Clinical Outcomes Following Median to Radial Nerve Transfers

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Purpose To evaluate the clinical outcomes in patients with radial nerve palsy who underwent nerve transfers using redundant fascicles of median nerve (innervating the flexor digitorum superficialis and flexor carpi radialis muscles) to the posterior interosseous nerve and the nerve to the extensor carpi radialis brevis.

Methods This was a retrospective review of the clinical records of 19 patients with radial nerve injuries who underwent nerve transfer procedures using the median nerve as a donor nerve. All patients were evaluated using the Medical Research Council (MRC) grading system. The mean age of patients was 41 years (range, 17–78 y). All patients received at least 12 months of follow-up (range, 20.3 ± 5.8 mo). Surgery was performed at a mean of 5.7 ± 1.9 months postinjury.

Results Postoperative functional evaluation was graded according to the following scale: grades MRC 0/5 to MRC 2/5 were considered poor outcomes, whereas an MRC grade of 3/5 was a fair result, 4/5 was a good result, and 4+/5 was an excellent outcome. Postoperatively, all patients except one had good to excellent recovery of wrist extension. A total of 12 patients recovered good to excellent finger and thumb extension, 2 had fair recovery, and 5 had poor recovery.

Conclusions The radial nerve is commonly injured, causing severe morbidity in affected patients. The median nerve provides a reliable source of donor nerve fascicles for radial nerve reinnervation. The important nuances of both surgical technique and motor reeducation critical for the success of this transfer have been identified and are discussed. *(J Hand Surg 2011;36A:201–208. Copyright © 2011 by the American Society for Surgery of the Hand. All rights reserved.)*

Type of study/level of evidence Therapeutic IV.

Key words Nerve transfer, neurotization, brachial plexus, median nerve, radial nerve.

Proximal radial nerve injuries are a common orthopedic problem.[1–5] The radial nerve is the most commonly injured nerve after orthopedic trauma[6,7] and is highly correlated with open humeral shaft fractures.[5] Although radial nerve injuries can occur anywhere along the course of the nerve, the clinical picture is similar. Involvement of the posterior interosseous nerve (PIN) produces lack of finger and thumb extension and limited radial wrist deviation, whereas more proximal injuries invariably produce a complete radial nerve palsy. The traditional treatment has been tendon transfers, and although these transfers can produce good wrist and finger extension,[8–11] there is no clear consensus on the most appropriate combination of transfers; some authors have cited unsatisfactory results after transfer.[6,12–14] The use of autologous nerve grafts to repair radial nerve defects is also a viable option and has produced mixed results based largely on

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timely treatment of injuries.[15–20] If the radial nerve injury is proximally located and involves a long gap, long sural nerve grafts are required. Nerve transfer procedures have dramatically changed the treatment paradigm of brachial plexus injuries.[21–24] The success achieved by repair of brachial plexus injuries has also been realized in the periphery, with multiple authors describing good clinical outcomes.[25–29] Success with other nerve transfers led us to consider the use of redundant median nerve branches as donor nerves to recover radial nerve function. Although both tendon transfer and nerve grafts are appropriate for management of radial nerve injuries, there is a group of patients with notable hand stiffness who are not candidates for tendon transfer or are older patients with medical comorbidities that make them poor candidates for sural nerve grafting. We first devised median and radial nerve transfer for that group of patients.[27,30]

Our experience has evolved over time and we have expanded our indication for median to radial nerve transfer as our experience with this transfer has increased. Postoperative motor re-education and physical therapy are critical; nevertheless, our experience has been characterized by excellent return of radial nerve function with no appreciable loss of donor nerve function. In this article, we present our experience with median to radial nerve transfers after radial nerve injury. Over the past decade we have determined key points in technique that we believe are critical in the success of this transfer and discuss our "pearls and pitfalls" in this report.

MATERIALS AND METHODS

After we obtained approval from our institution's human studies committee, we performed a retrospective chart review of the office and hospital charts on all patients evaluated for radial nerve injuries. Patients who had undergone a nerve transfer using redundant fascicles from the median nerve to the radial nerve with at least 12 months' follow-up (mean, 20 mo) were included.

Patient population

The review included 19 patients (11 men and 8 women) (Table 1). All patients were initially evaluated at an outside hospital and subsequently referred for evaluation by the senior author. The mechanism of injury varied among patients, with motor vehicle collision representing the most common etiology. The mean patient age was 41 years (range, 17–78 y) and the mean time from occurrence of injury to surgery was 5.7 ± 1.9 months (range, 3–10 mo). All patients were evaluated in a systematic standardized fashion, including preoperative clinical and physical evaluation, muscle testing of involved extremity and contralateral extremity using the Medical Research Council (MRC) grading system, electromyography, and nerve conduction studies. All nerve conduction studies were performed at least 3 months after the initial injury, to assess for evidence of reinnervation. Patients that had motor unit potentials on electrical studies were not offered surgery and continued expectant management was pursued.

Surgical procedure

Surgical exploration and reconstruction procedures were offered if no clinical or electrical evidence of target muscle reinnervation was observed by 3 months postinjury. As we recently described, exploration and reconstruction were performed using a lazy-S–type incision over the volar forearm from the antecubital fossa.[12] Initially, step lengthening of the superficial head of the pronator teres was performed to allow easier exposure of the median nerve. At the proximal end of the incision and ulnar to the radial vessels, the branches of the median nerve were identified in a consistent branching pattern. Releasing the tendinous arch of the deep head of the pronator teres and flexor digitorum superficialis (FDS) allowed for further exposure of the median nerve branches. The nerve to the pronator teres branch was encountered in the proximal antecubital fossa. Distal to the antecubital crease, the branch to the flexor carpi radialis (FCR) and palmaris longus (PL) was identified coming off medially. Distal to the FCR/PL branch, 2 branches to the FDS were encountered, followed shortly by the main sensory branch and the anterior interosseous nerve. Once the median nerve branches had been identified and mobilized, intraoperative nerve stimulation was used to verify the FDS and FCR donor fascicles. Moving to the lateral side of the radial vessels, identification of the extensor carpi radialis brevis (ECRB) branch and posterior interosseous nerve (PIN) was carried out by following the radial sensory branch deep to the brachioradialis. After the PIN and ECRB branch were identified, the PIN was followed distally and the tendinous edge of the supinator was released. All transfers were based on our phrase, "donor distal and recipient proximal," to ensure a tension-free coaptation. If the donor nerve is not divided distally enough and the recipient nerve proximally enough, there is not enough overlap to allow a tension-free repair. Although we have performed nerve transfers since 1991, we still repeat that phrase at every nerve transfer. We always divide the donor nerve as distally as possible first and then move the donor nerve