

Basic and Applied Anatomy

## Anatomic variations of superficial peroneal nerve: clinical implications of a cadaver study

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### Summary

Superficial peroneal nerve and its branches are frequently at risk for iatrogenic damage. Although different studies on anatomical variations of superficial peroneal nerve are available in the medical literature, such reports are rare from India. Hence the present study was undertaken on Indian population. A total of 60 specimens of inferior extremities from 30 properly embalmed and formalin fixed cadavers were dissected and examined for the location and course of the superficial peroneal nerve including number, level, course and distributions of branches. The superficial peroneal nerve in 28.3% specimens was located in the anterior compartment of the leg. In 8.3% specimens the superficial peroneal nerve branched before piercing between the peroneus longus and extensor digitorum longus muscle whereas in 11.7% specimens it branched after piercing the aforementioned muscles and before piercing the deep fascia. In 41 out of 60 specimens the sensory division of superficial peroneal nerve branched into the medial dorsal cutaneous nerve and intermediate dorsal cutaneous nerve distal to its emergence from the deep fascia and proximal to its relation to the extensor retinaculum. In 20 out of 60 specimens the accessory deep peroneal nerve, an additional branch from the sensory division of superficial peroneal nerve, through its course in the anterior compartment of the leg passed deep to the extensor retinaculum and supplied the ankle and the dorsum of foot. Hopefully the present study will help in minimizing iatrogenic damage to the superficial peroneal nerve and its branches while performing arthroscopy, local anesthetic block, 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.

### Key words

anatomy, cadaver, specimen, study, leg, superficial peroneal nerve

### Introduction

Superficial peroneal nerve and deep peroneal nerve are branches of the common peroneal nerve. Anatomical variations including course and distribution of superficial peroneal nerve are important for clinicians planning surgical intervention around leg, ankle

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and foot. Different authors have time and again reported their studies on anatomy and topographic variations of the superficial peroneal nerve (Canovas *et al.*, 1996; Adkison *et al.*, 1991). Barrett *et al.* (2006) opined that superficial peroneal nerve is approached in the middle third of the leg to perform miscellaneous procedures like resection for treatment of dorsal foot pain, neurolysis, fasciotomy for trauma or surgery and grafting techniques involving elevation of a fasciocutaneous or fibular flaps. Canella *et al.* (2009) studied the location and course of superficial peroneal nerve by sonography and reported its important relations and variations. Agthong *et al.* (2008) reported important data regarding the morphometric anatomy of superficial peroneal nerve and its branches to use it as a nerve graft. Kim *et al.* (2010) suggested that the incidence of superficial peroneal nerve injuries can be reduced, during the open field reduction and internal fixation of the lateral malleolar fractures, by recognition and anterior transposition of the type B intermediate dorsal cutaneous nerve. Zhou *et al.* (2008) studied a safe method for common lateral surgical approach to the fibula and proposed that, to avoid injury to the superficial peroneal nerve, the surgical approach to the upper 2/3 part of the fibula should be at the posterior crural septum whereas to the lower 1/3 it should be at the anterior crural septum. Ucerler *et al.* (2007) concluded that medial midline portal is the best portal for the anterior arthroscopic procedures, safely away from the superficial peroneal nerve and deep peroneal nerve and their respective branches. Leeuw *et al.* (2010) reported that iatrogenic damage to the superficial peroneal nerve is the most frequently reported complication in anterior ankle arthroscopy. The aforementioned observation is interesting in the background that the superficial peroneal nerve is the only nerve throughout the body of human being which can be made visible to the naked eye (Leeuw *et al.* 2010). Studies reported by workers from India on the aforementioned subject are lacking in medical literature. Cadavers are still the best means to study all the domains of anatomy. Hence the present work was undertaken on cadavers to determine anatomical variations of superficial peroneal nerve in Indian population.

## Materials and methods

19 male and 11 female cadavers with age range between 16 to 75 years were selected for the present study. All the cadavers were properly embalmed and fixed in formalin. Hence a total of 60 specimens of inferior extremities from 30 cadavers were examined for anatomical variations. Dissection started with skin incision followed by that of superficial fascia and deep fascia of leg, ankle and foot. The location and course of the superficial peroneal nerve along with its relations with important adjacent structures were studied. Parameters including number, level, course and distributions of branches of superficial peroneal nerve were recorded in inferior extremities of both sides of all the cadavers.

## Results

The superficial peroneal nerve in 43 out of 60 (71.7%) specimens was located in the lateral compartment of the leg whereas in 17 out of 60 (28.3%) specimens it was located in the anterior compartment of leg. In 5 out of 60 (8.3%) specimens the super-



**Fig. 1** – Dissected cadaver showing branching of the sensory division of superficial peroneal nerve before it pierces the muscles and the deep peroneal nerve, passing deep to the extensor retinaculum.

1 Intermediate Dorsal Cutaneous branch of Superficial Peroneal Nerve. 2 Medial Dorsal Cutaneous branch of Superficial Peroneal Nerve. 3 Deep Peroneal Nerve. 4 Extensor Retinaculum. 5 Peroneus Longus muscle. 6 Extensor Digitorum longus muscle. 7 Tibialis Anterior muscle.

ficial peroneal nerve branched before piercing between the peroneus longus and extensor digitorum longus muscles (Fig. 1) whereas in 7 out of 60 (11.7%) specimens it branched after piercing the aforementioned muscles and before piercing the deep fascia. In 48 out of 60 (80%) specimens the superficial peroneal nerve branching was observed after it had pierced the deep fascia. In 41 out of 60 (68.3%) specimens the sensory division of superficial peroneal nerve branched into the medial dorsal cutaneous nerve and intermediate dorsal cutaneous nerve distal to its emergence from the deep fascia and proximal to its relation to the extensor retinaculum. In 7 out of 60 (11.7%) specimens the branching was observed distal to the extensor retinaculum. In 20 out of 60 (33.3%) specimens an additional branch from the sensory division of superficial peroneal nerve, which may be called accessory deep peroneal nerve, through its course in the anterior compartment of the leg passed deep to the extensor retinaculum (Fig. 2) and supplied the ankle and the dorsum of foot.

## Discussion

Variable location of superficial peroneal nerve either in the lateral or anterior compartment of leg and the risk of its damage should be considered by clinicians while planning surgery on the inferior extremity. Canella et al. (2009) reported the location of superficial peroneal nerve in anterior compartment in 26.7 of legs based on his study in France using sonography. Barrett et al. (2006) observed location of superficial peroneal nerve in the anterior compartment of legs in 23% of the cadaver specimens in United States of America. On the other hand in the present study on cadavers in Indian population the anterior location of superficial peroneal nerve was higher (28.3%) than in both aforementioned reports (Table 1). Different contradictory reports are available in the lit-



**Fig. 2** – Dissected cadaver showing branching of the sensory division of superficial peroneal nerve before it pierces the muscles and an additional branch from the sensory division, called accessory deep peroneal nerve, in the anterior compartment passing deep to the extensor retinaculum.

1 Intermediate Dorsal Cutaneous branch of Superficial Peroneal Nerve. 2 Medial Dorsal Cutaneous branch of Superficial Peroneal Nerve. 3 Accessory Deep Peroneal Nerve branch of Superficial Peroneal Nerve. 4 Extensor Retinaculum. 5 Peroneus Longus muscle. 6 Extensor Digitorum longus muscle. 7 Tibialis Anterior muscle.

**Table 1** – Comparison of the results of the present study with similar reports in the literature; data are given as percentage.

Loc1: Location of superficial peroneal nerve in the anterior compartment of leg.

Loc2: Location of superficial peroneal nerve in the lateral compartment of leg.

Sup1: Superficial peroneal nerve division before piercing the deep fascia.

Sup2: Superficial peroneal nerve division after piercing the deep fascia.

Prev: Prevalence of accessory deep peroneal nerve as branch from superficial peroneal nerve.

Author	Year of study	Loc1 (%)	Loc2 (%)	Sup1 (%)	Sup2 (%)	Prev (%)
Adkison et al.	1991	26	73	-	-	-
Kudoh et al.	1999	-	-	-	-	100
Hasegawa et al.	2001	-	-	-	-	17-28
Solomon et al.	2001	-	-	35	-	-
Barrett et al.	2006	23	77	-	-	-
Agthong et al.	2008	-	-	-	71.8	-
Zhou et al.	2008	-	-	82.1	-	-
Canella et al.	2009	26.7	-	6.7	-	-
Present study	2010	28.3	71.7	20	80	33.3

erature regarding the level of branching of the sensory division of superficial peroneal nerve into the medial dorsal cutaneous nerve and intermediate dorsal cutaneous nerve and its site of emergence from deep fascia of leg (Table 1). On one hand Canella et al. (2009), Agthong et al (2008) and Solomon et al. (2001) reported that superficial peroneal

nerve divides before piercing the deep fascia, respectively, in 6.7% French specimens, 71.8% Thai specimens and 35% Australian specimens. On the other hand Zhou et al. (2008) observed that superficial peroneal nerve divides before piercing deep fascia in 82.1% Chinese specimens. Our study on cadavers from India showed that in 8.3% specimens the superficial peroneal nerve branched before piercing between the peroneus longus and extensor digitorum longus muscle whereas in 11.7% specimens it branched after piercing the aforementioned muscles and before piercing the deep fascia. Kudoh et al. (1999) studied the presence of accessory deep peroneal nerve on Japanese cadavers and reported that it was consistently present in 100% of specimens. On the contrary Hasegawa et al. (2001) based on electrophysiological studies in Japanese live patients observed 17-28% prevalence of accessory deep peroneal nerve (Table 1). In our study on Indian cadavers the accessory deep peroneal nerve, an additional branch from the sensory division of superficial peroneal nerve which supplies the ankle and the dorsum of foot, was found in 33.3% specimens. We conclude that identification of superficial peroneal nerve before clinical intervention, including number, level, course and distributions of its branches, will help in minimizing iatrogenic damage to this nerve while performing arthroscopy, block with local anesthetics, or surgery on leg, foot and ankle.

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