Techniques in Hand and Upper Extremity Surgery 11(1):15–17, 2007

TECHNIQUE

Technique of the Double Nerve Transfer to Recover Elbow Flexion in C5, C6, or C5 to C7 Brachial Plexus Palsy

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ABSTRACT

In C5, C6, or C5-to-C7 root injuries, many surgical procedures have been proposed to restore active elbow flexion. Nerve grafts or nerve transfers are the main techniques being carried out. The transfer of ulnar nerve fascicles to the biceps branch of the musculocutaneous nerve is currently proposed to restore active elbow flexion. Recovery of biceps muscle function is generally sufficient to obtain elbow flexion. However, the strength of elbow flexion is sometimes weak because the brachialis muscle is not reinnervated. Therefore, the transfer of 1 fascicle of the median nerve to the brachialis branch of the musculocutaneous nerve may be proposed to improve strength of the elbow flexion. We describe the technique of this double transfer to restore elbow flexion. The results concerning 5 patients are presented.

Keywords: median nerve, nerve transfer, brachial plexus palsy, ulnar nerve

HISTORICAL PERSPECTIVE

Palsy of elbow flexion in brachial plexus palsies with C5, C6, or C5-to-C7 root injuries may be restored with nerve transfers or nerve grafts.[1] Nerve grafts cannot be performed in case of root avulsions. Moreover, nerve grafts need the harvesting of donor nerves and do not improve the outcome.[2] Therefore, most of the authors prefer nerve transfers. Concerning elbow flexion, partial ulnar nerve transfer to the biceps branch of the musculocutaneous nerve is currently routinely performed. Satisfactory results have been reported with this procedure.[1] However, if elbow function is generally restored, the strength of flexion is not always sufficient and may lead to other palliative procedure.[1,3,4] Therefore, the transfer of 1 fascicle of the median nerve to the brachialis branch of the musculocutaneous nerve has been proposed for the first time by Teboul et al.[1] A precise description of this technique and results concerning 5 patients are presented.

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INDICATIONS/CONTRAINDICATIONS

The transfer of 1 fascicle of the median nerve to the brachialis branch of the musculocutaneous nerve is performed in case of C5, C6, or C5-to-C7 root avulsions. This transfer is always associated with the transfer of fascicles of the ulnar nerve to the biceps branch (Fig. 1). Moreover, other nerve transfers are generally combined to restore shoulder function[3,4] in C5, C6, or C5-to-C7 root avulsions.

The results of this double transfer are improved if surgery is performed less than 6 months after the injury.[1] Therefore, this transfer is not indicated in the case of "old" brachial plexus palsy (more than 12 months).

TECHNIQUE

The patient is brought to the operating room where a general anesthetic is administered. The wrist and hand are then placed supine on the operating table.

A 16-cm incision is performed on the medial aspect of the arm 2 cm below the distal border of the pectoralis major muscle. The musculocutaneous nerve is located medially between the biceps and coracobrachialis muscles. Then, the biceps and brachialis branches of the musculocutaneous nerve are isolated (Fig. 2). One must take care of the vascular pedicle of the biceps which may be close to the biceps nerve. This pedicle must be preserved to ensure normal vascularization of the biceps muscle. Anatomical variations in the origin and distributions of the musculocutaneous nerve are possible. As a matter of fact, the biceps branch may sometimes come from the median nerve.

The median and ulnar nerves are exposed 3 cm at the same level. Further dissection is performed under

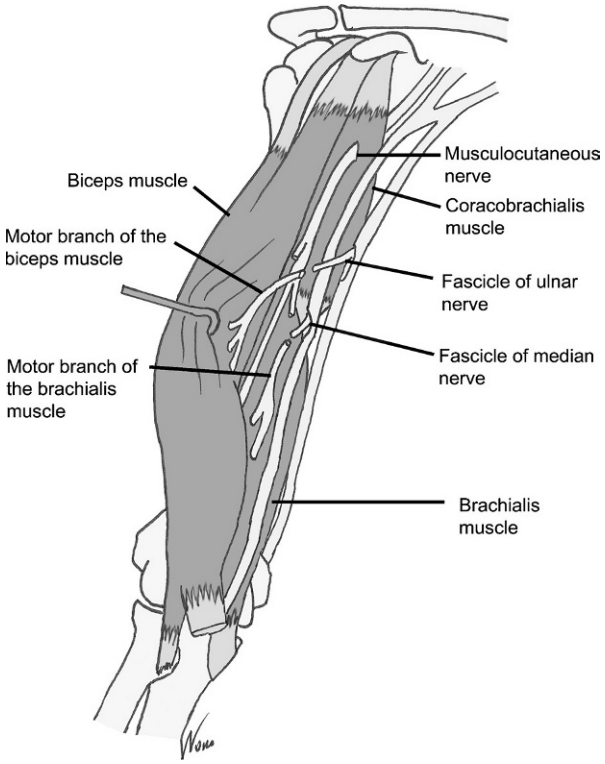

FIGURE 1. Principles of the technique of the double nerve transfer to restore active elbow flexion: 1 fascicle of the ulnar nerve is sutured to the biceps branch of the musculocutaneous nerve. One fascicle of the median nerve is sutured to the brachialis branch.

the microscope. The biceps branch is traced proximally into the musculocutaneous nerve for approximately 2 cm and divided (Fig. 3). The distal part of the biceps branch is then rotated toward the previously dissected ulnar nerve. A longitudinal epineurotomy is performed on the anteromedial aspect of the ulnar nerve. One to 3

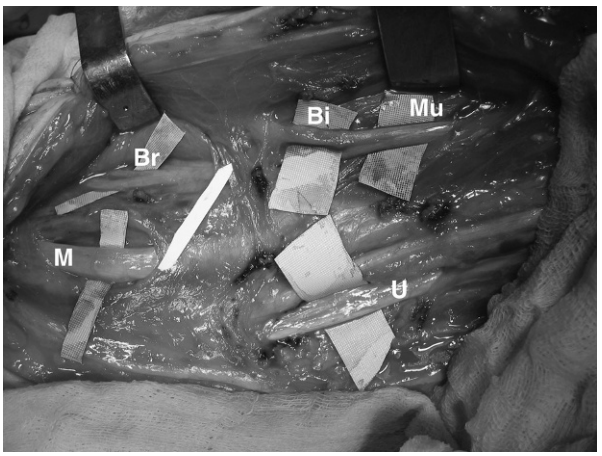

FIGURE 2. Exposition of the anatomical structures. Bi indicates biceps branch; Br, brachialis branch; M, median nerve; Mu, musculocutaneous nerve; U, ulnar nerve.

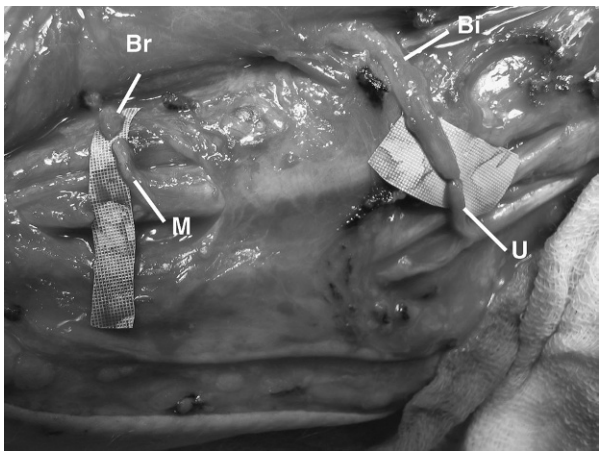

FIGURE 3. One fascicle of the median and ulnar nerves has been selected and distally divided. The biceps branch has been dissected, traced into the musculocutaneous nerve, and divided. The brachialis branch has been dissected, traced into the musculocutaneous nerve, and divided. Abbreviations are explained in the legend of Figure 2.

fascicles of adequate size are selected depending on the size of the biceps branch. Electrical stimulation allows choosing fascicles for extrinsic hand muscles (the flexor carpi ulnaris and the flexor digitorum profundus of the fourth and fifth fingers) starting with a low intensity (0.02 mA). The chosen fascicles are dissected from the rest of the ulnar nerve for a distance of 2 cm and divided distally. The fascicles are turned laterally and superiorly and sutured to the biceps branch under the microscope, with 3 separate 11-0 nylon sutures (Fig. 4).

The same procedure is performed for the transfer of the median fascicles to the brachialis branch. The brachialis branch is dissected proximally into the

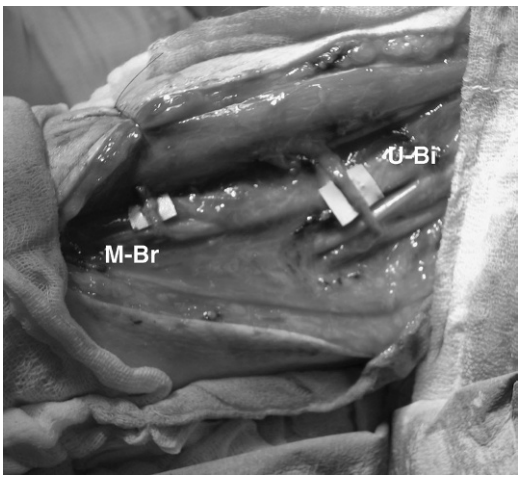

FIGURE 4. The fascicle of the ulnar nerve is sutured to the biceps branch. The fascicle of the median nerve is sutured to the brachialis branch. Abbreviations are explained in the legend of Figure 2.

musculocutaneous nerve. One must take care of the cutaneous branch of the musculocutaneous nerve which may be confused with the motor branch. Therefore, the cutaneous branch may be located at the anterior aspect of the elbow with a small incision. Then, a slight traction is applied distally to identify proximally the cutaneous branch of the musculocutaneous nerve division. The longitudinal epineurotomy is performed on the anterolateral aspect of the median nerve (Fig. 3). Then, fascicles for the extrinsic hand muscles (the flexor carpi radialis, the palmaris longus, the flexor pollicis longus, the flexor digitorum superficialis, and the flexor digitorum profundus of the second and third fingers) are selected with electrical stimulation. One fascicule is minimally dissected to match the brachialis branch and distally divided. Then, the selected fascicle is sutured to the brachialis branch under the microscope with 3 separate 11-0 nylon sutures (Fig. 4).

REHABILITATION

Postoperatively, the entire upper limb is placed in a thoracobrachial immobilization, with the elbow in 90-degree flexion for a period of 3 weeks. Then, passive range of motion of the elbow is performed for a period of 3 weeks. After 6 weeks, a physiotherapy protocol is started to improve the grip strength. As soon as the first biceps muscle contraction occurred, active supine and flexion exercises are initialized.

RESULTS

Three men with C5 and C6 root avulsions and 2 men with C5-to-C7 root avulsions were operated on between 2 and 6 months after their injury. The average age of the patients was 23 years (range, 10–30 years). Elbow extension and wrist and hand functions were present in all the patients. The average follow-up was 14 months (range, 9–20 months). The biceps and brachialis muscle contractions were present in all the patients. The first muscle contractions occurred between 4 and 9 months after surgery. Elbow flexion scored M4 according to Medical Research Council scoring. The average weight patients could lift was 6 kg (range, 2–8 kg). No palliative procedures such as Steindler procedure were necessary to improve elbow flexion.[1] No loss of ulnar and median nerve function was noted after surgery.

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