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EFFICACY OF NERVE TRANSFER FOR RESTORING ELBOW FLEXION IN TRAUMATIC BRACHIAL PLEXUS INJURY- A COMPARATIVE STUDY BETWEEN OBERLIN PROCEDURE AND INTERCOSTAL NERVE TRANSFER

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ABSTRACT

Aim: To compare the efficacy of Oberlin nerve transfer procedure with Intercostal nerve transfer(ICNT) for restoring elbow flexion in traumatic brachial plexus injury.

Methods: A cross sectional study was performed in 30 traumatic brachial plexus injury patients at Institute of Research and Rehabilitation of Hand, Stanley Medical College, Chennai between January 2018 and September 2019, 15 of whom underwent Oberlin nerve transfer procedure and 15 underwent Intercostal nerve transfer(ICNT) to Musculocutaneous nerve (MCN).

Results: Mean time duration to obtain biceps muscle power grade 1 (M1) in Oberlin and ICNT groups were 5.6 and 9.33 months respectively. For good recovery (ie) muscle power grade 3 (M3) , mean time duration in Oberlin group was 12.8 months and in ICNT group 18.2 months which were statistically significant ($P < 0.05$).

Conclusion: Oberlin group regained biceps muscle power much earlier and with significantly greater final muscle power score than ICNT group and hence we conclude that unless there are any contraindications for Oberlin procedure it should be the most preferable method for restoring elbow flexion in upper brachial plexus injury.

KEYWORDS : Brachial plexus , Biceps muscle, Nerve transfer

1. INTRODUCTION

Traumatic injury of brachial plexus is common among victims of road traffic accidents often causing severe and permanent disability affecting work and social life.

Upper trunk (C5-C6) brachial plexus injury results in loss of shoulder function (abduction and external rotation), elbow flexion, and supination of the forearm whereas Pan brachial plexus injury (C5-T1) is even more devastating since the entire upper limb is paralyzed.

For these patients the priority is to restore elbow flexion function, followed by abduction and external rotation of the shoulder [1,2] finally restoration of wrist and hand function in Pan brachial plexus injury only.

The commonly used reconstruction methods for restoring elbow flexion are a technique described by Oberlin [3] where the motor fascicle of ulnar nerve is transferred to the motor branch of the biceps which is done in upper brachial plexus injury, phrenic nerve transfer,[4] Intercostal nerve transfer (ICNT) [5] and Contralateral C7 (cC7) nerve root transfer [6] to the motor branch of the biceps usually reserved for Pan brachial plexus injury With the several surgical interventions available there is a need for outcome assessment of these surgical procedures which is essential in decision making as to which procedure is most effective and hence the purpose of this study.

In the current study, Intercostal nerve transfer (ICNT) to Musculocutaneous nerve (MCN) and Oberlin procedure were studied to compare the efficacy in terms of Biceps muscle strength recovery.

2.METHODS

A cross sectional study was performed in 30 patients with traumatic brachial plexus injuries from Institute of Research and Rehabilitation of Hand, Stanley Medical College, 15 of whom underwent Oberlin nerve transfer procedure and 15 who underwent Intercostal nerve transfer (ICNT) to Musculocutaneous nerve (MCN) for restoring elbow flexion. Clinical, electrophysiological, and imaging data were used to identify type and pattern of brachial plexus injury. Patients underwent a structured rehabilitation program and signed an informed consent form before inclusion in the study.

Inclusion criteria

Age between 18 and 60 years, cooperate in the rehabilitation program and review for regular follow up.

Exclusion criteria

Non traumatic brachial plexus lesion, obstetric brachial plexus palsy and patients with restricted elbow range of motion.

Outcome measure

Outcome was computed in terms of overall improvement in Biceps muscle power. Manual muscle test using British Medical Research Council (BMRC) scale[7] was performed on each patient before surgery and thrice a month after surgery. British Medical Research Council grading system has motor function scores divided into 6 grades from grade 0 to 5. Grade of three or above was regarded as an effective recovery.

The time required to obtain muscle power grade 1(M1) and grade3(M3) or more after surgery, were determined. At the end of the follow up period final muscle grade (Final MMT) was evaluated.

Statistical analysis

Descriptive statistics were expressed as mean and standard deviation, ICNT and Oberlin groups were compared using nonpaired Student's t-tests. Duration of time to achieve muscle grade 1(M1) , grade 3(M3) and final MMT were compared between the two groups using Mann-Whitney nonparametric *U* test. Statistical significance was set at $P < 0.05$.

Postoperative rehabilitation

In all patients, the operated upper limb was immobilized in shoulder arm sling for 3 weeks with elbow at 90° flexion and shoulder at 0° abduction and 0°flexion and 80-90° internal rotation. Finger flexion and extension range of motion exercises were allowed just after the surgery. Starting from three weeks after surgery, shoulder arm sling was discontinued, shoulder and elbow range of motion exercises, electrical stimulation to biceps muscle were started along with muscle re-education exercises. Muscle re-education exercises for ICNT group initially was to do elbow flexion movement synchronously with respiration and then later without simultaneous respiratory effort. For Oberlin transfer group , muscle re-education exercises was to do initially elbow flexion movement with simultaneous wrist flexion and later without wrist flexion movement. All patients underwent rehabilitation therapy daily for three to four months after surgery at our hand rehabilitation section. Following which, they continued to visit the center every two weeks and progress of Biceps muscle recovery was assessed clinically until the end of follow up period.

3.RESULTS

Patient characteristics in the two intervention groups are shown in

(Table 1 and Table 2).

Table1: Demographic characteristics and Postoperative data for Oberlin group

Patient	Age/ Gender	Injured Nerve roots	Injury-Surgery (m)	M1 (m)	Final MMT (BMRC grade)	Follow up period (m)
1	33/M	C567	16m	5m	3	12m
2	26/M	C56	4m	6m	2	15m
3	22/M	C567	14m	6m	3	12m
4	21/M	C567	12m	6m	2	14m
5	24/M	C567	18m	6m	3	12m
6	27/F	C567	19m	5m	2	12m
7	30/M	C567	12m	5m	3	12m
8	25/M	C56	12m	5m	5	8m
9	19/M	C567	15m	6m	2	16m
10	43/M	C567	12m	5m	3	12m
11	48/M	C56	6m	5m	3	14m
12	33/M	C56	8m	5m	4	14m
13	36/M	C567	8m	6m	3	15m
14	24/F	C567	7m	7m	4	12m
15	27/M	C56	6m	6m	4	12m

Note: M1- Time duration to achieve muscle grade 1, Final MMT- muscle grade achieved at the end of follow up period , M-Male, F-Female

A detailed preoperative muscle chart was done. Biceps muscle power which is the target muscle was 0 in all cases in both the groups. In Oberlin group wrist flexor power (flexor carpi ulnaris and flexor carpi radialis) was either 4 or 5 which is the requisite power for partial ulnar nerve transfer supplying flexor carpi ulnaris to musculocutaneous nerve .

The mean age in Oberlin group was 30.3 ± 8.96 years and in ICNT group was 29.8 ± 8.06 years.

Mean time between injury and surgery were 11.3 ± 4.61 months for patients in Oberl in group and 11± 4.4months for ICNT group, which was not statistically significant.

Two of fifteen patients in the Oberlin group complained of abnormal sensations (hypesthesia and paresthesia) along the ulnar nerve distribution in the hand; however, this disappeared within 3 weeks after surgery. None of the patients showed apparent motor deficits in muscles innervated by ulnar nerve after surgery.

The mean time duration to obtain M1 in Oberlin and ICNT groups were 5.6 and 9.33 months, respectively. The mean time duration to obtain good (ie) grade M3 or more in Oberlin group was 12.8 months and in ICNT group it was 18.2 months. Our results showed that Oberlin group required significantly less time to obtain M1 than ICNT group which was statistically significant ($P < 0.05$) (Table 3).

Table 2: Demographic characteristics and Postoperative data for ICTN group

Patient	Age/ Gender	Injured Nerve roots	Injury-Surgery (m)	M1 (m)	Final MMT (BMRC grade)	Follow up period (m)
1	26/M	C5678T1	14m	8m	1	16m
2	26/M	C5678T1	5m	-	0	18m
3	23/M	C5678T1	4m	9m	3	17m
4	18/M	C5678T1	15m	8m	4	15m
5	29/M	C5678T1	15m	-	0	19m
6	32/M	C5678T1	5m	11m	2	19m
7	40/M	C5678T1	12m	-	0	15m
8	19/M	C5678T1	15m	-	0	16m
9	30/M	C5678	18m	-	0	20m
10	22/F	C5678T1	13m	12m	1	21m
11	40/M	C5678T1	6m	10m	3	19m
12	34/M	C5678T1	14m	9m	2	19m
13	43/M	C5678T1	7m	9m	2	18m
14	30/M	C5678	11m	9m	2	20m
15	35/M	C5678T1	11m	9m	3	21m

Note: Patient number 2,5,7,8 and 9 did not show any recovery hence time duration to achieve muscle power 1 is marked as -

In ICNT group 4 out of 15 patients (26.7%) regained biceps strength of grade 3 or more whereas in Oberlin group results were much better with 10 out of 15 (66.7%) patients regaining power 3 or more. 5 patients in ICNT group showed no improvement in muscle power from baseline even at the end of follow up period.

Final MMT score was 3.07 ± 0.8 in Oberlin group and 1.53± 1.35 in ICNT group which was statistically significant. (Table 3)

Table 3: Comparison of statistical values between Oberlin and ICNT group

Variables	Oberlin group (mean and SD)	ICNT group (mean and SD)	p value
Age (years)	30.3± 8.96	29.8 ± 8.06	
Injury- Surgery(months)	11.3 ±4.61	11±4.4	0.416
M1 (months)	5.6 ± 0.63	9.33±1.23	<0.05
Follow up period (months)	12.8± 1.93	18.2±2	<.005
Final MMT	3.07 ± 0.8	1.53± 1.35	<0.05

4. DISCUSSION

No existing data clearly indicate the most successful strategy for restoring elbow flexion. According to several authors, Oberlin procedure is the most successful approach to restore elbow flexion in upper trunk brachial plexus injuries.[1] Intercostal nerve transfer to musculocutaneous nerve was initially reported by Seddon.[8] However, their use became more prevalent following the reports of Nagano and Chuang. [9,10] Nagano reported return of biceps grade 3 in 88% of cases while Chuang showed a success rate of 67%.

Our results of biceps strength of grade 3 or more in the Oberlin groups are similar to those published by Loy et al [11] but much lower than those of other authors such as Leechavervong. [12] In ICNT group results differ drastically from previously mentioned studies with only 26.7% of our patients regaining biceps strength grade 3. Such diverse results are justified by the presence of multiple variables acting separately or in association, interfere in the prognosis of the primary injury.

There are several factors related to recovery of muscle function one of which is time variable (ie) the time interval between injury and surgical treatment. A sufficient number of motor fibers should reach the target organ within a given period of time to achieve the desired function. [13] The literature defines a 6 to 12 month time interval as the appropriate time window for such surgery. Teboul et al. [14] observed that patients operated 6 months after injury had 64.7% chance and those operated before 6 month post injury had 86.7% chance of useful recovery of biceps. [15] Our patients were operated between 4-19 months post injury in Oberlin group and between 4- 18 months in ICNT group. Moreover in our study the time interval between injury and surgical treatment in both groups were identical and hence we were able to compare the other variables between two groups without any bias.

In our patients elbow flexion grade 3 or more was obtained in 66.7% cases in the Oberlin group who were operated up to 6 months after trauma and 71% of cases between 6 and 12 months after trauma. In the literature 81.8% achieved elbow flexion grade 3 or more when operated up to 6 months post injury, dropping to 63.4% when operated between 6 and 12 months and 0% after 12 months post injury. In spite of these findings, it is widely accepted that Oberlin transfer can still be attempted even in patients 12-24 months after injury since the risk-benefit ratio can be favorable. [16]

5. CONCLUSION

Even though our study population is small, important conclusions with respect to effectiveness of nerve transfer for biceps return of function can still be derived.

The Oberlin group regained biceps muscle power much earlier and with a greater final muscle power score compared to ICNT group which was statistically significant. Hence from this study we conclude that unless there are any contraindications for Oberlin procedure it should be the most preferable method for restoring elbow flexion strength in upper brachial plexus injury.

REFERENCES

1. Ali ZS, Heuer GG, Faught RW, Kaneriya SH, Sheikh UA, Syed IS, et al. Upper brachial plexus injury in adults: comparative effectiveness of different repair techniques. J Neurosurg. 2015;122(1):195–201.
2. Tsai YJ, Su FC, Hsiao CK, Tu YK. Comparison of objective muscle strength in C5-C6 and C5-C7 brachial plexus injury patients after double nerve transfer. Microsurgery. 2015;35(2):107–114
3. 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;19(2):232–237
4. El-Gammal TA, Fathi NA. Outcomes of surgical treatment of brachial plexus injuries using nerve grafting and nerve transfers. J Reconstr Microsurg. 2002;18:7–15
5. Ploncard P. A new approach to the intercosto-brachial anastomosis in the treatment of brachial plexus paralysis due to root avulsion. Late results. Acta Neurochir (Wien) 1982;61:281–290
6. Gu et al., 2002; Gu YD, Xu JG, Chen L, Wang H, Hu SN. Long-term outcome of contralateral C7 transfer: a report of 32 cases. Chin Med J. 2002;115:866–868
7. Seddon HJ. Peripheral Nerve Injuries. Medical Research Council Special Report Series. 282 Her Majesty's Stationery Office, London; 1954.
8. Seddon HJ. Nerve grafting. J Bone Joint Surg Br. 1963;45:447–61.
9. Nagano A, Ochiai N, Okinaga S. Restoration of elbow flexion in root lesions of brachial plexus injuries. J Hand Surg Am. 1992;17:815–21.
10. Chuang DC, Epstein MD, Yeh MC, Wei FC. Functional restoration of elbow flexion in brachial plexus injuries: Results in 167 patients (excluding obstetric brachial plexus injury) J Hand Surg Am. 1993;18:285–91.
11. Loy S, Bhatia A, Asfazadourian H, Oberlin C. Ulnar nerve fascicle transfer onto 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) : 275-84
12. 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;23(4):711–716
13. Liverneaux PA, Diaz LC, Beaulieu JY, Durand S, Oberlin C. Preliminary results of double nerve transfer to restore elbow flexion in upper type brachial plexus palsies. Plast Reconstr Surg. 2006;117(3):915–919.
14. Teboul F, Kakkar R, Ameur N, Beaulieu JY, Oberlin C. Transfer of Fascicles from the ulnar nerve to the nerve to the biceps in the treatment of upper brachial plexus palsy. J Bone Joint Surg Am. 2004;86-A(7):1485–1490.
15. Mohammad-Reda A. Early post-operative results after repair of traumatic brachial plexus palsy. Turk Neurosurg. 2013;23(1):1–9.
16. Sedain G, Sharma MS, Sharma BS, Mahapatra AK. Outcome After delayed oberlin transfer in brachial plexus injury. Neurosurgery. 2011;69(4):822–827.