SCIENTIFIC ARTICLE

Direct Radial to Ulnar Nerve Transfer to Restore Intrinsic Muscle Function in Combined Proximal Median and Ulnar Nerve Injury: Case Report and Surgical Technique

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A distal median to ulnar nerve transfer for timely restoration of critical intrinsic muscle function is possible in isolated ulnar nerve injuries but not for combined ulnar and median nerve injuries. We used a distal nerve transfer to restore ulnar intrinsic function in the case of a proximal combined median and ulnar nerve injury. Transfer of the nonessential radial nerve branches to the abductor pollicis longus, extensor pollicis brevis, and extensor indicis proprius to the motor branch of the ulnar nerve was performed in a direct end-to-end fashion via an interosseous tunnel. This method safely and effectively restored intrinsic function before terminal muscle degeneration. *(J Hand Surg Am. 2014;39(7):1358–1362. Copyright © 2014 by the American Society for Surgery of the Hand. All rights reserved.)*

Key words Intrinsic function, median nerve, nerve transfer, ulnar nerve.

Proximal ulnar nerve injuries result in profound dysfunction of the hand as a result of loss of associated intrinsic muscle function. A high ulnar nerve injury combined with a high median nerve injury presents a reconstructive challenge.

Nerve transfer techniques are commonly used to restore motor function in the setting of brachial plexus nerve root avulsion injuries in which an end-to-end repair of the native motor nerve is physically impossible. They are also useful more distally, where rapid restoration of function can be accomplished by rerouting expendable donor nerves. The axons have to travel only a short distance before supplying the paralyzed muscle's motor end plates before they irreversibly degenerate. If reinnervation does not occur within approximately 1 year after injury, the muscle will become unresponsive and will undergo fatty and fibrotic degeneration.

For that reason, proximal (above-elbow in most adults) ulnar nerve injuries have recently been treated with distal nerve transfer of the terminal anterior interosseous nerve to the deep branch of the ulnar nerve to restore critical function before terminal denervation of the muscle.[1,2] However, combined proximal median and ulnar nerve injuries pose a challenge not amenable to this treatment strategy.

We present a case of successful distal radial to ulnar direct nerve transfer for timely restoration of ulnar innervated intrinsic hand muscle function in the setting of a proximal combined median and ulnar nerve injury.

CASE REPORT

A 17-year-old man sustained jagged lacerations to the brachial artery and median and ulnar nerves at the

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elbow. He had normal axillary, musculocutaneous, and radial nerve function. The extent of median nerve injury required debridement of 6 cm and repair with interposition grafts; the ulnar nerve was transposed and repaired directly after minimal debridement. Approximately 1 month later, and because the nerve injuries were nearly 30 cm (12 in) proximal to the wrist, radial nerve branches were transferred to the motor branch of the ulnar nerve to restore some intrinsic muscle function. Branches of the posterior interosseous nerve to the extensor indicis proprius, abductor pollicis longus, and extensor pollicis brevis were transferred through the interosseous membrane and coapted to the distal motor branch of the ulnar nerve in the midforearm.

Immediately after the nerve transfer, he had loss of index finger metacarpophalangeal joint extension, which returned a few months later as the extensor digitorum communis function to index replaced absent extensor indicis proprius function. Thumb extension remained intact through extensor pollicis longus function. No functional loss occurred from denervation of the abductor pollicis longus.

One year after nerve transfer, the patient continued to gain extrinsic median and ulnar innervated function as a result of the direct nerve repairs. He had wrist and finger flexion and some clawing. Early signs of ulnar intrinsic muscle reinnervation included the ability to place and hold in the intrinsic plus position (Fig. 1) and volitional twitching of the first dorsal interosseous muscle.

FIGURE 1: Early postoperative result. The patient is able to hold the interphalangeal joints in extension while the metacarpophalangeal joints are stabilized in flexion.

Surgical technique

A dorsal forearm incision used anatomic landmarks that were previously described for locating the distal branches of the posterior interosseous nerve (Fig. 2).[3] To allow for intraoperative stimulation of the donor (functioning) branches, no tourniquet was used. Using the interval between brachioradialis and extensor carpi radialis longus, access to the supinator muscle was obtained. At the proximal edge of the supinator, we identified and protected the radial sensory nerve and branches to the extensor carpi radialis brevis, and supinator. The posterior interosseous nerve was again identified distal to the supinator. There, the terminal branches of the posterior interosseous nerve were separated and stimulated to confirm identification and function of the extensor digitorum communis, extensor digiti minimi, and the extensor carpi ulnaris. Additional branches more distally included extensor pollicis longus, extensor indicis proprius, and then, finally, branches to the abductor pollicis longus and extensor pollicis brevis. We found these branches sitting under the wrist extensors. The branches to the extensor pollicis longus and extensor indicis proprius ran on top of their respective muscle bellies. The abductor pollicis longus and extensor pollicis brevis branches were seen on top of their obliquely oriented muscle bellies. To facilitate this distal dissection, we retracted the brachioradialis, extensor carpi radialis brevis, and extensor carpi radialis longus radially, and retracted the extensor digitorum communis ulnarly. Dissection of these donor nerve branches was carried as far distally as possible. For a better size match to the recipient nerve and after confirming residual thumb and index finger extension through extensor pollicis longus and extensor digitorum communis, we chose to use the extensor indicis proprius, abductor pollicis longus, and extensor pollicis brevis branches as donors.

We then gained access to the ulnar nerve and its branches on the volar aspect of the midforearm. Because the nerve transfer was performed 1 month after injury, we used a tourniquet because intraoperative stimulation would not be useful for this portion of the procedure, because the recipient distal ulnar nerve was nonfunctional. (If, conversely, the nerve transfer were done within 72 h of the initial nerve injury, intraoperative stimulation of the recipient ulnar nerve to confirm the internal topography would have been useful. This is because of the presence of residual neurotransmitters in the terminal nerve fibers, which remain functional for about 72 h postinjury.) A longitudinal incision on the ulnar aspect of the midforearm was carried down to the fascia of the flexor carpi ulnaris. The flexor carpi ulnaris was retracted ulnarly, revealing the ulnar neurovascular bundle. At this level, the motor fascicles reside between the more medial sensory fibers of