รายงานการวิจัยฉบับสมบูรณ์

เรื่อง

การศึกษาทางกายวิภาคศาสตร์ของ sural nerve และความสำคัญทางคลินิก

(*Sural Nerve and Clinical Implications : Anatomical Study*)

โดย

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บทคัดย่อ

(Abstract)

การศึกษาทาง morphological ของเส้นประสาท sural ในร่างอาจารย์ใหญ่คนไทย 76 ร่าง เป็นเพศชาย 45 ร่าง เพศหญิง 31 ร่าง อายุในช่วง 15-92 ปี พบว่าเส้นประสาท sural ที่เกิดจากการเชื่อมต่อกันของ medial sural cutaneous nerve (MSCN) and lateral sural cutaneous nerves (LSCN) ซึ่งเป็นแขนงของเส้นประสาท tibial and the common peroneal ตามลำดับ 67.1 % โดยจุดเชื่อมต่ออยู่บริเวณ popliteal space 5.9% (6/102) mid leg 1.9% (2/102) , lower third of the leg 66.7 %(68/102) และ ankle 25.5% (26/102) มีเส้นประสาท sural หนึ่งเส้น (0.7%) ที่เกิดจากการเชื่อมต่อกันของ MSCN และแขนงจกเส้นประสาท common peroneal ที่ทอดขนานกับเส้นประสาท LSCNและไม่เชื่อมต่อกับเส้นประสาท LSCN ซึ่งเชื่อมต่อกันที่ lower third ของขา ส่วนที่เหลือ 32.2% (49/152) ของเสนประสท sural เกิดจากส่วนที่ต่อมาจากเส้นประสาท MSCN

เส้นประสาท sural มควมยาวอยู่ในช่วง 6-30 เซ็นติเมตร (ส่วนใหญ่อยู่ในช่วง 13-18 ซม.) และมีขนาดเส้นผ่าศูนย์กลาง 3.5-3.8 มิลลิเมตร และทอดอยู่ด้านหลังต่อขอบหลังของ lateral malleolus 1-1.5 เซ็นติเมตร

เส้นประสาท LSCN ซึ่งเป็นหนึ่งของเส้นประสาท sural ทอดอยู่ค่อนข้างผิวโดยมีความยาว 19-24 เซ็นติเมตร และขนาดเส้นผ่าศูนย์กลาง 2.7-3.4 มิลลิเมตร

เส้นประสาท sural มักถูกใช้อย่างแพร่หลายในทางคลินิกทั้งในแง่การวินิจฉัย (biopsy and nerve conduction velocity study) และการรักษา (nerve graft) ดังนั้นการศึกษารายละเอียดทางกายวิภาคศาสตร์ของมันอย่างถ่องแท้ย่อมเป็นประโยชน์ต่อทางคลินิกดังกล่าว จากผลการศึกษาพบว่าขนาดของเส้นประสาท LSCN ไม่ได้เล็กกว่าเส้นประสาท sural มากนักและยาวกว่าด้วย ฉะนั้นเส้นประสาท LSCN น่าจะเป็นทางเลือกหนึ่งที่แพทย์น่านำมาใช้ทางคลินิกแทนเส้นประสาท sural เพื่อลดบริเวณที่จะเกิดการศูญเสียความรู้สึกลงหลังการทำ procedure ทางคลินิก

Key words : sural nerve graft, sural nerve biopsy

Abstract

An anatomical morphological study of the sural nerves was carried out on 76 Thai cadavera, of which 45 were males and 31 females with an age range between 15 - 92 years. The results revealed 67.1 % of the sural nerves to be the result of a union between the medial sural cutaneous nerve (MSCN) and lateral sural cutaneous nerves (LSCN) , each a branch from the tibial and the common peroneal nerves respectively. The point of union was 5.9% (6/102) at the popliteal space, 1.9% (2/102) at the mid leg, 66.7 %(68/102) at the lower third of the leg and 25.5% (26/102) at the ankle. One sural nerve (0.7%) resulted from the union between MSCN and a branch of the common peroneal nerve, running parallel but not connecting with the LSCN and joining at the lower third of the leg.

The other 32.2% (49/152) of sural nerves were the direct continuation of the MSCN.

The sural nerves were 6-30 cm long (mostly 13-18 cm) and had a diameter between 3.5-3.8 mm., easily located 1-1.5 centimeters posterior to the posterior border of the lateral malleolus .

The LSCN, a precomponent of the sural nerve was found lying superficially in the subcutaneous tissue, mostly 19-24 cm long and had a diameter of 2.7 to 3.4 mm.

The sural nerve are widely used clinically for both diagnostic (biopsy and nerve conduction velocity study) and therapeutic purposes (nerve graft), thus a detailed knowledge of their anatomy would be useful for the above clinical applications. Besides, since the size of the LSCN was not much smaller than that of the sural nerve itself and was relatively longer , thus the LSCN could be a good alternative for the sural nerves and the resultant sensory deficit would also be smaller as well.

Key words : nerve graft, nerve biopsy, nerve conduction velocity

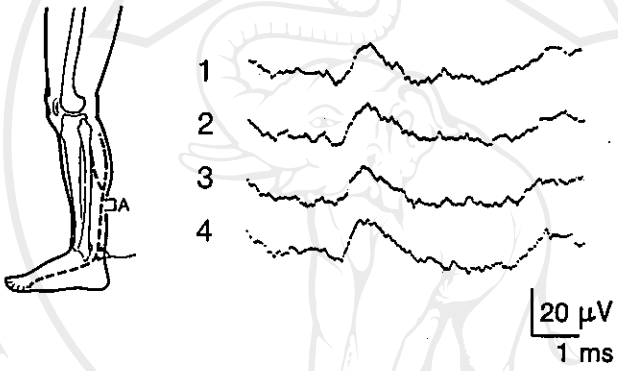
Introduction

The sural nerve is a sensory nerve supplying the skin of the lateral and posterior part of the inferior third of the leg and the lateral side of the foot (Moore and Dalley, 1999). Generally it is described as the product of a union between the medial sural cutaneous nerve (MSCN) which is a branch of the tibial nerve and the lateral sural cutaneous nerve (LSCN), a branch of the common peroneal nerve, or a union between the MSCN and the peroneal communicating branch (PCB) (Rosse and Rosse, 1997; Moore and Dalley, 1999; Snell, 1995; Leonard, 1995; April, 1990; McMinn, 1994; Hall-Craggs,1995; Chung, 1995; Woodburne and Burkel, 1994), at a highly variable level (Moore and Dalley , 1999; McMinn,1994; Woodburne and Burkel, 1994).

The site of union may be located at the popliteal fossa, distal third of the leg or the ankle but wihout a definite detail (Moore and Dalley, 1999; McMinn, 1994; Woodburne and Burkel,1994). Literature reviews revealed 80% of the sural nerves to be a union between MSCN and PCB, and 20% as the direct continuation of the MSCN alone (Ortiguela et al, 1987). Other study revealed the sural nerves to be the result of union between MSCN and LSCN, joining 12% at the popliteal fossa and 84% at the lower third of the leg (Coert and Dellon, 1994).

The sural nerves are widely used clinically for diagnostic puspose (in sensory nerve conduction velocity study and biopsy) (Fig.1) (Connolly, 1996; Olney, 1999,) and therapeutic purpose (as in nerve graft) (McGillcuddy, 1996) (Fig. 2). Ortiguela et al (1987) suggested to make use of the LSCN, a precedental component of the sural nerve, as the alternative for the sural nerve, since the size was not much different and the resultant sensory deficit would also be smaller. Thus a detailed morphological description of the sural nerve and its precedental components would be beneficial and desirable . However this is not available in Thai people, this study is thus made in Thai cadavera for the purpose.

A



B

Figure 1 : the procedure of sensory nerve conduction velocity (A) and the result of SNCV (B)

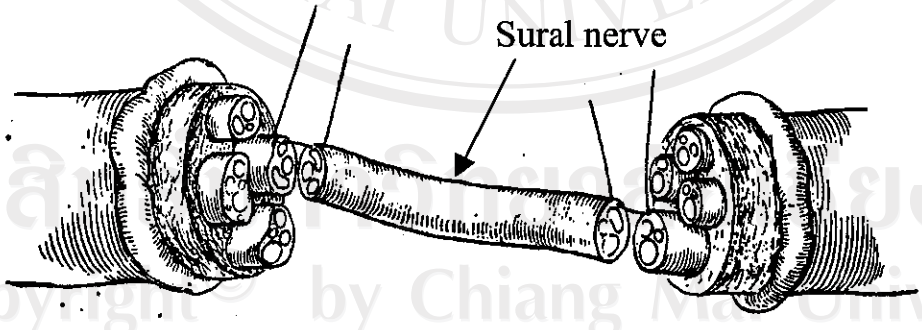


Figure. 2 : The procedure of sural nerve graft by perineurium suturing

(McGillcuddy,1996)

Material & Methods

The study was made on 76 Thai cadavera, 45 male and 31 female with an age range between 15-92 years.

The dissection was made through a longitudinal incision, one centimeter posterior to and parallel with the posterior border of the lateral malleolus. The sural nerve was located and identified in the subcutaneous tissue level in the vicinity, and traced proximally upto the point where the MSCN and LSCN (or peroneal communicating branch)converged to form the sural nerve. The MSCN and LSCN were further traced to where each branched off from the tibial and common peroneal nerve respectively, or until the sural nerve was confirmed to be derived from the tibial nerve.

Records were made of the courses of the MSCN and LSCN, the point where they joined (if any), and the size or diameter of each nerve including the sural ,MSCN, LSCN in millimeters, using vernier calipers. The length of each nerve was measured in centimeters, using a measuring tape.(from the point of branching to joining for MSCN and LSCN; and from lateral malleolus to the point of joining for the sural).

The diameter of the sural nerve deriving from the MSCN alone was measured arbitrarily at its point of emergence from the deep crural fascia, and the length from the same point to the lateral malleolus.

The distance between the posterior border of the lateral malleolus to the location of the sural nerve was also measured in centimeters.

Results

The results revealed asymmetry in 80.3% (61/76) and symmetry in 19.7% (15/76) between the legs of all specimens. 67.1% (102/152) of the sural nerves were the result of union between MSCN and LSCN with 0.7% (1/152) the union between MSCN and a branch (not the LSCN) from the common peroneal nerve, and 32.2% (49/152) the continuation of MSCN. The point of convergence was located 5.9% (6/102) in the popliteal fossa, 1.9% (2/102) at mid leg, 67.4% (69/102) at lower third of the leg and 25.5% (26/102) at the ankle. (Table 1) (Fig. 3)

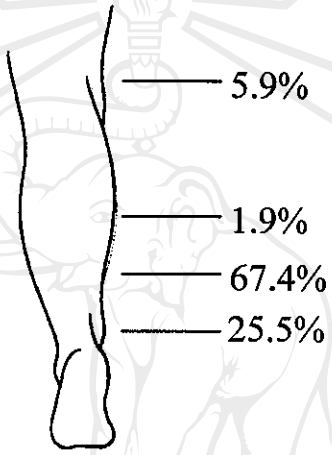


Figure. 3 : percentage of site of union

Table 1 : precedental components of sural nerve and sites of union

No of cadaver	Age range	sex		Precedental components		Site of union			
		Male	female	MSCN+LSCN	MSCN	Popliteal fossa	mid-leg	lower1/3	Ankle
76	15-92	45	31	102	49	6	2	69*	26

* Including one sural nerve (0.7%) resulting from the union between MSCN and a branch of the common peroneal nerve, running parallel but not connecting with the LSCN and joining at the lower third of the leg.

One sural nerve resulted from the union between MSCN and a branch of the common peroneal nerve, running parallel but not connecting with the LSCN and joining at the lower third of the leg, (as stated in the preceding paragraph).

The MSCN was a branch of the tibial nerve, leaving it posteriorly into the popliteal fossa and descended between the two heads of the gastrocnemius muscle. It pierced the deep crural facia at the lower third of the leg either to join the LSCN to become the sural nerve (Fig. 4) , or continued distally as the sural nerve. (Fig. 5) Its length ranged between 17-31 cm , mostly between 21-26 cm and its diameter 2.3-2.5 mm. (Table 2)

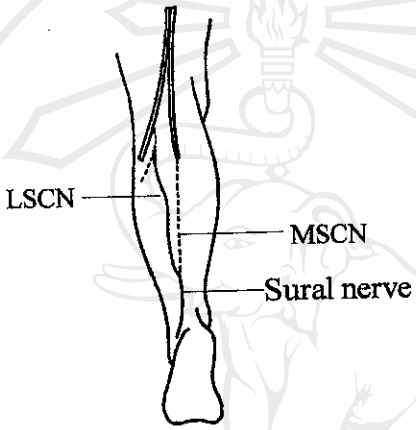


Figure. 4 : sural nerve and its precedental component LSCN, latral sural cutaneous nerve; MSCN, medial sural cutaneous nerve

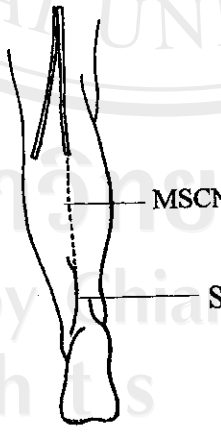


Figure. 5 : sural nerve, continuation of MSCN MSCN : medial sural cutaneous nerve

The LSCN was a branch of the common peroneal nerve, piercing the deep fascia of the popliteal fossa to lie superficial in the superficial crural subcutaneous tissue and joined the MSCN to become the sural nerve (Fig.4). The portion of the LSCN jointing the MSCN is called peroneal communicating branch by some authors(Ortiguela et al, 1987; Rosse and Rosse, 1997; Snell, 1995; McMinn, 1994; April, 1990; Chung, 1995). Its length ranged between 15-32 cm, mostly between 19-24 cm and its diameter 2.7-3.4 mm. (Table 2)

Table 2 : Size and length of the sural nerve & its precedental components

Nerve	diameter at branching off (mm)	Length range (cm)
Medial sural cutaneous nerve	2.3 – 2.5	17-31
Lateral sural cutaneous nerve	2.7 – 3.4	15-32
Sural nerve (after joining)	*3.5 – 3.8	6-30

* excluding those sural nerves, joining at the ankle and those derived from MSCN alone.

The sural nerves after joining (Fig.4), accompanied the lessor saphenous vein, without branching and had a length of 6-30 cm, mostly 13-18 cm with a diameter between 3.5-3.8 mm (Table2). Those that were derived from the MSCN alone had a diameter between 2-3.5 mm., and were 8-11 cm long (Fig.5). All sural nerves were 1-1.5 cm posterior to and parallel with the posterior border of the lateral malleolus (Table 2).

Discussion

Asymmetry of 80.3% between sural nerves in both legs seems to be the rule rather than an exception. This is of no surprise when considering that sural nerves are sensory nerves. Concerning the precedental components of the sural nerves, this study showed the sural nerves to be a result of union between MSCN and LSCN of 67.1% and the continuation of the MSCN alone of 32.2%. While Ortiguela et al (1987) found as union between MSCN and peroneal communicating branch (PCB) of 80% and the continuation of MSCN alone of 20%. But those found by Coert and Dellon (1994) of 96% and 4 % respectively were quite diferrent from ours (Table 3). However these variations could be from racial , geographical, life style difference or even the number of specimens studied. Besides, Moore and Dalley (1999) would not accept the continuation of MSCN as the sural nerve, while Coert and Dellon (1994) called the union between MSCN and LSCN common sural nerve.

Table 3 : Comparing the studies with other authors

Authors	no. cadaver	MSCN+LSCN (%)	MSCN alone (%)	popliteal fossa (%)	mid-leg (%)	lower1/3 (%)	ankle (%)
Ortiguela et al., 1987	10	80	20				
Coert and Dellon, 1994	25	96	4	12		84	-
Mahakkanukrauh	76	67.1	32.2	5.9	1.9	67.4*	25.5

* Including one sural nerve, the result of union between MSCN and a branch of the common peroneal nerve, (not the LSCN).

The site of convergence or joining between MSCN and LSCN to become sural nerves was mostly found in the lower third of the leg : 66.7%+0.7% as most other authors, although our study showed scattering sites from the popliteal fossa to the ankle (Table 1) , with two converging in mid leg (1.9%) and 26 (25.5%) in the ankle . In this study a separate branch from the common

peroneal nerve, running along side a LSCN, traversed the leg to join the MSCN in the lower third of the leg to become the sural, Ortiguela et al (1987) also reported one just like this.

The size of the LSCN of 2.7-3.4 mm was quite close to that of the sural nerve of 3.5-3.8 mm, and its length was quite long. These findings were in agreement will those of Ortiguela et al (1987). Thus to use it as an alternative for biopsy or grafting is quite worthy of consideration. Furthermore, in utilizing sural nerve as grafting material Ortiguela et al (1987) found a 6.1 % (or 4/66 patients) incidence of painful neuroma and 9.1% (or 6/66 patients) incidence of some degree of dissatisfaction due to altered sensation over the lateral aspect of the foot and ankle while Staniford and Fisher (1978) also found 44% incidence of uncomfort at the lateral aspact of the foot and ankle and 42% incidence of calf tenderness, characteristic of neuroma. By using LSCN as the alternative all these ill effects may hopefully be minimized.

The MSCN is not suitable for a sural nerve alternative because it is rather small and situated rather deep.

The location of the sural nerve at 1-1.5 cm. posterior to the posterior border of the lateral malleolus can be an accurate landmark for surgical approach or for electrode placement for sensory nerve conduction velocity study.

Another noteworthy point is that quite a number (25.5%) of the sural nerves formed at the ankle with a diameter of 4-7 mm so, clinically useful nerve grafting material would have to depend on the LSCN in such instances.

Finally this study yielded quite useful informations for clinical applications reconfirming what many authors (Connolly, 1996; Olney, 1999; McGillcuddy, 1996) have stated that since the sural nerve is long, relatively superficially situated, with relatively constant anatomical location , unbranching throughout its whole length and can be evokely tested electrically, making it the most common donor nerve for nerve graft, and most commonly used for nerve biopsy which is most helpful in the diagnosis of peripheral neuropatly and for sensory nerve conduction velocity in evaluating polyneuropathy .

Conclusion : An anatomical study of 152 limbs in 76 Thai cadavera revealed 67.1 % of the sural nerves to be the result of a union between MSCN and LSCN. The point of union was 5.9% at the popliteal space, 1.9% at the mid leg, 67.4 % at the lower third of the leg and 25.5% at the ankle. The other 32.2% was the direct continuation of the MSCN.

The sural nerve was mostly 13-18 cm long and had a diameter between 3.5-3.8 mm, easily located 1-1.5 cm posterior to the posterior border of the lateral malleolus . The LSCN was mostly 19-24 cm long and had a diameter of 2.7 to 3.4 mm.

The results should be useful both for diagnostic and therapeutic purposes . The LSCN could be a good alternative for the sural nerve clinically.

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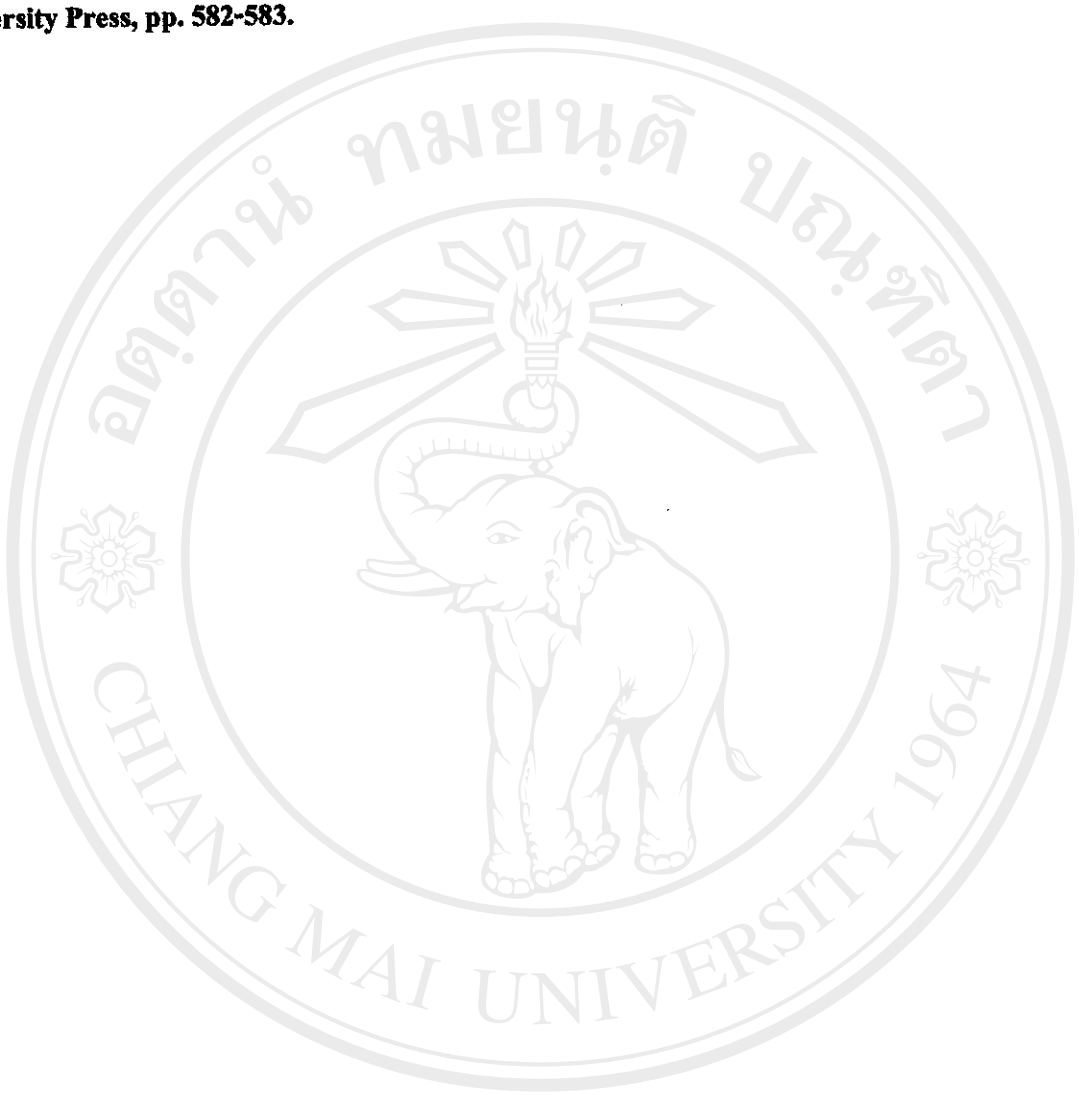

Curriculum Vitae

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