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CASE REPORT
Peripheral Nerve

Simultaneous Use of the Anterior Interosseous Nerve as Both a Target and Donor Nerve in Radial to Median Nerve Transfers

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Summary: Nerve transfers play a crucial role in the management of nerve injuries. I present a case where a young weightlifter had a devastating high median nerve injury resulting in absent thumb flexor pollicis longus function and absent flexor digitorum superficialis (FDS) and flexor digitorum profundus function of the index finger. An extensor carpi radialis brevis branch of the radial nerve was transferred to the anterior interosseous nerve (AIN), and the distal AIN was then mobilized and reflected from distal to proximal to supply a second nerve transfer to an FDS-index branch of the median nerve. In this configuration, the AIN served as both the target motor nerve for the first transfer and the donor nerve for the second transfer. The use of the AIN in this manner had the effect of minimizing donor morbidity (only 1 functioning donor nerve sacrificed) while also delivering an additional donor nerve to a target in an anatomically distinct area, avoiding sacrifice of additional donors or use of nerve grafts. The patient had full recovery of flexor pollicis longus function and flexor digitorum profundus index function at 10 months, as well as full recovery of FDS function of the index finger at 1.5 years postoperatively.
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Nerve transfers are an invaluable tool in the armamentarium of nerve surgeons. Other techniques include nerve autografting, allografting, sensory transfers, functional muscle transfers, neuroma prevention techniques, intraoperative nerve stimulation, neurolysis, and decompression. Modern nerve surgery combines these approaches in an incredibly patient- and injury-specific way to provide patients with devastating injuries the most functional, pain-free, and sensate reconstruction possible. With our increased understanding of the branching patterns of peripheral nerves, several highly targeted motor nerve transfers have become available.

There are clinical scenarios where target nerves lack a donor nerve in close proximity. I report a case of a radial to median nerve transfer involving a single donor nerve successfully transferred to 2 anatomically distinct nerve targets.

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CASE REPORT

A healthy 19-year-old right-hand dominant man sustained a right-sided pectoralis major tear while weightlifting. This was treated surgically 1 month later by an orthopedic surgeon. Upon waking in the recovery room, the patient had severe median nerve distribution numbness, pain, and motor deficits. The patient was referred to the author for evaluation 3 weeks later and was found to have absent thumb interphalangeal joint flexion, absent flexor digitorum profundus (FDP) function of the index finger, and absent flexor digitorum superficialis (FDS) function of the index finger along with complete median sensory distribution numbness. (**See Video 1 [online],** which displays the preoperative clinical examination.)

The patient's history, nerve studies, and clinical examination prompted infraclavicular brachial plexus exploration 1 month after his pectoralis muscle repair. The pectoralis muscle repair was taken down, and severe iatrogenic injury to the infraclavicular brachial plexus was identified, with a large zone of injury and severe scarring encountered. Meticulous dissection of the infraclavicular brachial plexus was performed, and a very large suture and

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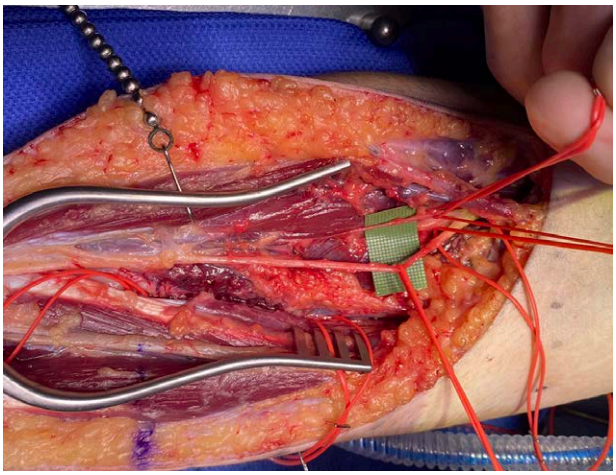

Fig. 1. Donor nerve dissection of the radial nerve. The radial sensory nerve and ECRB branches are isolated and prepared for transfer. For reference, each intraoperative photograph is within the operative field at the volar forearm.

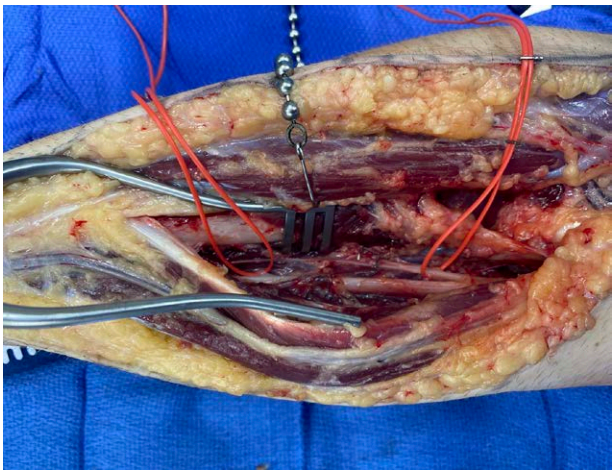

Fig. 2. Recipient nerve dissection of the median nerve. The AIN is shown branching proximally from the median nerve. The FDS branch is seen distally emerging from the median nerve proper. Note the separation of the AIN and FDS target nerves by several centimeters in this patient. For reference, each intraoperative photograph is within the operative field at the volar forearm.

associated granuloma was found to have completely avulsed the medial and lateral cord contributions to the median nerve. Given the proximal location of the injury, the terribly scarred operative field with risk of further injury, and focal clinical deficits limited to the Median nerve, the decision was made to proceed with nerve transfers for definitive management.

At 3 months postinjury, the patient was taken to the operating room for definitive reconstruction. There was no change in his clinical examination. Goals of reconstruction were to restore flexor pollicis longus (FPL) function of the thumb along with FDS and FDP function of the index finger if possible. The plan discussed with the patient preoperatively was for extensor carpi radialis brevis (ECRB) branch to anterior interosseous nerve (AIN) transfer, with the possibility for an additional transfer to the FDS branch if a second donor nerve with acceptable donor morbidity was available. He had normal, Medical Research Council (MRC) 5 of 5 grade radial nerve function in all examined muscles, including supinator, ECRB, extensor digitorum communis, and extensor pollicis longus.

Operative details of radial to median nerve transfers are well described.[1,2] The ECRB branch was identified and demonstrated robust intraoperative stimulation of central wrist extension at physiological settings (Fig. 1). The median nerve with an FDS branch was identified along with the AIN (Fig. 2). These 2 targets were noted to be separated anatomically by 8–10 cm in distance (Fig. 2). The decision was made to proceed with an ECRB to AIN transfer in an end-to-end manner. There were no additional healthy donor nerves in proximity to the FDS-index branch of the median nerve. The AIN was then dissected out distally within the pronator quadratus muscle and mobilized (Fig. 3). The AIN was divided distally and then transposed and tunneled from distal to proximal and deep to superficial to the FDS muscle, allowing tension-free end-to-end neurorrhaphy to the FDS-index branch of the median nerve (Fig. 4).

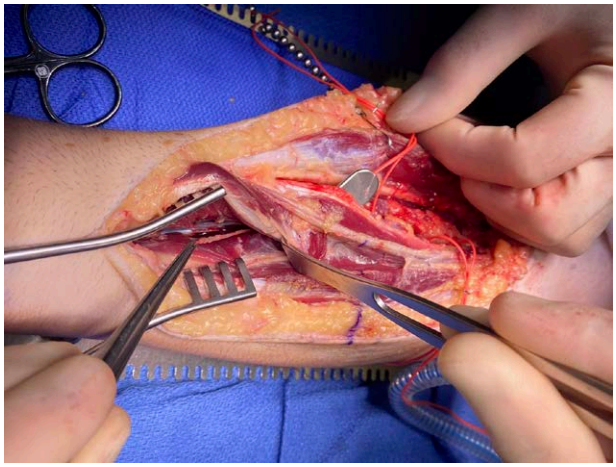

Fig. 3. Conversion of the AIN from recipient nerve to donor nerve. After transfer of the ECRB branch to the AIN proximally, the AIN is dissected distally and mobilized from within the pronator quadratus. For reference, each intraoperative photograph is within the operative field at the volar forearm.

Starting at 2 weeks postoperatively, the patient began hand therapy focused on donor-specific activation and retaining passive motion of the thumb and index fingers. The patient regained active FPL function and FDP index function at approximately 10 months, with slight weakness compared with the contralateral side. At 1.5 years postoperative, MRC 5 strength of both the FPL and FDP index was recovered as well as MRC 5 FDS-index function. (**See Video 2 [online],** which displays the postoperative results at 10 months.) (**See Video 3 [online],** which displays the postoperative results at 1.5 years.)

The patient experienced subjective weakness/pain with wrist extension for a few weeks after surgery (MRC 4 of 5), followed by complete recovery with

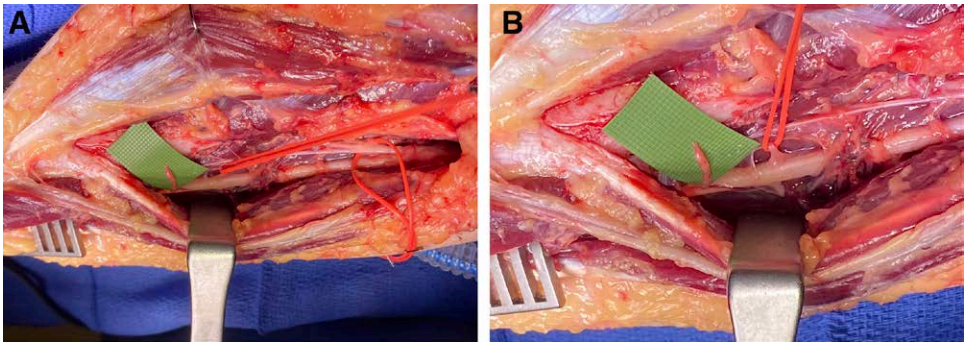

Fig. 4. Mobilization of the distal AIN. A-B, The AIN is mobilized and transposed from distal to proximal, and deep to superficial to facilitate tension-free neurorrhaphy to the FDS branch of the median nerve. For reference, each intraoperative photograph is within the operative field at the volar forearm.

centralized, and pain-free MRC 5 of 5 wrist extension by 6 weeks postoperatively.

DISCUSSION

The AIN is well documented in a number of nerve transfers.[1,3–5] Its long length, predominant motor composition, relatively high axon count, and dispensability distally position it ideally for use as a donor nerve. In this case, use of the AIN as both a target *and* donor nerve allowed for functional restoration of all target functions using only a single donor nerve branch from the radial nerve (ECRB). This has the advantage of limiting donor morbidity with sacrifice of only a single donor nerve while also supplying healthy motor axons to a second target nerve in an anatomically distant location where there was a paucity of available donor nerves. This concept also has important implications for functional muscle transfers, where lack of available donor nerves can be a crucial limiting factor. The length and mobilization of the AIN also obviated the need for any nerve grafts. To the author's knowledge, use of the AIN as a simultaneous target and donor nerve has not been described.

Donor nerve selection is a critical aspect of any nerve transfer surgery. Preoperative clinical examination, nerve study data, nerve location, nerve composition, functional synergy, and intraoperative stimulation guide the surgeon in selecting appropriate donor nerves.[6] Unique to this case was the utilization of a nonfunctional nerve (the AIN) as the donor nerve for the second transfer to another nonfunctional nerve (FDS-index branch). This configuration did not compromise success of the first transfer while capturing regenerating motor axons traveling distal to the FPL and FDP branches of the AIN.

The patient reported here is young, healthy, and highly motivated. An additional study is needed to determine the extent to which the outcome demonstrated here can be replicated in older or less healthy populations.

CONCLUSIONS

The AIN can be used as both a target and donor nerve simultaneously in select nerve transfers. In the setting of proximal lesions involving the AIN with other deficits, it is the author's intention that nerve surgeons consider the distal AIN as an additional donor nerve to restore additional functions, as dictated by the clinical scenario. The motor branch of the ulnar nerve, the deep branch of the posterior interosseous nerve, and the FDS branch of the median nerve each represent possible potential targets for reinnervation from the distal AIN.

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DISCLOSURE

The author has no financial interest to declare in relation to the content of this article.

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