(iv) Scapulothoracic fusion

Simon Fogerty

Abstract

Scapulothoracic fusion can, in appropriately selected cases, achieve substantial pain relief and functional improvement for the patient. It can be indicated in patients with severe scapular winging who have failed nonoperative rehabilitation measures and dynamic muscle transfers. In 1921, the first true scapulothoracic arthrodesis was performed using a portion of the fourth rib without internal fixation. Since then, a multitude of different techniques have been tried to secure the scapula against the thorax. Initially techniques introduced metal wires, before progression onto the use of wires with a plate to distribute the forces and, more recently, a plate with screw fixation to the ribs. Various complications have been reported, including metalwork failure, adhesive capsulitis, nonunion, pneumothorax, pleural effusion, thoracic outlet syndrome, pneumonia, scapula fracture and deep venous thrombosis. Scapulothoracic fusion can relieve shoulder pain, allow for smooth functional abduction and flexion of the upper extremity and can improve the appearance of the neck and shoulder in patients who have symptomatic scapular winging. The procedure is associated with a significant complication rate, although many of the potential complications resolve without an extended period of morbidity for the patient.

Keywords facioscapulohumeral dystrophy; scapula winging; scapulothoracic fusion

Introduction

Scapulothoracic (ST) arthrodesis (fusion) is an uncommonly performed procedure in which the medial border of the scapula is fused to the underlying ribs. Due to the relative rarity of the surgical indications, few surgeons have a lot of experience in performing this procedure and textbooks typically do not present comprehensive descriptions of the techniques.[1] However, in appropriately selected cases, substantial pain relief and functional improvement can be achieved following successful completion of this procedure. Disorders affecting the muscles that attach to the scapula, coordinating scapulothoracic movement, or injury to the nerves that innervate these muscles can result in winging of the scapula (Figure 1) and subsequent scapular dyskinesis. Examples include fascioscapulohumeral dystrophy (FSHD), neuralgic amoyotrophy, poliomyelitis, long thoracic nerve palsy (affecting serratus anterior muscle), spinal accessory nerve palsy (affecting trapezius muscle) and dorsal scapular nerve palsy (affecting the rhomboids and levator scapulae muscles).[2] Loss of scapular fixation results in an unstable base for efficient glenohumeral motion, scapular winging and subsequent loss of shoulder movement. Scapulothoracic arthrodesis provides rigid fixation of the scapula to the thorax and long-term results of the procedure have generally been favourable.[3] The different surgical techniques utilized in the past for scapulothoracic fusion and a review of the results obtained using these techniques are presented.

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History

In the past, patients with scapular winging were treated with orthotic devices (Figure 2) that attempted to stabilize the scapula against the posterior chest wall.[3] Rather like the rotator cuff stabilizes the humeral head on the glenoid for efficient deltoid activity, the scapula functions as a controlled, dynamic base from which the shoulder functions. These orthoses were not well tolerated by patients and efficacy was limited. However, they still have a role in demonstrating to the patient and clinician the function that could be achieved by surgical stabilization of the scapula and indeed, in patients deemed unsuitable for surgery. Surgical options for scapular stabilization, other than various muscle transfers that provide dynamic scapular stability, include scapulopexy (scapulothoracic fixation without arthrodesis) and scapulothoracic arthrodesis. Scapulopexy procedures were thought to have an advantage over scapulothoracic fusion because the less rigid fixation provided by scapulopexy still allowed for some scapular movement and immediate postoperative mobilization was possible. In addition, the concerns of stress fractures, nonunion, and respiratory compromise secondary to reduced rib excursion from arthrodesis procedures could be avoided.[3]

The first attempted surgical stabilization of the scapula by scapulopexy was described by Putti in 1906. He presented a case report describing interscapular fixation that unfortunately resulted in vascular compromise of the upper extremity.[4] In 1927, as a treatment for scapular winging due to chronic trapezius paralysis, Henry described the use of fascia lata strips placed through the medial border of the scapula and looped around the spinous processes of the thoracic vertebrae.[3] In 1932, Whitman[5] described a very similar technique for the treatment of serratus paralysis.[2] By 1950, Dewar and Harris were using fascia lata strips and lateral transfer of the levator scapulae muscle to provide scapular stability.[6] Lowman then described using fascia lata strips to connect the medial borders of both scapulae. Ketenjian used fascia lata, Mersilene tape or Dacron strips to secure the medial border of the scapula to the underlying ribs.[3] Despite the theoretical advantages of scapulopexy over scapulothoracic arthrodesis, the results of these various scapulopexy procedures deteriorated with time due to inevitable stretching and loosening of the constructs.

In 1921, the first true scapulothoracic arthrodesis was performed by Nove-Josserand using a portion of the fourth rib without internal fixation. However, this was not reported in the literature until 1967 by Stromboni. In 1961, Howard performed scapulothoracic arthrodeses using tibial bone cortical strut grafts fixed with screws[3] and in the 1970's, Bunch et al described the use of iliac crest bone graft and stainless steel wires to secure the scapula to the rib cage in patients with FSHD.[7] They used two wires for each rib with one passing through the scapula near its medial border and the other through the lateral border. This

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Figure 1 Winging of the right scapula due to serratus anterior palsy, accentuated by active flexion of the arms. In addition to the medial border lifting off the posterior thoracic wall, note the medial and superior translation of the right scapula when compared to the normal left side.

achieved good fusion and improvement in function. Similar techniques were reported by Jakab et al,[8] Twyman et al[9] and Andrews et al.[10] In 1990, Letournel and colleagues published their results of an arthrodesis technique securing a rib through a window in the medial border of the scapula with plate and screw fixation, along with wire-plate fixation of the scapula inferiorly.[11] A technique using stainless steel wires and plate fixation of the scapula with bone graft augmentation was published by Hawkins et al in 1990.[12] A case report by Kocialkowski et al in 1991 described bilateral scapulothoracic arthrodeses in a patient with FSHD using screw fixation of the scapula to the underlying ribs augmented with humeral allograft struts and posterior iliac crest autograft.[3] In another case report, Szomor used allograft Achilles tendon strips along with bone allograft and posterior iliac crest autograft to secure the scapula to the underlying ribs.[3] Howard and Copeland used a method of indirectly fixing the scapula to the underlying ribs with segments of tibial and iliac crest bone graft using screws.[13] Subsequently, a different method was used by the same authors and involved the scapula being directly fixed to the underlying ribs using screws but no strut graft, bone graft being interposed between the scapula and the ribs.

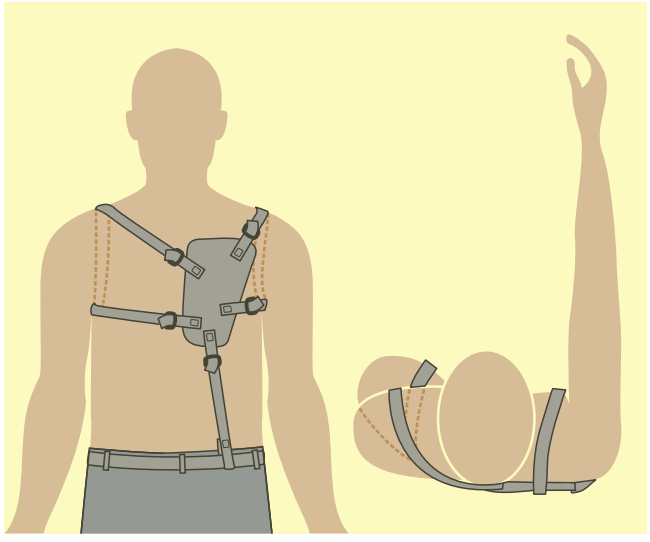

Figure 2 A nonoperative treatment option for scapular winging. The brace is designed to manually press the scapula against the posterior thoracic wall, preventing stretching of the paralyzed muscle and providing limited functional recovery.

Techniques employing a plate along the medial border of the scapula have been used by several surgeons.[1,3,14] Roland et al described such a technique using a four- or five-hole 4.5 mm reconstruction plate contoured over the medial border of the scapula in the infraspinatus fossa. This was held by wires threaded around the underlying ribs, through holes made in the scapula and into the corresponding holes in the plates.[3] No plates were used in the supraspinatus fossa; instead, a wire was tied directly around the underlying rib and through a hole in the scapula. Diab et al[1] and Ziaee et al[14] used a two plate technique. One plate was placed cephalad and the other caudal to the scapula spine.

Patient selection

Selection of patients for scapulothoracic fusion starts with a thorough history and clinical examination. Patients will be affected mostly by impaired shoulder function but also pain. Arthrodesis was introduced to improve shoulder function for patients in whom overhead activity was becoming gradually more difficult.[3] Whether or not the procedure will ease the patient's pain will depend partly on the proportion of the experienced pain that is arising from the scapulothoracic junction and this may be difficult to ascertain. In order to examine for the presence of scapular winging, patients should be examined with both shoulders fully exposed. The surgeon should inspect the shoulders from behind with the patients arms in the neutral position. Muscle atrophy of the muscles about the shoulder girdle should be noted. Patients with an injury to the spinal accessory nerve will demonstrate atrophy of the trapezius musculature and weakness on attempted shrugging of the affected shoulder. Patients with an injury to the dorsal scapular nerve may show atrophy of the rhomboids and levator scapulae along the medial border of the scapula. Inspection of patients with FSHD will reveal atrophy of the trapezius, rhomboids, serratus anterior, and latissimus dorsi. Injury to the long thoracic nerve or muscular disorders affecting the serratus anterior musculature will result in the scapula assuming a position of superior migration with medial rotation of the inferior border of the scapula (so called medial winging). Injury to the spinal accessory nerve affecting the trapezius muscle will cause the scapula to assume a protracted position with inferior migration and lateral rotation of the inferior border of the scapula (lateral winging).[3]

These positions will be accentuated as the patient is asked to forward flex the arm. Injury to the dorsal scapular nerve affecting the rhomboids and levator scapulae will present in a similar fashion to patients with trapezius palsy due to the unopposed action of the serratus anterior muscle. Patients with scapular winging will generally be unable to obtain complete forward elevation or abduction and winging of the scapula will be seen with active shoulder motion. Winging of the scapula can also be

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