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NEUROTISATION OF BICEPS BRACHII WITH SPINAL ACCESSORY NERVE AND ULNAR NERVE: AN OBSERVATIONAL STUDY

Plastic Surgery

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ABSTRACT

Introduction : Brachial Plexus Injuries have a profound impact on the functional and psychological aspect of the affected individual. This study focuses on the elbow reanimation phase in the treatment of Brachial Plexus Injuries.

Materials and methods: An Observational Study to assess the usefulness of Ulnar Nerve and Spinal Accessory Nerve as donor nerves for elbow reanimation was done. The Biceps Brachii muscle is neurotised in this study. Ulnar Nerve fascicles innervating Flexor Carpi Ulnaris muscle are coapted to branch of Musculocutaneous innervating Biceps Brachii muscle. This procedure is commonly called the Oberlin I procedure, named after the Surgeon who first ever described nerve transfer for elbow reanimation. The other donor nerve used is the Spinal Accessory Nerve along with the Sural Nerve graft for coaptation with Biceps Brachii branch of Musculocutaneous Nerve. Regular physical rehabilitation before and after surgery is carried out. Outcomes of these nerve transfers with regard to elbow flexion, patients compliance and compliactions are evaluated.

Results : Oberlin I procedure has better outcome with respect to number of days required for recovery, final muscle power attained and patient compliance.

KEYWORDS

Oberlin I Procedure, Elbow Reanimation, Brachial Plexus Injury

INTRODUCTION

Absence of functionality is a distressing effect of Brachial Plexus Injury. Apart from loss of function , loss of sensation also occurs in the affected limb. The normal life of the person is lost permanently. The person slips into a period of depression. Treatment for Brachial Plexus Injuries started in the beginning of the last century. Real improvements in brachial plexus injuries came only in the last forty years. Multiple surgeries are required in treating Brachial Plexus Injuries. More often separate surgeries are required for shoulder, elbow and finger reanimation. Since the treatment is multi-pronged and prolonged Physiotherapy and patients compliance plays a major role in the outcome of the treatment.

This study deals with one aspect of the Brachial Plexus Injury management namely elbow reanimation. This study compares the nerve transfer techniques of elbow reanimation using Ulnar Nerve and Spinal Accessory Nerve. The Biceps Brachii muscle is neurotised. Although the recovery is not complete, the patient will regain useful functional ability to carry out day to day activities.

Tuttle in 1913, was the first to describe neurotisation in Brachial Plexus Injuries. Forty years ago Narakas (Narakas AO.,1985) described the rationale and principles in nerve transfers in Brachial Plexus Injuries. Since then nerve transfers have become a mainstay in treatment of Brachial Plexus Injuries.

Muscles which lost their function due to Brachial Plexus Injury were rendered functional by nerve transfers. The principle is that – undamaged nerves innervating a muscle that has been affected by Brachial Plexus Injury can be reanimated using a donor nerve which serves another function.

The first ever nerve transfer for elbow reanimation was described by Dr. Christophe Oberlin (Oberlin C, Beal D, Leechavengvongs S, Salon A, Dauge MC, Sarcy JJ.,1994). He described transfer of Ulnar Nerve fibres to Musculocutaneous Nerve innervating the Biceps Brachii muscle. He hypothesized that Ulnar Nerve fibres can be safely separated at the level of the arm and transferred to the Musculocutaneous Nerve to innervate it.

Oberlin's study proved that resulting functional loss of the donor nerve is very minimal. A lot of novel nerve transfer techniques have come up lately. In cases of total Brachial Plexus Palsy extra plexial nerves are used. Songcharoen P, Mahaisavariya B, Chotigavanich C(1996) used Spinal Accessory Nerve as the donor nerve. The Spinal Accessory Nerve is anastamosed with the Musculocutaneous Nerve with a interposed cable nerve graft. Seddon H (1960,1968) used Intercostal nerve as donor nerve. Brandt and MacKinnon (1993) used Median Pectoral Nerve. Gu YD, Wu MM, Zhen YL, Zhao JA, Zhang GM, Chen DS, et al(1989) used Phrenic Nerve as the donor nerve.

Gu Y, Xu J, Chen L, et al.,(2002) described contralateral C7 fibres cross neck transfer for innervating the musculocutaneous nerve.

Terzis JK, Kokkalis ZT(2009) advocated additional transfer of lateral cutaneous nerve of forearm alongwith Intercostal Nerve transfer. Mackinnon SE, Novak CB, Myckatyn TM, Tung TH(2005) proposed double fascicular transfer for elbow flexion innervating Biceps Brachii and Brachialis. Vekris MD, Beris AE, Lykissas MG, Korompilias AV, Vekris AD, Soucacos PN(2008) used muscle transfers to restore elbow flexion in late presentation cases.

Materials and Methods:

A study was conducted at our department to evaluate the outcomes of the Biceps Brachii neurotisation with Ulnar Nerve fascicles and Spinal Accessory Nerve with interposed nerve graft.

A total of 21 cases of Biceps Brachii neurotisation was done. Of these 12 patients underwent Spinal Accessory Nerve to Musculocutaneous Nerve transfer. 9 of them underwent the Oberlin I procedure. In cases of partial Brachial Plexus Injuries where C8 and T1 nerve roots are intact, the Oberlin I procedure was done. In cases of total Brachial Plexus Injuries Spinal Accessory Nerve was used as donor nerve. All surgeries were performed within 12 months of injury. 19 of the patients were males and 2 of them are females.

For Oberlin I procedure a curvilinear incision over the medial side of the arm is given, with the patient in supine position with the affected arm in 90^0 abduction. The Musculocutaneous Nerve is identified and dissected. The Ulnar Nerve is identified and dissected. Intraperineural dissection of Ulnar Nerve is done. Using a nerve stimulator the fascicle innervating the Flexor Carpi Ulnaris muscle is identified. One or two fascicles are resected to match the thickness of the Musculocutaneous Nerve.

The branch of Musculocutaneous Nerve innervating the Biceps Brachii is resected at adequate distance so that coaptation can be done without tension. Under microscope coaptation is done using 9-0 nylon epineural sutures as shown in Figure 1. The arm is immobilised for 3 weeks post operatively. Physiotherapy is continued post-operatively.

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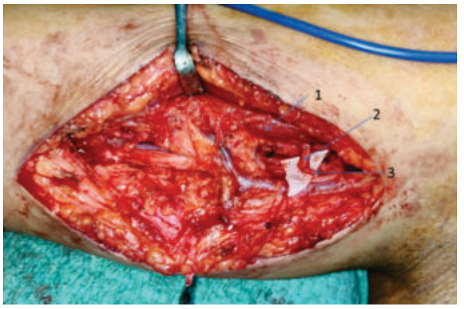
Figure 1: coaptation between Ulnar Nerve fascicle and Musculocutaneous Nerve



1-Biceps Brachii;2-Musculocutaneous Nerve;3-Ulnar Nerve Fascicle

Spinal Accessory Nerve is identified with a supraclavicular incision. The distal most branch of the nerve is identified and dissected, so that the functions of the Trapezius muscle are not affected. The Musculocutaneous Nerve is identified with a medial arm incision. The branch supplying the Biceps Brachii is identified and resected. A Sural nerve graft is harvested from the non dominant leg. A sub cutaneous tunnel is made from supraclavicular fossa to medial side of arm. The sural nerve is reversed and passed through the subcutaneous tunnel. The graft is interposed and anastomosis done with 9-0 nylon epineural sutures using microscope. Ideally the graft length should be less than 12 cms. The limb is immobilised for three weeks.

The patients are followed up till eighteen months. The muscle power attained at 6 ,12 and 18 months are noted. Any complications and functional loss of donor nerves are noted. In Oberlin procedure since the incision is small, only one case had wound related complication. But 5 patients reported transient paraesthesia in the ulnar nerve distribution. Paraesthesia subsided without intervention. Functional deficit was not noted in any of the patient.

Spinal Accessory Nerve transfer requires much longer incision with tunnelling between suprascapular fossa and medial side of arm. 5 patients had seroma formation and minimal wound dehiscence. At ten months post operative period two patients who complained of pain at medial arm without improvement in functional outcome were re-explored and neurolysis done. Post operative pain was also higher in this transfer compared to the ulnar nerve transfer. Moreover the Sural nerve harvested as the nerve graft leads to loss of sensation in the lateral aspect of foot. Recovery of these sensations takes a really long time.

The power of Biceps Brachii muscle was noted and graded according to the British Medical Research Council Grading system from 0 to 5. The power at 6,12 and 18 months for Spinal Accessory Nerve transfer are shown in Table 1.

Table 1 : Spinal Accessory As Donor Nerve

DURATION	MRC GRADE					
	0	1	2	3	4	5
6 MONTHS	12	0	0	0	0	0
12 MONTHS	0	5	5	2	0	0
18 MONTHS	0	1	2	7	2	0

Figure 2 : Spinal Accesory Nerve transfer at 18 months with Grade 3 power.

At 12 months, in spinal accessory nerve transfer, 5 patients(41.7%) had power of Grade 2 and 3 patients(25%) had Grade 3 muscle power. At 18 months 7 patients(58.3%) had grade 3 and 2 patients(16.7%) had grade 4 power. One patient had only grade 1 power at the end of 18 months. A 18 month follow up patient with Grade 3 power is shown in Figure 2.

Whereas in the Oberlin procedure, 3 patients(33.3%) had a power of grade 2 and grade 3 each at 12 months. At 18 months 3 patients(33.3%) had grade 3 and grade 4 each. One patient had grade 5 power (Table 2).

TABLE 2 : OBERLIN I PROCEDURE

DURATION	MRC GRADE					
	0	1	2	3	4	5
6 MONTHS	4	3	2	0	0	0
12 MONTHS	0	3	3	3	0	0
18 MONTHS	0	0	2	3	3	1

The use of nerve graft and the longer distance from the donor nerve to the recipient nerve makes the Spinal Accessory Nerve less attractive as the donor nerve. However in total Brachial Plexus Injuries it is one of the easily accessible and expendable nerve. The donor nerve morbidity is also negligible. Oberlin procedure has better outcomes in terms of duration of recovery and final recovery attained. Direct neurotisation without graft and minimal dissection may affect the final outcome of the procedure.

Conclusion:

Oberlin transfer should be the procedure of choice when C8 and T1 roots are spared. Spinal Accessory Nerve though not the ideal donor nerve in total palsies, should be considered when other donor nerves are sparse or are reserved for further procedures.

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