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# Anatomic study of selective neurectomy of gastrocnemius muscle for calf reduction in Chinese

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## KEYWORDS

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**Summary** *Background:* Selective neurectomy of the innervating nerves of the gastrocnemius muscle is a popular method employed for calf reduction. However, accidental injury to the untargeted adjacent nerves could happen. This study aims to provide detailed morphometry of the motor branches from the tibial nerve innervating the gastrocnemius muscle, the soleus and the medial sural cutaneous nerve in the popliteal fossa.

*Methods:* 23 lower legs from female cadavers were dissected to explore the origin, length of and the spatial relationship between the four branches given off from the tibial nerve in the popliteal fossa.

*Results:* Our study showed there were seven origin patterns existing among the four nerve branches; the origin of the branches to the medial and lateral heads of the gastrocnemius muscle was located ranging from –16 mm to 22 mm away from the midpoint of the line between the lateral and medial condyles of the femur; In 95% of the specimens, the location of the origin of the nerve branch to the medial head was proximal to its lateral counterpart. The nerve to the medial head was often given off from the medial aspect or the posteromedial aspect of the tibial nerve, while the other three often from the lateral aspect.

*Conclusions:* A variety of origin patterns among the nerves to the lateral and medial gastrocnemius muscle, the nerve to the soleus muscle and the sural cutaneous nerve exist, necessitating the formulation of diversifying surgical strategies preoperatively and the meticulous and sequential dissection intra-operatively to ensure the lowest level of accidental injury.

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With the rapid development of economy and then improvement of life standard in China, a variety of cosmetic problems which used to be neglected are now attracting growing attention, an example of which is the plump lower legs in Chinese women. Currently, an increasing number of Chinese women are now considering calf reduction. Due to the scarcity of the subcutaneous fat in the calf, pure liposuction is limited in its effect for calf reduction, which directs the plastic surgeons to seeking other measures. Reducing the volume of the gastrocnemius muscle is a choice. Currently, there are two methods available: one is direct resection of part of the gastrocnemius muscle,<sup>1-3</sup> the other selective neurectomy, causing denervation atrophy of the gastrocnemius muscle.<sup>4-6</sup> These two methods have their respective advantages, disadvantages and clinical implications. This study aims to elucidate the precise anatomic details of the muscular branches of the tibial nerve to the gastrocnemius muscle and the soleus, and the medial sural cutaneous nerve in popliteal area. The outcomes of this study can provide useful information for surgeons to avoid damage to untargeted nerves, preventing gait disturbance and sensory loss in selective neurectomy for calf reduction.

## Materials and methods

A total of 23 embalmed lower leg specimens were used, all with the arteries injected with red latex. A horizontal line was drawn from the medial condyle to the lateral condyle of the femur and designated as level 0. The origin of the motor branch of the tibial nerve above level 0 was categorized as positive and vice versa. Dissection and exploration of the tibial nerve in the popliteal fossa were then performed. The two heads of the gastrocnemius muscle were retracted apart to trace the entrance of nerve branches into the muscle. The origin, width and length of the motor branches to the medial and lateral heads of the gastrocnemius muscles from the tibial nerve were measured and documented. Due to the various origin patterns found in this study, we made a consensus in obtainment of the related data: in origin patterns where common trunk existed, the origin of a nerve branch was defined as the site where it was issued off from the tibial nerve (including the length of the common trunk), the length of a nerve branch was defined as the distance between its origin to the site where it entered the muscle and the width of a nerve was measured at the site immediately distal to the common trunk. The relationship among the motor branches to the medial and lateral heads of the gastrocnemius muscle, the motor branch to the soleus and the medial sural cutaneous nerve were also documented. The hip joint was used as the landmark when words such as "proximal" and "distal" were used. All data obtained were processed with SPSS 13 and expressed as Mean  $\pm$  SD.

## Results

Anatomic results of the lower legs from the female cadavers showed that the tibial nerve in the popliteal fossa gave off four nerve branches in a proximal-to-distal

direction: the medial sural cutaneous nerve, the motor branches to the medial and lateral heads of the gastrocnemius muscle and the motor branch to the soleus. These nerve branches had seven patterns of origin as listed in Table 1 and (Figure 1).

### The measurement of the motor branches to the medial and lateral gastrocnemius muscles

In our series of dissection, under the majority of circumstances, each of the lateral and medial heads of the gastrocnemius muscles was innervated by, a nerve branch emanated from the tibial nerve, respectively, whereas in two cadavers two nerve branches could be found to supply the medial head, with the proximal branch being larger in diameter and the distal branch bifurcating to enter the muscle. Through measurement, we found that the origin of the nerve branches to the medial and lateral heads ranged from -16 mm to 22 mm away from the midpoint of the datum line, with a mean value of  $3.8 \pm 6.9$  mm. Detailed data were shown in Table 2. The common trunks had an average length of  $1.2 \pm 0.5$  cm, with the longest one being 2.2 cm.

**Table 1** Patterns of origin that could found among the motor branches to the gastrocnemius muscle, soleus and the medial cutaneous nerve.

Pattern	Common trunk	Ratio
I	No common trunk among four nerve branches	10/23(44%)
II	Common trunk between the nerve branches to medial and lateral gastrocnemius muscles	4/23(17%)
III	Common trunk between the medial sural cutaneous nerve and the nerve branch to the medial gastrocnemius muscle	1/23(4%)
IV	Common trunk among the medial sural cutaneous nerve, the nerve branches to the lateral gastrocnemius muscle and the soleus muscle	4/23(17%)
V	Common trunk between the nerve branches to the lateral gastrocnemius muscle and the soleus muscle	2/23(9%)
VI	Two common trunks, one between the nerve branch to the medial gastrocnemius muscle and the medial sural cutaneous nerve, and the other between nerve branches to lateral gastrocnemius muscle and the soleus muscle	1/23(4%)
VII	Common trunk among the nerve branches to the medial and lateral gastrocnemius muscles and the soleus muscle	1/23(4%)

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