Technical Note

Combined Arthroscopic Scapulothoracic Bursectomy, Partial Scapulectomy, and Pectoralis Minor Release for the Treatment of Snapping Scapular Syndrome

Phob Ganokroj, M.D., Kohei Yamaura, M.D., Ph.D., Mitchell S. Mologne, B.S., Ryan J. Whalen, B.S., C.S.C.S., and CAPT Matthew T. Provencher, M.D., M.B.A., M.C., U.S.N.R. (Ret.)

Abstract: Snapping scapula syndrome (SSS) is a source of pain and discomfort in patients. It is not uncommon for patients who present with SSS to have some degree of scapular dysfunction, especially with the tightness of the pectoralis minor (PM) muscle. In this Technical Note, we demonstrate our preferred technique for arthroscopic scapulothoracic bursectomy and partial scapulectomy with concomitant pectoralis minor release for the treatment of symptomatic SSS and PM tightness. In the treatment of these patients, PM release is beneficial because arthroscopic scapulothoracic bursectomy or partial scapulectomy alone may result in residual scapular dyskinesis.

Snapping scapula syndrome (SSS) is a source of pain and discomfort in patients and is often caused by scapulothoracic bursitis or other anatomic abnormalities that cause an atypical interplay between the scapula and thorax.[1,2] SSS often occurs in young, active patients and is often a result of repetitive overhead activity such as baseball or throwing sports. SSS is typically treated without surgery, including injections, extracorporeal shock wave therapy, or exercise/rehabilitation. A recent scoping review by Baldawi et al.[3] found that each of these nonoperative options typically resulted in an improvement in symptoms, as well as good patient-reported outcomes. However, when patients do not show improvement with nonoperative management, they may be indicated for surgical intervention. Techniques have been described in the past for surgical treatment of SSS, such as a bursectomy or a partial scapulectomy, and showed improvement in functional outcome and satisfaction.[1,4,5]

It is not uncommon for patients who present with SSS to have some degree of scapular dyskinesia.[3,6,7] Tightness of the pectoralis minor muscle (PM) may disrupt the normal kinematics of the scapula and cause pain in the overhead throwing athletes who present with tenderness at the medial aspect of the coracoid process.[8] PM release is indicated in patients who have refractory pain despite adequate conservative treatment, and scapular dysfunction owing to the pathologic tightness of PM. Techniques for PM release have been described in both an arthroscopic approach and mini-open approach with acceptable outcomes.[8,9] The pectoralis minor release theoretically functions to return the scapula to a more anatomic position, in which patients undergoing a pectoralis minor release for SSS saw a reduction in scapular protraction on the inferomedial border from 1.2 cm to 0.3 cm before to after surgery.[8] Hence, in this Technical Note, we display our preferred technique for arthroscopic scapulothoracic

From the Steadman Philippon Research Institute (P.G., K.Y., M.S.M. R.J.W., M.T.P.), and the Steadman Clinic (M.T.P.), Vail, Colorado; the Faculty of Medicine Siriraj Hospital, Mahidol University (P.G.), Bangkok, Thailand; the Department of Orthopaedic Surgery, Kobe University Graduate School of Medicine (K.Y.), Kobe, Japan.

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Address correspondence to CAPT Matthew T. Provencher, MD, MC, USNR (Ret.), Steadman Philippon Research Institute, The Steadman Clinic, 181 W Meadow Dr, Ste 400, Vail, CO 81657, U.S.A. E-mail: mprovencher@thesteadmanclinic.com

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bursectomy, partial scapulectomy with concomitant pectoralis minor release for the treatment of symptomatic snapping scapular syndrome.

Surgical Technique

The surgical technique for arthroscopic scapulothoracic bursectomy and partial scapulectomy combined with arthroscopic pectoralis minor release is developed to show the safety and effectiveness of merging these complex surgeries in the same setting. Indications for arthroscopic scapulothoracic bursectomy and partial scapulectomy include patients who present with scapulothoracic bursitis or SSS and have failed conservative treatment. Besides, the indications for adding arthroscopic pectoralis minor release are symptomatic shoulder pain (duration > 6 months), limited overhead range of motion (ROM), and examination findings consistent with scapular dysfunction secondary to a tight PM muscle (scapular dyskinesia with anterior tilt and internal rotation with a lateral shift scapula) and tenderness to palpation of the PM tendon. The surgical technique can be reviewed in Video 1.

Patient Positioning and Anesthesia

The patient is placed in a prone position at first. An interscalene nerve block is placed under ultrasound guidance by the anesthesia pain service, and the patient will receive light general anesthesia afterward. All bony prominences and the face are well padded. A padded towel is also placed anterior to the left shoulder to elevate the shoulder away from the bed, improving arm position. Preoperative examination with the patient under anesthesia is carried out to identify the crepitus location and to mark an area of the scapula resection. The affected (left) arm is extended and maximally internally rotated, with the dorsum of the hand placed at the back in a a chicken-wing position (Fig 1). Winging of the scapula aids in the portal placement by increasing the potential space between the scapula and the underlying chest wall.[4,5] Next, the surgical site is cleaned, prepped, and draped in a sterile fashion for prone position, ensuring that the affected arm (left) is free to move in a chicken-wing position.

Portal Placement and Scapulothoracic Bursectomy

If an optimal chicken-wing position is not achieved, the additional space can be established by placing a medial force at the lateral aspect of the shoulder as the surgeon leans against the affected arm (Fig 1). The anatomical landmarks and essential surgical sites marked with a solid line include the medial scapular border, superomedial scapular corner, superior scapular border, inferior scapular border, the scapular spine, and the area of resection. For the inferomedial viewing portal, a 1-cm skin incision is made, measured by an arthroscopic trocar's length from the superomedial scapular corner to the point of 3 cm medial to the medial border of the scapula (Fig 2). This step is crucial to reduce the risk of injury to the transverse neurovascular structures (dorsal scapular artery and nerve) and to facilitate adequate viewing of the resection area,

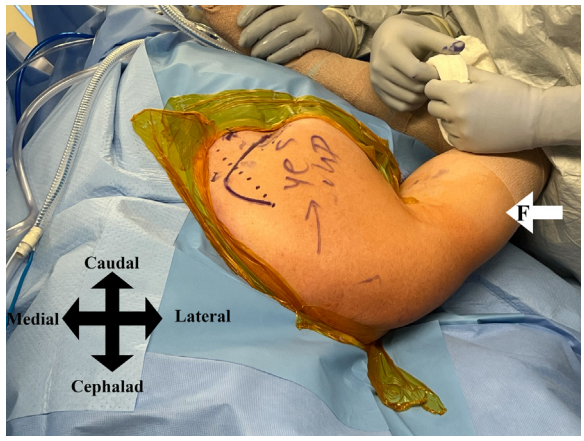

Fig 1. The patient is placed in a prone position (left shoulder). The affected (left) arm is extended and maximally internally rotated with the dorsum of the hand placed at the back, a chicken-wing position. Winging of the scapula facilitates in portal placement by increasing the potential space between the scapular and the underlying chest wall. The additional space can be established by placing the medial force (*F*) at the lateral shoulder as the surgeon leans against the affected arm.

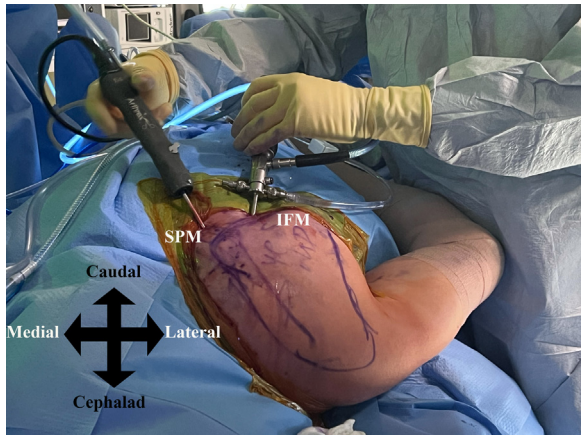

Fig 2. Intraoperative figure of the left shoulder (prone position). The anatomical landmarks and essential surgical sites that are marked with a solid line include the medial scapular border, superomedial scapular corner, superior scapular border, inferior scapular border, the scapular spine, and the area of resection. An inferomedial viewing portal (IFM), a 1-cm skin incision, is made, measured with an arthroscopic trocar's length from the superomedial scapular corner to the point 3 cm medial to the medial border of the scapula. A superomedial working portal (SPM) is created by an outside-in approach using an 18-gauge spinal needle inserted from 3 cm medial to the medial border of the scapula at the same level of the scapular spine.

which is the superomedial corner of the scapula. Next, a 30° arthroscope is inserted, followed by the creation of the superomedial working portal. This portal is created by an outside-in approach using an 18-gauge spinal needle inserted from the 3-cm medial to the medial border of the scapula at the same level as the scapular spine (Fig 2). A switching stick with the Switching Stick Inserter (Arthrex, Naples, FL) is introduced to facilitate finding the optimal subscapular space and the area of resection. Then, a 4.5 mm arthroscopic shaver (Arthrex) is inserted into the scapulothoracic bursa, and scapulothoracic bursectomy is then performed with a combination of a radiofrequency wand (Super Turbovac Coblation Wand; Smith & Nephew, Andover, MD). The inflamed scapulothoracic bursa and scar tissue are removed, and adequate hemostasis is ensured by utilizing the radiofrequency wand. Care is taken to not violate the thoracic wall structures inferiorly (intercostal muscle and rib) and not to resect tissue beyond the medial border of the scapula to protect the transverse neurovascular structure and the rhomboid musculature insertion. In addition, the arthroscopic pressure pump should be maintained at 50 mm Hg or lower to prevent the high potential of fluid extravasation, which causes compartment syndrome, especially in the paracervical region.

Arthroscopic Superomedial Scapulectomy

The superomedial corner of the scapula is identified by inserting the 18-gauge spinal needle by an outside-in approach. Next, the underlying soft tissue and muscle attachment are removed from the superomedial corner of the scapula using the combination of an arthroscopic shaver and radiofrequency wand (Fig 3A). Arthroscopic superomedial scapulectomy is performed using a high-speed bur to trim and remove the osteophyte and contour the triangulation of the scapula. Resection adequacy is determined by removing the superomedial scapular corner approximately 1.5 cm (superior to inferior) by 1.5 cm (medial to lateral) (Fig 3B). Care should be taken to remove all the sharp edges of the scapula and to prevent excessive resection. Bleeding is checked and stopped. The dynamic examination of the scapula after resection is performed to ensure that the crepitus is resolved with an optimal resection. Afterward, the suction is attached to the trocar outflow to remove as much excess fluid as possible to prevent compartment syndrome. The skin is closed in a standard fashion.

Arthroscopic Examination and Pectoralis Minor Release in Beach-Chair Position

After completing the arthroscopic scapulothoracic bursectomy and superomedial scapulectomy, the patient is repositioned in a beach-chair position with the head of the bed at 45°. All bony prominences are padded, and 2 small, folded towels are placed on the medial border of the scapula to stabilize the scapula on the table. The completed arthroscopic examination is performed via a standard posterior central glenoid portal. Next, the anterior portal is established just lateral and superior to the coracoid process utilizing the guidance 18-gauge spinal needle by an outside-in approach (Fig 4). Synovitis within the rotator interval and the anterior capsule are debrided using a combination of an arthroscopic shaver, basket, and radiofrequency wand. The base of the coracoid process, the conjoint tendon, and the superior border of the subscapularis tendon are clearly identified in the glenohumeral joint.

Afterward, the arthroscope is inserted into the subacromial space from the posterior portal. An anterolateral portal is made using the guidance 18-gauge spinal needle by an outside-in approach. The subacromial decompression is carried out using the combination of an arthroscopic shaver and radiofrequency.

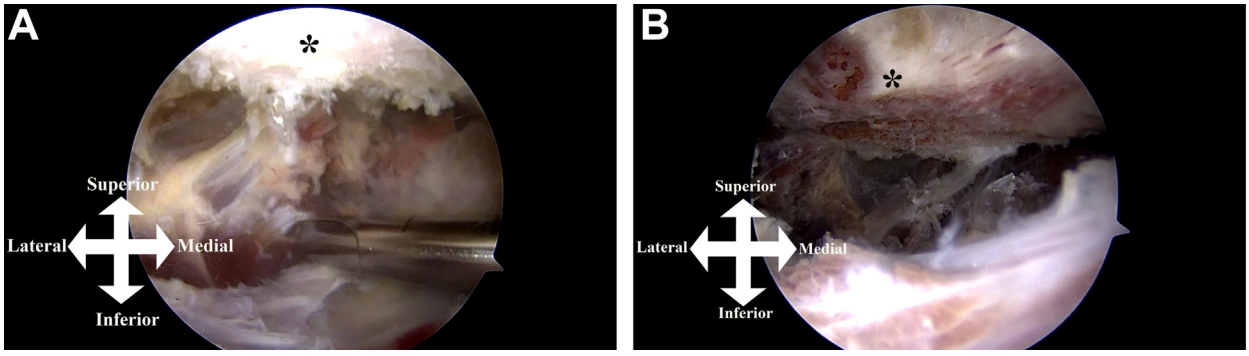

Fig 3. Arthroscopic findings of the left shoulder (prone position). (A) The underlying soft tissue and muscle attachment are removed from the superomedial corner of the scapula (*) using the combination of an arthroscopic shaver and a radiofrequency wand. (B) Arthroscopic superomedial scapulectomy is performed using a high-speed bur to trim and remove the osteophyte and contour the triangulation of the scapula (*). Resection adequacy is determined by removing the superomedial scapular corner approximately 1.5 cm (superior to inferior) by 1.5 cm (medial to lateral).

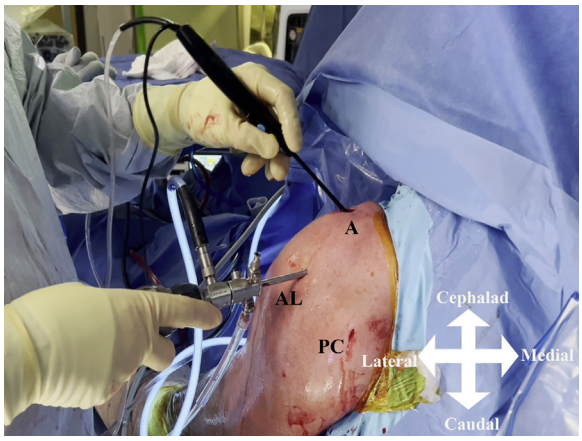

Fig 4. Patient is repositioned into a beach-chair position (left shoulder). The completed arthroscopic exam is performed via a standard posterior central glenoid portal (PC). Next, the anterior portal (A) is established just lateral and superior to the coracoid process using the guidance 18-gauge spinal needle by an outside-in approach. Then, the arthroscope is moved to the anterolateral portal (AL) as the new viewing portal during the pectoralis minor release procedure.

Next, the 18-gauge spinal needle is inserted just medial and superior to the coracoid process and helps to define the area of pectoralis minor release. Then, the arthroscope is moved to the anterolateral portal as the new viewing portal. The subcoracoid space is identified, and subcoracoid decompression is carried out via the anterior portal. Care is taken not to put the instruments medial to the coracoid process to prevent the adjacent neurovascular structures, especially the musculocutaneous nerve. The border of the pectoralis minor is carefully identified and released with the radiofrequency wand (Fig 5A). After that, a grasping instrument is used to confirm the completed release of the pectoralis minor attachment or any fibrosis/scar attachment (Fig 5B). Bleeding is checked and stopped, and the skin is closed in the standard fashion. The patient is then placed in a padded abduction sling.

Postoperative Rehabilitation

The patient uses a sling for comfort for the first 1 to 2 weeks after surgery and is encouraged to wean off the sling after the first week after surgery. On postoperative day 2, the patient is started on a full passive ROM and full stretching program. Active ROM exercise is started in the second week. Postoperative rehabilitation included a comprehensive PM stretching program, a progressive scapular strengthening program including scapular low-rowing exercise and active-assisted ROM in the scapular plane. At approximately 6 weeks to 3 months after surgery, once the scapula has stabilized and is not exhibiting signs of dyskinesia, the patient is allowed to return to overhead lifting and full activities.

Discussion

SSS is generally caused by various anatomic mismatches between the concave anterior scapula and the convex thoracic wall, leading to inflammatory subscapular bursitis.[10] The pathogenesis of SSS is multifactorial and includes post-traumatic changes, subscapular elastofibromas, osteochondromas, Luschka tubercles, anterior angulation of the medial scapula, and an excessively concave scapula.[11,12] First-line treatment of SSS is nonoperative and consists primarily of physical therapy and rehabilitation,[3] with additional anti-inflammatory steroid injections reported.[13] However, SSS resistant to conservative treatment can cause impingement and subsequent inflammation of the surrounding structures, leading to significant disability and pain; therefore, surgical treatment is usually indicated.[11] Baldawi et al.[3] recommend surgical treatment as indicated for patients who failed after 3 to 6 months of conservative therapy. This Technical Note describes a combined arthroscopic scapulothoracic bursectomy and partial scapulectomy with the arthroscopic release of the pectoralis minor tendon for SSS. The pearls and pitfalls, including the advantages and disadvantages, are listed in Tables 1 and 2.

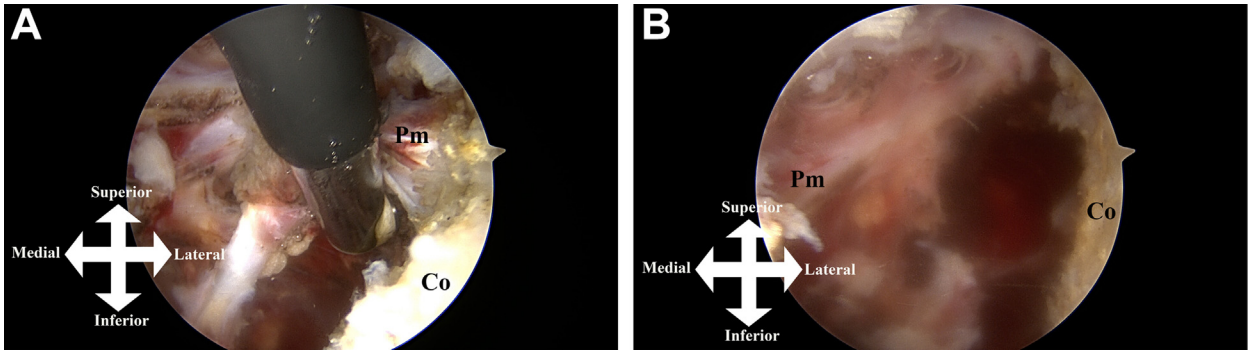

Fig 5. Arthroscopic findings of the left shoulder (beach-chair position) viewing from the anterolateral portal. (A) The border of the pectoralis minor (PM) is carefully identified and released with the radiofrequency wand from the medial side of the coracoid process (Co). (B) After the completed release of the pectoralis minor, there was no attachment or any fibrosis/scar at the coracoid process.

Table 1. Pearls and Pitfalls

Pearls
Positioning the patient in the "chicken-wing" position and placing the medial force at the lateral shoulder as the surgeon lean against the affected arm to increase the scapulothoracic space
Preoperative EUA to identify crepitus and mark the area of resection
Establish an inferomedial portal by measuring arthroscopic trocar length from an area of resection and 3 cm medial to the scapular border to prevent injury to the neurovascular structures and adequate visualization
A thorough understanding of arthroscopic anatomy is critical to prevent an iatrogenic neurovascular injury.
Pitfalls
Poor positioning increases the risk of violation of the thoracic wall because of inadequate visualization.
Crepitus may persist after arthroscopic scapular resection; the dynamic EUA should be confirmed to ensure adequate resection
Portal placement, if too inferior, causes poor visualization during resection and, if too close to the medial border of the scapula, increases the risk of iatrogenic transverse neurovascular injury
Using a shaver or radiofrequency device too lateral from the superomedial corner of the scapula increase risk of the suprascapular nerve. Too lateral and inferior from the coracoid process poses the risk of musculocutaneous nerve injury.

The efficacy of arthroscopic scapulothoracic bursectomy and partial scapulectomy for SSS has been previously reported.[5,14-16] The advantages of arthroscopic procedures are the preservation of the periscapular muscles and the ability to perform additional lysis of adhesions as in scacpulectomy.[5] Patient arm positioning in arthroscopic procedures is important to reduce the risk of neurovascular injury. Previous studies have reported that the chicken wing position not only provides space for the subscapularis but also moves the dorsal scapular nerve a significantly safer distance from the superomedial border of the scapula.[17,18] However, we encounter patients with scapular dyskinesis complicated by SSS with the tightness of the pectoralis minor muscle, as presented in this study. Scapular dyskinesis is defined as a change in the position and movement of the scapula, with respect to the thorax.[19] This change in scapular position has been reported to result in an abnormal scapulothoracic joint, which may worsen into SSS by causing bursitis.[11] The primary function of the pectoralis minor muscle is to stabilize and mediate the anterior tilt of the scapula, and tightness of the pectoralis minor muscle results in a shift outward from the midline and a downward tilt of the coracoid, contributing to scapular dyskinesis.[8] Provencher et al.[8] investigated 46 patients with pectoralis minor muscle tightness and reported that in 87%, physiotherapy and rehabilitation significantly improved clinical outcomes. However, they also reported that 13% of patients were refractory to conservative treatment and that mini-open surgical release of the pectoralis minor tendon significantly improved clinical outcomes and abnormal scapular tilt. There are similarities between the 2 disorders, such as the common occurrence of stiffness of the pectoralis minor muscle, as well as SSS in overhead athletes, and a certain number of patients may be expected to have a combination of both disorders, as in the present study.[3,6,7] Therefore, when examining patients with SSS, it is clinically important to consider the complication of PM tightness and to carefully examine patients for tenderness in the medial aspect of the coracoid process and abnormal scapular position to provide more appropriate surgical treatment.

Table 2. Advantages and Disadvantages

Advantages
Performing and addressing the pathologies in the same setting (scapulothoracic and subcoracoid spaces) and glenohumeral joint
Minimal invasive surgery, which preserves the muscular attachment of the scapula and coracoid process
Performing arthroscopic pectoralis minor from the subacromial and subcoracoid spaces improves surgical visualization compared with the glenohumeral joint approach
Offer a limited immobilization and accelerated rehabilitation time
Disadvantages
Repositioning of the patient from a prone position to a beach-chair position
High learning curve for arthroscopic approach
Potential risk of fluid extravasation causing compartment syndrome, especially at the peri-cervical region
Injury to the major vascular structure or thoracic wall may need open management

In conclusion, this Technical Note introduces a combined arthroscopic scapulothoracic bursectomy and partial scapulectomy with the arthroscopic release of the PM tendon for a patient with PM tightness in SSS resistant to conservative treatment. In the treatment of these patients, PM release is beneficial because arthroscopic scapulothoracic bursectomy and partial scapulectomy alone can result in residual scapular dyskinesis because of PM tightness.

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