Outcome of Dual Nerve Transfer in C5-C6 Brachial Plexus Injuries.

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ABSTRACT

Objective: To determine the outcome of Spinal Accessary nerve to Suprascapular nerve and motor branch of Radial nerve transfer to the Axillary nerve for restoration of shoulder abduction and external rotation in patients with C5-C6 brachial plexus injury.

Methods: We conducted this descriptive study in National Orthopedics Hospital Bahawalpur. The study period extended from 12th June 2015 to 12th December 2020.All patients with C5-C6 injury fulfilling the inclusion criteria were operated with Spinal Accessary nerve to Suprascapular nerve and motor branch of Radial nerve transfer to the Axillary nerve. Post operative functional assessment was done by measuring shoulder abduction, external rotation and strength of abduction.

Results: The total number of patients in this study were 14. Male patients were 13(92.85%) and female 1(7.14%).The mean age was 29.2±7 years. Right shoulder was affected in 9(64.28%) patients and left in 5(35.7%). The mean follow up period was 24.2±3.3 months. The shoulder abduction improved from pre operative 0° to 97.8°±4° while external rotation from 0° to 30°± 5° postoperatively. The abduction muscle strength as per Medical Research Council (MRC) scale was M4 in 9(64.28%) and M3 in 3(21.42%) patients.

Conclusion: Satisfactory shoulder abduction with adequate muscle strength and external rotation was achieved in majority of our patients of C5-C6 brachial plexus injury treated with dual nerve transfer,This transfer utilized Spinal Accessary nerve to Suprascapular nerve and motor branch of Radial nerve to the Axillary nerve.

Keywords: Axillary nerve, Brachial plexus, Nerve transfer, Spinal Accessary nerve, Suprascapular nerve.

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INTRODUCTION

Restoration of shoulder function and elbow flexion is the prime concern and top priority in all brachial plexus surgeries.[1-3] In brachial plexus injuries a deficient shoulder control is a major handicap even if hand function is spared or restored because the arm cannot be moved in space or appropriately placed in a desired function.[4,5] Shoulder abduction is controlled by combined function of Supraspinatus, Infraspinatus and Deltoid which receive their innervation from Suprascapular and Axillary nerves.[4,6] A common strategy of reestablishing shoulder function has been Spinal Accessory nerve transfer to Suprascapular nerve and neurotization of the posterior division of the upper trunks by nerve grafting if one or more roots are available.[5,7] With the introduction of nerve transfers there has been a significant paradigm shift and more options have now become available for reanimation of shoulder. Many surgeons prefer nerve transfers rather than nerve grafting for reestablishment of shoulder function in brachial plexus injuries.[3,8] By nerve transfer an expendable nerve is coupled to a more vital nerve to reinnervate that nerve. Many studies comparing nerve transfer and nerve graft revealed better and more predictable results with nerve transfers.[7,9] Dual nerve transfers to reinnervate Supraspinatus and Infraspinatus and

reinnervation of deltoid has yielded better results than single nerve transfer.[1,10]

The objective of our study was to determine the outcome of Spinal Accessary nerve to Suprascapular nerve and motor branch of Radial nerve transfer to the Axillary nerve for restoration of shoulder abduction and external rotation in patients with C5-C6 brachial plexus injury. We hypothesized that peripheral dual nerve transfer for reanimation of shoulder would yield better functional results than single nerve transfer.

METHODS

We conducted this descriptive study in National Orthopedics Hospital Bahawalpur from 12th June 2015 to 12th December 2020.All adults patients of either gender and age with isolated traumatic brachial plexus injury, avulsion/rupture of C5-C6 or upper trunk injuries without clinical or electromyographic signs of recovery for 4 months duration and irreparable injuries were included in this study. All patients with shoulder or elbow contracture, rotator cuff tear, ipsilateral shoulder fractures and previously surgically treated C5-C6 injuries were excluded. The study protocols were approved by the hospital Ethical Committee and informed written consent was taken from all study participants. In the included subjects complete history, physical examination and relevant investigations(radiographs,MRI,NCS,EMG) were undertaken to confirmed the diagnosis of C5-C6 injury. Pre operative abduction and external rotation was measured in all patients.

Surgical Technique

We performed all surgeries under general anesthesia. The same surgical team performed all surgeries following identical standard surgical technique in all cases. Lateral decubitus position was used and nerve transfers were done through posterior approach both for neurotization of the Suprascapular nerve and for transfer of a branch of Radial nerve to the Axillary nerve. First Accessory nerve was transferred to the Suprascapular nerve followed by transfer of Radial nerve motor branch to the Axillary Nerve.

For transfer of the Accessory nerve patient was placed in lateral position.An incision was made along the scapular spine from acromion to the medial scapular border after subcutaneous injection of diluted adrenaline.(Fig I) The Suprascapular nerve is located approximately midway between angle of acromion and the medial scapular border. The Trapezius muscle attachment was lifted from the scapular spine and the muscle was retracted proximally. The Supraspinatus muscle was exposed and retracted inferiorly. The Suprascapular ligament was identified along the superior border of scapula. The Suprascapular vessels were mobilized and moved away from the ligament. The nerve was delivered by transecting the Suprascapular ligament. It was mobilized and dissected superiorly. It was divided after gaining enough length to transposed the nerve to Supraspinatus area for easy anastomosis with the Accessory nerve. Accessory nerve was identified about midway between dorsal spinous process and acromion near the medial border of the scapula along the undersurface of the Trapezius muscle. The Accessory nerve was dissected free of the surrounding tissue to provide adequate length and then divided after confirmation with the nerve stimulator. Both the nerves were coapted under magnification.(Fig II) The Trapezius muscle was reattached to the spine of scapula.

For transfer of Radial nerve motor branch to the Axillary Nerve the same lateral position was utilized. A posterior arm incision from acromion to mid arm region was used.(Fig. I) After retracting the deltoid superiorly the anterior branch of Axillary nerve was isolated in quadrangular space and was dissected as proximally as possible deep into the quadrangular space. It was divided and delivered out of quadrangular space. We tried to incorporate the branch to the Teres minor which comes off proximally and runs in superomedial direction. The motor fibers of radial nerve to triceps were identified inferior to Teres major whose borders are made of triceps medially, humerus shaft laterally and Teres major superiorly. We generally preferred branch to long head, the first branch to come off the Radial nerve but if there was any issue with its length or girth, fibers to the medial head of Triceps can be used. The motor Radial branch was ascertained with the nerve stimulator and divided as distally as possible and delivered proximally over the Teres major. A direct anastomosis with the Axillary nerve was achieved without tension.(Fig III) The motor branch to the Triceps was mobilized for sufficient length to be transferred without tension on the anastomosis. The Teres major fascia or part of the muscle was incised to achieve a tension free repair.

Postoperatively the arm was placed in a sling and strapped to the chest with a body bandage for 2 weeks. Stitches were removed at 2 weeks and gentle passive exercises of the shoulder were started. All the patients were clinically assessed every 3 months

for 12 months and then every 4 months for the next one year. At 24 months follow up shoulder range of motion was measured with a goniometer and abduction strength was assessed with Medical Research Council (MRC) Scale.[11]

We analyzed our data with SPSS version 24. Mean and standard deviations were calculated for quantitative variables like age, abduction and external rotation while frequency and percentages were calculated for qualitative data like gender and side. Data was presented in table where necessary.

RESULTS

We operated 14 patients of C5-C6 brachial plexus injury with dual nerve transfer. Majority (92.85%, n=13) of our patients were male while female patient was only 1(7.14%). The mean age was 29.2±7 years. Right shoulder was affected in 9(64.28%) patients and left in 5(35.7%). The aetiology was road traffic accident in 11(78.57%) patients and fall from height in 3(21.42%) patients. The outcome details of our patients are shown in table I. The mean follow up period was 24.2±3.3 months. The mean shoulder abduction improved from pre operative 0 ° to 97.8°±4° while mean external rotation from 0 ° to 30 °± 5° postoperatively. The muscle strength as per Medical Research Council (MRC) scale was M4 in 9(64.28%) and M3 in 3(21.42%) patients and M0 in 2(14.28%). In our study 2(14.28%) patients could not achieved any abduction, external rotation or muscle power but had stable shoulder joint without subluxation. No reduction of elbow extension or other complication was noted.

Fig I: Patient position and incision markings for dual nerve transfers.

Fig II: Transfer of Spinal Accessory nerve to the Suprascapular nerve.

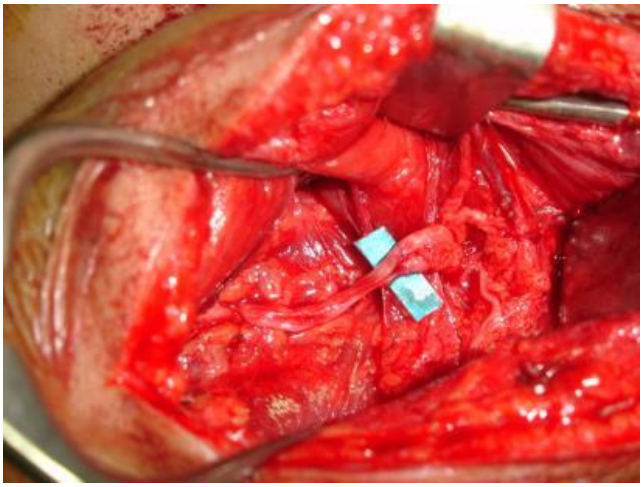

Fig III. Transfer of Radial nerve to the Axillary nerve.

DISCUSSION

In our study we treated 14 patients with dual nerve transfer and noted that the mean shoulder abduction had improved from 0 ° to 97.8°±4° while mean external rotation from 0 ° to 30 °± 5° postoperatively. The muscle strength as per Medical Research Council (MRC) scale was M4 in 9(64.28%) and M3 in 3(21.42%) patients and M0 in 2(14.28%). We approach the Accessory nerve posteriorly for transfer to Suprascapular nerve as it was closer to the targeted muscles thus shorted the recovery time and avoided the risk of missing the additional injury to Suprascapular nerve at the scapular notch. For axillary nerve neurotization motor triceps branch of radial nerve was our preferred choice because it is always available and expendable if C7 is intact. It has adequate size and length to provide easy coaptation

with Axillary nerve. If there is any issue with its length or size, one can use branch to the medial head of Triceps. Merrell and colleagues[12] showed that double nerve transfer restoring both Axillary and Suprascapular nerves had better potential for restoring shoulder movements. Similarly Favila[13] had also documented that double nerve transfer resulted in significantly increased external rotation than single nerve transfer when transfer was done within one year of injury. Xiao[14] treated 10 patients with C5-C6 root avulsion injuries with Spinal Accessory nerve to Suprascapular nerve alone and 10 patients with dual nerve transfer utilizing Accessory nerve to Suprascapular nerve and Intercostal or Radial nerve branch of Triceps to Axillary nerve. The shoulder abduction was more in dual transfer than single transfer and 90% of patients with dual transfer had excellent and good functional outcome compared to 50% in single nerve transfer.

In a systematic review Grag and colleague[15] analyzed the data of 51 patients collected from 6 studies published between 2003 and 2010.All the patients had dual nerve transfers. They found that muscle power as per RMC was M4 in 56% patients and M3 in 87% .The mean range of motion was 108° (range 70° -140°).These authors were of the opinion that dual nerve transfer to Suprascapular nerve and Axillary nerves were better than single nerve transfer in restoring shoulder abduction and external rotation. Leechavengvongs[16] treated 15 patients with dual nerve transfer and documented that the strength of external rotation as per MRC grading was M4 in 60% patients and M3 in 86% and range of motion was 97° (range 60° -130°). Bertelli[17] achieved 100% success with Spinal Accessory nerve to Suprascapular nerve and Radial branch of Triceps to Axillary nerve. Bertelli was able to achieved 92° shoulder abduction and 93° shoulder rotation in his series.

The limitation of our study were the relatively small number of cases, descriptive study design and only range of motion and recovery of muscle power had been used as a criteria for evaluation of our results. Shoulder disability scales like DASH score would have provided more information from functional point of view. Despite these limitations we believe that dual reinnervation of Axillary and Suprascapular nerves in C5-C6 brachial plexus injuries is a sound strategy resulting in useful and predictable results.

Table I: Outcome details of all patients included in our study.

Case No.	Age (years)	Gender	Interval between the injury and operation (months)	Follow up (months)	Abduction (degrees)	MRC (in abduction)	External Rotation (degrees)
1	40	Male	6.5	29.9	110	M4	20
2	30	Male	8.4	27.00	95	M4	35
3	25	Male	12.00	26.00	115	M3	20
4	30	Male	10.00	28.4	130	M4	30
5	35	Male	12.4	27.04	0	M0	0
6	25	Male	4.00	27.00	100	M4	45
7	30	Male	4.9	29.8	95	M4	30
8	22	Male	6.4	26.00	105	M4	35
9	17	Male	5.00	27.6	165	M3	20
10	15	Male	5.7	29.7	110	M4	30
11	55	Male	8.6	26.00	0	M0	0
12	40	Female	6.7	27.00	105	M4	45
13	22	Male	8.00	28.5	110	M4	40
14	24	Male	5.9	30.6	120	M3	25

CONCLUSION

Satisfactory shoulder abduction with adequate muscle strength and external rotation was achieved in majority of our patients of C5-C6 brachial plexus injury treated with dual nerve transfer.This transfer utilized Spinal Accessary nerve to Suprascapular nerve and motor branch of Radial nerve to the Axillary nerve.

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