

THE RESULTS OF USING A PART OF ULNAR NERVE FOR RESTORATION OF ELBOW FLEXION IN PATIENTS WITH UPPER BRACHIAL PLEXUS INJURY

R. Shahriar-Kamrani*, S. M. Jafari and M. R. Guiti

Department of Orthopedic Surgery, Shariati Hospital, School of Medicine, Tehran University of Medical Sciences, Tehran, Iran

Abstract- In upper brachial plexus (C5-C6 or C5-C6-C7 roots) injuries, restoration of elbow flexion is the first aim. Several methods have been used to achieve this goal. Among these procedures, Oberlin's method (transfer of part of ulnar nerve to the nerve to biceps muscle) is the newest one. From April 2002 to March 2003 we used this method in 9 cases, 8 males and 1 female, of upper brachial plexus injury with impaired active elbow flexion and intact ulnar nerve. Patients' age ranged from 9 to 53 years. In 6 acute cases only Oberlin's method was used and in 3 old cases this technique was combined with gracilis free muscle transfer. The minimum follow up period was 6 months. Six cases gained effective elbow flexion and 3 cases showed fair or poor results. No permanent impairment of ulnar nerve function was observed. We found Oberlin's method to be a safe, simple and effective way to achieve elbow flexion in patients with upper brachial plexus injury.

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Key words: Brachial plexus injury, elbow flexion, nerve transfer, Gracilis free muscle transfer

INTRODUCTION

Upper brachial plexus injuries may cause impairment of shoulder and elbow function which could be very disabling for the patient. In this situation restoration of elbow flexion is the first goal that must be achieved (1, 2). In repairable types (nerve root rupture), 70% show successful results after repair (3), but in irreparable types (nerve root avulsion) repair is impossible and tendon or nerve transfer must be used. The common sources for tendon transfer are flexor-pronator (Steindler flexorplasty), pectoralis major, latissimus dorsi and triceps. The most commonly used nerves for nerve transfers are accessory nerve, intercostal nerves and contralateral C7 nerve root.

Although not generally accepted, it seems that the overall results of nerve transfer are superior to tendon transfer; more over, the previous function of the transferred muscle is lost after tendon transfer and the surgeon loses the proper time for nerve transfer. After nerve transfer no function is disturbed and the chance of tendon transfer still exists (2).

In 1994 Oberlin presented a new method for nerve transfer (4, 5). He transferred 10% of fascicles of ulnar nerve to the nerve supplying the biceps muscle in 4 cases, among which 3 cases achieved M4 elbow flexion. We tried to investigate the efficacy of this new method in our cases.

MATERIALS AND METHODS

From April 2002 to March 2003, nine patients with upper brachial plexus injury who showed no return of function after at least three months of follow up from the time of injury entered the study. All these patients had impaired active elbow flexion, intact

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* Corresponding Author:

R. Shahriar Kamrani., Department of Orthopaedic Surgery, Shariati Hospital, School of Medicine, Tehran University of Medical Sciences, Tehran, Iran

Tel: +98 21 84902388, +98 21 88717178

Fax: +98 21 88633039

E-mail: kamranir@sina.tums.ac.ir

ulnar nerve and full passive range of motion. Normal power of flexor carpi ulnaris and normal two point discrimination were considered as signs of healthy ulnar nerve. After obtaining complete history and performing physical examination and electrodiagnosis, all the patients underwent surgical exploration of the brachial plexus. In acute cases (less than 1 year from the injury) with rupture of nerve roots, repair of the roots by sural graft was done and in irreparable types (avulsion types) transfer of accessory nerve to suprascapular nerve was performed. Then musculocutaneous nerve, the motor branch to biceps muscle and the ulnar nerve were found at the midarm level. After performing a 2 cm longitudinal epineurotomy in the ulnar nerve, one or two fascicles were found and sutured end to end to the branch of nerve to biceps by 3 or 4 stitches of 10-0 nylon (Figs. 1 and 2). In old cases (more than 1 year from the injury), gracilis muscle was harvested with its pedicle and then attached proximally to clavicle and distally to biceps tendon (Fig. 3) and then, the nerve of transferred muscle was sutured to 1 or 2 fascicles of ulnar nerve. In first four patients we used the ulnar fascicle randomly but in the next cases we used electrical stimulator to choose the suitable motor fascicle.

Postoperatively all the patients had sling for 3 weeks and were visited monthly. In each outpatient visit the power of elbow flexion (according to the grading system of Medical Research Council), two point discrimination in the territory of the ulnar nerve and the intrinsic muscles force were recorded. The cases with at least 6 months follow-up entered the study.

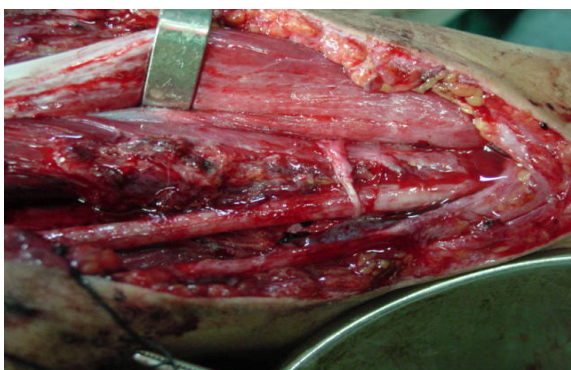


Fig. 1. Transfer of one fascicle of ulnar nerve to the nerve to biceps muscle.

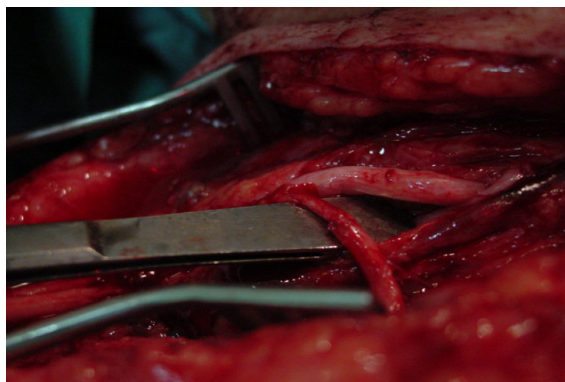


Fig. 2. Close up of transfer of the fascicle

RESULTS

Nine cases entered the study, 6 acute (less than 1 year from the injury) and 3 old (more than 1 year from the injury) cases. There were 8 males and 1 female (Table 1).

The patients were 9 to 53 year-old (mean, 23.8). In acute cases the time from injury to operation ranged from 5 to 12 months and in old cases ranged from 3 to 32 years. They were followed from 6 to 15 months. In acute group, 2 cases had repairable lesions, one with C5 and another with C2 rupture. Four cases had irreparable injuries, with C5-C6 avulsion. The recovery time after operation was 2-4 months (mean, 3 months).



Fig. 3. Gracilis muscle transferred to the arm

Table 1. Summary of results

Case	Sex	Age (year)	Type of injury	Interval between injury & surgery	Cause	Operation	The last evaluation
1	F	36	C5-C6 root avulsion	12 m	Fall	Oberlin	M1
2	M	21	C5-C6 root avulsion	7 m	Motorcycle Accident	Oberlin	M4
3	M	9	C5-C6 root avulsion	6 y	Car Accident	Oberlin + FFMT	M3
4	M	10	C5-C6 root avulsion	3 y	Car Accident	Oberlin + FFMT	M1
5	M	18	C5-C6 root avulsion	6 m	Motorcycle Accident	Oberlin	M4
6	M	22	Upper and middle trunk rupture	5 m	Motorcycle Accident	Nerve repair with sural graft + Oberlin	M2
7	M	47	C5-C6 rupture	5 m	Car Accident	Repair + Oberlin	M4
8	M	20	C5-C6 avulsion, C7 rupture	6 m	Motorcycle Accident	Oberlin	M3
9	M	32	C5-C6 root avulsion	32 y	Erb's palsy	Oberlin + FFMT	M4

Abbreviations: FFMT, functioning free muscle transfer; M, male, F, female; m, month; y, year.

Postoperatively three cases had hypoesthesia in the territory of ulnar nerve but after less than three months all had complete recovery with similar two point discrimination of both ulnar nerve territories and the same wrist flexion power.

In two cases that underwent gracilis free transfer, alopecia areata was observed that disappeared within 6 months. No other complications were seen. No Trumpet sign developed in patients with combined repair and Oberlin nerve transfer.

A 34 year-old lady achieved M1 elbow flexion power probably because of long delay between injury and operation (12 months). One case of gracilis free flap failed presumably due to technical problem at the site of nerve anastomosis (excessive tension due to long distance between ulnar nerve fascicle and the nerve of the flap). One patient gained M2 power after 15 months of follow up (Fig. 4) and then Steindler flexorplasty was done for him. The remaining 6 cases showed satisfactory (M3<) results (Table 1, Fig. 5 and 6).



Fig. 4. A case with M2 biceps contraction



Fig. 5. M4 elbow flexion after Oberlin method



Fig. 6. M4 elbow flexion after Oberlin method plus repair of the brachial plexus (the oldest patient)

DISCUSSION

In upper brachial plexus injuries (C5-C6 or C5-C6-C7 roots) despite normal function of hand, the impairment of shoulder and elbow functions makes the upper extremity relatively useless. Although in repairable cases the success rate is higher than the avulsion type but the efficacy of direct nerve repair is only 70% and in addition, repair in avulsion types is impossible.

In 1994 Oberlin introduced a new technique for restoration of elbow flexion. He used 10% of fascicles of the ulnar nerve which were selected randomly because in upper arm sensory and motor fascicles are mixed with interfascicular connections. Loy *et al.* (6), Leechavengvong *et al.* (7) and Sungpet *et al.* (8) used this method in 18, 32 and 36 cases, respectively, and all had good success rates (73%, 93% and 83%, respectively). Hattori *et al.* successfully used Oberlin's method combined with free gracilis transfer in a patient with polio like syndrome (9). Al-Qattan *et al.* from Saudi Arabia reported effective use of ulnar nerve fascicles transfer in 2 patients with Erb's palsy (10). None of the mentioned surveys reported any residual ulnar nerve deficit.

Cases with more than one year from trauma treated with classic Oberlin neurotization have been reported with moderate results (5, 6), but to our knowledge there is no report of using Oberlin's

technique with free gracilis functional flap in old brachial plexus injuries. Also we didn't find combination of Oberlin's technique with repair in rupture types. We think there are two reasons for the later procedure to be logical. First, the patients will have quicker recovery and rehabilitation. Second, after repair of upper brachial plexus patients with rupture may develop "Trumpet sign" due to co-contraction of biceps and deltoid muscles but with this method biceps will have separate innervations and consequently this disability would be omitted.

The success rate of our study is inferior to the other reports in the literature. There are several reasons to explain this difference; the most important is long delay between injury and surgery in our cases compared to the other reports which can significantly decrease the possibility of favorable results (2, 11), only two of our patients were operated within 6 months after the time of injury. We found that the Oberlin's method is also useful in combination with free muscle transfer in cases with old upper brachial plexus injuries in which we often have difficulty to find proper donor nerve. Although the number of our cases is limited, it seems reasonable to combine Oberlin's method with repair to prevent development of the Trumpet sign. This combination must be evaluated further and perhaps can be used to cure cases who had already developed this sign.

REFERENCES

1. Millesi H. Update on the treatment of adult brachial plexus injuries. In: Gilbert A, editor. Brachial Plexus Injuries. London: Martin Dunitz 2001. p. 77-90.
2. Gutowski KA, Orenstein HH. Restoration of elbow flexion after brachial plexus injury: the role of nerve and muscle transfers. *Plast Reconstr Surg.* 2000 Nov; 106(6):1348-1357
3. Leffert RD. Brachial Plexus. In: Green DP, editor. Green's Operative Hand Surgery. 4th edition. Philadelphia: 1999; p. 1557-1587.
4. Oberlin C, Beal D, Leechavengvongs S, Salon A, Dauge MC, Sarcy JJ. Nerve transfer to biceps muscle using a part of ulnar nerve for C5-C6 avulsion of the brachial plexus: anatomical study and report of four cases. *J Hand Surg [Am].* 1994 Mar; 19(2):232-237.

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5. Oberlin C, Ameer NE, Teboul F, et al. Restoration of elbow flexion in brachial plexus injury by transfer of ulnar nerve fascicles to the nerve to the biceps muscle: Technique. *Techniques in hand and upper Extremity Surg* 2002; 6(2): 86-90.
6. Loy S, Bhatia A, Asfazadourian H, Oberlin C. [Ulnar nerve fascicle transfer onto to the biceps muscle nerve in C5-C6 or C5-C6-C7 avulsions of the brachial plexus. Eighteen cases]. *Ann Chir Main Memb Super*. 1997; 16(4):275-284.
7. Leechavengvongs S, Witoonchart K, Uerpairojkit C, Thuvasethakul P, Ketmalasiri W. Nerve transfer to biceps muscle using a part of the ulnar nerve in brachial plexus injury (upper arm type): a report of 32 cases. *J Hand Surg [Am]*. 1998 Jul; 23(4): 711-716.
8. Sungpet A, Suphachatwong C, Kawinwonggowit V, Patradul A. Transfer of a single fascicle from the ulnar nerve to the biceps muscle after avulsions of upper roots of the brachial plexus. *J Hand Surg [Br]*. 2000 Aug; 25(4): 325-328.
9. Hattori Y, Doi K, Baliarsing AS. A part of the ulnar nerve as an alternative donor nerve for functioning free muscle transfer: a case report. *J Hand Surg [Am]*. 2002 Jan; 27(1): 150-153.
10. Al-Qattan MM. Oberlin's ulnar nerve transfer to the biceps nerve in Erb's birth palsy. *Plast Reconstr Surg*. 2002 Jan; 109(1): 405-407.
11. Terzis JK, Papakonstantinou KC. The surgical treatment of brachial plexus injuries in adults. *Plast Reconstr Surg*. 2000 Oct; 106(5): 1097-1122.