk and terminated into MDCN and IDCN [3]. In 8% of the specimens, the SPN terminated into Medial and IDCN even before piercing deep fascia. The findings were in accordance to the present study.

Bas O et al., dissected 40 lower limb specimen from 20 Turkish foetuses and reported that in 75%, the SPN was in the lateral compartment of leg [4]. And in 15% of specimens the nerve was within the anterior compartment. In current study in all 50 lower limb specimens, SPN was within the lateral compartment of the leg.

Pacha D et al., studied 12 lower limb specimens and reported that in three specimens, the SPN terminated before piercing the deep fascia, in two out of three specimens one branch emerged within anterior compartment and the other emerged within lateral compartment [5]. And in one specimen both branches emerged from anterior compartment [5]. In our study, in 5 (10%) of the specimens, the nerve terminated before piercing the deep fascia, and both branches were confined to the lateral compartment.

Canella C et al., performed sonography of the lower limb on 30 healthy adult volunteers (60 lower limb) and found that the SPN terminated before piercing the deep fascia in 6.7% of the legs [6]. In this study, it was seen in 10% of the lower limb specimens.

Prakash et al., studied 60 lower limb specimens and found that in 43 (71.7%) specimens, SPN was located within the lateral compartment of leg and 5 (8.3%) SPN branched before piercing PL and Extensor digitorum longus [7]. In 7 (11.7%), SPN branched before piercing deep fascia and in 48 (80%) specimens, SPN branched after piercing the deep fascia. In the present study, in one specimen SPN branched before piercing the PL muscle 1 cm above the head of fibula and in 5 (10%) of the specimen, SPN branched before piercing deep fascia. And in 90% of the specimen, SPN branched after piercing the deep fascia.

Sayli U et al., studied 60 lower limb specimens and found that in 73% of specimens the SPN pierced the deep fascia proximal to the elbow joint and divided into terminal branches [8]. In 23% of the specimens, they found that the nerve terminated higher level and the two terminal branches pierced the deep fascia separately. In the present study, it was seen that in 10% of the specimens the nerve terminated at a higher level and in 90% of the specimens the nerve became cutaneous in the distal third of the leg and terminated.

Zhou Q et al., studied 66 lower limb specimens and found that in 50 specimens the SPN terminated before piercing the deep fascia [9], in 12 specimens the nerve terminated after piercing the deep fascia, and in 4 specimens the nerve terminated before piercing the PL muscle. In current study in one specimen nerve terminated before piercing the PL muscle and in 5 specimens the nerve terminated before piercing the deep fascia and in 45 specimens the nerve terminated after piercing the deep fascia.

Barret SL et al., studied 75 lower limb specimens and found that in 72% of specimens, the SPN was within lateral compartment, in 5% of specimens terminal branches of the nerve were present in both anterior and lateral compartment and in 23% of the specimens the terminal branches were located within the anterior compartment [10]. In this study, all 50 specimens, the terminal

branches of SPN were located within the lateral compartment of leg.

Ucerler H and Ikiz A, dissected 30 lower limb specimens and found that in 63.3% of the specimens, the SPN pierced the deep fascia and then terminated, in 26.7% of the specimens the nerve terminated high above and the two terminal branches pierced the deep fascia separately [11]. In our study, in 10% of the specimens the nerve terminated before piercing the deep fascia and in 90% the nerve terminated after piercing the deep fascia.

It is seen that the SPN becomes cutaneous in the distal 1/3rd of the leg most commonly [Table/Fig-7]. However, cases have been reported where the SPN has terminated at a higher level and medial and lateral dorsal cutaneous nerves have become cutaneous at a different distance with reference to the lateral malleolus, and a single terminal branch should not be confused as SPN and utmost care has to be taken during any surgical procedures performed in its territory and avoid iatrogenic injury to the nerve [3-11]. Hence, complete knowledge about the course, branches, and termination, along with variations exhibited by the SPN is necessary.

Authors, place and year of study	Distance at which Superficial Peroneal Nerve (SPN) became cutaneous to lateral malleolus (in cm)
Biswas S et al., in 2019 at Kolkata, India [3]	16.7±1.3
Bas O et al., in 2012 at Turkey [4]	1.88±0.34
Pacha D et al., in 2003 at Spain [5]	11.68
Canella C et al in 2009 at America [6]	9.22
Present study in 2023 in Bengaluru, India	10±2.8

[Table/Fig-7]: Distance at which the Superficial Peroneal Nerve (SPN) became cutaneous to lateral malleolus.

Limitation(s)

Sample size was limited. The findings of the study cannot be generalised as the study was done in a single centre.

CONCLUSION(S)

SPN had higher termination before piercing the deep fascia. These data help us to identify the variations exhibited by SPN and take proper care to prevent iatrogenic injury to the nerve in various surgical procedures.

REFERENCES

- [1] Peter LW, Mary D. Gray's Anatomy, 37th edition, New York Churchill Livingstone. 1993;1148-49.
- [2] Chaurasia BD. BD Chaurasia's human anatomy, volume 2: Regional and applied dissection and clinical: lower limb, abdomen and pelvis. 8th ed. New Delhi, India: CBS Publishers and Distributors; 2019.
- [3] Biswas S, Pal A, Ghoshal AK. Anatomical variations of the superficial peroneal nerve in the leg-A cadaveric study on Indian population. Indian Journal of Basic and Applied Medical Research. 2019;(8)2:485-90.
- [4] Bas O, Bilgic S, Salbacak A, Sonmez OF, Erkut A. Variations of the superficial peroneal nerve and its terminal branches in the Turkish newborn fetuses. Turk Neurosurg. 2012;22(1):62-67. Doi: 10.5137/1019-5149.JTN.4872-11.0. PMID: 22274973.
- [5] Pacha D, Carrera A, Llusa M, Permanyer E, Molona O, Morro R. Clinical anatomy of the superficial peroneal nerve in the distal leg. Eur J Anat. 2003;7(Suppl.1):15-20.
- [6] Canella C, Demondion X, Guillin R, Boutry N, Peltier J, Cotten A, et al. Anatomic study of superficial peroneal nerve using sonography. American Journal of Roentgenology. 2009;193:174-79.
- [7] Prakash, Bhardwaj AK, Singh DK, Rajini T, Jayanthi V, Singh G. Anatomic variations of superficial peroneal nerve: Clinical implications of a cadaver study. Ital J Anat Embryol. 2010;5(3):223-28.
- [8] Sayli U, Tekdemir Y, Çubuk HE, Avci C, Tüccar E, Elhan HA. The course of superficial peroneal nerve: An anatomical cadaver study. Foot and Ankle Surgery. 1998;4(2):63-69.
- [9] Zhou Q, Tan DY, Dai ZS. The location of superficial peroneal nerve in the leg and its relation to the surgical approach of the fibula. Hongguo Gu Shang. 2008;21(2):95-96.

- [10] Barrett SL, Dellon AL, Rosson GD, Walters L. Superficial peroneal nerve (superficial fibularis nerve): The clinical implications of anatomic variability. *J Foot Ankle Surg.* 2006;45(3):174-76. Doi: 10.1053/j.jfas.2006.02.004. PMID: 16651197.
- [11] Ucerler H, Ikiz A. The variations of the sensory branches of the superficial peroneal nerve course and its clinical importance. *Foot Ankle Int.* 2005;26:946-46.

PARTICULARS OF CONTRIBUTORS:

1. Assistant Professor, Department of Anatomy, Annapoorna Medical College and Hospital, Salem, Tamil Nadu, India.
2. Assistant Professor, Department of Anatomy, Bangalore Medical College and Research Institute, Bengaluru, Karnataka, India.

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

B Shwetha,
A23, Staff Quarters, Annapoorna Medical College and Hospital, Periyaseeragapadi
Salem, Tamil Nadu, India.
E-mail: shwethaiims@gmail.com; pradeepkumar6@gmail.com

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

- Plagiarism X-checker: Oct 21, 2022
- Manual Googling: Nov 14, 2022
- iThenticate Software: Jan 18, 2023 (18%)

ETYMOLOGY: Author Origin**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? No
- For any images presented appropriate consent has been obtained from the subjects. No

Date of Submission: **Oct 20, 2022**Date of Peer Review: **Dec 07, 2022**Date of Acceptance: **Jan 27, 2023**Date of Publishing: **Mar 01, 2023**