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REVIEW ARTICLE

VARIANT SURAL NERVE FORMATION WITH SURGICAL SIGNIFICANCE

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ABSTRACT

The sural nerve is formed by joining of the medial sural cutaneous nerve, branch of tibial nerve and lateral sural cutaneous nerve, branch of common peroneal nerve. It innervates the skin on posterolateral surface of leg and a variable area of the skin on the dorsum of the foot laterally. Clinicians use the nerve quite frequently to do nerve conduction studies, nerve grafting and also for nerve biopsy. We are describing many variations in the formation and course of the sural nerve such as : variability in location of formation of sural nerve, either in upper third, in middle third or in lower third of leg. Also in few specimens the medial sural cutaneous nerve continued as sural nerve on the dorsum of the foot. In some legs the medial sural cutaneous nerve was passing through the gastrocnemius muscle. Becoming familiar with these variations in sural nerve can be of great help to the clinicians while doing nerve conduction studies and to the plastic/ reconstructive surgeons for minimizing the complications that may occur at the time of surgery.

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INTRODUCTION

Sural nerve is the cutaneous nerve supplying posterior and lateral skin of distal third of the leg. It is formed by joining of medial sural cutaneous nerve, branch of tibial nerve with lateral sural cutaneous nerve, branch of common peroneal nerve. The medial sural cutaneous nerve (MSCN) descends between the two heads of gastrocnemius, pierces the deep fascia proximally in the leg and is joined at a variable level by the sural communicating branch of the common peroneal nerve. Some authors term this branch as the lateral sural cutaneous nerve (LSCN). In further course the sural nerve (SN) lies lateral to the calcaneal tendon, near the short saphenous vein. It then passes distal to the lateral malleolus along the lateral side of the foot and fifth toe and supplies the overlying skin (Gray). In clinical set up sural nerve is commonly used for diagnostic purposes, such as in nerve conduction velocity studies for differential diagnosis of peripheral neuropathies. It is also used for therapeutic purposes, such as in nerve grafting procedures (Pasuk Mahakkanukrauh and Ranida Chomsung, 2002).

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The anatomical variations in the sural nerve can influence a number of clinical situations, including nerve conduction study (NCS), nerve biopsy, and nerve graft procedures in the sural nerve (Ortiguela, 1987). Since the sural nerve has immense applied significance, the study was taken up to know the variations in the formation and course of sural nerve.

MATERIALS AND METHODS

The authors dissected 50 lower extremities from 25 cadavers in Anatomy department of Dr. D Y Patil Medical College, Hospital and Research Centre, Pune to study the formation patterns of sural nerve. Cadavers were embalmed with 10% formalin. The legs were dissected following the guidelines given in the Cunningham's manual for dissection (15th edition). The vertical incision was taken on the skin from the beginning of the popliteal fossa till the heel on the posterior aspect of the leg (Romans, 1989). Then the skin was exposed. The popliteal fossa was dissected to locate the tibial and common peroneal nerves. Their branches MSCN and LSCN were dissected and cleaned. The formation of sural nerve was observed. Any variations in the formation and course of sural nerve were noted. Location of formation of sural nerve was also noted and classified under three types according to its formation in upper third, middle third or lower third of the leg. The photographs of dissection were taken and labeled.

Observations

The observations were noted and arranged in pie chart (Chart1).

In 100% of legs MSCN and LSCN were present.

- In 60% of lower extremities the MSCN joined with the LSCN to form the sural nerve (Fig.1). These showed variation in site of formation of sural nerve. In 4% of legs it was formed in upper third (Fig.1), in 22% in the middle third (Fig.2) and in 34% in lower third of leg (Fig.3).
- In 40% of legs MSCN continued as the sural nerve on the dorsum of the foot (Fig.4). The LSCN was present in all of them but did not join with MSCN.
- In 30% of legs the MSCN passed through the gastrocnemius muscle instead of passing superficial to it (Fig. 5).

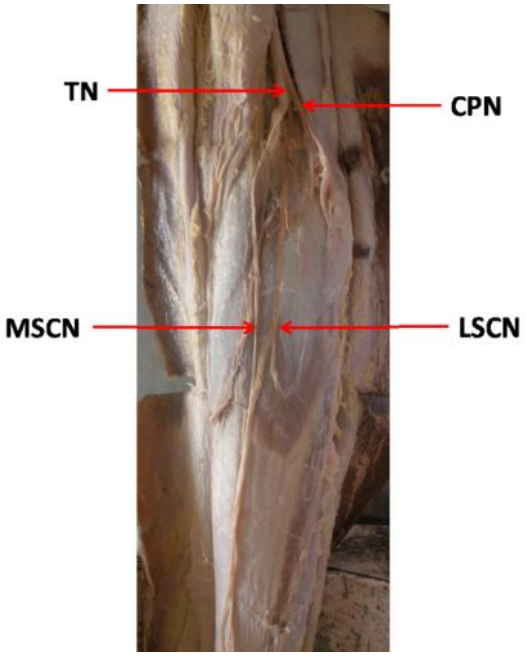

Figure 1. MSCN joined with LSCN to form SN in upper third of leg

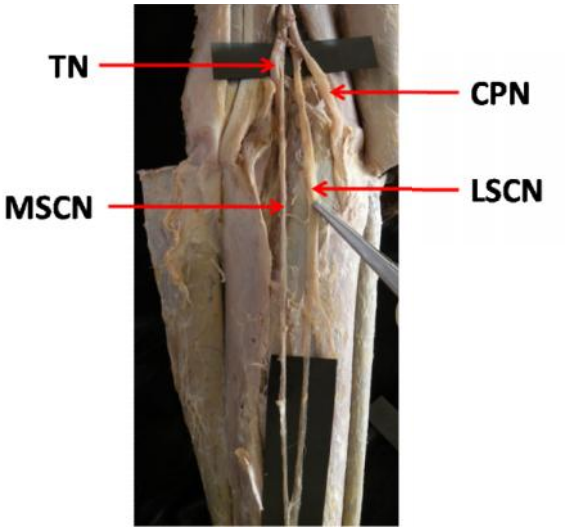

Figure 2. MSCN joining with LSCN to form SN in middle third of leg

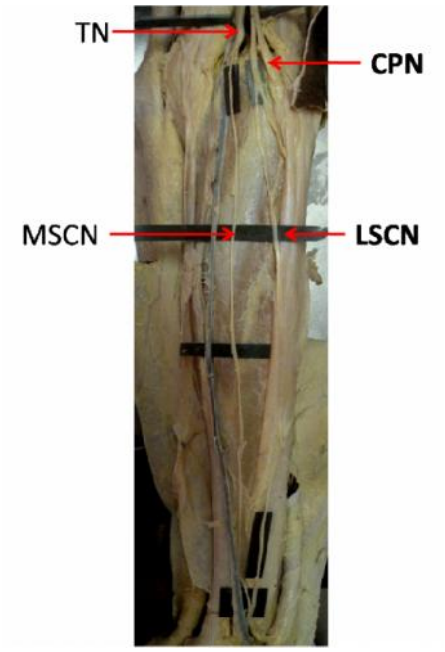

Figure 3. MSCN joining with LSCN to form SN in lower third of leg

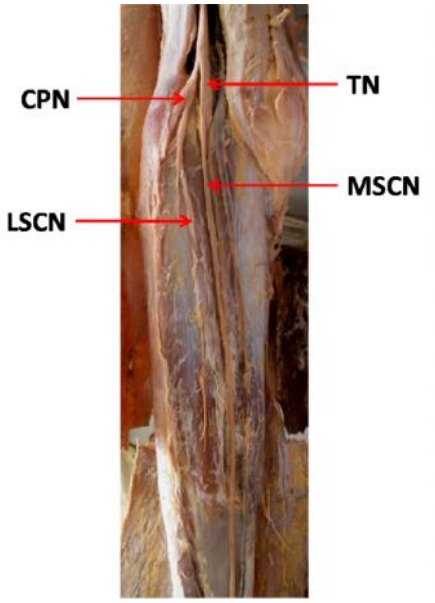

Figure 4. MSCN continued as SN

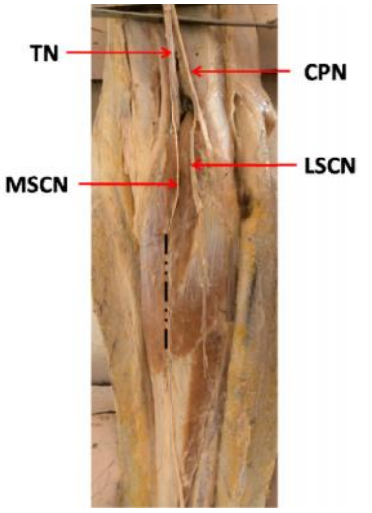

Figure 5. MSCN passing through Gastrocnemius muscle

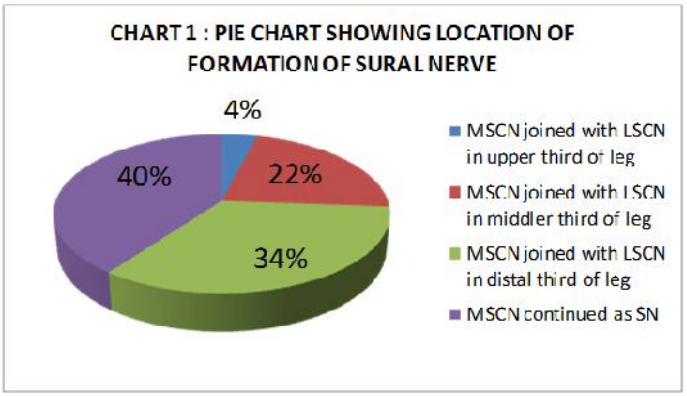

Table 1. Comparison between various studies done on sural nerve formation

Authors	Year	Total number of legs studied	SN formation			MSCN absent	LSCN absent
			MSCN + LSCN	MSCN continued as SN	Separate course of MSCN and LSCN		
P.Mahakkanukrauh et al	2002	152	67.1%	32.2%	-	-	-
Ikiz AZA et al	2005	30	70%	-	6.7%	6.7%	16.7%
Pyun S-B et al	2008	26	76.9%	15.4%	7.7%	-	-
Kavyashree et al	2013	50	72%	28%	-	-	28%
Present study	2017	50	60%	40%	40%	0	0

Table 2. Comparison between various studies done on location of sural nerve formation

Authors	Year	Total number of legs studied	Formation of sural nerve		
			In upper third of leg	In middle third of leg	In distal third of leg
P.Mahakkanukrauh et al	2002	152	5.9%	1.9%	66.7%
Ikiz AZA et al	2005	30	20%	40%	10%
Pyun S-B et al	2008	26	-	34.6%	42.3%
Kavyashree et al	2013	50	5.6%	33.3%	58.3%
Present study	2017	50	4%	22%	34%

DISCUSSION

Gaining the information about the topography of the sural nerve along the leg can help the surgeons to protect the nerve during any operation done in vicinity of this nerve. It can also help to identify the nerve to harvest it as a nerve graft and to localize the nerve while giving sural nerve block. The authors reviewed many articles to compare the observations with the observations noted in studies done over last few years. Same are tabulated below. From above chart it is clear that our study correlates with the study done by P. Mahakkanukrauh et al, in relation with formation of SN by joining of MSCN and LSCN. Our study correlates with the study done by P. Mahakkanukrauh *et al* (Pasuk Mahakkanukrauh, 2002) and Kavyashree et al (Kavyashree, 2013), pertaining to joining of MSCN and LSCN in upper third of leg. In 2005, Maria Lucia Pimentel *et al* found that MSCN was descending through the gastrocnemius in 13.33% of legs (Maria Lucia Pimentel, 2005)**.** Kavyashree A. N. *et al* observed same variation in 22% of legs (Kavyashree, 2013). The authors also found that in 30% of legs the MSCN was passing through gastrocnemius muscle and after a short course it pierced the muscle to join the LSCN. This variation is an important surgical consideration when this nerve is used as an autograft for peripheral nerve reconstruction (Maria Lucia Pimentel, 2005). Ortiguela M E, Wood M B, Cahill D R suggest that the lateral sural cutaneous nerve can be used as an alternative to sural nerve for grafting, because its length and diameter are similar to that of sural nerve and the resultant sensory deficit would be less following grafting. In a situation requiring a limited length of nerve graft material, the peroneal communicating nerve may also be harvested and the MSCN can be preserved (Ortiguela, 1987). Chang-Hwan Kim, Han-Young Jung, Myeong-Ok Kim *et al* found that not only the PCN (LSCN) but also the MSCN can be a better substitute for nerve graft or biopsy than the sural nerve (Chang-Hwan Kim, 2006).

Conclusion

The lateral sural cutaneous nerve was present in all the dissected specimens. This increases the opportunity to use the LSCN as the graft instead of MSCN or sural nerve in a scenario requiring a limited nerve graft length. The clinicians can preserve the main sural nerve which innervates variable area on the dorsum of the foot. The intramuscular course of sural nerve should also be kept in mind if the surgeon wants a considerable length of MSCN to use as a graft.

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