Surg Radiol Anat 22: 97-100

Original articles

Formation and location of the sural nerve in the newborn

H. Uluutku, M.A. Çan and Z. Kurtoglu

Karadeniz Technical University, Faculty of Medicine, Department of Anatomy

Received May 26, 1999 / Accepted in final for March 16,2000

Key words: Sural nerve - Biopsy - Neural grafting - Anatomy.

Correspondence to: H. Uluutku, KTÜ Tip Fakültesi, Anatomi Anabilim Oali, 61080 Trabzon Turkey

Abstract

In this study, the location and formation of the sural nerve were examined in 40 legs of new-born cadavers. The sural nerve was formed by the peroneal communicating branch from the common peroneal nerve joining the medial sural cutaneous nerve in 27 of 40 legs (67.5%). It was formed by the peroneal communicating branch from the lateral sural cutaneous nerve joining the medial sural cutaneous nerve in 4 (10%). It was formed by the peroneal communicating branch from the common peroneal nerve and fibers from the posterior femoral cutaneous nerve joining the medial sural cutaneous nerve in 2 (5%). In 5 of 40 legs (12.5%), the medial sural cutaneous nerve was in the place of the sural nerve without joining any other nerve. In one case (5%), the sural nerve was not formed bilaterally.

Biopsy material taken from the sural n. (SN) is of great importance in the diagnosis of neural diseases. Besides, the SN is the most suitable one for use as a nerve graft in surgery. There may be some difficulties to access it surgically due to various formations of the nerve [2 - 5, 12 - 14]. The anatomic location and formation of this nerve have already been described in adults. The present study was performed to analyse the composition of this nerve in new-born cadavers.

The structures forming the SN [6, 12, 13, 15] are:

1. Medial sural cutaneous n. (MSCN): This nerve arises from the tibial n. in the popliteal fossa.

2. Lateral sural cutaneous n. (LSCN) This nerve arises from the common peroneal n. (CPN).

3. Peroneal communicating branch (PCB) This nerve comes from either the LSCN or the CPN and it forms the SN by combining with this nerve in the place where the MSCN penetrates the fascia.

4. Posterior femoral cutaneous n. (PFCN) This nerve formed of sensory fibers only is one of the sacral plexus branches.

The MSCN generally forms the SN by joining the PCB which arises from either the LSCN or CPN, at the middle part of the leg. The SN, next to the small saphenous v., extends downwards following the lateral margin of the tendo calcaneus. Later, it extends forward to the lateral part of the foot and

fifth toe passing behind the lateral malleolus. While passing behind the lateral malleolus, the SN gives off lateral calcaneal branches spreading out on the outer part of the calcaneus [9, 12, 13, 15].

In other cases, it is formed only by the MSCN without the PCB [15]. A strand from the PFCN rarely joins the structure of the SN. The SN may not be formed in some cases.

In this study, the location and formation of the SN were examined in 40 legs of new-born cadavers.

Material and methods

40 legs of 20 new-born cadavers (13 females, 7 males) were examined. The skin was incised horizontally between the lateral and medial condyles of the femur, and between the lateral and medial margins of the foot. The other incision was performed vertically, from the upper point of the popliteal fossa to the calcaneal tubercle and the skin was removed carefully. Then the components forming the SN and their arrangements were observed.

The formation of the SN was classified in 4 main groups. The SN could be formed by

1. PCB from the CPN joining the MSCN (Figs. 1A-B),

2. PCB from the LSCN joining the MSCN (Fig. 1C),

3. PCB from the CPN and fibers the PFCN joining the MSCN (Fig. 1D),

4. Only the MSCN (Fig. 1E).

The formation level of the SN was observed at 3 locations

1. upper third of the leg.

2. middle third of the leg.

3. lower third of the leg.

Results

The SN was formed by the PCB from the CPN joining the MSCN in 27 of the observed 40 legs (67.5%) (Fig. 1A). The formation level was at the middle third of the leg in 22 of these (81.5%). In 4 legs, it was at the lower third of the leg (14.8%). In one leg, while some fibers of the PCB from the CPN joined the MSCN at the upper third of the leg, the rest joined at the lower third of the leg (3.7%) (Fig. 1B) (Table 1) (Table 2). In four of 40 legs (10%), the SN was formed by the PCB from the LSCN joining the MSCN (Fig. 1C). The formation level of all was at the middle third of the leg. In 2 of 40 legs (5%), the SN was formed by the PCB, PFCN and MSCN (Fig. 1D). The formation level was at the middle third in one and at the lower third in the other.

Forming location	Male				Female				Total	
	Right		Left		Right		Left			
	n	%	n	%	n	%	n	%	n	%
Upper third of leg	-	0.0	-	0.0	1*	3.0	-	0.0	1	3.0
Middle third of leg	7	21.2	6	18.2	7	21.2	7	21.2	27	81.8
Lower third of leg	-	0.0	1	3.0	1	3.0	3	9.0	5	15.2
Total	7	21.2	7	21.2	9	27.3	10	30.3	33	100

* A case in which two peroneal communicating branches came from the CPN. One of these branches contributed to the MSCN in the upper third, and the other in the lower third of the leg

Table 1. Forming location of the sural n.

Formation pattern	Upper third		Middle third		Lower third		Total	
	n	%	n	%	n	%	n	%
Peroneal communicating branch from CPN joining MSCN	1*	3.0	22	66.6	4	12.2	27	81.8
Peroneal communicating branch from LSCN joining MSCN	-	0.0	4	12.2	-	0.0	4	12.2
Peroneal communicating branch from CPN and fibers from PFCN joining MSCN	-	0.0	1	3.0	1	3.0	2	6.0
Total	1	3.0	27	81.8	5	15.2	33	100

* A case in which two peroneal communicating branches came from the CPN. One of these branches contributed to the MSCN in the upper third, and the other in the lower third of the leg

Table 2. Formation pattern of the sural n.

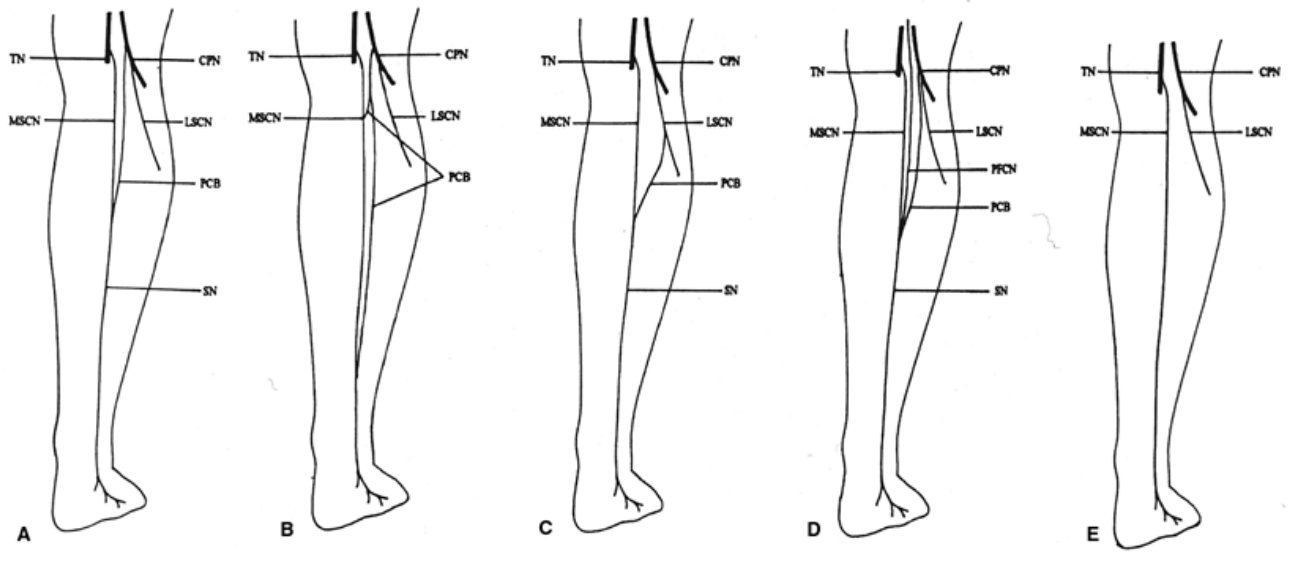

Fig. 1 A-E. Various formations of the sural n., *CPN*, commen peroneal n.; *LSCN*, lateral cutaneous n.; *MSCN*, medial sural cutaneous n.; *PCB*, peroneal communicating branch; *PFCN*, posterior

femoral cutaneous n.; *SN*, sural n.; *TN*, tibial n.

The PCB was thicker than the MSCN in 6 of 33 legs (18.2%). In the others, the MSCN was thicker or both branches had the same thickness. It was observed that the PCB from the LSCN was thinner than the one from the CPN. In 5 of the 40 legs (12.5%), the MSCN was in the place of the SN without joining another nerve (Fig. 1E). This situation was bilateral in 2 cases. An MSCN lying under the fascia without passing between the medial and lateral heads of the gastrocnemius m. was observed in 5 of the 38 legs (13.15%). Two of these were in the same cadaver. The two bilateral cases were in the pattern that the MSCN replaced the SN.

In one case (5%), the SN was not formed bilaterally. A branch departing from the CPN with the superficial peroneal n. under the peroneus longus m. went downward deep to the muscle. This nerve ran across the distal part of the fibula behind the lateral malleolus and took the distal place of the SN.

Discussion

It is pointed out that there is a complex relation between the tibial and peroneal-oriented components in the formation of the SN [1, 3, 6, 8, 13]. Besides, there is a diversity of terminology in the literature. Some researchers claim that the SN is formed by the PCB joining the MSCN [3, 6, 9, 13]. Some researchers call this nerve arising from the tibial n. in the popliteal fossa the SN without distinguishing the SN from the MSCN [8, 15]. In this paper, the part of the MSCN after joining the PCB is accepted as the SN.

While the presence of the SN was observed in 38 of 40 legs (95%), it was absent in one case bilaterally (5%). A similar case was reported by Huene and Bunnell [7]. Ortigüela et al observed the SN in all cases [13]. In this series, the LSCN was present in all legs, and the MSCN was present in 38 (95%). Similarly, Ortigüela et al report MSCN presence in all cases and LSCN presence in 95% [13]. There is no significant difference between those two studies about the presence of the PCB. The rate was 82.5% in our study and 80% in Ortigüela's series [13]. However, there is a meaningful difference in the origin of the PCB. This branch originated directly from the CPN in 87.9% (29 out of 33), and from the LSCN in 12.1% of the legs (4 out of 33) in our series. Ortigüela et al stated that the PCB arose from the LSCN in 93.75% of the cases and from the CPN in 6.25% [13]. The original difference of the PCB in our series from the adult series suggested that this might be related to age rather than race and that there might be a changing in the position of the nerve during life. Unfortunately, there is no available data about either age or race differences in the formation of the SN or position of its components.

In the study, 12.5% of SN were constituted only by the MSCN. This rate is reported in 20% of the cases in the literature [13]. The rare situation that the PFCN joins in the formation of the SN [15] was observed in 5% of our series. This high rate might be due to chance or the result of the lower age group. A larger series of new-born and young cadavers can help to clarify this question.

Similarity in the formation of the SN was investigated in both legs of each cadaver. Interestingly, similarity was present in 75% of the 20 cadavers. The pattern with the PCB from the CPN joining the MSCN was bilateral in 11 of the 20 cases. In two of the rest, the PCB from the CPN and fibers from the PFCN joined the MSCN and constituted the SN. In two cases, the PCB from the LSCN joined the MSCN. In one case, the SN was bilaterally formed by the MSCN only.

There was no significant difference between the male and female cadavers in respect to the formation and location of the SN (, 3).

Formation pattern	Male				Female				Total	
	Right		Left		Right		Left			
	n	%	n	%	n	%	n	%	n	%
Peroneal communicating branch from CPN joining MSCN	7	17.5	4	10.0	7	17.5	9	22.5	27	67.5
Peroneal communicating branch from LSCN joining MSCN	-	0,0	2	5.0	1	2.5	1	2.5	4	10.0
Only MSCN	-	0.0	-	0.0	3	7.5	2	5.0	5	12.5
Peroneal communicating branch from CPN and fibers from PFCN joining MSCN	-	0.0	1	2.5	1	2.5	0.0	2	5.0	
Other situations	-	0.0	-	0.0	1	2.5	1	2.5	2	5.0
Total	7	17.5	7	17.5	13	32.5	13	32.5	40	100

Table 3. Formation pattern of the sural n.

The junction level was at the middle third of the leg in 81.8% of 33 legs, the lower third of the leg in 15.2% and the upper third of the leg in 3.0% (except for absence of the SN in two legs and formation of the SN only by the MSCN in 5 legs), in accordance with the literature [6, 12, 13, 15] (Table 1). In one case, while a branch of the PCB contributed to the formation of the SN at the upper third of the leg, the other branch also joined it at the lower third (Table 2).

In the study, the thicknesses of the components of the SN, MSCN and PCB, were compared with each other. We determined that the PCB was thicker than the MSCN in only 6 of 33 legs (18.2 %), and both have the same thickness or the MSCN is thicker in the others. Ortigüela et al claim that the PCB is frequently thicker than the MSCN, while Hill reports the MSCN as always thicker than the PCB [5, 13].

Obtaining biopsy material from the SN or its components in a child might be important for diagnosis of peripheral neuropathies, and a knowledge of the differences of this nerve in the child might be important in respect to reducing loss of sensation in such an approach.

The SN often used as a donor in autogenous nerve grafting in the child as well as the adult [2, 4, 5]. In the interfascicular nerve grafting method described by Millesi, it is stated that a small-diameter cutaneous nerve is preferred since it promotes nutrition by diffusion [11]. The loss of sensation is reduced in the part from which the nerve is removed if the nerve used for grafting has a small diameter. Besides, it was reported that the risk of growth of a superficial subcutaneous neuroma is reduced if the grafting material is removed from the deep parts of the components forming the nerve or unbranched parts of the SN. That is why the loss of sensation will be less serious and the chance of success increased when components forming this nerve are used instead of the SN in grafting [10]. According to our results, a vertical incision at the posterior aspect of the middle third of the leg is enough to reach both the SN and its components in grafting or biopsy procedures.

References

1. Anatomical Society of Great Britain and Ireland (1982) Second Annual Report of the Committee of Collective Investigation of the Anatomical Society of Great Britain and Ireland for the Year 1890-1891. Question IV. The distribution of the cutaneous nerves on the dorsum of the foot and toes. J Anat Physiol 26 89-90

2. Brooks D (1955) The place of nerve grafting in orthopedic surgery. J Bone Joint Surg 37 299-304

3. De Moura W, Gilbert A (1984) Surgical anatomy of the sural nerve. J Reconstr Microsurg 1 31-39

4. Hankin FM, Jaeger SH, Beddings A (1985) Autogenous sural nerve grafts. A harvesting technique. Orthopedics 8 1160-1164

5. Hill HL, Vascones LO, Jurkiewicz MJ (1978) Method for obtaining a sural nerve graft. PlastReconstr Surg 61 177-179

6. Horwitz MT (1938) Normal anatomy and variations of the peripheral nerves of the leg and foot. Arch Surg 36 626-636

7. Huene DB, Bunnell W (1985) Operative anatomy of nerves encountered in the lateral approach to the distal part of the fibula. J Bone Joint Surg 77 1021-1024

8. Kosinski C (1926) The course, mutual relations and distribution of the cutaneous nerves of the metazonal region of leg and foot. J Anat 60 274-297

9. Mann RA, Plattner PF (1989) Nerve entrapment syndromes of the foot and ankle Part I. In Robert M Szabo, MD (ed.) Nerve compression syndromes diagnosis and treatments. Thorofare, USA, pp 278-280

10. McGillicudy JE (1996) Techniques of Nerve Repair. Neurosurgery, Second ed., Vol. III. Wilkins RH, Rengachery SS (Eds.), McGraw - Hill Co., New York, pp 384-391

11. Millesi H (1981) Reappraisal of nerve repair. Surg Clin North Am 61 321-340

12. Moore KL (1992) Clinically Oriented Anatomy. Third ed., Williams & Wilkins, Baltimore, p 429

13. Ortigüela ME, Wood MB, Cahill DR (1987) Anatomy of the sural nerve complex. Hand Surg 12 1119-1123

14. Staniforth P, Fisher TR (1978) The effects of sural nerve excision in autogenous nerve grafting. Hand 10 187-190

15. Williams PL, Warwick R, Dyson M, Bannister LH (1995) Gray's Anatomy, 38th edition. Churchill Livingstone, Edinburgh, p 1285

Back to the SRA-EE Home Page

Last change: August 29, 2000

helpdesk.link@springer.de