The SAN is found in the posterior cranial fossa, and is formed from spinal and cranial nerve roots. After supplying the sternocleidomastoid muscle, the SAN descends obliquely in the posterior cervical triangle of the neck, between the superficial and deep layers of the deep cervical fascia. Here it is embedded in loose connective tissue and is in contact with the cervical lymph node chain. The nerve gives off several branches to the upper part of the trapezius muscle before passing deep to its anterior edge to travel on its anterior surface.7,8

Kotani et al.5 and Allieu et al.1 introduced the use of the SAN as a transferable nerve in 1971 and 1984, respectively. Kotani et al. used this nerve for reinnervation of the upper trunk and radial and musculocutaneous nerves, and Allieu et al. used 1–2 long cutaneous grafts from this nerve to transfer to the musculocutaneous and axillary nerves. Such nerve transposition, with and without intervening cable grafts, has been used to treat suprascapular and musculocutaneous nerve lesions.

The traditional anterior approach to the SAN results in a limited length of nerve available for transfer.10 The posterior approach to the SAN has more recently been reported by some authors for ipsilateral neurotization procedures.3,4,6,8 For example, Vathana et al.10 successfully used a posteriorly harvested SAN for ipsilateral neurotization of the cadaveric suprascapular nerve both proximal and distal to the suprascapular ligament, the latter for selective reinnervation of the infraspinatus muscle, which is selective for improving external rotation of the arm. These authors also suggested that this posterior harvest of the SAN could be used for radial nerve branches to the triceps brachii muscle and the axillary nerve at its exit from the quadrangular space.

Contralateral spinal accessory nerve for ipsilateral neurotization of branches of the brachial plexus: a cadaveric feasibility study

Laboratory investigation

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Object. Additional nerve transfer options are important to the peripheral nerve surgeon to maximize patient outcomes following nerve injuries. Potential regional donors may also be injured or involved in the primary disease. Therefore, potential contralateral donor nerves would be desirable. To the authors’ knowledge, use of the contralateral spinal accessory nerve (SAN) has not been explored for ipsilateral neurotization procedures. In the current study, therefore, the authors aimed to evaluate the SAN as a potential donor nerve for contralateral nerve injuries by using a novel technique.

Methods. In 10 cadavers, the SAN was harvested using a posterior approach, and tunneled subcutaneously to the contralateral side for neurotization to various branches of the brachial plexus. Measurements were made of the SAN available for transfer and of its diameter.

Results. The authors found an SAN length of approximately 20 cm (from transition of upper and middle fibers of the trapezius muscle to approximately 2–4 cm superior to the insertion of the trapezius muscle onto the spinous process of T-12) available for nerve transposition. The average diameter was 2.5 mm.

Conclusions. Based on these findings, the contralateral SAN may be considered for ipsilateral neurotization to the suprascapular and axillary nerves. (DOI: 10.3171/2011.2.JNS1122)

Key Words • anatomy • neurosurgery • peripheral nerve • nerve transfer

Abbreviation used in this paper: SAN = spinal accessory nerve.
Contralateral spinal accessory nerve

Because recovery of even minimal function can be significantly important to patients with paralyzed limbs, and because often the injuries that traumatized the nerves also damaged ipsilateral donor nerves, in the current study we aimed to identify a novel method of upper limb neurotization in which the contralateral SAN could be used.

Methods

For this study, 10 adult cadavers ranging from 54 to 89 years of age (mean 78 years) at death underwent dissection of the SAN via a posterior approach. Six specimens were male and 4 were female. With the cadavers in the prone position, 5 specimens underwent dissection of the left SAN from approximately the junction between the middle and lower fibers of the trapezius muscle. The nerve was liberated from its course deep to the trapezius muscle and tunneled subcutaneously to the contralateral supraspinatus fossa, which had undergone previous dissection to isolate the suprascapular nerve at the suprascapular ligament (Fig. 1). The nerve was exposed deep to the intersection between the upper and middle fibers of the trapezius muscle and distally to approximately 2–4 cm superior to the insertion of this muscle onto the spinous process of T-12. Additionally on this side, the axillary nerve as it exited the quadrangular space was exposed. Five additional specimens underwent this same procedure but in reverse, so that the right SAN was dissected and the left aforementioned contralateral nerves were exposed. Subcutaneously, the SAN was passed contralaterally to the exposed suprascapular and axillary nerves. No specimen was found to have signs of disease or past surgery in the areas dissected. Statistical analysis was performed between sides and sexes by using Statistica for Windows (StatSoft), with significance set at p < 0.05.

Results

We found that on average, 20 cm (range 15–24 cm; from transition of upper and middle fibers of the trapezius muscle to approximately 2–4 cm superior to insertion of the trapezius onto the spinous process of T-12) was available for transfer. The average diameter of the SAN in this area was 2.5 mm (range 1.9–2.7 mm), and enough length of nerve was available for tension-free contralateral transfer to the suprascapular (Fig. 2) and axillary nerves as described above. Although nerve lengths were slightly shorter in female specimens, this did not reach statistical significance.

Fig. 1. Schematic drawing of the method used in the present study. Note that the contralateral SAN could be brought to both the suprascapular and axillary nerves. Also note the proposed skin incisions (inset) for performing such a procedure.

Fig. 2. Upper: Cadaveric specimen with the right SAN dissected via a posterior approach. The left suprascapular nerve (n.) has been dissected deep to the trapezius and supraspinatus muscles. Note that the skin over the back has been removed for clarity in this specimen. Lower: The left SAN, following dissection, is passed across the midline to the suprascapular nerve. Also note with this specimen that the rhomboid muscles have been cut from the midline, with resultant shifting of the scapula laterally. This illustrates the excess nerve available for transfer. Also observe the intact right SAN on the underside of the right trapezius muscle, which has been reflected for clarity.
significance. There was no difference found in the size or available length between left and right sides.

Discussion

We found that the SAN can be isolated from deep to the trapezius muscle by using a posterior approach, and tunneled tension free to various contralateral nerves of the brachial plexus. The diameter of the SAN approximated that of the nerves evaluated for neurotization, the suprascapular and axillary nerves. Additional length of SAN as shown with a posterior approach is useful because this allows direct anastomosis of donor to target nerve without an intervening graft, thus eliminating 2 suture lines, which is associated with a diminished reinnervation potential.8 In an earlier feasibility study, we used an anterior approach for harvesting the contralateral long thoracic nerve for neurotization procedures of the ipsilateral axillary and musculocutaneous nerves.9

Vathana et al.10 have compared the length of SAN available with anterior versus posterior harvest in cadavers. These authors found that the anterior approach resulted in a mean nerve length of 2.1 cm, and that a posterior approach provided an additional 10.5 cm of available nerve. They commented that additional palsy of the trapezius muscle from such denervation procedures does not significantly alter the total function of the shoulder. Loss of this muscle is compensated for by the levator scapulae and the serratus anterior muscles.7 The average number of myelinated fibers in the SAN is 2000.2 More specifically, Vathana et al. found that the midpoint of this nerve contains 1021 axons and, at its termination, 817 axons.

Conclusions

Based on our cadaveric study, the contralateral SAN might be considered by the peripheral nerve surgeon for ipsilateral neurotization procedures of the suprascapular and axillary nerves and radial nerve branches to the triceps brachii muscle. Although a function deficit of the contralateral trapezius is likely to occur, this is considered to be of less concern than the deficit of suprascapular or axillary nerve injury.7,8

Disclosure

The authors report no conflict of interest concerning the materials or methods used in this study or the findings specified in this paper.

Author contributions to the study and manuscript preparation include the following. Conception and design: Tubbs, Mortazavi. Acquisition of data: Tubbs, Mortazavi. Analysis and interpretation of data: all authors. Drafting the article: Tubbs, Mortazavi. Critically revising the article: all authors. Reviewed final version of the manuscript and approved it for submission: all authors.

References