ORIGINAL RESEARCH

Dorsal Approach for transfer of Spinal Accessory to Suprascapular Nerve for Restoration of Shoulder Function in Brachial Plexus Injuries

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Received: 02 November, 2023 Accepted: 07 December, 2023

ABSTRACT

Introduction-Patients with complete brachial plexus injuries have a high priority for surgical shoulder restoration. This is due to the fact that innervation of muscles below the elbow has a generally lower success rate, in addition to the critical role of functional control of the shoulder. The aim of present study is to neurotize suprascapular nerve by spinal accessory nerve through posterior approach in brachial plexus.**Material and methods-**The present prospective study was conducted at a tertiary care centre for a period of 3 years among 30 patients who visited to hospital for brachial plexus injuries. Complete history of patients was taken before and after operation. The statistical package for social science (SPSS), version 25.0, was used to analyze the data.**Results-**78% were male and 22% were females. 65% had injury on right side while 35% had injury on left side. Average value of shoulder flexion had increased significantly from 3.24±2.4 preoperative to 58.78±7.12 (P=0.001). Similarly, the average value of shoulder abduction had increased significantly from 5.47±3.78 preoperative to 66.32±6.8postoperative (P=0.001). Lastly, the average value of external rotation was enhanced significantly from 5.82±6.12 preoperative to 64.21±8.12 postoperative.**Conclusion-**Patients with brachial plexus palsy respond well to treatment when the spinal accessory nerve is transferred to the suprascapular nerve via the posterior route, thereby restoring shoulder abduction and external rotation.

Keywords- brachial plexus,injury,posterior approach,shoulder**,** spinal accessory nerve,suprascapular nerve

INTRODUCTION

Of all the peripheral neuronal units, the brachial plexus is the most intricate. It provides the arm, forearmand hand, enabling mental expression via writing, painting, physical activity, and careful environmental manipulation [1]. Recovery of the shoulder's stability, abduction, and external rotation is required in the majority of brachial plexus injuries [2]. While there are numerous ways to accomplish this, one of the most popular methods is nerve transfer, which involves moving accessory nerve (XI) fascicles to the suprascapular nerve (SSN). This method produces superior results than nerve grafts from ruptured C5 roots. An anterior approach or a posterior approach might be used to execute this procedure [3].

Any surgeon who wishes to access the brachial plexus via a supraclavicular path can do the anterior approach, which is straightforward and doable. Unfortunately, there are numerous challenges with this procedure, such as the laborious dissection of the spinal accessory nerve, which is located deep within fatty tissue that is dense with blood and lymphatic veins. Injury to the distal suprascapular nerve may also go unnoticed if plexus exploration and nerve transfer are carried out using an anterior route. Moreover, in clavicular fractures that had healed and have excessive callus production. Therefore, suprascapular nerve dissection carries some risk and difficulty. Furthermore, in the process of trying to reach a sufficient length, a few of the spinal accessory nerve's significant branches to the upper trapezius muscle may be sacrificed during anterior exploration [4].

All grades of severe brachial plexus injuries indicate the use of the posterior route in SSN transfer. It makes it easier to identify distal injuries in the SSN and

allows for clear view of the distal course of the SSN close to the suprascapular notch. This approach will obviously not be appropriate in the event that the SAN sustains an injury.[5]

In C5, 6 root avulsion injuries, there is evidence of a nerve transfer between the anterior branch of AXN and the triceps branch of the radial nerve. The innervation of the three heads of the triceps muscle comes from the C6 to T1 roots, with the C7 root providing the greatest contribution. Consequently, using this course of treatment is somewhat contraindicated if the middle trunk or the C7 nerve root are injured.

Recent clinical series suggest that better results in shoulder abduction and external rotation can be obtained when the XI – SSN neurotization is performed using a posterior approach.[6]

This study aimed to neurotize suprascapular nerve by spinal accessory nerve through posterior approach in brachial plexus.

MATERIAL & METHODS

The present prospective study was conducted at a tertiary care centre for a period of 3 years who visited to hospital for brachial plexus injuries. Ethical permission was taken from ethical review board of allied institution before commencement of study. Patients were asked to sign an informed consent form after explaining them the procedure of study.

Total 30 patients of brachial plexus injuries were selected through consecutive sampling. Patients were selected on the basis of following inclusion and exclusion criteria:

Inclusion criteria – Patients of age greater than 18 years and who were willing to participate.

Exclusion criteria- Obstetric brachial plexus injuries cases, Cases with spinal accessory nerve injury and those who doesn't want to participate in the study.

A complete history, evaluation of the patient's muscle power using the MRC scale, laboratory investigations (such as complete blood count (CBC), coagulation profile, RFTs, liver function tests (LFTs), viral markers), preoperative surgical chemoprophylaxis (third generation cephalosporin, such as giving each patient one gram of cefotaxime sodium IV an hour before surgery), preoperative photography for scientific and medicolegal documentation, and patient communication and explanation of the problem, procedure, and post-operative management plan were all completed at the Outpatient Clinic.

The patient had general anesthesia without the use of a muscle relaxant. placing the patient in a lateral or prone posture and raising the head of the operating table by forty degrees. The acromioclavicular joint (ACJ), the scapula's spine, the scapula's upper and inner angles, the scapula's inner border, and SAN and SSN, which are situated 44% along a line connecting the dorsal midline to acromian and halfway point between medial border of scapula and acromian on an oblique oriented line at superior aspect of scapular spine respectively, are anatomic landmarks that should be palpated and marked as shown in figure 1.

Figure 1

Using sharp scissors, the trapezius muscle was separated from the scapular spine, and a plane was cut between the supraspinatus and trapezius muscles.

When the trapezius muscle was slightly raised, the neurovascular bundle beneath it was visible. After being isolated, the spinal accessory nerve was checked with nerve stimulator. The trapezius muscle showed contractions in response to electrical stimulation. The suprascapular notch was felt by feeling the upper border of the scapula with the index finger. When the upper border of the supraspinatus muscle was forcefully pulled downward, the gleaming white suprascapular ligament covering the notch was exposed. The ligament was cutpreserving the suprascapular artery and vein. The suprascapular nerve beneath the ligament was shielded throughout the sectioning process. Using a 10-0 nylon suture, the suprascapular nerve was mobilized proximally to provide enough length, and the distal spinal accessory nerve was then covered as shown in figure 2.

A 3-0 polyglactin suture was used to reconnect the trapezius muscle to the scapular spine. The wound on the skin was sealed without a drain.

Figure 2

Analgesics, NSAID's, were used to manage the minor pain following the procedure. For three weeks following surgery, splint/slab was given that prevented shoulder movement. To keep joints flexible

and strengthen healing muscles, physical therapy is crucial. Using a topical anti-scar cream, the incision wound is treated clinically. Evaluation of the patient's muscle power following surgery using the MRC scale. The statistical package for social science (SPSS), version 25.0, was used to analyze the data. The nominal data were reported as frequency and percentage, whereas the continuous data were expressed as Mean ± SD. The preoperative and postoperative shoulder flexion (º), abduction (°), and external rotation (°) averages were compared using the paired sample t-test. P values < 0.05 were deemed significant in all tests.

RESULTS

In the present study out of 30 patients 78% were male and 22% were females. 65% had injury on right side while 35% had injury on left side. The main reason of injury was RTA in 18 patients, falling from height in 9 patients, gunshot in 2 patients and contact sports in 1 patient as shown in table 1.

Table 1: Baseline characteristics

Variable		Frequency (%)
Gender	Male	(78)
	Female	(22)
Side of lesion	Right	(65)
	Left	(35)
Etiology	RTA	18
	Falling from height	9
	Gun shot	2
	Contact sports	1

Among 50% patients had avulsion of all roots, 23.3% had rupture of C5-6 roots, 16.6% had rupture of C 5-6 roots +avulsion of C7 and 10% had rupture of C5 root and avulsion of C6 and T1 roots as shown in table 2.

Table 2 Nature of brachial plexus injury

Nature of injury	Frequency (%)
Avulsion of all roots	15 (50)
Rupture of C5-6 roots	7 (23.3)
Rupture of C 5-6 roots +Avulsion of C7	5 (16.6)
Rupture of C5 root + Avulsion of C6 +T1 roots	3 (10)

Regarding the assessment of the enhancement in shoulder range of motion through a comparison of the pre- and postoperative range of motion, it was noted that the average value of shoulder flexion had increased significantly from 3.24±2.4 preoperative to 58.78±7.12 (P=0.001). Similarly, the average value of shoulder abduction had increased significantly from 5.47±3.78 preoperative to 66.32±6.8postoperative (P=0.001). Lastly, the average value of external rotation was enhanced significantly from 5.82±6.12 preoperative to 64.21±8.12 postoperative as shown in table 3.

Table 3 Shoulder range of movement

Shoulder range of movement		Mean±SD	P value
Flexion	Pre operative	3.24±2.4	0.001
	Post operative	58.78±7.12	
Abduction	Pre operative	5.47±3.78	0.001
	Post operative	66.32±6.8	
External rotation	Pre operative	5.82±6.12	0.001
	Post operative	64.21±8.12	

DISCUSSION

One of the main objectives of rehabilitation for patients with isolated or complete upper brachial plexus lesions is the restoration of shoulder function. Because they can activate multiple muscle groups at once, nerve transfers have demonstrated superior results compared to muscle and tendon transfers. In shoulder reanimation, the axillary nerve (AXN) and the suprascapular nerve (SSN) are the two nerves that are primarily targeted.[7,8] The spinal accessory nerve (SAN) has been favored as a donor to the SSN because its role in shoulder elevation is synergistic with an abduction movement.[9] Nonetheless, a weakening of the top half of the trapezius muscle may result from a supraclavicular transfer of the SAN into the SSN. This has been appropriately handled by using the so-called "dorsal or posterior approach" to move the distal portion of the SAN into the SSN.

In this study, concerning the evaluation of the improvement of shoulder range of movement by the comparison between pre- and postoperative range of movement, it was recorded that the mean value of shoulder flexion had significantly elevated from 3.24±2.4 preoperative to 58.78±7.12 (P=0.001). In addition, the mean value of shoulder abduction was increased significantly from 5.47±3.78 preoperative to

66.32±6.8postoperative (P=0.001). Moreover, the mean value of external rotation was improved significantly from 5.82±6.12 preoperative to 64.21±8.12 postoperative.

With regards to the assessment of our findings, a number of investigations virtually attained the same percentage as Texakalidis et al, in which 10 patients received posterior SAN to SSN transfer. Furthermore, patients experienced an average increase in shoulder abduction of 67.5° throughout the course of the long-term follow-up, with 64.3% of them achieving effective shoulder abduction (> M3). [10]

Nine individuals had a posterior SAN to SSN transfer in another investigation by Luo et al. The EMG examination indicated evidence of re-innervation in the recipient muscles at a mean of 4 months post-operatively. Six out of nine patients regained near normal ranges for shoulder abduction and external rotation, with strengths classified as M3 or M4, after a mean follow-up of 33 months. The range of weight lifting with the shoulder fully abducted was 0 to 3 kg.The external rotation was accomplished by the remaining three patients, going from 30° to 80° and shoulder abduction from 50° to 130°. In all instance, the shoulder subluxation was removed.[11]

However, when using the anterior route, as demonstrated by the research conducted by Socolovsky et al [12] and Bhatia et al [13] on 49 patients with complete brachial plexus palsy, inferior outcomes were achieved. Of their 49 patients, 43 (88%) showed some abduction recovery; in 36 of them, the range was between 30° and 45°, and in the remaining 7, it was between 70° and 80°.

In a different study by Emamhadi et al [14], which involved 22 patients, the mean shoulder abduction was 55.55 ± 9.95° (range, 40–72°), and 13.6 and 63.6% of the subjects had recovered their M3 and M4 motor functions, respectively. Nonetheless, 22.7% of the participants continued to have M2 motor function. Shapira and Midha [15] found that in a large trial involving 110 patients, the overall failure rate was just 9%, suggesting that the patients recovered less than 30° abduction on average, with an approximate range of recovery of 60° (SD 25°). After evaluating 577 spinal accessory nerve transfers, Songcharoen et al [16] found that 80% of motor recovery after nerve transfer to suprascapular nerve resulted in a mean of 45° for shoulder flexion and 60° for shoulder abduction.

Due to the study's primary limitation—the very small patient population—more extensive or multicentric investigations are advised in order to thoroughly examine the results and advantages of these procedures.

CONCLUSION

One successful therapy for brachial plexus palsy patients is the posterior approach, which transfers spinal accessory nerve to the suprascapular nerve, restoring shoulder abduction and external rotation. One of the benefits was being able to see the nerves precisely at a much closer level to the target muscles. A more near-target amount of coaptation will result in a more functional recovery. The more distal donor neurotomy made possible by the dorsal technique preserves the function of the upper and middle trapezius.

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