International Journal of Medical and Health Research
ISSN: 2454-9142
Impact Factor: RJIF 5.54
www.medicalsciencejournal.com
Volume 3; Issue 9; September 2017; Page No. 36-39

Brachial plexus injury in adult: Comparative effectiveness of anterior and posterior approach for shoulder function

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Abstract
Restoration of shoulder function is one of the most critical goals of treatment of brachial plexus injuries. Primary repair or nerve grafting of avulsion injuries of the upper brachial plexus in adults often leads to poor recovery. As our knowledge of shoulder neuromuscular anatomy and physiology improves and our experience with nerve transfers increases, so evolve the specific transfer procedures. This article presents a technique and rationale for reconstructing shoulder function by transferring the distal spinal accessory nerve to the suprascapular nerve through a posterior approach in 15 patients and anterior approach in 15 patients of different type of brachial plexus injury. Many different nerves have been utilized as donor nerves for transfer to the suprascapular nerve and axillary nerve for return of shoulder function with variable results. After identification of spinal accessory nerve on the anterior surface of trapezius and suprascapular nerve in suprascapular notch through posterior approach, trapezius function is preserved.

Keywords: nerve palsy, traumatic brachial plexus reconstruction, nerve transfer-shoulder, brachial plexus

1. Introduction
Shoulder stabilization is a high priority in the treatment of patients with brachial plexus injuries. Suprascapular and axillary are the target nerves in achieving this goal. Experience has shown better results when suprascapular nerve is neurotized with spinal accessory nerve than using nerve grafts from a ruptured C5 root [1]. Today transfer of spinal accessory nerve to suprascapular nerve is a standard procedure, being performed through a transverse incision placed just above the clavicle. As pointed out by Bertelli [2], in severe traction injuries distal migration of the origin of suprascapular nerve can occur. Suprascapular nerve may be injured in scapular neck fractures or avulsed near the suprascapular or spin glenoid notch in extensive traction injuries [3]. For these difficult cases, anterior approach is not suitable and exploration near the notch is highly justified. During anterior explorations of spinal accessory nerve, few of its important branches to the upper trapezius muscle may be sacrificed while attempting to gain a sufficient length. Upper trapezius muscle has important function in the stabilization and elevation of scapula during shoulder abduction. In dorsal or posterior transfers innervation of upper trapezius muscle remains intact and this is expected to improve overall function of the shoulder.

2. Materials and Methods
All patients with Brachial plexus injury admitted during the period from October 2013, to March 2017 are included in this study. Patients with Brachial plexus injury initially treated elsewhere and referred to our department for further treatment are included in the study. This study included only adult brachial plexus injury.
Patients operated for reconstructive procedures for deformities outside following Brachial plexus injury are not included. Pediatric brachial plexus injury or Obstetric brachial plexus palsy are not included.
The preoperative muscle power of the trapezius muscle was tested and graded by MRC scale. The probable locations of spinal accessory nerve and suprascapular nerve were marked on the back with patient in upright position (Fig 1). The anatomical landmarks considered were; angle of acromion, spine of scapula, and medial border of scapula and midline of the back. The spinal accessory nerve was marked at a point approximately 70% of the distance from the angle of acromion to the dorsal midline. The suprascapular nerve was marked at a point approximately 30% of the distance from angle of acromion to the medial border of scapula. These preoperative markings helped in localizing the nerves during surgery as in lying position bony landmarks are considerably changed.

Fig 1: Pre-operative marking

The patient is induced under general anaesthesia in the supine position and then placed onto the operating table in the prone position with the arms adducted at the sides. The superior and posterior shoulder, the axilla, and the entire arm are prepped as a surgical field. Surgical markings are presented A 12 to 15 cm long incision was made parallel to the spine of scapula. The trapezius muscle was elevated from the scapular spine with sharp scissors and a plane was dissected between the trapezius and supraspinatus muscles. The spinal accessory nerve was isolated and taped. Contractions of the trapezius muscle were observed on its electrical stimulation. With the index finger, upper border of scapula was palpaled for suprascapular notch. A strong downward traction on upper border of supraspinatus muscle revealed the glistening white suprascapular ligament overlying the notch. Suprascapular artery and vein were try to preserve or ligated superficial to the ligament. The ligament was sectioned while protecting the underlying suprascapular nerve. The nerve runs within the adipose tissue, sometime giving off a proximal branch to the supraspinatus muscle. The suprascapular nerve was mobilized proximally to allow sufficient length and coapted with distal spinal accessory nerve using 10-0 nylon suture (Fig 2). The trapezius muscle was sutured back to the spine of scapula with 3-0 polyglactin suture. Skin incision was closed without a drain (Fig 3).

Tables and Figures

Fig 2: Tension free coaptation of Target nerves

Fig 3: Incision closed with drain

3. Results & Discussion

After studying 30 cases, P (Posterior Approach) group having posterior approach n=15 and A (Anterior Approach) group having anterior approach n= 15 the observation and results were summarized in tabulated form and described below. All patient had brachial plexus injury underwent for physiotherapy and nerve current therapy before and after surgery. Surgery was done at the 4 - 6 month following injury. Before surgery all Patient were investigate inform of MRI study, EMG – NCV, Muscle charting of affected limb, Ultrasonography of abdomen and thorax for check the diaphragmatic movement. Colour Doppler ultrasound done in selected cases in which suspected for vascular injury.

There were 14 male and 1 female in P (Posterior Approach) group. when in A (Anterior Approach) group 15 male patient, result are shown in Table 1. It suggest that brachial plexus injury is more common in male compared to female. All patients fall in the age between 20 to 58 years hence we divided them in to two P (Posterior Approach) and A (Anterior Approach) group groups according to age. Data suggest that brachial plexus injury occurs more commonly in age group of 20-30 years, result are shown in Table 2. We record the mode of injury as etiology of brachial plexus injury and found that 12 and 13 patients had Road traffic injury and history of fall down from terrace and tree had noted 03 and 01 in P (Posterior Approach) and A (Anterior Approach) group, result are shown in Table 3. Our data suggesting that patient with brachial plexus injury is more common in Road traffic injury. We noted that global C5-T1 injury was maximum 60% and 63.34% respectively in P (POSTERIOR APPROACH) and A (ANTERIOR APPROACH) GROUP. Isolated C5-C6

injuries were less in compare to global palsy, result are shown in Table 4.

In our study we are found result in form of shoulder function recovery and shoulder stabilization at the end of 6 months 100 and 93.4 respectively in P (POSTERIOR APPROACH) and A (ANTERIOR APPROACH) GROUP, result are shown in Table 5. Posterior approach for shoulder function got batter and early recovery as compare to anterior approach.

Table 1: Sex distribution

Sex	Male	Female
P (posterior approach) group	14	01
A (anterior approach) group	15	00

Table 2: Age group

Age in years	P (posterior approach) group	A (anterior approach) group
20-30	O8	09
30-40	04	03
40-50	02	03
>50	01	00

Table 3: Mode of injury

Mode of injury	Road traffic accident	Fall down	Other
P (posterior approach) group	12	03	00
A (anterior approach) group	13	01	01

Table 4: Type of injury

Site of injury	P (posterior approach) group (%)	A (anterior approach) group (%)
C5-C 6	13.34	20
C5-C7	26.66	26.66
C5-T1	60	63.34

Table 5: Recovery

Mode of injury	P (posterior approach) group (%)	A (anterior approach) group (%)
P (posterior approach) group	100	00
A (anterior approach) group	93.4	6.6

4. Discussion

Restoration of shoulder function is an important goal in the management of devastating brachial plexus injuries. Merrell et al reported that the best nerve transfer for restoration of shoulder abduction was the spinal accessory to suprascapular nerve transfer [4]. In the conventional anterior approach, one or two branches of accessory nerve innervating the upper part of trapezius muscle are spared. The nerve is sectioned closed to the clavicle and transferred to the suprascapular nerve. This approach may partially denervate the upper trapezius and will not be effective when supra scapular nerve is injured more distally.

Nagano [5] pointed out that double or triple level injury in the suprascapular nerve is not infrequent and poor results for the infraspinatus muscle are due to possible ruptures at the distal portion of the nerve.

Mikami et al found a double lesion of the suprascapular nerve in seven out of twenty-two patients [6]. Dorsal approach as described initially by Guan *et al*. [7] and Bahm *et al.* [8] is expected to overcome some of these drawbacks of the anterior transfers. Direct transfer of distal spinal accessory nerve can effectively manage suprascapular nerve injuries near the notch. This approach preserved the function of upper trapezius muscle. The nerve transfer being close to the target muscle produced an early reinnervation of the supraspinatus and infraspinatus muscles, as revealed best in the partial palsy group.

5. Conclusions

Transfer of spinal accessory nerve to the suprascapular nerve through posterior scapular approach is a new and effective technique in restoring shoulder abduction and external rotation. This approach to the target nerves avoids nerve grafting in distal suprascapular nerve reconstruction. We consider this a standard approach in suprascapular neurotization in all grades of devastating brachial plexus injuries.

6. References

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