NERVE TRANSFERS IN CHILDREN WITH TRAUMATIC PARTIAL BRACHIAL PLEXUS INJURIES

JEAN-NOËL GOUBIER, M.D., Ph.D.,* FRÉDÉRIC TEBOUL, M.D., M.S., and ELLADA PAPADOGEORGOU, M.D.

Brachial plexus trauma is a rare condition in children except for obstetrical lesions, for which nerve grafting is generally proposed. Two children (9 and 12 years old) with C5 and C6 traumatic brachial plexus avulsion lesions are presented, where elbow flexion and shoulder abduction and external rotation were the functions to be restored. Nerve transfers have been performed. Shoulder abduction was restored by an accessory-to-suprascapular nerve transfer in one patient, while the triceps long head motor branch was transferred to the axillary nerve in both patients. Fascicles of the ulnar and median nerve were transferred respectively to the biceps muscle nerve and the brachialis motor branch. At 11 months follow-up, the elbow flexion scored M4 and the shoulder abduction recovered in both patients. No complications were observed. Nerve transfers currently used in adult patients may be applied in children with traumatic partial brachial plexus palsies. © 2008 Wiley-Liss, Inc. Microsurgery 28:117–120, 2008.

Partial brachial plexus injuries remain a true surgical challenge as far as shoulder and elbow function recovery is concerned. Currently nerve grafting from C5 and C6 roots is the method of treatment commonly proposed. However, in case of root avulsions, nerve grafting is not indicated. Therefore, nerve transfers have been developed, as the only possibility for repair, especially in adult patients. Concerning shoulder abduction recovery, spinal-to-suprascapular nerve transfer is usually performed in case of C5 and C6 root avulsions.[1–4] Moreover, the transfer of the long triceps branch (radial nerve) to the axillary nerve has been described when elbow extension is preserved.[5] For the restoration of shoulder flexion, the double nerve transfer is commonly performed in adults with partial brachial plexus palsy.[5,6]

Additionally, the traumatic aetiology of brachial plexus palsy is a rare entity in children, while most of the traumatic brachial plexus palsy cases during childhood are of obstetrical cause. Only few publications have described this condition in the literature. Therefore, we present two children with traumatic plexus injury treated with nerve transfers.

CASE NO: 1

A nine-years-old boy sustained a partial brachial plexus injury, with shoulder abduction and elbow flexion palsy, after a car accident. Elbow extension, wrist and fingers flexion and extension were preserved. No vascular injury or bone fractures were present. MRI revealed C5 and C6 root avulsions. Therefore, surgical treatment has been decided in order to restore elbow flexion and shoulder abduction and external rotation if possible.

Nerve transfers have been performed three months after the accident. The operation was performed under general anaesthesia with the patient in the supine position. The biceps motor branch (musculocutaneous nerve), median and ulnar nerve, as well as the brachial artery were identified at the proximal humeral level. The fascicles corresponding to the motor fascicle of the ulnar nerve were confirmed by electric stimulation. Actually electric stimulation allowed us to identify the fascicles for the extrinsic hand muscles (the flexor carpi ulnaris and the flexor digitorum profundus of the ring and small finger), one of which was then separated and transferred to the motor branch of the biceps muscle. Additionally, one motor fascicle of the median nerve was transferred to the brachialis muscle motor branch at the same level. Both transfers were performed by an end-to-end nerve repair under microscope, using 10–0 sutures. The above double nerve transfer technique was chosen in order to achieve brachialis muscle reinnervation and therefore elbow flexion reinforcement[6] (Fig. 1). The identification and dissection of the upper trunks was achieved after resection of the omohyoid muscle. The spinal accessory, the suprascapular and the radial nerve were identified. The spinal accessory nerve was transferred to the suprascapular nerve. The long head of the triceps motor branch (radial nerve) was transferred to the motor branch of axillary nerve.[5]

The upper limb was immobilized postoperatively for three weeks. Then, physiotherapy started to improve grip strength and to preserve passive motion of the shoulder and elbow joints. Active supination and flexion exercises begun after the first biceps muscle contractions occurred.

No loss of ulnar, radial, and median nerve function was noted after surgery. Primary contraction of the biceps muscle appeared at 4 months after the nerve transfers. Ten months postoperatively, elbow flexion scored M4 according to Medical Research Council scoring (Fig. 2b).

International Center of Hand Surgery, clinique du parc Monceau, 21 rue de Chazelles, 75017 Paris, France

*Correspondence to: Jean-Noël Goubier, M.D., Ph.D., International Center of Hand Surgery, clinique du parc Monceau, 21 rue de Chazelles, 75017 Paris, France. E-mail: jngoubier@gmail.com

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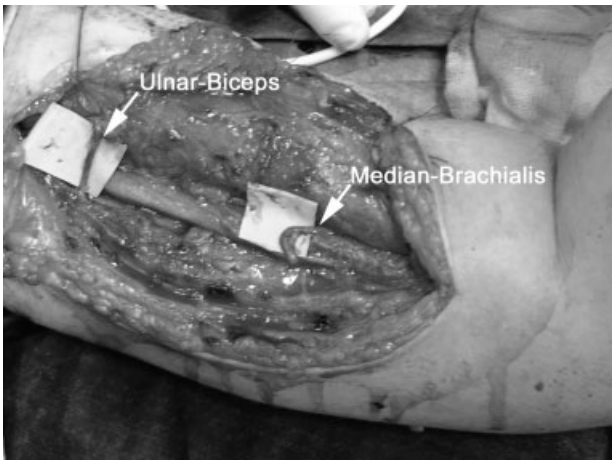

Figure 1. The double nerve transfer for the restoration of elbow flexion: one fascicle of the ulnar nerve (selected with electric stimulation) is transferred to the nerve of the biceps muscle (Ulnar-Biceps) and one fascicle of the median nerve is transferred to the nerve of the brachialis muscle (Median-Brachialis).

No palliative procedures, such as Steindler procedure,[7] were necessary to improve elbow flexion.

Hundred degrees of active shoulder abduction was obtained at 11 months after surgery (Fig. 2a). Shoulder external rotation reached 30°.

CASE NO: 2

A 12-year-old boy sustained a partial brachial plexus injury, as a result of a car accident. Shoulder abduction and elbow flexion palsy were diagnosed. C5 and C6 root avulsions were confirmed with MRI. Elbow extension, wrist and fingers flexion and extension were preserved. Surgical treatment was decided in order to recover elbow and shoulder function.

Surgery was performed four months after the accident. The same surgical technique than in case no 1 was used to restore elbow flexion. As far as the shoulder function repair was concerned, the identification and dissection of the upper trunks was achieved as previously described, during which a suprascapular nerve lesion was identified. Therefore, a single long head of the triceps motor branch-to-axillary nerve transfer was performed.

The same postoperative care was followed than in case no 1. No complications were noted after surgery. Primary contraction of the biceps muscle appeared at 4 months after the nerve transfers. Ten months postoperatively, elbow flexion scored M4. At 11 months postoperatively, 100° of active shoulder abduction was obtained and shoulder abduction scored M3. At the last follow-up, two years after the operation, active abduction was about 110° (Fig. 3a) and elbow flexion was complete and scored M4 (Fig. 3b). However, shoulder external rotation was not recovered.

DISCUSSION

Most of brachial plexus lesions diagnosed during childhood are birth injuries.[8] Traumatic brachial plexus palsy accounts for a small percentage, however it has been described in the literature.[9] Actually it emerges that the avulsion of cervical roots is the result of peripheral nerve traction. In general this condition occurs as a result of motorcycle or car accidents just as in adult injuries.[9] Nevertheless other rare causes, such as wounds of war and cardiac catheterization, have been reported.[10,11]

Nerve grafting is the surgical treatment usually selected for the restoration of shoulder and elbow function, even in cases of partial brachial plexus palsy. We have chosen to perform nerve transfers in our young patients. Even if in children nerve recovering after nerve grafting has been proven to be faster than in adults, we believe that nerve transfers are more reliable when ulnar and median nerves are preserved. The reason is probably the fact that the distance between the neurorraphy site and the muscle fibres is very short while using this technique; therefore the muscle reinnervation is faster. Primary muscle contractions are obtained at about four to six months postoperatively in adult patients series.[6,7] Because of the strength of biceps muscle contraction noted (M4), which was sufficient to obtain elbow flexion, no palliative procedures are necessary, contrary to nerve grafting.[6]

No complications concerning ulnar or median nerves have been described despite harvesting ulnar or median nerve fascicles. Moreover, no donor nerves are sacrificed in nerve transfers. Therefore, this technique could be perfectly adapted in young patients. The results of this double transfer are undoubtedly improved if surgery is performed before six months after the injury.[7] Therefore this transfer is not indicated in case of "old" brachial plexus palsy (more than 12 months).

The suprascapular nerve is currently used in order to restore shoulder function in adults or children.[1,6,12] However, the transfer of the long head of the triceps motor branch of the radial nerve to the axillary nerve concerned adult surgery in publications to our knowledge.[5] The specific nerve transfer is possible only if radial nerve is preserved after the accident. The harvesting of the long head of triceps motor branch of the radial nerve allows preserving the elbow extension with the preserved function of the lateral and the medial head of triceps. The diameter of the triceps long head motor branch matches perfectly with the motor branch of the axillary nerve. Moreover, the distance between the neurorraphy site and the deltoid muscle is short. Therefore, the reinnervation period is expected to be shorter than in nerve grafting procedures usage. However, external rotation is not restored if the accessory spinal nerve is not transferred to the suprascapular nerve, as in our second patient.

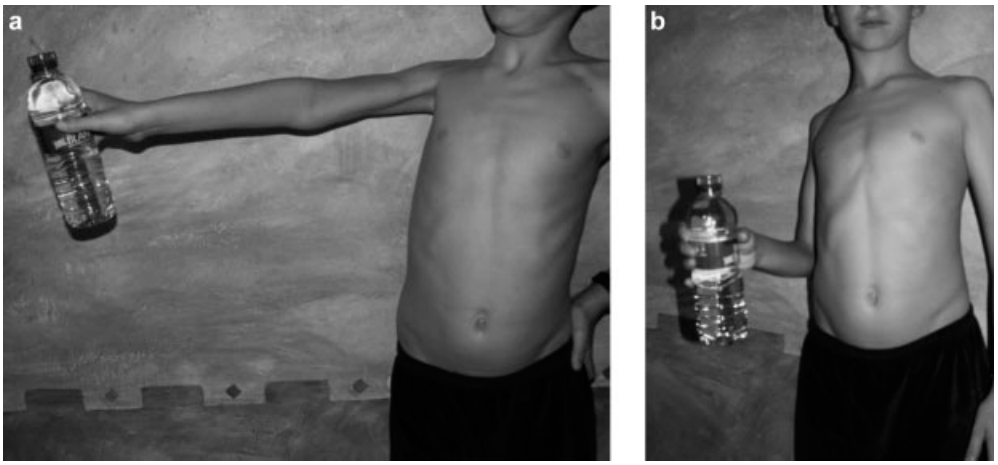

*Figure 2. Results at ten month follow up, concerning shoulder elevation (**a**) and elbow flexion (**b**) in Patient 1.*

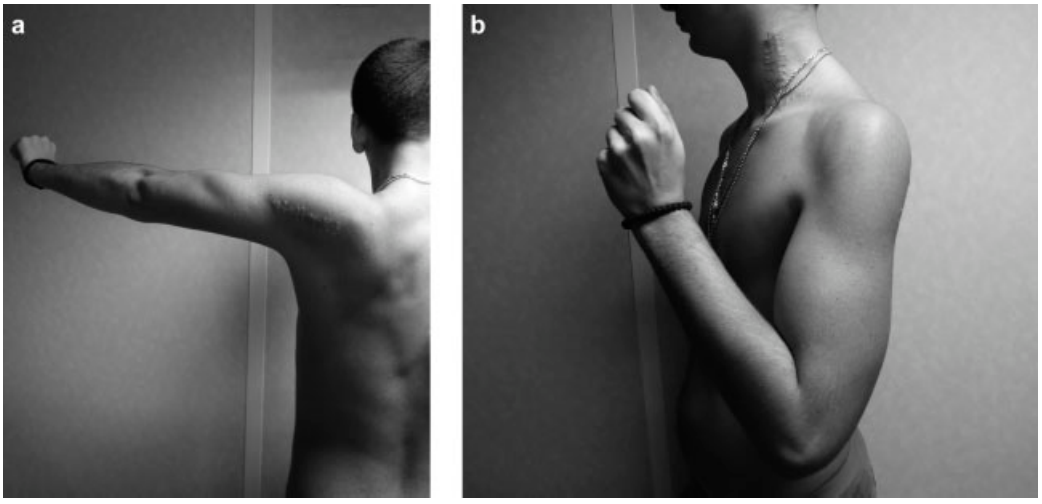

*Figure 3. Results at two years follow-up, concerning shoulder abduction (**a**) and elbow flexion figure (**b**) in Patient 2.*

CONCLUSION

Nerve transfers currently performed in adults may be applied in children surgery, in case of brachial plexus partial palsies. The reinnervation period is expected to be shorter than the one reported after nerve grafting procedures and no palliative operations are necessary because of the recovery of biceps muscle strength that is adequate for elbow flexion. Therefore an accessory-to-suprascapular nerve transfer and a triceps long head motor branch-to axillary nerve transfer together with a partial ulnar and median nerve transfer in order to restore shoulder abduction and external rotation and elbow flexion in children, constitute a valid strategy and should be considered as a standard procedure for this kind of injuries. For this reason a larger number of cases will need to be studied for it to be widely accepted for C5 and C6 traumatic brachial plexus avulsion lesions in children.

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