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Scapulothoracic fusion: outcomes and complications

Danny P. Goel, MD, MSc, FRCSC[a], James R. Romanowski, MD[b], Lewis L. Shi, MD[c], Jon J.P. Warner, MD[c,*]

[a]*Division of Arthroscopic, Reconstructive Surgery and Joint Preservation, UBC Department of Orthopedics, Burnaby, BC, Canada*
[b]*Charlotte Shoulder Institute, Gill Orthopaedic, Charlotte, NC, USA*
[c]*Harvard Shoulder Service, Massachusetts General Hospital, Boston, MA, USA*

Background: Scapulothoracic fusion (STF) may be an option to alleviate pain and restore function. The purpose of this study is to report the clinical outcome of patients who underwent STF for the treatment of painful scapular winging.
Materials and methods: From 1999 through 2008, 10 patients (12 shoulders) underwent an STF for painful winging of the scapula. The mean follow-up period was 41 months (range, 8-72 months). Indications for STF included winging in association with excessive medial and/or lateral clavicular resection and facioscapulohumeral dystrophy, as well as scapular winging related to combined long thoracic and spinal accessory nerve palsy. A retrospective review was performed to evaluate the subjective shoulder value, visual analog scale score, range of motion, unions, and complications.
Results: There was a statistically significant improvement in the subjective shoulder value, visual analog scale score, range of motion, and satisfaction postoperatively. The overall complication rate was 50% (6 of 12). There were 2 persistent nonunions (2 of 12, 17%), and 50% (6 of 12) of all fusions required subsequent hardware removal because of discomfort. Complications included pleural effusion (3 of 12, 25%), hemopneumothorax (1 of 12, 8%) pulmonary embolus (1 of 12, 8%), and infection (1 of 12, 8%). With the exception of the revision nonunion, all complications resolved with no negative sequelae.
Conclusion: STF results in improved function and pain relief. STF is associated with a high short-term complication rate with limited long-term sequelae.
Level of evidence: Level IV.

Keywords: Scapulothoracic fusion; complications; scapular winging; facioscapulohumeral dystrophy

Painful loss of scapulothoracic function represents a unique and challenging clinical entity. This may occur because of either systemic neurologic disease or direct trauma and loss of clavicular stabilization of the shoulder.[5,7] When function is severely affected and activities of daily living are no longer possible, scapulothoracic fusion (STF) becomes an option.

Few studies have reported on the outcome of STF and the associated complications. Demirhan et al[3] evaluated patients undergoing scapulothoracic arthrodesis in the setting of facioscapulohumeral dystrophy (FSHD). By use of a monofilament cable technique, 13 patients (18 shoulders)

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*Reprint requests: Jon J. P. Warner, MD, Harvard Shoulder Service, Massachusetts General Hospital, Yawkey Center for Outpatient Care, Ste 3G, 55 Fruit St, Boston, MA 02114, USA.

E-mail address: jwarner@partners.org (J.J.P. Warner).

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were evaluated at a minimum of 24 months (range, 24-87 months) postoperatively. Fusion was achieved in 16 shoulders (89%) after the initial operation, with revision surgery in 2 shoulders, yielding an ultimate fusion rate of 100%. Disabilities of the Arm, Shoulder and Hand scores improved from a preoperative value of 33.6 ± 8.9 to a postoperative value of 11.6 ± 8.0. Patients also had significant improvement within range of motion: Preoperative active abduction averaged 46.2° ± 11.6° and improved to 102.2° ± 10.0°; forward flexion improved from 55.6° ± 16.1° to 126.1° ± 20.9°.[3] The authors reported no postoperative complications.

In a separate population of patients with FSHD, Rhee and Ha[11] evaluated 9 shoulders (6 patients) that underwent a scapulothoracic arthrodesis. In this series, preoperative active forward flexion averaged 71° (range, 45°-90°) and improved to 109° (range, 65°-135°). Active abduction improved from 76° (range, 60°-90°) to 108° (range, 70°-135°). There was 1 pleural effusion. No other complications were documented, nor was patient satisfaction. In a similar series of patients, Diab et al[4] reported on 8 fusions in patients with FSHD. There was little mention of complications.

The purpose of our study was to evaluate the outcome of STF with particular attention to complication rate and patient satisfaction.

Materials and methods

A retrospective chart review over a 10-year period (1999-2008) of the practice of the senior shoulder surgeon (J.J.P.W.) identified 11 patients (13 shoulders) who underwent STF (Table I). One patient could not be located, thus leaving 10 patients (12 shoulders) for follow-up. There were 6 male and 4 female patients (mean age, 43.2 years; range, 19-67 years). The mean follow-up length was 41 months (range, 8-72 months). Indications for surgery included 3 patients (5 shoulders) with FSHD, 4 patients (4 shoulders) with long thoracic and/or spinal accessory nerve palsy, 2 patients (2 shoulders) with painful loss of scapular control after excessive resection of the lateral or medial clavicle, and 1 patient (1 shoulder) with trapezius tendon dysfunction after prior spine surgery.

Surgical technique

All STFs within this series were performed by the same surgical technique. The patient is positioned prone, and arm supports are positioned to allow for the forearm to rest with the arm in flexion (Fig. 1). This is the optimum position to ensure contact between the scapula and the ribs for fusion. The entire hemithorax across the midline and the affected arm are sterilely prepared and kept free so that during the procedure, the arm can be moved into positions required for access to the scapulothoracic region. All patients receive preoperative antibiotics 30 minutes before the incision is made.

The incision is made midway between the medial border of the scapula and the spinous processes; the longitudinal incision averaged 16 to 18 cm. The soft tissue is undermined to the level of the trapezius. This muscle, in most cases, is atrophic, and it is incised and released from the scapula, permitting it to be retracted medially. Next, the rhomboid major and minor are released from the scapular attachments and reflected medially (Fig. 2). The shoulder is then internally rotated so that the dorsum of the hand is resting on the iliac crest. The serratus anterior is identified and is detached from its insertion on the medial border of the scapula. The interval between this muscle and the subscapularis is then developed, and it is dissected to its attachments along the ribs. It is then resected with the aid of electrocautery. Although large vessels may be encountered and controlled by electrocautery, this muscle is usually atrophic because of the disease process, leading to scapular winging. The subscapularis muscle is detached from its medial attachment on the scapula. It is elevated out of its fossa with an elevator and electrocautery. This muscle is dissected and freed to about the lateral third of the scapula. The subscapularis muscle is then resected with electrocautery, leaving the lateral one-third of the muscle intact (Fig. 3). This step is necessary to have bone-on-bone contact of the scapula to the ribs for successful fusion. Next, the soft tissue overlying the ribs is removed with electrocautery until ribs 3, 4, 5, and 6 are clearly free of soft tissue. A small burr is then used to lightly decorticate the ribs. The undersurface of the scapula (subscapularis fossa) is also decorticated lightly.

Eighteen-gauge stainless steel wires are bent into a loop and passed around ribs 3, 4, 5, and 6. Careful subperiosteal elevation of the soft tissue around the ribs is performed (Fig. 3). After passage of the wires, sterile saline solution is irrigated into the incision so that it covers the ribs and chest wall. The anesthesiologist then performs several positive pressure ventilations so that any pleural perforation can be seen as bubbles appearing in the saline solution.

In preparation for placement of a plate on the scapula to reinforce these wires, the infraspinatus and supraspinatus muscles are elevated in a medial-to-lateral direction with electrocautery and an elevator, such that 4 to 5 cm of the medial scapula is exposed. A 5-hole limited contact dynamic compression plate (DePuy Synthes, West Chester, PA, USA) is then gently bent so that it sits flush in the infraspinatus fossa just inferior to the scapular spine (Fig. 4). The arm is brought into flexion so that the scapula sits against the ribs, and the proper location for the holes in the scapula is determined. A burr is then used to create holes through the scapula corresponding to the plate holes. One additional hole is made in the supraspinatus fossa above the plate. The wires are then passed through the corresponding holes so that they will compress the scapula and plate against the ribs when tightened.

Bone graft is harvested from the ipsilateral posterior iliac crest. This is performed with a straight longitudinal incision over the posterior superior iliac crest, which is exposed subperiosteally. An osteotome is used to open up the cortical surface of the outer table; curved gouges or curettes are used to harvest cancellous bone. Approximately 15 cm^3 of autograft is then combined with 15 cm^3 of allograft bone chips. The bone graft is positioned into the space between the scapula and ribs, with care taken to place as much as possible directly on the ribs, which have been decorticated (Fig. 4).

The wires are tightened with a heavy-duty needle driver. To obtain uniform compression, each wire is gently tightened, moving from the most inferior to the most superior and then back to the first set of wires, finally completing the tightening. After the