Selective upper trunk posterior division fascicular nerve transfer for proximal spinal accessory neuropathy: illustrative case

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BACKGROUND Spinal accessory nerve palsy can lead to severe shoulder pain and weakness, lateral scapular winging, and limitations in overhead activity. It most often occurs because of iatrogenic injury from procedures within the posterior triangle of the neck.

OBSERVATIONS The authors present the case of a 39-year-old male with symptoms of right shoulder weakness and neck pain after a total thyroidectomy and right neck dissection. With ultrasound findings of a neuroma-in-continuity but no clinical or electromyographic signs of reinnervation at 6 months, surgical intervention was indicated. Operative exploration confirmed a very proximal injury and nonconducting neuroma-in-continuity of the spinal accessory nerve. A selective distal nerve transfer from the posterior division of the upper trunk was performed. At the 2.5-year follow-up, the patient demonstrated excellent recovery of full active shoulder abduction and forward flexion, return to full-time employment, and mild residual scapular winging.

LESSONS Distal nerve transfers should be considered in cases of late presentation when primary repair is not possible or long interpositional grafts are required. Selective fascicular transfer from the posterior division of the upper trunk provides the advantages of a single incision, short reinnervation time, and synergistic donor function to facilitate motor reeducation.

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KEYWORDS spinal accessory nerve palsy; nerve transfer; trapezius

Illustrative Case

History and Physical Examination

A 39-year-old male presented with symptoms of right shoulder weakness and neck pain that became apparent immediately after a total thyroidectomy and right neck dissection for papillary thyroid carcinoma. Physical examination revealed absent sternocleidomastoid (SCM) muscle function and asymmetrical shoulder elevation (Fig. 1A and B). His active shoulder abduction was limited to 45° and active forward flexion to 90°, with prominent lateral scapular winging (Fig. 1C and D). Function of the serratus anterior and rhomboid muscles was normal and comparable to the contralateral side.

Electromyography (EMG) showed increased insertional activity and fibrillations in both the trapezius and SCM muscles, confirming a proximal SAN injury. Ultrasound delineated the course of the SAN, traversing through an area of significant scarring deep to the

Patients with spinal accessory nerve (SAN) palsy experience altered scapulothoracic kinematics, weakness in shoulder abduction, lateral scapular winging, and shoulder pain.1 This condition is most often the result of an iatrogenic injury within the posterior triangle of the neck from lymph node biopsy or neck dissection or from intentional sacrifice for tumor resection.2,3 The relatively superficial and long course of the SAN along the trapezius muscle renders it especially susceptible to injury. In patients with nerve injury without meaningful spontaneous recovery, primary nerve repair or nerve grafting can be used to help restore trapezius function. However, in cases of delayed presentation and proximal nerve injuries, distal nerve transfers should be considered. We present the case of a patient with an iatrogenic proximal SAN injury who underwent surgical exploration and distal fascicular nerve transfer of the posterior division of the upper trunk to the SAN, with excellent functional recovery at the 2.5-year follow-up.
SCM muscle, and sonographic signs of a neuroma-in-continuity. There was atrophy of both the trapezius and SCM muscles. Six months after his original surgery, there was no improvement to his shoulder function and no signs of reinnervation on EMG. Given these findings, surgical exploration and distal nerve transfer were recommended.

Surgical Findings

A low transverse 4-cm supraclavicular incision overlying the trapezius muscle was utilized. Subplatysmal flaps were raised, and the supraclavicular nerves were identified and protected. The distal SAN was first identified on the medial border of the trapezius muscle (Fig. 2A). It was then traced proximally toward the SCM muscle, where the nerve was densely scarred. Intraoperative stimulation did not show any conduction across the neuroma, and there was no activity in the SCM or trapezius muscles. With a proximal injury and nonconducting neuroma-in-continuity, a decision was made to proceed with a distal fascicular transfer of the posterior division of the upper trunk to the SAN.

In the medial portion of the incision, the suprascapular nerve (SSN) was identified and traced proximally to the anterior and posterior divisions of the upper trunk (Fig. 2B). The SAN was transsected proximally, just distal to the SCM branch. There were healthy fascicles at this level, and the SAN was mobilized under the SSN toward the posterior division of the upper trunk (PDUT; Fig. 2C). Interfascicular dissection of the posterior division was performed, and a fascicle in the superolateral portion was isolated (Fig. 2D). Stimulation of this fascicle produced firing in the deltoid and triceps muscles, while stimulation of the medial portion of the posterior division produced similar but stronger contractions, ensuring functional redundancy. The selected fascicle was cut distally and mobilized toward the SAN stump, allowing for a tension-free nerve repair (Fig. 2D). The neurorrhaphy between the SAN and posterior division fascicle was performed with two 8–0 nylon sutures and reinforced with fibrin glue, using a standard microsurgical technique.

Postoperatively, the patient was placed in a shoulder immobilizer with the shoulder adducted for 3 weeks.

At the 2.5-year follow-up, the patient recovered significant shoulder function with full active range of motion in shoulder abduction and forward flexion and M4 trapezius strength (Fig. 3A). There was improved but persistent mild lateral scapular winging, asymmetry in the neck contour, and atrophy of the SCM muscle (Fig. 3B and C). He had normal strength with shoulder abduction and elbow extension, without any clinically detectable donor deficits. The patient was able to return to work full-time as a manual laborer. Repeat EMG demonstrated mixed large and nascent motor unit potentials in the upper trapezius muscle, which were activated with shoulder abduction. As expected, there was no clinical or electrophysiological recovery in the SCM muscle.

Patient Informed Consent

The necessary patient informed consent was obtained in this study.

Discussion

Observations

SAN palsy can result in disabling shoulder pain and dysfunction due to the disruption of normal scapulothoracic kinematics and compensation from the levator scapulae and rhomboids. Distal nerve transfers provide an attractive alternative option in cases in which primary end-to-end repair is not feasible (because of delayed presentation or a very proximal level injury) or long nerve grafts are required.
Distal nerve transfer using a selective fascicle of the PDUT has been previously described in two case series. Cambon-Binder et al. preferentially selected a fascicle to the triceps as a donor. In their series of 11 patients at the 2-year follow-up, the mean postoperative active shoulder abduction was 115° (compared to 95° preoperatively). Although most patients attained good to excellent results, with all patients obtaining ≥ M3 trapezius strength (5 M5, 5 M4, 1 M3), 4 patients still had scapular instability. Mayer et al. reported on their series of 5 patients with preferential selection of a fascicle for deltoid function as a donor. At an average 20-month follow-up, the mean postoperative active shoulder abduction was 151° (compared to 55° preoperatively), 4 of 5 patients had complete pain resolution, and all obtained ≥ M4 trapezius strength. There were no reported donor deficits in either case series. Despite excellent recovery of active shoulder abduction, as occurred in our case, patients can still have mild persistent scapular winging after nerve transfer because of residual weakness in the middle and lower trapezius muscles. However, reinnervation of the upper trapezius muscle seems to allow for better balance of levator scapulae and rhomboid compensation and alleviation of pain.

Numerous other distal nerve transfer options have also been described including the use of the anterior C3 levator scapulae motor branch, medial pectoral nerve, lateral pectoral nerve, and C7 posterior division or medial pectoral fascicle as donors. A case report on using the C3 levator scapulae motor branch as a donor demonstrated good outcomes with no donor morbidity in one patient. In cases of failed primary nerve procedures or delayed presentation, where reinnervation of the trapezius muscle is not possible, secondary reconstruction with tendon transfers have been described. The Eden-Lange procedure involves tendon transfers of the levator scapulae to the lateral scapular spine and rhomboid major and minor to the infraspinatus fossa. Therefore, the use of the C3 nerve transfer can theoretically weaken or preclude secondary tendon transfer options.

Ye et al. reported on the selective use of a C7 posterior division donor fascicle in 2 patients with early follow-up. One patient attained M3 trapezius function and 90° shoulder abduction at 6-month follow-up, and a second patient attained M4 trapezius function and 160° shoulder abduction at the 1-year follow-up. Magill et al. described a similar case using a C7 pectoral fascicle transferred to the SAN with the return of full shoulder range of motion at 1 year postoperatively.

The senior author (R.J.S.) first reported the use of the lateral pectoral nerve as a donor for SAN injuries. This was our preference prior to switching to the fascicular nerve transfer from the PDUT described in the present case. Compared to the use of the pectoral nerves as donors, this nerve transfer has the advantage of utilizing a synergistic donor fascicle for deltoid function, where trapezius function is activated with shoulder abduction. This facilitates relearning in this nerve transfer and decreases the need for extensive motor reeducation. Furthermore, this can be performed through a single incision and allows for a direct and distal nerve coaptation close to the motor target of the trapezius muscle. This nerve transfer does not target reinnervation of the SCM muscle. The nerve transfer and coaptation is performed distal to the SCM branch to decrease the time required for trapezius reinnervation, which is functionally prioritized over the SCM. We add to the literature and report on the long-term 2.5-year follow-up of a patient with this nerve transfer, demonstrating excellent functional recovery.

**Lessons**

SAN injury can result in severe limitations in shoulder function and pain from compensation of other periscapular muscles. Distal nerve transfers should be considered in cases when primary repair is not possible or long interpositional grafts are required. Although many nerve transfers have been proposed, our current preference is to use a selected fascicle from the PDUT, which provides the advantages of a single incision, short reinnervation time, and synergistic donor function to facilitate motor reeducation.

**References**


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Author Contributions
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