TRANSFER OF THE TRAPEZIUS FOR FLAIL SHOULDER AFTER BRACHIALPLEXUS INJURY

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Shoulder arthrodesis is often used to treat flail shoulder after a brachial plexus injury, but has a high complication rate and entails loss of passive mobility. We have reviewed 27 patients with brachial plexus injury treated by transfer of the trapezius to the proximal humerus at an average time from injury of 31.3 months.

Pre-operatively, all 27 shoulders were subluxated, with an average abduction of 3.5°. Postoperatively, shoulder abduction averaged 45.4°, and subluxation was abolished. All patients were satisfied with their improvement in function. Trapezius transfer is recommended as a simple procedure that requires only a brief period in hospital, allows early rehabilitation, and gives a satisfactory outcome, while retaining passive mobility of the shoulder.

Flail shoulder secondary to a brachial plexus injury is difficult to treat. Shoulder fusion has been accepted as an adequate treatment, but has a high complication rate (Vastamäki 1987). However, using absence of pain, improvement of function, and subjective satisfaction as criteria, Richards, Waddell and Hudson (1985) found fusion unsatisfactory. Technical difficulties, a long rehabilitation, complications, loss of passive mobility, and the irreversibility of the procedure were some of the factors against shoulder fusion in these cases.

Several muscle transfers have been advocated to restore movement and stability of the shoulder after poliomyelitis (Mayer 1927, 1939; Ober 1932; Haas 1935; Steindler 1949; Harmon 1950; Saha 1967), and, more recently, the use of these procedures after brachial plexus injury has been reported (Karev 1986). In a classic monograph, Saha (1967) gave details of his experience with transfer of the trapezius, using a modification of the technique originally described by Bateman (1954). However, the absence of clear indications for the operation and expecting too much from this transfer alone has led to its infrequent use.

There have been several reports of the success of brachial plexus exploration and grafting (Kline and Judice 1983; Millesi 1984), but the results take several years to reach a plateau, and it is difficult to predict the extent of recovery. The choice of other treatment lies between muscle transfers and an arthrodesis, which is essentially irreversible and therefore unacceptable where there is a possibility that the patient may regain muscle control of the glenohumeral joint.

We have evaluated the results of trapezius transfer for flail shoulder secondary to brachial plexus injury.

PATIENTS AND METHODS

We treated 27 patients, 23 male and four female, by transfer of the trapezius to the proximal humerus. Their average age was 31.2 years (range 14 to 58), and the average time after injury was 31.3 months (range 6 months to 10 years). The average follow-up was 14.6 months (range 6 to 46).

Before the transfer, 10 patients (37%) had had brachial plexus exploration (seven had nerve grafts and three had neurolysis). Nine patients had had other muscle transfers, and eight had had more than one procedure, for example, brachial plexus exploration and latissimus dorsi transfer for elbow flexion. All but one were unemployed at the time of trapezius transfer and all had some associated pain.

Pre-operative evaluation included physical and radiographic examinations, with EMG in 13 patients. Nine patients (33%) had radiological subluxation of the shoulder after the initial injury, and all showed some subluxation prior to the transfer. Shoulder abduction was
measured as the angle between the trunk and the arm: the pre-operative average was 3.5° (range 0° to 30° with 22 of the 27 having none). The average shoulder flexion was 4.2° (range 0° to 50°, again with 22 having none). In 16 patients the C5 and C6 roots had been injured; in six C5, C6, and C7 roots; and in five there were complete brachial plexus injuries.

**Surgical technique.** We use a modification of the surgical technique described by Mayer (1927) and Bateman (1954) and amended by Saha (1967). Patients are positioned on the operating table with a 45° foot-down tilt and full lateral decubitus using a bean bag for support. The shoulder, the neck, and the whole arm are prepared and free.

A transverse skin incision begins above the clavicle over the insertion of the trapezius, crosses the lateral clavicle, and continues round the acromion and along the spine of the scapula. A vertical extension is made laterally over the mid-deltoid. The deltoid origin is then cut from the lateral third of the clavicle, the acromion, and the lateral half of the spine of the scapula (Fig. 1).

A Gigli wire saw is used to transect the root of the acromion, and then the lateral clavicle, so as to separate the lateral 1 cm of the clavicle with the acromion (Fig. 2). The remaining insertions of the trapezius are elevated from the clavicle and the scapular spine to 2 cm from the vertebral border of the scapula. Careful dissection is needed to define the interval between the trapezius and the supraspinatus. Special attention is needed to preserve the neurovascular bundle of the spinal accessory nerve and transverse cervical artery, which courses from deep to superficial through the trapezius.

The partly detached deltid is split longitudinally to expose the proximal humerus (Fig. 2), which is scored with an osteotome. The arm is then abducted to 90°, and the acromioclavicular fragment with its trapezius insertion is fixed to the humerus with two 4.5 mm cortical lag screws, ensuring firm bone-to-bone contact (Fig. 3). The wound is thoroughly irrigated with saline solution, and the deltid is sutured on top of the new trapezius insertion (Fig. 4). The skin is closed in two layers over suction drains, a bulky dressing applied and the patient immobilised in a soft abduction support.

**Postoperative management.** Drains are removed on the second or third day. The soft abduction support is worn for six weeks or until union is seen between the acromion fragment and the humerus. The arm is then allowed to adduct progressively and a vigorous physical therapy programme is started. As strength improves, more resisted muscle strengthening exercises are added.

**RESULTS**

Time under anaesthesia averaged 3 hours (range 2 to 5), and the estimated mean blood loss was 150 ml. Hospital stay averaged four days (range 3 to 5) and there were no postoperative complications or infections. Two patients required two additional weeks of immobilisation because of poor bone stock.

Postoperatively, 24 patients (89%) were pain-free, but three with complete brachial plexus lesions still had pain. Subluxation was fully reduced and muscle power was graded M4 or better in all patients (Figs 5 and 6). The average gain in shoulder abduction was 45.4°
(p < 0.001, Fisher's exact test), with a range of 20° to 120°; the gain in shoulder flexion averaged 35.2° (p < 0.001), with a range of 0° to 120°. All the patients had stable shoulders and were satisfied with the improvement in function.

**DISCUSSION**

Trapezius muscle transfer has several advantages. The procedure is relatively simple and entails minimal blood loss. There is functional improvement in all patients with elimination of pain in most. The only contra-indication is advanced degeneration of the shoulder.

Shoulder arthrodesis has been considered the procedure of choice in patients with a flail shoulder after brachial plexus injury, but has a high complication rate. Cofield and Briggs (1979) reported a 24% incidence of fractures, while 15% had aggravation of pain and 25% had no improvement. Richards et al (1988) reported arthrodesis in 11 brachial plexus patients, using pelvic reconstruction plates. Shoulders were fused in 30° each of abduction, flexion and internal rotation. They had better results with fewer complications, but five of the 11 patients had had brachial plexus exploration and could have been candidates for trapezius transfer. Arthrodesis is irreversible and gives less active and passive movement than trapezius transfer.

Recent advances in brachial plexus surgery, including intercostal nerve neurotisation, will give better functional outcomes (Kline and Judice 1983; Takahashi 1983; Millesi 1984), but recovery takes a few years, and most patients require some kind of splinting to prevent subluxation and pain. Trapezius muscle transfer is also compatible with the return of some function to the shoulder girdle muscles, acting in a similar manner as Jones' transfer for high radial palsy. Even when functional recovery is not adequate, the trapezius transfer is strong enough to keep the shoulder stable and allow some active abduction, while allowing a full passive range.

The treatment of a patient with a flail shoulder must be directed to the specific deficits. Should paralysis be limited to the deltoid, for instance, abduction splinting...
(Dehne and Hall 1959) may be all that is needed. In more severe cases, and especially after a brachial plexus injury, trapezius transfer will allow the patient to position the arm much better. Trapezius transfer can be used with other transfers to achieve maximum use of the arm. Careful choice from such procedures as latissimus dorsi transfer for elbow flexion (Hovnanian 1956), elbow flexorplasty (Steindler 1949), and wrist fusion are important in planning reconstructive surgery for patients with brachial plexus injury.

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