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ANOMALOUS COURSE OF THE MEDIAL SURAL CUTANEOUS NERVE AND ITS CLINICAL IMPLICATIONS

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ABSTRACT

The sural nerve is formed by the union of the medial sural cutaneous nerve, which is a branch of the main trunk (the tibial nerve), and the common fibular communicating branch of the lateral sural cutaneous nerve, which is a branch of the common fibular nerve. Anatomical variations in the formation of the sural nerve are common, although the topographical localization of this nerve is constant. In this report, we describe three cases of an anomalous course of the medial sural cutaneous nerve which descended through the gastrocnemius via a tunnel formed within the muscle. Such anatomical variations of the sural nerve are clinically important when evaluating sensory axonal loss in distal axonal neuropathies since sural nerve mononeuropathy is less likely to occur.

Key words: Gastrocnemius, leg, medial sural cutaneous nerve, variations

INTRODUCTION

Anatomical variations are frequent in the formation of the sural nerve, although the topographical localization of this nerve is invariable [1]. The sural nerve is generally formed by the union of the medial sural cutaneous nerve, derived from the tibial nerve, and the communicating fibular branch of the lateral sural cutaneous nerve, a branch derived from the common fibular nerve [1,3,8,10,15,16]. The union that results in the formation of the sural nerve occurs in the middle or lower third of the leg, at the popliteal fossa, at or just below the ankle [7], after the medial sural cutaneous nerve exits the deep fascia [3].

According to Bergman *et al.* [1], the medial sural cutaneous nerve may pierce the medial head of the gastrocnemius muscle prior to continuing distally and descending laterally to the calcaneal tendon [15,16]. Beyond the calcaneal tendon, the nerve curves beneath the lateral malleolus with the fibular tendons and passes along the lateral border of the foot, where it divides into medial and lateral branches [1,16].

In its course, the medial sural cutaneous nerve descends between the heads of the gastrocnemius muscle, beneath the deep fascia, after originating as a branch of the tibial nerve in the popliteal fossa [3]. In the leg, the sural nerve is responsible for sensitive innervation of the lateral border of the foot and of the fourth and fifth toes, and also provides branches to the lateral side of the ankle and heel [15,16].

The clinical importance of the sural nerve can be appreciated from the fact that this is the main nerve used to evaluate sensory axonal loss in distal axonal neuropathies, primarily because sural nerve mononeuropathy is a very rare event [14]. The intactness of this nerve is also assessed when diagnosing certain peripheral neuropathies of unknown etiology [9]. This assessment must be done carefully since alterations may be associated with symptoms such as hypoesthesia in the area innervated by the sural nerve and mild, persistent pain [5].

Although generally considered to be a sensory nerve, the existence of some communication between the sural and tibial nerves in humans suggests that the sural nerve may have a motor function [13]. This possibility increases the clinical importance of this nerve, especially in the electrophysiological diagnosis of tibial nerve dysfunctions that affect plantar muscle innervation (tarsal tunnel syndrome).

In this report, we describe three cases in which the medial sural cutaneous nerve passes through the gastrocnemius muscle and discuss the clinical implications of this anatomical variation.

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CASE DESCRIPTIONS

During the regular dissection of 30 adult male cadavers fixed and preserved in 10% formalin, three showed an unusual transmuscular course (Fig. 1A, B; see Fig. 2 for a schematic representation), the length of which was measured with a digital pachymeter. This variation in the course of the medial sural cutaneous nerve was observed only in the left leg of two cases. The length of the muscular course was 6.4 cm in one leg and 7.5 cm in the other; there were no anomalies in the course of this nerve in the right legs of these two cadavers. In the third case, the anomalous nerve course occurred in both legs, with the length of the muscular course being 9 cm and 6.5 cm for the left and right leg, respectively.

DISCUSSION

Prolonged compression, calcaneal tendon reconstructive procedures or direct trauma associated with fractures may lead to sural neuropathies anywhere along the course of the nerve [12]. Sural nerve entrapment may be associated with ganglia or post-traumatic scarring [11].

Birbilis *et al.* [2] reported a case of sural nerve neuropathy in which the nerve was compressed by induration of the surrounding soft tissue as a result of external pressure produced by the use of tightly laced boots. Seror [14] reported a similar finding in three males who used new ski boots; in these cases, the hypoesthesia in the external border of the right foot indicated sural nerve involvement.

Husson *et al.* [6] described a new canal syndrome that involved increased pain in the region of the sural nerve during plantar flexion of the leg. Pain was felt because there was compression of the sural nerve by myositis ossificans when the nerve passed through a non-extensible tunnel formed by the fold of the posterior sural aponeurosis.

Complete blockade of sensory conduction at the site where the sural nerve penetrates the deep fascia, with a mild imprint of the nerve, was described by Seror [14]. In this case, the fibrosis of the deep fascia was probably related to the lower limb injury sustained 10 months earlier.

Bryan *et al.* [3] reported the case of a patient who suffered injury to the right medial gastrocnemius

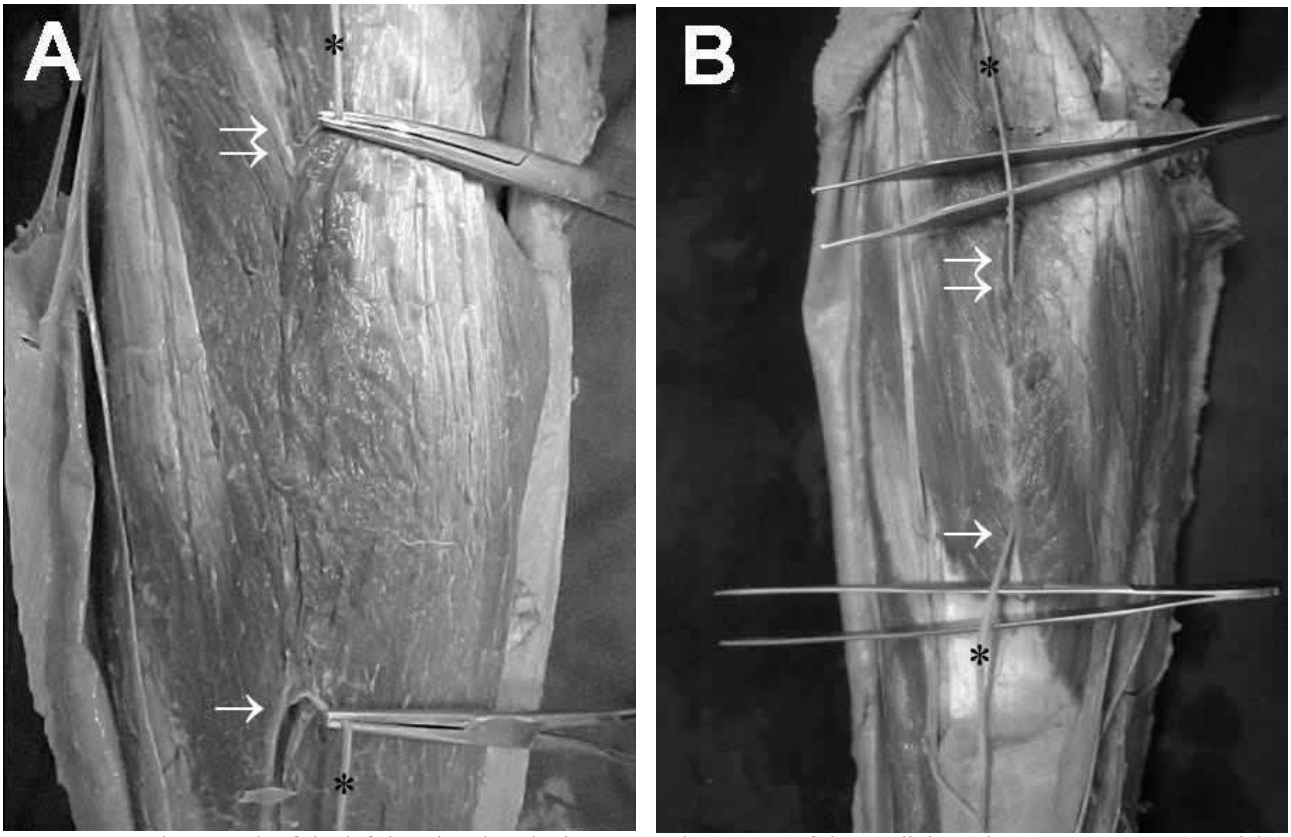

Figure 1. A) Photograph of the left leg showing the intramuscular course of the medial sural cutaneous nerve (asterisks) piercing the gastrocnemius muscle (double arrow). The single arrow shows the point of exit. **B)** Subfascial course of the sural nerve.

muscle that was complicated by referred pain in the lower leg and foot in the area innervated by the sural nerve; this pain was accentuated by plantar flexion. Surgical exploration under local anesthesia found that the sural nerve was encased in scar tissue beneath the deep fascia at the level of the gastrocnemius muscle.

Coert and Dellon [4] postulated a mechanism for entrapment of the lateral sural cutaneous nerve when it pierces the deep fascia. These authors concluded that during knee extension the fascia could exert a compressive force on the nerve, and that a biopsy of the sural nerve could result in a false diagnosis of axonal polyneuropathy in a patient with the nerve in this situation.

As shown by the foregoing literature reports, there are many cases in which the sural nerve or its branches are surrounded by fascia or scar tissue. However, the penetration of muscle by this nerve has been poorly documented in the literature. As shown here, the sural nerve followed a transmuscular course in four of 60 limbs dissected, which corresponded to a frequency of 6.7% of all legs and 10% of the cadavers. The frequency of 10% of all cadavers means that this variation is an important surgical consideration when this nerve is used as an autograft for peripheral nerve reconstruction. During the regular dissection, a precise assessment of the frequency of this muscular course is important because of the possibility of this nerve being confused with included fascia instead of the muscular course.

Clinically, this muscular course of the sural nerve could account for the calf pains experienced by patients during contraction of the gastrocnemius that is responsible for plantar flexion of the leg. Clinical confirmation of this situation might include a positive Tinel's sign at the site of nerve entrapment and the electrodiagnosis of complete sensory conduction blockade. Anatomically, this variation in nerve course may be important for evaluating sensory axonal loss in distal axonal neuropathies since sural nerve neuropathy is a rare event. Finally, this variation should be borne in mind by clinicians, surgeons and academicians who manipulate this particular anatomical site.

Figure 2. Schematic drawing of the leg to show the relationship of the sural nerve to the gastrocnemius muscle.

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