Scapulothoracic stabilisation for winging of the scapula using strips of autogenous fascia lata
Erdoğan Atasoy, Mohammad Majd
From the University of Louisville and the Christine M. Kleinert Institute for Hand and Micro Surgery, Louisville, USA

We have used a modified technique in five patients to correct winging of the scapula caused by injury to the brachial plexus or the long thoracic nerve during transaxillary resection of the first rib. The procedure stabilises the scapulothoracic articulation by using strips of autogenous fascia lata wrapped around the 4th, 6th and 7th ribs at least two, and preferably three, times.

The mean age of the patients at the time of operation was 38 years (26 to 47) and the mean follow-up six years and four months (three years and 11 months). Satisfactory stability was achieved in all patients with considerable improvement in shoulder function. There were no complications.

Received 12 May 1999; Accepted after revision 25 January 2000

Winging of the scapula is the most common scapulothoracic disorder and is seen after injury to the brachial plexus, isolated paralysis of serratus anterior, fascioscapulohumeral muscular dystrophy or injury to the long thoracic nerve occurring during resection of the first rib for decompression of a thoracic outlet compression syndrome. Winging can be classified as primary, secondary, or rarely, voluntary. Primary winging occurs after neurological injury, usually involving the long thoracic, spinal accessory, or dorsal scapular nerves and in association with a tumour of the ribs or scapula, with malunited fractures of the scapula and with rupture or absence of the periscapular muscles. Secondary winging is due to glenohumeral and subacromial disorders such as tears of the rotator cuff, adhesive capsulitis or impingement which produce abnormal scapulothoracic movement. Voluntary winging of the scapula is very rare, and psychological factors play an important role.

The position of the winged scapula depends on the specific nerve injury and the resulting pattern of muscle paralysis. Injury to the long thoracic nerve causes paralysis of serratus anterior. The scapula assumes a high position with the upper medial corner rotated laterally and the inferior pole medially (Fig. 1a) because of the unopposed action of trapezius, levator scapulae, and the rhomboid muscles. Injury to the spinal accessory nerve causes paralysis of the intact serratus anterior, which is innervated solely by the long thoracic nerve, a mainly motor nerve arising from the C5, C6 and C7 roots.

The senior author (EA) carried out a modification of the surgical procedure of Ketenjian on five patients with winging of the scapula caused by injury to the brachial plexus and the long thoracic nerve during transaxillary resection of the first rib. The procedure and the results.

Patients and Methods

Five patients (three men and two women) had surgical treatment between 1986 and 1996. Their mean age at the time of operation was 38 years (26 to 47) and the mean follow-up was 6 years 4 months (39 months to 11 years).
Two of the men had an injury to the brachial plexus mainly involving the upper trunk, one from a motor-vehicle collision and the other from a fall. The third had an injury to the long thoracic nerve after a motor-vehicle accident with multiple rib fractures and injury to the left shoulder (Table I). All had electromyography and nerve-conduction studies as well as muscle testing of the shoulder girdle, which showed involvement of the nerve roots of C5, C6 and C7 in the two patients with injury to the brachial plexus and denervation of the serratus anterior muscle in the three male patients. The two women suffered an injury to the long thoracic nerve during resection of the first rib. The indications for surgery included pain around the scapula, limitation of abduction and flexion of the shoulder beyond 80° and cosmesis. All the patients had active abduction and flexion of the shoulder to 70° or 80°. Further abduction induced winging of the scapula, discomfort and instability. Manual stabilisation of the scapula improved abduction and flexion significantly and relieved pain. This technique can only be successful if there is functional abduction of the glenohumeral joint. The procedure is contraindicated in patients in whom there is paralysis of the deltoid and rotator-cuff muscles in association with paralysis of the long thoracic nerve.4

Operative technique. Under general anaesthesia, three strips of fascia lata 25 cm long and 1.5 to 2 cm wide are harvested. The patient is then placed in the prone position on a Wilson frame. The ipsilateral shoulder and arm are left free. The medial border of the scapula is exposed through a curvilinear incision (Fig. 2). Trapezius, levator scapulae, and the rhomboid muscles are separated from the medial border of the scapula. Supraspinatus, infraspinatus, and subscapularis are elevated subperiosteally, approximately 3 cm from the medial border of the scapula. After the scapula is positioned appropriately, three or four drill holes are made 1.5 to 2 cm from the medial border at the levels of the adjacent ribs (Fig. 3). If four holes are to be made, one is placed above and one below the spine of the scapula. The ribs underlying the drill holes (usually the 4th, 6th and 7th) are exposed subperiosteally for 4 to 5 cm in length and care

---

**Table I. Details of the five patients having scapulothoracic stabilisation with autogenous fascia lata**

<table>
<thead>
<tr>
<th>Case Age (yr)</th>
<th>Gender</th>
<th>Occupation</th>
<th>Cause</th>
<th>Delay in diagnosis (mth)</th>
<th>Complaints of shoulder blade (side)</th>
<th>Preop ROM of shoulder (degrees)</th>
<th>Time of operation (mth)</th>
<th>Follow-up (mth)</th>
<th>Postop ROM of shoulder (degrees)</th>
<th>Final results</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>47</td>
<td>F</td>
<td>Office worker</td>
<td>Long thoracic nerve injury during resection of the first rib</td>
<td>Winging and pain in (R) shoulder blade</td>
<td>Abd, 70 Flex, 75 Exro, 25 Inro, 35</td>
<td>24 mths after first operation</td>
<td>132</td>
<td>Abd, 130 Flex, 130 Exro, 45 Inro, 45</td>
<td>Good</td>
</tr>
<tr>
<td>2</td>
<td>43</td>
<td>F</td>
<td>Waitress</td>
<td>Long thoracic nerve injury during resection of the first rib</td>
<td>Winging and pain in (R) shoulder blade</td>
<td>Abd, 80 Flex, 90 Exro, 40 Inro, 35</td>
<td>6 mths after first operation</td>
<td>108</td>
<td>Abd, 125 Flex, 120 Exro, 43 Inro, 43</td>
<td>Good</td>
</tr>
<tr>
<td>3</td>
<td>26</td>
<td>M</td>
<td>Student</td>
<td>MVA‡ isolated injury to the long thoracic nerve</td>
<td>Winging and pain in (L) shoulder blade</td>
<td>Abd, 70 Flex, 80 Exro, 40 Inro, 35</td>
<td>22 mths after MVA‡</td>
<td>56</td>
<td>Abd, 113 Flex, 120 Exro, 40 Inro, 40</td>
<td>Good</td>
</tr>
<tr>
<td>4</td>
<td>37</td>
<td>M</td>
<td>Vehicle mechanic</td>
<td>MVA injury to the brachial plexus</td>
<td>Winging and pain in (L) shoulder blade</td>
<td>Abd, 70 Flex, 75 Exro 35 Inro 30</td>
<td>22 mths after MVA</td>
<td>60</td>
<td>Abd, 120 Flex, 135 Exro, 40 Inro, 30</td>
<td>Good</td>
</tr>
<tr>
<td>5</td>
<td>37</td>
<td>M</td>
<td>Musician</td>
<td>Traction injury to the brachial plexus</td>
<td>Winging and pain in shoulder blade, limited shoulder movement (R)</td>
<td>Abd, 75 Flex, 90 Exro, 40 Inro, 40</td>
<td>180 mths after injury to the brachial plexus</td>
<td>39</td>
<td>Abd, 150 Flex, 120 Exro, 45 Inro, 23</td>
<td>Excellent</td>
</tr>
</tbody>
</table>

* range of motion
† Abd, abduction; Flex, flexion; Exro, external rotation; Inro, internal rotation
‡ motor-vehicle accident

---

**Figure 1a** – The position of the scapula in winging as a result of palsy of serratus anterior caused by injury to the long thoracic nerve. The scapula is elevated and medially translated with a medial rotation of the inferior angle. **Figure 1b** – The position of the scapula in winging caused by palsy of trapezius due to injury to the spinal accessory nerve. The shoulder is depressed with lateral translation of the scapula and lateral rotation of the inferior angle (modified with permission from *J Acad Orthop Surg* 1995;3:320.)
is taken to preserve the subcostal neurovascular bundles and pleura (Fig. 3).

The spinous processes are identified. Normally, the medial border of the scapula is parallel to the spinous processes of T3 and T4. The shoulder will have greater abduction if the scapula is stabilised at an angle 15° to 20° between the medial border and a line joining the spinous processes of T3 and T4. If the scapula is stabilised at more than 30°, adduction of the arm will be limited. The shoulder is abducted until an angle of 15° to 20° is obtained. The forearm and the upper arm are then stabilised in this position on a firm, foam support. The graft of fascia lata is passed through the hole, wrapped around the ribs at least twice, preferably three times (Fig. 4) and sutured to itself. The tied-down muscles along the medial border of the scapula are reattached and the wound is closed.

After operation the arm is supported in a sling. One week later, gentle shoulder movement is started within the sling which is worn for three months. The patient is allowed to remove it for flexion and extension exercises of the elbow. Gentle resistance exercises are started at about 16 weeks and increased as tolerated. Six months after surgery, patients will usually have some mobility of the scapula without winging, and will have improved movement of the shoulder.

Results

We considered the result to be poor when the increase in abduction was less than 30°, good with an increase of 30° to 60°, and excellent with an increase of more than 60°. The results were good or excellent in all our patients (Table I) and all reported symptomatic improvement. Two continued to have well-localised discomfort in the trapezius and the paraspinal muscles. The scapula has continued to be stable and in place in one patient after 11 years. Abduction and flexion of the shoulder improved in all patients. The mean abduction of the shoulder was 73° (70 to 80) before and 128° (113 to 150) after operation (Fig. 5). The mean flexion was 82° (75 to 90) before and 125° (120 to 130) after operation. There were no postoperative complications.

Discussion

Winging of the scapula can be a disabling deformity. The functional disability results from diminished abduction and forward flexion of the shoulder, principally because of loss of muscle control of the scapulothoracic articulation. In most patients, there is local discomfort, possibly due to stretching of weakened muscles during abduction.

---

**Diagram of the procedure showing exposure of the medial border and the outer and inner surface of the scapula by dividing and stripping supraspinatus, infraspinatus and subscapularis. Exposure of the 4th, 6th and 7th ribs corresponds to the appropriate positions of the holes along the medial border of the scapula where the medial border makes an angle of 15° to 20° with the spinal processes of the spine and is externally rotated. The superior medial corner of the scapula corresponds to the position of the normal scapula in the other shoulder. The openings of three to four holes along the medial border of the scapula correspond to the exposed 4th, 6th and 7th ribs (with permission, The Christine M. Kleinert Institute for Hand and Micro Surgery, Inc).**
shoulder on the involved side slopes downwards and is cosmetically unsatisfactory.

In the past, the most common causes of winging of the scapula have been poliomyelitis and, less often, paralysis of the long thoracic nerve. It may also be seen in fascio-scapulohumeral muscular dystrophy, injury to the brachial plexus associated with injury to the dorsal scapula and spinal accessory nerve, especially that surgically induced during biopsy of lymph nodes in the upper lateral neck, and in injury to the long thoracic nerve related to transaxillary resection of the first rib.

Scapulothoracic fusion has been suggested for patients with muscular dystrophy. This procedure restores the mechanical advantage of the intact deltoid and rotator cuff, thus increasing active abduction and flexion of the shoulder. Varied results have been reported after fusion. Howard performed scapulothoracic fusion in six patients using a tibial graft and screw fixation and Copeland and Howard reviewed 11 fusions in six patients. Complications included pleuritic pain resulting from a protruding screw, pneumothorax, stress fracture, and nonunion. Bunch reported a decrease of 20% in pulmonary vital capacity after bilateral scapulothoracic fusion. Letournel et al described the results of fusion in patients with fascioscapulohumeral muscular dystrophy. Postoperatively, abduction of the shoulder increased by a mean of 25° and flexion by a mean of 33°. These authors also reported complications such as pneumothorax, pleural effusion, atelectasis, fracture of the scapula, and pseudarthrosis.

Winging of the scapula has been treated without fusion by transferring active muscles around the shoulder for dynamic stabilisation. These include teres major, pectoralis major, pectoralis minor, the rhomboids, and lat-

---

Fig. 4

Diagram showing passing of the fascia lata strips at least two, preferably three, times through the holes and around the exposed 4th, 6th and 7th ribs, the tying of each strip on itself and suturing to itself with 2.0 or 3.0 Ethilon and Vicryl sutures (modified with permission from J Bone Joint Surg [Am] 1978;60-A:477).

Fig. 5a Fig. 5b

Photographs showing a) the preoperative view of winging of the right scapula with a droopy right shoulder and limited shoulder abduction and b) three months after operation. The right scapula is stabilised with much improved abduction of the right shoulder (with permission, The Christine M. Kleinert Institute for Hand and Micro Surgery, Inc).
issimus dorsi, but the most commonly used is the sternal aspect of pectoralis major, lengthened with a graft of fascia lata and inserted into the lower pole of the scapula.

Iceton and Harris reported the results of transfer of pectoralis major in 15 patients with a follow-up of between 1 and 16 years. The results were successful in nine and fair in two, with four failures. They advised that transfer of pectoralis major is not successful when muscles other than serratus anterior are non-functional, and under those circumstances fusion is indicated. Post remarks that serratus anterior are non-functional, and under those circumstances fusion is indicated. Post noted a mean increase of 27° in abduction and 28° in flexion.

They noted a mean increase of 27° in abduction and 28° in flexion.

The techniques for fusion described by Whitman and Lowman do not, however, address the appropriate pathology which is in the scapulothoracic articulation. We have found that scapulothoracic stabilisation achieved with autogenous fascia lata wrapped around the 4th, 6th and 7th ribs gives satisfactory stability with improvement of shoulder function. Since pectoralis major is not transferred, its biomechanical role is preserved.

We express sincere appreciation for the contributions of Robert Jacoby, Michael Moskal, MD, and Amit Gupta, MD. No benefits in any form have been received or will be received from a commercial party related directly or indirectly to the subject of this article.

References