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Transfer of the radial branch of the superficial radial nerve to the sensory branch of the ulnar nerve for sensory restoration after C7-T1 brachial plexus injury

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Summary Previously, we have reconstructed the motor function of patients with C7-T1 brachial plexus palsies through combined nerve and tendon transfers. However, these patients lose not only the motor function of the hand but also the sensation on the ulnar side of the hand. Without sensory recovery, the injured hand may be further damaged, particularly by burns in this contact zone. Therefore, we described a technique to restore the sensation at the ulnar aspect of the hand by performing a transfer of the radial branch of the superficial radial nerve to the sensory branch of the ulnar nerve.

Introduction

In the treatment for C7-T1 brachial plexus injury, the primary goal is to restore the motor function of the paralyzed hand. We previously performed a successful transfer of the brachialis branch of the musculocutaneous nerve to the

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flexor fascicles of the median nerve to restore the flexion function of the finger.[1] On the other hand, to restore finger extension, we have transferred the motor branch of the supinator to the posterior interosseous nerve.[2–4] In addition, we have reported a staged process to restore the motor function of the C7-T1 brachial plexus, which involves the nerve and tendon transfer. In the second stage, the brachioradialis muscle was used as a donor for restoration of thumb opposition.[5] This strategy successfully restored hand functions in patients, particularly the grasp and pinch functions.

Unfortunately, patients diagnosed with C7-T1 brachial plexus palsies lose not only the motor function of the hand but also the sensation on the ulnar side of the hand. Without sensory recovery, the injured hand may be further damaged, particularly by burns in this contact zone. Therefore, we tested a technique to restore the sensation of this area by performing a transfer of the radial branch of the superficial radial nerve (SRN) to the sensory branch of the ulnar nerve (SBUN).

Patients and methods

Patients

Between September 2012 and June 2013, four male patients (average age, 30.5 years) diagnosed with a C7-T1 brachial plexus injury were included in this study. Normal shoulder and elbow function with M4 muscle strength was noticed. Muscle strength of the flexor carpi radialis was M4, while the palmaris longus and flexor carpi ulnaris were M0. Wrist extension was preserved with radial deviation, and the muscle strength of the extensor carpi radialis longus and extensor carpi radialis brevis were M4. The muscle strength of the extensor carpi ulnaris was M0. No active flexion or extension of the finger or thumb was observed, and intrinsic muscles of the hand were also paralyzed. All participants presented with a Horner sign. Electromyography studies revealed normal innervation in the muscles by the C5 and C6 nerve roots, and total denervation in the muscles innervated by C7, C8, and T1 nerve roots. Before this surgery, they received a distal nerve transfer for finger flexion and extension. That is, the brachialis motor branch was transferred to the finger flexor fascicles of the median nerve,[1] and the supinator motor branch was transferred to the posterior interosseous nerve.[2–4]

Pinprick sensation disappeared in the one and a half fingers on the ulnar side, ulnar aspect of the hand and forearm, and decreased in the index finger, middle finger, and radial side of the ring finger. We anticipated that the protective sensibility at the ulnar side of the hand would be compensated through sufficient time. However, after a long interval (mean, 33.3 months), all the patients had sensory loss on the ulnar part of the injured hand, despite partial sensory recovery on the ulnar aspect of the forearm. Figure 1 shows the mapping of the preoperative sensation.

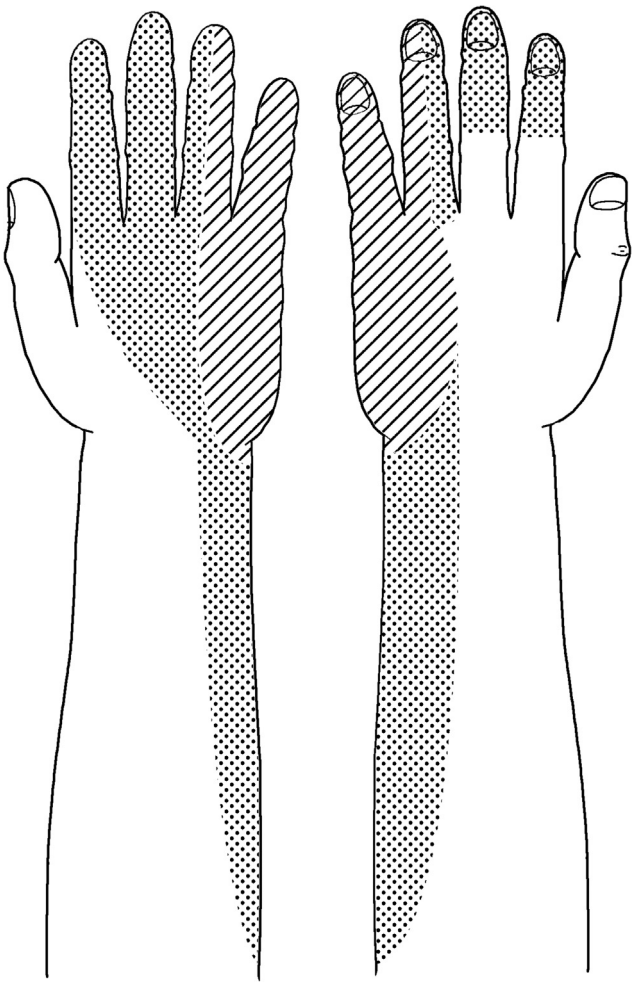

Figure 1 The mapping of patients' preoperative sensation on the hand and forearm. Pinprick sensation disappeared in the one and a half fingers on the ulnar side, ulnar aspect of the hand (slash marks), and decreased in the index finger, middle finger, radial side of the ring finger, and ulnar aspect of the forearm (dots).

Surgical procedure

An "S"-shaped incision was made on the radial side of the wrist from the radial styloid continuing for a length of 7 cm. After exposing the tendon of the brachioradialis, the SRN could be easily identified underneath. Then, in order to release the potential entrapment of the SRN,[6] we released the fascia from the brachioradialis to the extensor carpi radialis. The SRN is divided in ulnar and radial branch, with the diameter being 2 mm and 1.5 mm, respectively (Figure 2A). During an intraoperative electrophysiological test, we confirmed that these two branches were functional by the presence of somatosensory-evoked potentials. Near the radial styloid, the radial branch of the SRN was sectioned distally.

Afterwards, we made another "S"-shaped incision on the ulnar side of the wrist. After decompression of the Guyon canal, we identified both the superficial terminal branch and deep branch of the ulnar nerve (Figure 2B). The SBUN was traced back proximally until its nerve fibers mixed with the deep branch (about 5 cm proximal to the distal wrist crease). Then, after a confirmation of paralysis was made through electrical stimulation, the SBUN was sectioned proximally. Finally, the radial branch of the SRN was passed through a subcutaneous tunnel and coapted with the SBUN