We have reviewed 26 patients treated by trapezius transfer for deltoid paralysis due to brachial plexus injury or old poliomyelitis. We assessed the power of shoulder abduction and the tendency for subluxation. There were good results in 16 patients (60%); five were fair and five poor.

Trapezius transfer appears to give reasonable results in the salvage of abductor paralysis of the shoulder.

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Abduction of the shoulder to 90° is provided by supraspinatus and deltoid. After 90° of abduction at the glenohumeral joint, the main external rotators of the scapula for full shoulder abduction are serratus anterior and trapezius, while other muscles are involved in rotating and stabilising the humeral head.

In the scapular plane, shoulder abduction is mainly by the action of the anterior and middle thirds of the deltoid with some involvement of the posterior third. In the coronal plane and posterior to it, the contribution of the anterior third decreases and that of the posterior third becomes greater. Paralysis produces weakness in abduction and some flexion and is most commonly due to old poliomyelitis or to injuries of the brachial plexus. Loss of abduction at the shoulder is a severe disability in daily living and in employment. A number of tendon transfers have been described to replace the function of the deltoid. Haas reports that Hildebrandt described the transfer of the origin of pectoralis major to the clavicle and acromion in 1906. Other tendon transfers which have been used are the long head of triceps to the acromion and short head of biceps to the acromion and the posterior deltoid to the paralysed anterior part.

Transfer of the trapezius insertion was first described by Mayer, who used a fascia lata graft to extend its attachment to the deltoid tuberosity. The results were poor because the graft stretched and became adherent to surrounding structures. Bateman modified the procedure by advising resection of part of the spine of the scapula with the trapezius, to allow screw fixation of the transfer to the humerus. This procedure was further modified by Saha.

Patients and Methods

We treated 26 patients with deltoid paralysis by trapezius transfer. Eighteen had residual paralysis due to old poliomyelitis and eight had injuries of the brachial plexus. The latter were all young men aged between 15 and 25 years; one had been stabbed in the neck and the others had had closed injuries in road-traffic accidents. The patients with poliomyelitis were mainly children aged from nine to 14 years with an equal gender distribution. All the patients had good ipsilateral hand function, and six had had previous Steindler’s flexor plasties on the same side to improve elbow flexion.

Operative technique. Trapezius transfer to the proximal humerus was accomplished by a modification of Bateman’s technique, described by Saha. The patient is placed supine with a sand-bag under the shoulder. A Y-shaped incision is made over the lateral third of the clavicle and the acromioclavicular joint and acromion, extending down the arm. The origin of the deltoid is exposed and detached subperiosteally. The clavicle is then divided lateral to the conoid ligament and the spine of the scapula medial to the acromion in 1906. Other tendon transfers which have been used are the long head of triceps to the acromion, the long head of triceps and short head of biceps to the acromion and the posterior deltoid to the paralysed anterior part.

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(Figs 2 and 3). The wound is closed and a shoulder spica applied with the shoulder in 45 to 60° of abduction. The spica is removed at six weeks and carefully supervised physiotherapy is started.

Results

Patients were reviewed at a mean of 12 months (10 to 25). We assessed our results by recording the power of shoulder abduction and any tendency for the joint to sublux (Table I). There were 16 good results (Fig. 4), five fair and five poor. In the eight patients with brachial plexus injuries there were five good results, two fair and one poor (Table I). The last was due to persistent paraesthesiae which made the patient reluctant to move his shoulder. Of the post-poliomyelitis group, 11 had good results, three fair and four poor. Two of the patients with poor results had associated severe weakness of all rotator-cuff muscles, and the other two had shown anterior subluxation of the shoulder before operation, which did not improve after surgery (Fig. 5). No patient became infected and there was no failure of fixation or pain on movement. The average gain in active abduction of the shoulder was 60° in the brachial plexus group and 45° in the poliomyelitis group.

Discussion

In India, both poliomyelitis and injury to the brachial plexus are relatively common causes of shoulder weakness. The disability from this is considerable both for activities of daily living and in earning a livelihood. Many patients demand a reconstructive procedure.

Saha's logical modification of the trapezius transfer described by Bateman provides a more distal fixation of the transfer after a more proximal release. This gives a greater lever arm, and fracture of the bony insertion transferred from the acromion allows better fixation to the narrow cylindrical shaft of the humerus. An important modification was to consider transfer for paralysed muscles of the rotator cuff, to improve control of the humeral head and prevent subluxation. Saha recommends careful assess-

| Table I. Results of 26 patients at 12 months |
|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| Power (MRC)     | Subluxation     | Post-polio      | Brachial plexus | Total           |
| Good            | 4               | No              | 11 (61%)        | 5 (62.5%)       | 16              |
| Fair            | 2 to 3          | No              | 3 (16%)         | 2 (25%)         | 5               |
| Poor            | 0 to 1          | Yes             | 4 (22%)         | 1 (12.5%)       | 5               |
| Total           | 18              | 8               |                 |                 | 5               |
ment of all muscles about the joint. He considered the deltoid and the clavicular head of the pectoralis major as prime movers for abduction; they also lift the humeral shaft. Subscapularis, supraspinatus and infraspinatus are a steering group which stabilise the humeral head in the glenoid. The sternal head of pectoralis major, latissimus dorsi, teres major and teres minor form a depressor group which also rotate the shaft and pull the humeral head downwards during the last few degrees of abduction. Saha confirmed that when any two of the steering group of muscles were paralysed a single muscle transfer to replace the deltoid would not provide abduction beyond 90°. He describes the transfer of pectoralis minor, the upper two digitations of serratus anterior, latissimus dorsi and teres major in various combinations. He also discusses transfers of the levator scapulae, sternocleidomastoid, scalenus anterior, scalenus medius and scalenus capitis. He reported that these principles make it possible to restore reasonable function of the shoulder with nearly normal control and no subluxation.

Trapezius transfer in poliomyelitis has also been discussed by Yadav,9 who used a modified Meyer’s technique with two separate incisions and no slot in the acromion. He believed that these modifications prevented the formation of adhesions, but did not discuss the role of the rotator-cuff muscles. He reported frequent subluxation of the humeral head with satisfactory results only when there was good residual power in the accessory muscles.

An alternative management is by arthrodesis of the shoulder which is indicated especially in an associated dislocation with good power in the trapezius and serratus anterior. Saha argues against arthrodesis after poliomyelitis and points out that the fulcrum is moved to the scapulothoracic joint. This gives a much longer lever arm for the thoracic muscles, which may defeat the very purpose of rehabilitation. He found that the use of spare thoracic muscles for glenohumeral abduction provided a better option and also emphasised that the principles of rehabilitation were as important as surgical technique.

Aziz, Singer and Wolff9 discuss trapezius transfer for flail shoulder after injury to the brachial plexus, finding it a simple procedure with minimal blood loss, which provided functional improvement and usually eliminated pain. Cofield and Briggs point out that the disadvantages of arthrodesis include a high incidence of fracture, worsening of pain and relative reduction of passive movements. Aziz et al5 also argue that simple trapezius transfer is compatible with the later return of some function to other shoulder girdle muscles, while arthrodesis is irreversible and no benefit can be derived from any late return of brachial plexus function.

We consider that trapezius transfer can provide satisfactory functional improvement and is a better procedure than arthrodesis for paralysis of shoulder abduction caused by poliomyelitis or injury to the brachial plexus.

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References