

A STUDY OF THE FORMATION OF THE SURAL NERVE IN ADULT MAN

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FIVE FIGURES

INTRODUCTION

According to textbooks of anatomy the sural nerve is either a direct continuation of the medial sural cutaneous branch of the tibial nerve or is formed by the union of this nerve with the peroneal communicating branch of the lateral sural cutaneous nerve (a branch of the common peroneal nerve). This union may take place anywhere between the popliteal fossa and the lateral malleolus.

Information on the site and type of formation of the sural nerve in various nationalities has been gathered by Bardeen ('06), Gluschkow ('18), Catania ('24), Kosinski ('25), Andreassi ('31), Ssokolow ('33), Mogi ('38), P'an ('39) and Williams ('54). In the majority of these studies the cadaver material was known to be of one nationality. In general, however, the nationality and the degree of racial mixture of the cadaver material in the United States is unknown to the anatomist.

MATERIALS AND METHODS

The material of this study consisted of 352 lower limbs of which approximately 70% were dissected by the author. The remainder were checked and recorded by the author from routine classroom dissections. One hundred eighty-one (51.4%) right side and 171 (48.6%) left side dissections

were recorded. Separation according to race and sex was not made.

The data here presented were obtained by examination of material in the Anatomy Department of the University of Illinois School of Medicine; Loyola University School of Medicine; The Chicago Medical School; The University of Chicago School of Medicine; University of Michigan Medical School; and the University of Illinois, Department of Physiology, Urbana, Illinois.

To determine the cutaneous pattern of the posterior aspect of the leg, the tibial and common peroneal nerves were isolated in the popliteal fossa. Each nerve was then dissected to expose the origin of the medial sural cutaneous, the lateral sural cutaneous, and the peroneal communicating branches. These nerves were then traced to their termination. The manner in which the sural nerve was formed was recorded, and, if the pattern of the formation proved unusual, a sketch was made (figs. 2, 3, 4, 5).

OBSERVATIONS AND RESULTS

Three types of sural nerves, designated A, B, and C may be described (after P'an, '39). In type A, the sural nerve is formed by the union of the medial sural cutaneous branch of the tibial nerve and the peroneal communicating branch of the common peroneal nerve. Occasionally the peroneal communicating branch joins the medial sural cutaneous nerve by more than one branch (figs. 4 and 5). The union of these two nerves occurs in the lower half of the leg. In type B, the sural nerve is the continuation of the medial sural cutaneous nerve and the peroneal communicating branch is absent. The type C sural nerve is formed by the peroneal communicating branch only. This type is rare; in only one specimen was the medial sural cutaneous nerve completely absent (fig. 1).

The frequency of occurrence of the three types of sural nerves is presented in table 1. Of the 352 lower extremities, 284 or 80.7% belong to type A; 67 limbs (19.0%), to type B;

and only one limb (0.3%), to type C. The A and B types appear with the same frequency whether in the right or the left limb.

Previous investigations of the formation of the sural nerve in American cadavers have shown conflicting results (table 2). The data of Williams agree closely with those of this study,

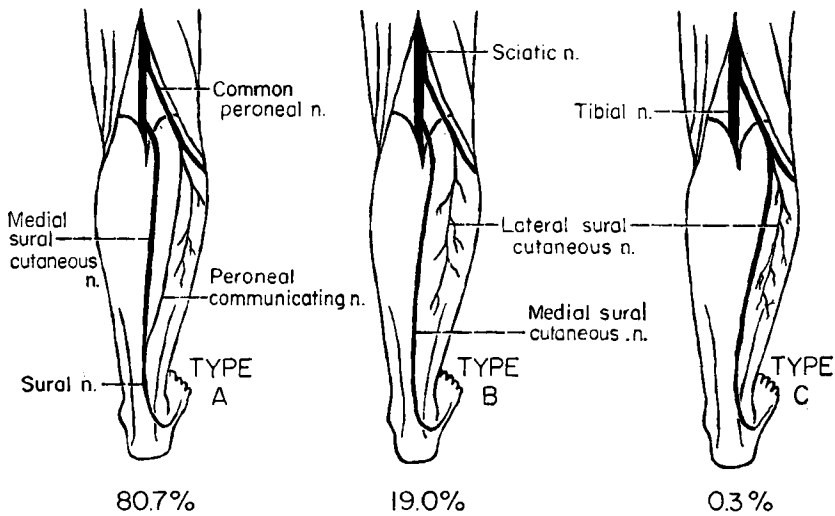


Fig. 1 The manner of formation of the sural nerve. A type A sural nerve is formed by both components. A type B nerve is a continuation of the medial sural cutaneous nerve. Type C is the rare type of formation in which only the peroneal communicating branch extends to the foot as the sural nerve.

TABLE 1
The distribution of the three types of sural nerves

TYPE	RIGHT		LEFT		COMBINED	
	Number	%	Number	%	Number	%
A. Anastomotic	146	80.7	138	80.7	284	80.7
B. Tibial non-anastomotic	35	19.3	32	18.7	67	19.0
C. Peroneal non-anastomotic	0	0.0	1	0.6	1	0.3
Total	181	100.0	171	100.0	352	100.0

but Bardeen's data differ considerably. He indicated that the type A formation is found in only 59.2% of cases, while type B occurred in 39.5% of the dissections.

Examination of the distribution of the three types of sural nerves in Chinese, Japanese, Russian, Italian and Polish material show a marked difference between the Oriental and European groups (table 3). Comparison of tables 2 and 3 reveals that American and Oriental groups are quite similar both having approximately the same distribution of the three types of sural nerve. It might be expected that the present findings and those of Williams would approximate those of

TABLE 2
Frequency of the three types of sural nerves in American cadavers

TYPES	HUELKE 1956 352 Cases ¹	WILLIAMS 1954 257 Cases	BARDEEN 1906 76 Cases
	%	%	%
A. Anastomotic	80.7	83.7	59.2
B. Tibial non-anastomotic	19.0	15.9	39.5
C. Peroneal non-anastomotic	0.3	0.4	1.3

¹ In this study, data were taken from 132 limbs which were also used by Williams in his report.

the European series since most of the American cadavers are Caucasian (89.8% in this study; Williams — 83.1%). This is not the case however, for the European groups have a markedly different distribution of the three types of sural nerves (table 3). The non-Caucasian limbs of this study are from Negro cadavers. The findings on these limbs do not alter the percentages presented, for the type A sural nerve is predominant among the Negro cadavers.

In type A the site of union of the medial sural cutaneous nerve and the peroneal communicating branch is extremely variable. This union may take place anywhere between the popliteal fossa and the lateral malleolus. In recording the

TABLE 3
Frequency of the three types of sural nerves in Oriental and European groups

	CHINESE (P'an) 1939 286 cases	JAPANESE (Mogi) 1938 180 cases	RUSSIAN (Gluschkow ¹) 1918	RUSSIAN (Skoklow) 1933 500 cases	ITALIAN (Andrassi) 1911 144 cases	ITALIAN (Catania) 1924 94 cases	POLISH (Kosinski) 1924 234 cases
	%	%	%	%	%	%	%
A. Anastomatic	81.5	83.3	38.0	52.6	63.9	51.0	40.2
B. Tibial non-anastomatic	13.3	16.7	58.0	43.8	34.7	35.0	53.8
C. Peroneal non-anastomatic	5.2	0.0	4.0	3.6	1.4	14.0	6.0

¹ Number of cases not stated.

TABLE 4
Analysis of the site of formation of sural nerves of type A

	AMERICAN (Huelke) 284 cases	CHINESE (P'an) 233 cases	POLISH (Kosinski) 94 cases	JAPANESE (Mogi) 150 cases	RUSSIAN (Skoklow ¹) 263 cases
1. Upper quarter of the leg	Right 32 } Left 37 } 24.3%	Right 7 } Left 9 } 6.9%	9.3%		
2. Second quarter of the leg	Right 25 } Left 23 } 16.9%	Right 11 } Left 14 } 10.7%	18.6%		
3. Third quarter of the leg	Right 58 } Left 46 } 36.6%	Right 64 } Left 56 } 51.5%	65.1%		
4. Fourth quarter of the leg	Right 31 } Left 32 } 22.2%	Right 32 } Left 40 } 30.9%	7.0%		
1. Upper one-half and of the leg	Right 57 } Left 60 } 41.2%	Right 18 } Left 23 } 17.6%	27.9%	33.3%	34.2%
3. Lower one-half and of the leg	Right 89 } Left 78 } 58.8%	Right 96 } Left 96 } 82.4%	72.1%	66.7%	65.8%
Ratio (1 and 2):(3 and 4)	1:1.4	1:4.7	1:2.6	1:2.0	1:1.9

¹ The author in this series divided the leg into three regions instead of four. P'an converted the data to conform with the Chinese and Polish series.

² No data available for the Italian (Catania and Andrassi), Russian (Gluschkow), or American (Bardcen and Williams).

TABLE 5
Symmetry and asymmetry in the formation of the sural nerve¹

TYPES OF SURAL NERVE	AMERICAN (Huelke ²) 150 bodies		CHINESE (Pan) 148 bodies		JAPANESE (Mogi) 90 bodies		RUSSIAN (Sokolow) 250 bodies	
	no.	%	no.	%	no.	%	no.	%
A. Anastomatic	108	72.0	105	73.4				
B. Tibial non-anastomatic	16		12					
C. Peroneal non-anastomatic	0	10.7	3	10.5				
Total (A + B + C)	124	82.7	120	83.9				
MIXED TYPES:								
Right A; Left B or C	15		9					
Left A; Right B or C	11	17.3	14	16.1				
Asymmetrical								

¹ See footnote 2, table 4.
² Of the 352 limbs used in this study, 52 were unpaired; therefore only 300 limbs (150 individuals) are presented.

observations, each leg was considered to be divided into 4 parts. The popliteal fossa was designated as region 1. The limb distal to the fossa was divided into three equal parts — the second quarter, the third quarter, and the fourth quarter of the leg. Analysis of the level of formation of the type A sural nerve of this study, along with the data collected by other investigators, is presented in table 4.

The Chinese and Polish series are very much alike in that the sural nerve is formed more frequently in the lower half of the leg than in the upper, and most frequently in the third quarter of the leg. The Japanese and Russian series also show the lower half of the leg as being the more frequent site of union.

The data collected in this study indicate that the third quarter of the leg is the most constant site for the formation of the sural nerve. The ratio between the upper half and the lower half of the legs examined is 1:1.4, whereas in the nationalities mentioned above this ratio is more striking, Chinese 1:4.7; Polish 1:2.6; Japanese 1:2.0; Russian 1:1.9 (table 4).

Observations on symmetry and asymmetry in the formation of the sural nerve in both legs of the same body are presented in table 5. The symmetrical group had the same type of formation in both legs, while the asymmetrical group had the anastomotic type (A) in one leg and a non-anastomotic type (B or C) in the other leg.

In 150 bodies (300 paired lower limbs), 124 nerve patterns were symmetrical and 26 were asymmetrical. Of the 124 symmetrical patterns 108 were the anastomotic type (A); 16 were of the non-anastomotic type (B). The American, Chinese, Japanese and Russian groups had practically the same percentage of symmetrical and asymmetrical distribution. In the symmetrical group the anastomotic type was more frequent in the American (72.0%), Chinese (73.4%) and Japanese (74.4%) than in the Russian (42.0%). Conversely the non-anastomotic type appeared more often (36.8%) in

the Russian group than in the American (10.7%), Chinese (10.5%) or Japanese (7.8%) groups.

Information on the distribution of the cutaneous nerves in anthropoids indicates that the sural nerve is always of the tibial non-anastomotic type (Ssokolow, '33). In man the formation of this nerve is more complex; in 80.7% the sural nerve is formed by two component branches, one from the tibial nerve, the other from the common peroneal nerve. Rarely (0.3%) is it formed only by a branch from the common peroneal nerve. Approximately one instance in five is of the tibial non-anastomotic type, which is the constant type among the anthropoids.

SUMMARY

1. The site and formation of the sural nerve were studied in 352 lower limbs of adult cadavers from midwestern United States.

2. The sural nerve was formed by two components; one from the tibial, the other from the common peroneal nerve in 284 limbs (80.7%). Occasionally the sural nerve is a continuation of the tibial portion only (19.0%); very rarely does it consist of a peroneal branch without a tibial component (0.3%).

3. The sural nerve was formed most frequently in the third quarter of the leg (36.6%) and more often in the lower half (58.8%) than in the upper half (41.2%).

4. The majority of cadavers (82.7%) had the same type of sural nerve in both legs.

5. The similarities of the site and formation of the sural nerve in American, Chinese and Japanese bodies, and the differences between these and European groups are noted.

ACKNOWLEDGMENT

The author is indebted to Dr. W. P. Elhardt, Department of Physiology, University of Illinois; Drs. R. T. Woodburne,

W. T. Dempster, and T. M. Oelrich, Department of Anatomy, University of Michigan Medical School, for their encouragement, assistance and criticism.

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PLATE 1

EXPLANATION OF FIGURES

Variations in the formation of sural nerves of type A

- Sc --- sciatic nerve; T --- tibial nerve; Cp --- common peroneal nerve; Pc --- peroneal communicating branch; MSC --- medial sural cutaneous nerve; LSC --- lateral sural cutaneous nerve; S --- sural nerve.
- 2 The peroneal communicating branch crosses over the medial sural cutaneous nerve to join it on its medial side in the 4th quarter of the leg.
 - 3 The peroneal communicating branch gives off a large branch to the skin behind the lateral malleolus just before forming a sural nerve of type A.
 - 4 A type A sural nerve formed by two peroneal communicating branches joining the medial sural cutaneous nerve.
 - 5 The medial sural cutaneous nerve is shown joining the peroneal communicating branch by two radicles and then ending in a cutaneous termination behind the medial malleolus.

