



Case Report

Variations in the cutaneous innervation of the dorsum of foot - A case report

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Abstract

The skin on the dorsum of the foot is innervated by the superficial peroneal, deep peroneal, sural and saphenous nerves. Most of the dorsum is supplied by the superficial peroneal nerve. Here we report a variation in the sensory innervation of the dorsum of the left foot in a 52 years old male cadaver. The skin of the first inter-digital cleft i.e., the cleft between the great and second toes which is normally innervated by the deep peroneal nerve was also supplied by the superficial peroneal nerve. A communication between the superficial and the deep peroneal branches were also observed prior to innervation. In addition, the fourth inter digital cleft i.e., cleft between the fourth and fifth toes which is normally innervated by the superficial peroneal nerve was supplied by the sural nerve. Cutaneous nerves on the dorsum of foot are at risk for iatrogenic damage while performing arthroscopy, local anaesthetic block, and surgical approach to the fibula, open reduction and internal fixation of lateral malleolar fractures, application of external fixators, elevation of a fasciocutaneous or fibular flaps for grafting, surgical decompression of neurovascular structures, or miscellaneous surgery on leg, foot and ankle. Therefore a detailed knowledge about the variations in the pattern of cutaneous innervation of dorsum of foot may decrease the damage to these nerves during operative procedures.

Key words

Dorsum of foot, Innervation, Surgery, Variations, Superficial peroneal nerve, Deep peroneal nerve, Sural nerve.

Introduction

The skin of the dorsum of the foot is supplied by four sets of nerves. Most of the dorsum is supplied by the superficial peroneal nerve (SPN).

The nerve pierces the deep fascia of leg in the lower third and divides into medial and lateral branches above the ankle joint and appears on the dorsum of the foot. The medial subdivision divides into branches which supply the medial

side of the great toe and the adjacent sides of the second and third toes. The lateral subdivision provides branches to supply the clefts between the third and fourth toes, and the fourth and the fifth toes. The cleft between the great and second toes is supplied by the deep peroneal nerve (DPN). The lateral margin of the dorsum including that of the little toe is supplied by the sural nerve (SN). The medial margin of the dorsum up-to the head of the first metatarsal bone is supplied by the saphenous nerve [1]. However the sensory innervation of the dorsum may show some alteration as reported in the present case.

Anatomical variations in the course and distribution of cutaneous nerves are important for clinicians who are planning surgical intervention around leg, ankle and foot [2]. The sensory branches in this region are frequently at risk of injury during various operative procedures performed [3]. Iatrogenic damage to the SPN is the most frequently reported complication in anterior ankle arthroscopy [4]. Additionally, knowledge of the variability of the peripheral nerve distribution especially the SN is clinically important, as it is commonly used for nerve conduction studies, nerve biopsies, and as a convenient source for nerve grafting [5].

Case report

During routine dissection of formalin fixed 52 years old male cadaver utilized for educational purposes in the Department of Anatomy, Kasturba Medical College, Manipal, variations were observed unilaterally in the cutaneous innervation of the dorsum of the left foot.

After careful reflection of the skin flap, the cutaneous nerves were identified in the subcutaneous tissue. The subcutaneous layer was carefully dissected to avoid distortion of the nerves and their anatomic relationship as far as

possible. The nerves were carefully dissected to track their course and then painted. The variant pattern was then photographed with Nikon lens camera.

The skin of the first inter-digital cleft i.e., the cleft between the great and second toes which is normally innervated by the deep peroneal nerve was also supplied by the superficial peroneal nerve in this case. A communication between the superficial and the deep peroneal branches were also observed prior to innervation. **(Figure - 1)** The superficial peroneal nerve divided into medial and lateral branches above the ankle joint and appeared on the dorsum of the foot. The medial subdivision supplied the medial side of the great toe. The lateral division further provided branches to supply the cleft between the great and second toe, second and third toes and third and fourth toes. In addition, the fourth inter digital cleft i.e., cleft between the fourth and fifth toes which is normally innervated by the superficial peroneal nerve was supplied by the sural nerve. **(Figure - 2)** No other variations were observed.

Discussion

Knowledge about variations in cutaneous innervation patterns on dorsum of foot improves understanding of the variability of distal sensory loss in nerve entrapments and iatrogenic nerve injury. The nerves over the dorsum of foot also influence surgical incisions and the designing of neurovascular free flaps in this region [3].

The branches of the SPN supply the skin of the dorsal surfaces of all the toes excluding the lateral side of the little toe, and the contiguous sides of the great and second toes, the former being supplied by the lateral dorsal cutaneous branch of the SN, and the latter by the medial branch of the DPN.

Prakash, et al. found that in 68.33% of specimens the sensory division of SPN branched into the medial and lateral branches distal to its emergence from the deep fascia and proximal to its relation to the extensor retinaculum [2]. However in our case, the SPN provided the medial and lateral cutaneous branches further distal to the superior extensor retinaculum.

Wahee, et al. in 2009 had classified the cutaneous innervation of foot into 6 types [3].

- **Type 1 (53.3%):** DPN supplied the 1st cleft, SN supplied the lateral border of little toe and the remaining part on the dorsum of the foot supplied by SPN.
- **Type 2 (28.3%):** DPN supplied the 1st cleft, SPN supplied the medial border of big toe, 2nd cleft and lateral 2½ digits supplied by the SN.
- **Type 3 (8.3%):** DPN supplied the 1st cleft, lateral 1½ digits supplied by the SN and the remaining dorsum by SPN.
- **Type 4 (3.3%):** DPN supplied the 1st and 2nd clefts, SPN supplied the medial border of great toe and lateral 2½ digits were supplied by the SN.
- **Type 5 (5%):** DPN supplied 1st and 2nd clefts, lateral border of the little toe by SN and remaining part of the dorsum of foot by SPN.
- **Type 6 (1.7%):** DPN supplied 2nd cleft, lateral border of little toe supplied by the SN and the remaining area by SPN.

Many other authors have also supported these findings [5, 6, 7]. Additionally Gupta, et al. reported a communication between the branches of SPN and the branches of SN [6].

Narendiran, et al. reported a case of abnormal distribution of the SPN. They found that the nerve after supplying the peroneal muscles of lateral compartment provided medial and lateral branches. The medial branch supplied the skin

of medial side of the great toe, the medial side of the 1st metatarsal region and the 1st web space including the adjacent sides of great and second toes. The lateral branch further provided terminal branches to supply adjacent sides of the 2nd, 3rd, 4th and 5th toes. The DPN on the other hand, after supplying the muscles of anterior compartment of leg continued on the dorsum of foot without providing any terminal branches and also failed to supply the skin of first web space and adjacent sides of great and second toes. It ended by supplying the extensor digitorum brevis muscle [8].

However in the present case the skin of the second inter digital cleft was innervated by the lateral branch of the SPN in addition to the DPN. This kind of innervation is unusual. Additionally, the fourth inter digital cleft was solely supplied by the SN. Co-existence of these variations is rare and is seldom reported.

Entrapment of the SN at the lateral side of the ankle and foot has been reported. In such cases, it is possible that some patients may complain of pain and sensory loss over the lateral one fourth of the dorsum of foot and lateral 1½ toe to 2½ toes. It is important that neurologists and surgeons consider SN involvement in cases of pain or sensory deficit over the lateral one fourth of the dorsum of the foot and lateral 1½ or 2½ toes. Awareness of the extent of the function of the SN in innervating the dorsum of the foot in various races would facilitate an accurate diagnosis when this area is affected [5].

The SN is the most common cutaneous nerves of the inferior extremities used for grafting. In several cases where multiple or very long nerve grafts are needed, other cutaneous nerves like SPN may also be used [7].



Conclusion

It is important that neurologists and surgeons consider the variations in the nerve supply of the dorsum of the foot. Awareness of the same in various races would facilitate an accurate diagnosis when this area is affected. A detailed knowledge of the branching patterns of the SPN and SN and their variations will also help to decrease iatrogenic injury to these nerves.

References

1. Standring Susan, Borley NR, Collins Patricia, Crossman AR, et al. Gray's Anatomy, 40th edition, London Press; 2008, p. 1427-1429.
2. 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; 115: 223-8.
3. Wahee P, Aggarwal A, Harjeet, Sahni D. Variable patterns of cutaneous innervation on the dorsum of foot in fetuses. *Surg Radiol Anat*, 2009; 32: 469-75.
4. Ucerler H, Ikiz AA. The variations of the sensory branches of the superficial peroneal nerve course and its clinical importance. *Foot Ankle Int*, 2005; 26: 942-6.
5. Madhavi C, Isaac B, Antoniswamy B, Holla SJ. Anatomical variations of the cutaneous innervation Patterns of the sural nerve on the dorsum of the foot. *Clin Anat*, 2005; 18: 206-9.
6. Gupta C, Kiruba LN, Dsouza AS, Radhakrishnan P. A morphological study to note the variable patterns of cutaneous innervation on the dorsum of foot in south Indian human fetuses and its clinical implications. *Adv Biomed Res*, 2013; 2: 15.
7. Agthong S, Huanmanop T, Sasivongsbhakd T, Ruenkhwon K, Piyawacharapun A, Chentanez V. Anatomy of the superficial peroneal nerve related to the harvesting for nerve graft. *Surg Radiol Anat*, 2008; 30: 145-8.
8. Narendiran K, Rao Mohandas KG, Somayaji SN, Koshy S, Rodrigues V. Clinically important anatomical variation of cutaneous branches of superficial peroneal nerve in the foot. *Open Anat J*, 2010; 2: 1-4.

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Figure - 1: Variations in the cutaneous innervation of the dorsum of foot. The superficial peroneal nerve (SPN) divides into medial and lateral branches on the dorsum of the foot. The medial subdivision was supplying medial side of the great toe (SPN1). The lateral division was supplying the first cleft, (SPN2), second and third clefts (SPN3). The deep peroneal nerve (DPN) also innervating the first inter digital cleft. A communication (*) between the superficial and deep peroneal nerves was also observed in this region. The fourth cleft by the sural nerve (SN). (DPA - Dorsalis pedis artery)

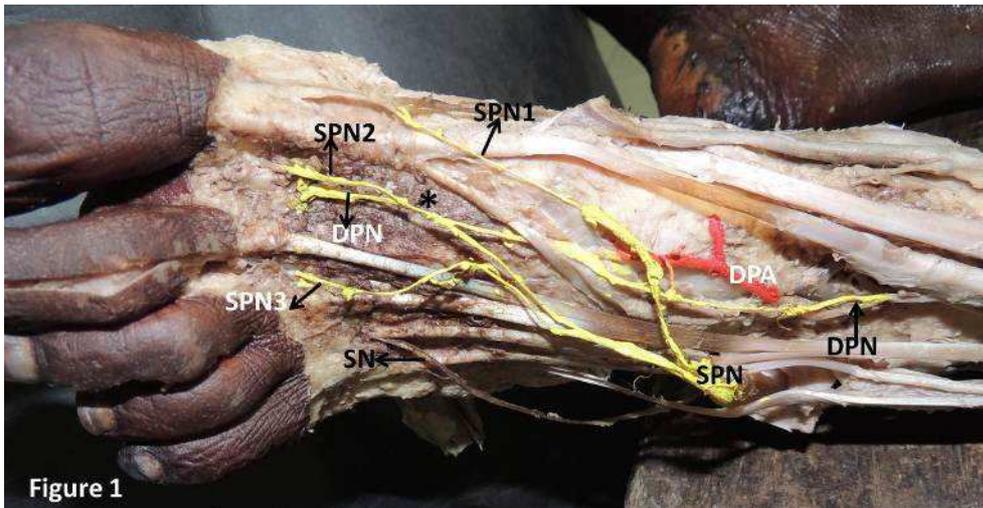


Figure - 2: Sural nerve (SN) supplying the cleft between the fourth and fifth toes (fourth inter digital cleft) in addition to its normal innervation to the lateral margin of the dorsum including that of the little toe.

