

THE SENSORY–MOTOR BRIDGE NEURORRAPHY: AN ANATOMIC STUDY OF FEASIBILITY BETWEEN SENSORY BRANCH OF THE MUSCULOCUTANEOUS NERVE AND DEEP BRANCH OF THE RADIAL NERVE

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Introduction: Restoring elbow flexion remains the first step in the management of total palsy of the brachial plexus. Non avulsed upper roots may be grafted on the musculocutaneous nerve. When this nerve is entirely grafted, some motor fibres regenerate within the sensory fibres quota. Aiming potential utilization of these lost motor fibres, we attempted suturing the sensory branch of the musculocutaneous nerve onto the deep branch of the radial nerve. The objective of our study was to assess the anatomic feasibility of such direct suturing of the terminal sensory branch of the musculocutaneous nerve onto the deep branch of the radial nerve. **Methods:** The study was carried out with 10 upper limbs from fresh cadavers. The sensory branch of the musculocutaneous muscle was dissected right to its division. The motor branch of the radial nerve was identified and dissected as proximally as possible into the radial nerve. Then, the distance separating the two nerves was measured so as to assess whether direct neurorrhaphy of the two branches was feasible. **Results:** The excessive distance between the two branches averaged 6 mm (1–13 mm). Thus, direct neurorrhaphy of the sensory branch of the musculocutaneous nerve and the deep branch of the radial nerve was possible. **Conclusions:** When the whole musculocutaneous nerve is grafted, some of its motor fibres are lost amongst the sensory fibres (cutaneous lateral antebrachial nerve). By suturing this sensory branch onto the deep branch of the radial nerve, 'lost' fibres may be retrieved, resulting in restoration of digital extension. ©2011 Wiley-Liss, Inc. *Microsurgery* 31:303–305, 2011.

Total palsy of the brachial plexus generates numerous therapeutic issues, especially as regards donor nerves. In fact, some functions cannot be restored without a graft. Many nerve neurotizations have been described, but grafting may be performed when roots are healthy.^{1,2} It is sometimes difficult to graft two nerves distal from the root for two different functions. Our aim is to show the interest of suturing the distal sensory branch of a sensory motor grafted nerve to another motor nerve. The sensory part of the grafted nerve is used as a bridge between the proximal motor nerve graft and distal motor nerve. We present a study of the anatomic feasibility of such grafting on the musculocutaneous nerve of which the sole terminal sensory branch can be sutured on the deep (motor) branch of the radial nerve (Fig. 1).

METHODS

Five fresh cadavers (10 upper limbs) were dissected for this study, approved by the institution board. The sensory branch of the musculocutaneous nerve (lateral antebrachial cutaneous nerve) was dissected from its origin, at the level of the biceps muscle, up to its end at the level of the elbow crease just before its division as sev-

eral cutaneous branches. The radial nerve was identified and dissected in the lateral bicipital groove right to its division as deep (motor) branch and sensory branch above the supinator muscle. The deep branch was cut close to the radial nerve so as to obtain maximal length. Then, the distance separating the sensory branch of the musculocutaneous nerve and the deep branch of the radial nerve was measured so as to evaluate feasibility of direct suturing. The macroscopic diameter of the sensory branch of the musculocutaneous nerve and deep branch of the radial nerve was also measured.

RESULTS

The results showed that there was an excess in the length of the distance between the lateral antebrachial cutaneous nerve and the deep branch of the radial nerve; its average length was 6 mm (1–13 mm) (Fig. 2). The layout of the two nerves allowed direct suturing. In case the distance in excess between the two nerves was insufficient (<3 mm long), a 30° flexion of the elbow provided 2 to 3 extra millimetres. The average diameter of the sensory branch of the musculocutaneous was 3.4 mm (3–4 mm), and the average diameter of the deep branch of the radial nerve was 2.8 mm (2–4 mm).

DISCUSSION

In total palsy of the brachial plexus, the lack of donor nerve may be a limitation to the restoration of some functions. Usually, elbow flexion is the priority, as is shoulder elevation. Recently, some authors have reported some attempts to restore elbow extension.^{3–5} Even

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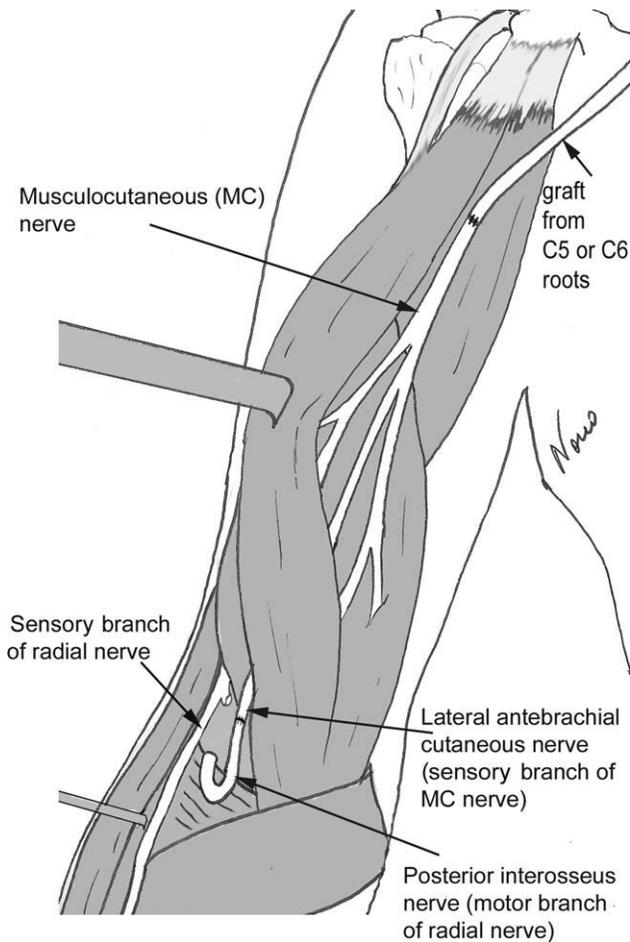


Figure 1. Principle of sensory-motor bridge neurotomy: the sensory branch of the musculocutaneous nerve (lateral antebrachial cutaneous nerve) was directly sutured onto the deep motor branch of the radial nerve at the level of the elbow crease. Motor fibres from the C5 or C6 root regenerate within the whole musculocutaneous nerve. The fibres constituting the sensory fibres quota of the musculocutaneous nerve (lateral antebrachial cutaneous nerve) will spread into the deep branch of the radial nerve, allowing the restoration of digital extension.

though, hand functions remain challenging in such complete palsies. Grafting from contralateral roots may be considered but functional outcome remains disappointing.⁶ Free muscle transfers also necessitate a donor nerve, and their results are conditional upon some hazard related to vascular microsurgery and perfect adjustment of a proper tension to the transferred muscle.⁷ Tendon transfers may provide an interesting but yet imperfect help to passive prehension.⁸ However, when cervical root, spinal, or intercostal nerves are utilized, no more solutions exist to restore the motor nerve of digital flexors or extensors. This is the reason why using the sensory quota of a restored sensorimotor nerve allows preventing the loose of motor fibres. Obviously, this may be done only with sensorimotor nerves in which the sensory trunk is easily

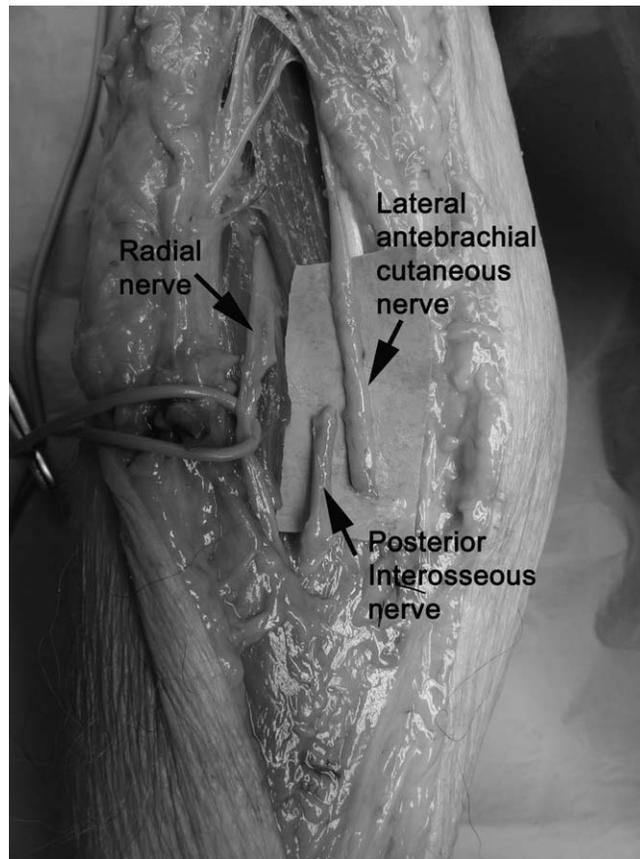


Figure 2. Direct neurotomy was possible between the lateral antebrachial cutaneous nerve and the deep branch of the radial nerve. The excess in length may range from 1 mm to 13 mm. Elbow bending may provide extra 2-3 mm.

individualizable, such as the musculocutaneous nerve of which the terminal branch is easy to isolate. When this nerve is grafted from a C5 root, for example, the motor fibres that regenerate within the sensory fibres quota may be rehabilitated into the lateral antebrachial cutaneous nerve. The latter is isolated and cut at the level of the elbow crease just before its division and sutured on a pure motor branch of the forearm. Such neurotomy appears to be feasible on the deep branch of the radial nerve, which results in fingers extension.

As in any other grafting, the distance is still long as regards the donor nerve, which may limit the restoration; however, this distance remains inferior to contralateral C7 root of which the efficiency in terms of hand restoration is debated currently.⁶ The existence of three sutures (between the root and the graft and then between the graft and the motor nerve in the forearm) may also limit reinnervation. Nevertheless, the diameter of the restored motor branch (deep branch of the radial nerve) is small and does not necessitate using many functional fibres. In any case, such fibres would remain non utilized if this distal motor neurotomy was not done.

This was an anatomic study based on a technique of which the interest, i.e., the quality of distal reinnervation, remains to be demonstrated by a clinical study.

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