Modified trapezius transfer technique for restoration of shoulder abduction in brachial plexus injury

Arun K. Singh, Durga Karki
Post Graduate Department of Plastic and Reconstructive Surgery, King George Medical University, Lucknow - 226 001, Uttar Pradesh, India

Address for correspondence: Dr. Durga Karki, Flat. No. 210, Kasmanda Apartments, 2 Park Road, Hazratganj, Lucknow, Uttar Pradesh, India. E-mail: dkarki10@yahoo.co.in

ABSTRACT

Aims and Objectives: Shoulder stability and restoration are very important in providing greater range of motion to the arm and forearm. When brachial plexus repair does not have the desired outcome and in patients with long standing denervation, the trapezius muscle is frequently used for transfer to restore the shoulder abduction and external rotation. We propose a modified simple technique for trapezius muscle transfer.

Materials and Methods: From February 2004 to February 2006, eight patients with posttraumatic brachial plexus injury with insufficient shoulder abduction were treated by trapezius muscle transfer. All patients with brachial plexus palsy were posttraumatic, often resulting from motor cycle accidents. Before operation a full evaluation of muscle function in the affected arm was carried out. All patients were treated with trapezius muscle transfer performed by the modified technique. S-shaped incision from the anterior border of the trapezius just above the clavicle to the Deltoid up to its insertion was made. The accessory nerve and its branches to the trapezius were secured. The trapezius was dissected and detached from its insertion along with the periosteum and sutured to the insertion of the Deltoid muscle.

Results: All patients had improved functions and were satisfied with the outcome. The average increase in active abduction of shoulder was from 13.7 degrees (0 to 35 degrees) preoperatively to 116 degrees (45 to 180 degrees) postoperatively and of shoulder flexion from 24.3 degrees (15 to 30 degrees) to 107 degrees (90 to 180 degrees).

Conclusion: The modified technique proposed here for trapezius transfer is safe, convenient, simple and reliable for restoration of shoulder abduction and stability with clear subjective benefits.

KEY WORDS

Brachial plexus injury, technique, trapezius transfer

INTRODUCTION

Shoulder abduction is important in providing greater range of motion to the arm and forearm. After brachial plexus injuries, shoulder function is frequently impaired or lost. For reconstruction of the most important functions, muscle transfers are indicated. To restore abduction and external rotation of the shoulder the trapezius muscle transfer is mainly used. Most brachial plexus palsies are due to trauma, often resulting from motorcycle accidents. In brachial plexus palsy involving the shoulder, when nerve reconstruction does not have the desired outcome or with long denervation time, the Deltoid and supraspinatus palsy is frequently addressed by transfer of the trapezius muscle.

The Mayer’s transfer of the insertion of the trapezius muscle had been described by Haas for complete paralysis of the deltoid muscle. Bateman modified the Mayer’s trapezius muscle transfer by osteotomizing the acromion and transferring it laterally along with the trapezius muscle and anchoring the acromion directly to the humerus. Saha also modified Mayer’s trapezius muscle transfer, by completely mobilizing the superior and middle trapezius muscle laterally from its origin. As per currently available techniques, Trapezius transfer includes osteotomy of acromion, spine of scapula and lateral part of clavicle and bone fixation. So there is a problem of loosening of screws, bony non-unions, longer period of immobilization and longer operating time. We propose a modified simple, easy, convenient technique to obviate such problems and report the results of trapezius muscle transfer.

MATERIALS AND METHODS

From February 2004 to February 2006, eight patients with post traumatic brachial plexus injury with insufficient shoulder abduction were treated by trapezius muscle transfer. We had one female patient and seven male patients, their ages ranged from 18 to 50 years (mean 31.5 years). The majority of them were young. A total of six patients (75%) had injury on their right side. Mean delay between injury and trapezius transfer was 20.3 months (11 months to three years). High velocity motor vehicle accidents were the most common cause of injury. A total of five patients (62.5%) had motorcycle accidents, three (37.5%) were injured in a car accident. The mean follow-up period was 15.3 months (10 months to two years).

The average preoperative shoulder abduction was 13.7 degrees (0-30 degrees). The average shoulder flexion was 24.3 degrees (15-30 degrees). Out of eight patients, three patients had axillary nerve injury due to close traction injury, presented late with Deltoid paralysis with good elbow and hand functions. The upper trunk injury was found in two patients, brachial plexus was explored and upper trunk neuroma was excised and repaired with sural nerve grafts. Both patients presented with residual weakness of shoulder abduction and flexion with weak elbow flexion and good hand movements. Three patients had C 5,6,7 injury, presented late with spontaneous inappropriate recovery with marked weakness of shoulder, elbow and wrist in two patients and one patient had associated C 8, T1 injury also and was operated earlier and presented with residual weakness.

All patients were treated with transfer of trapezius muscle. Preoperatively patients were evaluated by clinical, radiological and electrodiagnostic examination. Before operation a full evaluation of muscle function was carried out.

Indications for trapezius transfer:
- Failure of nerve repair
- Late brachial plexus injuries
- Trapezius full strength against resistance
- A normal glenohumeral joint and Passive abduction of at least 80°

Contraindications for trapezius transfer:
- Trapezius strength less than M4 on MRC scale
- Advanced degenerative arthritis of glenohumeral joint
- Old unreduced shoulder dislocation

Operative technique

We performed the operation using modified technique of Trapezius transfer. The patient was placed in the semi-lateral decubitus position with head turned to the opposite side. The anterior border of the Trapezius muscle was located above the posterior aspect of the lateral one-third of the clavicle. S-shaped incision was taken extending from the anterior border of the trapezius 2-3 cm above the clavicle, initially convex posteriorly then anteriorly over the Deltoid up to its insertion. The fascia over the trapezius muscle was incised and dissected from the anterior surface initially close to the clavicle and then proximally. The trapezius muscle was detached from its insertion along with the periosteum attached to the clavicle for 3-4 cm. The accessory nerve and its branches entering the Trapezius muscle were identified and secured. Then insertion on the acromion and spine of scapula were also detached along with the periosteum [Figures 1 and 2]. The Deltoid muscle was exposed up to its insertion. In 110 degrees of abduction detached Trapezius muscle was transferred and sutured as near to the insertion of the Deltoid muscle as possible with silk No. 1 [Figure 3]. Care was required in selecting the point to achieve the highest possible tension in the transferred muscle.
Postoperatively the arm was immobilized at about 110 degrees abduction in POP cast for four weeks. Assisted and active exercises for elbow and hand started on the first day. From the seventh day isometric contractions of transferred muscle were started. In the fifth week POP cast was removed and arm was kept in abduction humeral splint and assisted active exercises began. In the sixth week the arm was then allowed to adduct progressively and then full active exercise started. As the strength improved, more resisted muscle strengthening exercises were added. The aim is a steady increase in active abduction and forward flexion with an actively stabilized scapula.

**RESULTS**

The results are presented in Table 1.

In all eight patients, an improvement of shoulder mobility and reduced multidirectional instability of the shoulder was seen, assessed clinically and individually by the patient. The results were encouraging. Shoulder abduction was measured as the angle between the trunk and the arm. Our results showed an average increase in active shoulder abduction from 13.7 degrees (0-30 degrees) to 116 degrees (45-180 degrees). Mean forward flexion improved from 24.3 degrees (15-30 degrees) to 107 degrees (90-180 degrees).

Passive movements of the shoulder joint were not affected. Results were evaluated in terms of range of abduction. Satisfactory (30 to 80 degrees), good (81 to 130 degrees) and excellent (131 to 180 degrees). The results were excellent in three patients (37.5%) [Figures 4-6], good in three patients (37.5%) [Figures 7-9] and satisfactory in two patients (25%).

**DISCUSSION**

In brachial plexus palsy after full neurological treatment and adequate physiotherapy, secondary surgery may be needed to improve the stability and function of the shoulder.[1-3] Depending on the type of lesion and the degree of involvement of arm muscles, good stability and function of the shoulder will help to achieve use of the elbow and hand, possibly aided by other tendon transfers. Deltoit and Suprascapula paralytic arm may be managed by muscle transfers. Trapezius muscle transfer was most satisfactory.


Mayer in 1927 described the technique of trapezius transfer in complete Deltoit palsy.[4] Bateman modified the Mayer technique by osteotomizing the spine of scapula near its base and transferring it laterally along with the Trapezius muscle and anchoring the acromion directly to the humerus as far distally as possible with two or three screws.[5]

Saha modified Bateman’s technique of trapezius transfer and improved the technique. The superior and middle trapezius is completely mobilized laterally from its origin and thus transfer is made 5 cm longer without endangering its nerve or blood supply. In his technique the entire insertion of trapezius along with attached lateral end of clavicle, acromioclavicular joint, acromion and adjoining part of scapular spine were anchored to lateral aspect of humerus distal to the tuberosities by two screws.[6]

These techniques involved osteotomy of the spine of scapula, acromion and lateral part of clavicle and bone fixation with screws. So there is a technical difficulty.

<table>
<thead>
<tr>
<th>Patient No.</th>
<th>Age (years)</th>
<th>Sex</th>
<th>Follow-up (months)</th>
<th>Interval between injury and surgery (months)</th>
<th>Shoulder abduction Pre-operative (degrees)</th>
<th>Shoulder abduction Post-operative (degrees)</th>
<th>Shoulder Flexion Pre-operative (degrees)</th>
<th>Shoulder Flexion Post-operative (degrees)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>20</td>
<td>M</td>
<td>11</td>
<td>12</td>
<td>0</td>
<td>45</td>
<td>20</td>
<td>90</td>
</tr>
<tr>
<td>2</td>
<td>50</td>
<td>M</td>
<td>10</td>
<td>24</td>
<td>30</td>
<td>180</td>
<td>20</td>
<td>180</td>
</tr>
<tr>
<td>3</td>
<td>23</td>
<td>M</td>
<td>14</td>
<td>11</td>
<td>10</td>
<td>170</td>
<td>30</td>
<td>100</td>
</tr>
<tr>
<td>4</td>
<td>34</td>
<td>M</td>
<td>20</td>
<td>20</td>
<td>15</td>
<td>90</td>
<td>15</td>
<td>95</td>
</tr>
<tr>
<td>5</td>
<td>36</td>
<td>F</td>
<td>20</td>
<td>36</td>
<td>20</td>
<td>180</td>
<td>30</td>
<td>180</td>
</tr>
<tr>
<td>6</td>
<td>19</td>
<td>M</td>
<td>24</td>
<td>14</td>
<td>0</td>
<td>60</td>
<td>30</td>
<td>80</td>
</tr>
<tr>
<td>7</td>
<td>24</td>
<td>M</td>
<td>12</td>
<td>22</td>
<td>20</td>
<td>100</td>
<td>20</td>
<td>110</td>
</tr>
<tr>
<td>8</td>
<td>46</td>
<td>M</td>
<td>12</td>
<td>24</td>
<td>15</td>
<td>110</td>
<td>30</td>
<td>120</td>
</tr>
</tbody>
</table>

**Table 1: Clinical data**
Singh, et al.

**Figure 1:** Schematic diagram showing line of detachment of trapezius from the acromion and spine of scapula with dotted lines

**Figure 2:** Trapezius muscle detached subperiosteally and mobilized proximally from lateral clavicle, acromion process and spine of scapula

**Figure 3:** Trapezius muscle transferred and sutured to the trapezius near its insertion with arm abducted 110°

**Figure 4a:** Preoperative view. A 50-years old man with 2 years old right upper trunk injury with only 30 degrees shoulder abduction

**Figure 4b:** Preoperative view with 20 degrees shoulder flexion

**Figure 5a:** A patient in semilateral decubitus position with S-Shaped incision 2 cm above the clavicle to the deltoid insertion, convex posteriorly in the upper and anteriorly in the lower part

**Figure 5b:** Skin flaps raised, deltoid and trapezius muscles insertions exposed

**Figure 5c:** Trapezius muscle insertion detached along with the periosteum from acromion process, spine of scapula and lateral third of clavicle
Modified trapezius transfer technique

Figure 5d: Detached trapezius muscle with periosteum transferred and sutured to the insertion of the deltoid muscle with shoulder in 100 degrees abduction.

Figure 7a: Preoperative view. A 34 year old man with C5,6,7, 8, T1 injury operated earlier with shoulder abduction and flexion 15° with elbow flexion 100° and weak elbow and wrist extension and poor hand function.

Figure 6a: Excellent result after 12 months of trapezius muscle transfer with full shoulder abduction.

Figure 7b: Preoperative view showing involvement of supraspinatus, infraspinatus and deltoid muscle.

Figure 6b: Excellent result after 12 months of trapezius transfer with full shoulder flexion.

Figure 7c: Postoperative result with shoulder abduction.

Figure 6c: Postoperative result with shoulder abduction.

Figure 7b: Trapezius muscle insertion detached along with the periosteum from acromion process, spine of scapula and lateral third of clavicle.

Figure 8a: Preoperative view showing deltoid and trapezius muscles insertions.

Figure 8b: Trapezius muscle insertion detached along with the periosteum from acromion process, spine of scapula and lateral third of clavicle.
This PDF is available for free download from a site hosted by Medknow Publications.

longer operating time, longer period of shoulder immobilization, problems of bone healing and sometimes morbidity at the osteotomy site. Problems of bone healing may be due to complications which occurred with loosening of screws, wound infection, earlier humeral fractures in same sites and osteoporosis secondary to inactivity after brachial plexus injury. Ruhmann et al (1998) used the technique of Saha in trapezius muscle transfer in 38 patients and reported the complication of loosening of screws in 9.7% patients, wound infection needed revision with early removal of fixation screws in 6.5% patients and bony deformities after fracture with difficulty in fixation in 38.7% patients.

To obviate such problems we have proposed a modified simple technique of trapezius transfer with encouraging results. Conventional tendon to tendon transfers commonly done in the upper and lower limbs are simple without any morbidity and significant complications. So like other tendon transfers, we have described a technique which is different from earlier described trapezius transfer with osteotomy techniques, involving transfer of only the trapezius musculoperiosteal unit to the Deltoid muscle more distally with arm kept in more abduction of about 100 to 110 degrees as compared to the earlier described techniques of osteotomy. So our technique is more physiological because the trapezius muscle is attached to the Deltoid muscle along the direction of the muscle fibers and the pull of the transferred trapezius is more effective along its insertion on the mid-humerus level. The appropriate tension on the trapezius muscle with more distal attachment has a greater arc of movement and more abduction as compared to the earlier described techniques where the acromion is anchored more proximally near the neck of the humerus, so less movement is expected. This technique is simple, easy, involves less operating time with a short period of immobilization and avoids unnecessary osteotomy so avoids the morbidity due to osteotomy. The arm was kept in more abduction at about

Figure 8c: Detached trapezius muscle with periosteum retracted laterally on the deltoid muscle

Figure 8d: Detached trapezius muscle with periosteum transferred and sutured to the insertion of the deltoid muscle with shoulder in 110° abduction

Figure 9a: Postoperative result with 90° shoulder abduction

Figure 9b: Postoperative view with good shoulder abduction & trapezius transfer scar
Modified trapezius transfer technique

100-110 degrees so that more distal transfer of trapezius was possible to the Deltoid.

Aziz, Singer, and Wolff (1990) reviewed 27 patients of brachial plexus injury treated by transfer of Trapezius. They used a modification of the surgical technique described by Mayer (1927) and Bateman (1955) and amended by Saha (1967). A transverse skin incision over the insertion of the Trapezius, crossed the lateral clavicle and continued round the acromion and along the spine of the scapula. A vertical extension was made laterally over the mid-Deltoid. Acromion and lateral clavicle were transected and the Trapezius freed from the underlying Supraspinatus muscle. The Deltoid was split longitudinally to expose the proximal humerus. The arm was then abducted to 90 degrees, the acromioclavicular fragment with its Trapezius insertion was fixed to the humerus. Preoperatively an average abduction of 3.5 degrees was noted. The average gain in shoulder abduction was 45.4 degrees with a range of 20 to 120 degrees, the gain in shoulder flexion averaged 35.2 degrees, with a range of 0 to 120 degrees. He proposed that the absence of a clear indication for Trapezius transfer and high expectations from this transfer alone have led to its infrequent use.\(^7\)

Mir-Bullo et al (1998) transferred the trapezius with its bone insertion to the proximal humerus in six patients for treatment of a paralytic shoulder secondary to traumatic lesions of the brachial plexus. After one year, the shoulder abduction was improved from average 13 degrees (0 degree-30 degrees) preoperatively to 76 degrees (50 degrees-100 degrees) postoperatively and the shoulder flexion from 18 degrees (0-40 degrees) to 78 degrees (45-110 degrees) postoperatively. All the patients were satisfied with the outcome. They reported that transfer of the Trapezius in a paralytic shoulder after brachial plexus injury gives a better outcome than shoulder fusion.\(^8\)

Ruhmann et al included 31 patients with paralysis of the Deltoid and Supraspinatus and Trapezius transfer was performed according to the method of Saha. Average increase in active abduction was from 7.3 degrees (0-45 degrees) to 39 degrees (25-80 degrees) at the latest review. The mean forward flexion increased from 20 degrees (0-85 degrees) to 44 degrees (20-90 degrees). Twenty-nine of the 31 were satisfied with the improvement in function.\(^9\) Ruhmann et al performed Trapezius transfer in 54 patients for Deltoid and supraspinatous and found that there was an improvement in shoulder function and stability.\(^10\) Ruhmann et al demonstrated the correlation of preoperative pattern of paralysis and outcome in 80 patients. Operations were performed according to Saha's technique, with a modification in the last 22 cases. The mean increase in active abduction was from 6 degrees (0-45) to 34 degrees (5-90). The mean forward flexion increased from 12 degrees (0-85) to 30 degrees (5-90). The best results were achieved in those patients with most preoperative power of the biceps, coracobrachialis and triceps muscles (n = 7), with a mean of 42 degrees of abduction and 56 degrees of forward flexion.\(^11\)

Kotwal et al treated 27 patients with Deltoid paralysis by Trapezius transfer by Saha's technique in poliomyelitis and brachial plexus injury patients and found that the average gain in active abduction was 60 degrees in the brachial plexus group and 45 degrees in the poliomyelitis group.\(^12\)

In our study trapezius transfer was done by modified technique. All our patients had a definite increase in shoulder stability and function. The average increase in active abduction of shoulder was from 13.7 degrees (0-30 degrees) to 116 degrees (45-180 degrees) postoperatively and in shoulder flexion was from 24.3 degrees (15-30 degrees) preoperatively to 107 degrees (90-180 degrees) postoperatively. Passive shoulder abduction of 80 degrees is an important prerequisite. The absence of clear indications for the operation and expecting too much from this transfer alone has led to its infrequent use.

**CONCLUSIONS**

The modified technique proposed here for Trapezius transfer is safe, easy, convenient, simple, without complications and reliable for restoration of shoulder abduction and stability with clear subjective benefits. Trapezius muscle transfer is considered when the functional sequelae persist after the maximal recovery, either by spontaneous incomplete recovery or after nerve reconstruction.

**REFERENCES**


Source of Support: Nil, Conflict of Interest: None declared.