Arthroscopic Treatment of Snapping Scapula Syndrome: Outcomes at Minimum of 2 Years

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Purpose: To investigate clinical outcomes after primary and revision arthroscopic treatment for snapping scapula syndrome (SSS) and identify predictive factors associated with outcomes. **Methods:** Patients who underwent arthroscopic treatment for SSS between October 2005 and December 2013 were identified in a prospectively collected database. The inclusion criteria were patients with a diagnosis of symptomatic SSS, in whom extensive nonoperative modalities failed, who underwent arthroscopic surgery for SSS, and who had undergone surgery a minimum of 2 years earlier. Postoperative clinical outcomes were assessed with the American Shoulder and Elbow Surgeons score; short version of the Disabilities of the Arm, Shoulder and Hand questionnaire; and general health Short Form 12 (SF-12) scores, including both physical component summary and mental component summary. Patient satisfaction was recorded on a 10-point visual analog scale. Scapular bony morphology was determined on preoperative magnetic resonance imaging. **Results:** Ninety-two scapulae underwent arthroscopic treatment for SSS. There were 74 scapulae that met the inclusion criteria, including having undergone surgery a minimum of 2 years earlier. An outcome questionnaire was completed for 60 of 74 (81%). The mean age was 33 years (range, 12-65 years), and the mean duration of symptoms before surgery was 4 years (range, 90 days to 20.4 years). The mean follow-up period was 3.4 years (range, 2-7 years). Eight scapulae failed initial surgical management (10.9%) because of recurrent pain and underwent revision surgery at a mean of 309 days (range, 120-917 days). After surgery, there was a significant improvement in all outcome scores, including SF-12 physical component summary score, from 39.2 to 45.4 ($P = .002$); SF-12 mental component summary score, from 45.0 to 49.6 ($P = .023$); American Shoulder and Elbow Surgeons score, from 52.6 to 75.8 ($P < .001$); and score on the short version of the Disabilities of the Arm, Shoulder and Hand questionnaire, from 40.2 to 24.2 ($P = .001$). The median patient satisfaction rating was 7 of 10. Greater age, lower preoperative psychological score, and longer duration of symptoms before surgery correlated with lower postoperative outcome scores. **Conclusions:** Arthroscopic surgery is an effective treatment for SSS in both primary and revision cases, showing significant improvements in all postoperative outcome scores at a mean of 3.4 years. Lower preoperative mental status score, longer duration of symptoms, and greater age were associated with poorer outcomes. **Level of Evidence:** Level IV, therapeutic case series.

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Snapping scapula syndrome (SSS), or scapulothoracic bursitis, is a rare cause of shoulder pain and dysfunction. The scapula plays an important role in the function of the shoulder girdle and upper extremity by providing a stable base for glenohumeral motion. Unlike most other joints in the body, however, the scapulothoracic joint is inherently incongruent and lacks features such as a synovial lining or cartilaginous interface at its articulation. Instead, the anterior scapula glides over the convex thoracic wall with several bursal and

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soft-tissue planes interposed between the bony surfaces.[1] Because the only scapular attachments to the axial skeleton are through the acromioclavicular and sternoclavicular joints, the scapula is stabilized through dynamic control of the periscapular musculature. Any alterations in the normal anatomy or kinematics of the scapula, chest wall, or surrounding tissues can therefore result in pathologic irritation of the subscapular bursa or fibrosis of the bursa, leading to crepitus or snapping of the scapulothoracic joint.[2] Recent literature has suggested that patients with anterior angulation of the medial scapula in the axial plane are at greater risk of having SSS.[2] However, it remains unclear if the bony morphology of the scapula affects the patients' functional outcome. As with other musculoskeletal disorders, it has been postulated that there is also a psychological profile or tendency that is associated with this disorder.[3,4]

Initial nonoperative treatment is successful in most patients and should include physical therapy, anti-inflammatory medications, and activity modification.[5,6] Corticosteroid injections can also be used as both a diagnostic and therapeutic modality. For patients who do not respond well to extensive conservative management, surgical intervention may be considered. Since the first description of arthroscopic bursectomy with partial scapulectomy for SSS in 1999 by Harper et al.,[7] there have been limited outcome studies. These have reported good to excellent clinical outcomes, although prior data are limited to case reports or small case series.[8] More recently, arthroscopic approaches have been developed, allowing for symptomatic bursal debridement and bony resection through a minimally invasive approach.[7-10] Although technically challenging, arthroscopy offers additional advantages of preservation of muscular attachments, improved cosmetic appearance, and faster recovery times.

Although our knowledge of SSS and associated surgical techniques continues to evolve, there is limited information in the current literature regarding patient-reported outcomes after arthroscopic treatment.[11] The purpose of this study was to investigate clinical outcomes after primary and revision arthroscopic treatment for SSS and identify predictive factors associated with outcomes.

Methods

Patient Selection and Demographic Data

This study was conducted with the approval of, and in concordance with, Institutional Review Board (IRB2002-03) policies. Data were prospectively collected and retrospectively reviewed. Primary surgical procedures for SSS were performed from October 2005 through December 2013. Patients were included in this study if they were diagnosed with symptomatic SSS, extensive nonoperative modalities had failed, and they underwent arthroscopic surgery for SSS and had undergone surgery a minimum of 2 years earlier. In addition, in cases with differential diagnoses, patients underwent a local anesthetic injection with bupivacaine hydrochloride (0.25% plain, 3 mL) into the scapulothoracic bursa with documented relief prior to surgery. Patients were excluded from the study if they reported a history of scapula or rib surgery or concomitant, subsequent sternoclavicular procedures or refused to participate in follow-up surveys. Patient demographic characteristics included in data analysis were age, sex, affected shoulder, and duration of symptoms prior to surgery.

Patients underwent a thorough history and physical examination of the shoulder and periscapular region at the time of initial presentation. Clinical symptoms included pain and/or other mechanical symptoms isolated to the scapulothoracic joint that did not improve with conservative management. Extensive conservative treatment included anti-inflammatory medication, local anesthetic injections, rest, and physical therapy for a minimum of 6 weeks to address any scapular dyskinesis and periscapular strengthening.

In patients who had previously been treated in the study with primary arthroscopic surgery for SSS and had recurrent pain, an initial course of physical therapy, including scapular motion and periscapular strengthening, was attempted for a minimum of 6 weeks. In addition, oral anti-inflammatory medication and local anesthetic injections were used. If extensive conservative therapy did not result in relief of their symptoms, they were candidates for revision surgery.

Advanced imaging, including magnetic resonance imaging without contrast, was obtained in all patients to evaluate for the presence of bursal inflammation, soft-tissue lesions, bony abnormalities, or other pathology in the periscapular area. A computed tomography scan was obtained in all patients in whom bony pathology was a concern. A board-certified musculoskeletal radiologist read and interpreted all imaging studies.

Operative Technique

We used the arthroscopic technique performed for SSS in all patients as previously described by Millett et al.[9] The patient was placed in a prone position, and both the operative extremity and posterior thorax were prepared and draped in a sterile fashion. The dorsum of the operative hand was placed posteriorly on the mid-lumbar spine, creating winging of the scapula and thus increasing the potential space between the scapula and chest wall for portal placement (Fig 1). An initial viewing portal was established approximately 3 cm medial (toward the midline) to the inferomedial angle of the scapula with subsequent placement of a 30° arthroscope. A second working portal was then established using triangulation with the assistance of a spinal needle approximately 3 cm medial to the scapula just caudal to the scapular spine.

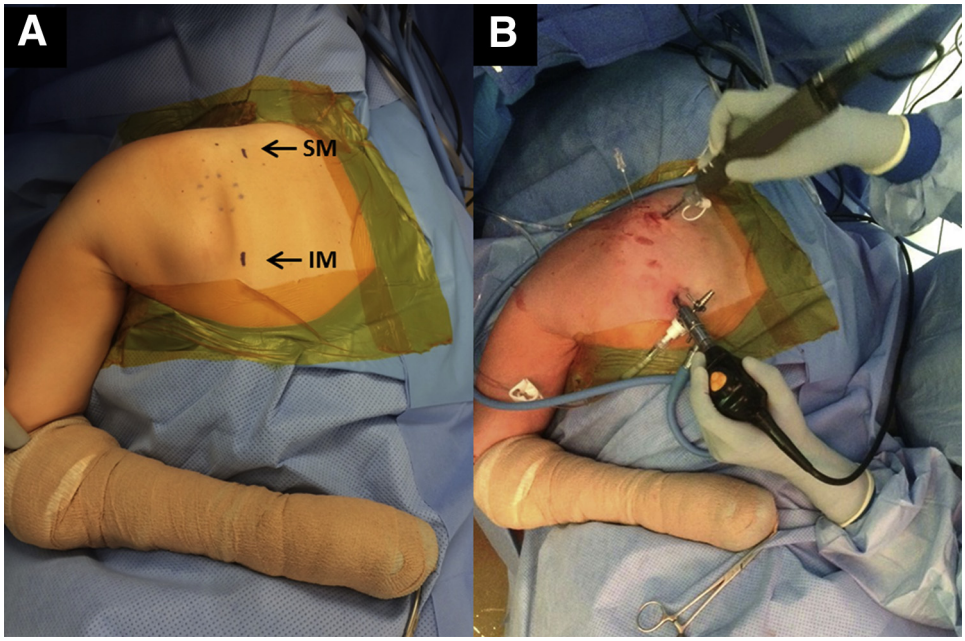

Fig 1. Patient placed in the prone position with the dorsum of the operative hand placed posteriorly on the midlumbar spine, creating winging of the scapula of the left shoulder (A), and 2 portal placements at the superomedial aspect (SM) and inferomedial aspect (IM) of the scapula (arrows) (B).

After a diagnostic arthroscopy was performed and confirmation of bursal hypertrophy was ascertained, a shaver and radiofrequency ablator were used to clear inflamed bursal tissue and any fibrous bands in the area of the patient's symptoms as previously determined by preoperative anesthetic injections. The superomedial angle of the scapula was then exposed by careful partial removal of the underlying muscular attachments with a radiofrequency probe. Any bony prominence in this region was resected with a shaver and high-speed arthroscopic burr (Fig 2). Placement of spinal needles outlining the border of the scapula was used to mark the extent of the planned resection, followed by the aforementioned arthroscopic scapuloplasty. A typical resection was 2 cm (anteroposterior) × 3 cm (mediolateral). A dynamic examination of the scapula was performed to ensure no mechanical crepitation or other abnormalities remained. The portals were then closed, and a sling was applied to the affected extremity.

Postoperatively, patients were allowed full range of motion, and early scapular protraction and retraction were encouraged. Return to full activities was typically permitted at 8 weeks postoperatively.

Data Collection

Subjective questionnaires were collected from each patient preoperatively and independent of medical staff, during subsequent office visits, and yearly thereafter by mail or email. Preoperative and postoperative pain and functioning levels were assessed with the American Shoulder and Elbow Surgeons (ASES) score; short version of the Disabilities of the Arm, Shoulder and Hand questionnaire (QuickDASH); and general health Short Form 12 (SF-12) including both physical component summary (PCS) and mental component

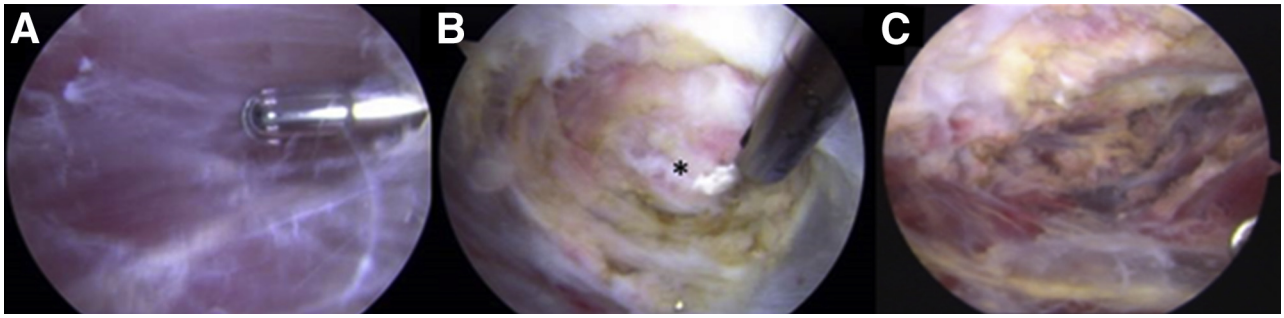

Fig 2. (A) Severe inflammation of bursal tissue, which was subsequently excised with a mechanical shaver. (B) The superomedial angle of the scapula is identified (asterisk). (C) Scapuloplasty has been performed with a combination of a mechanical shaver and high-speed burr.

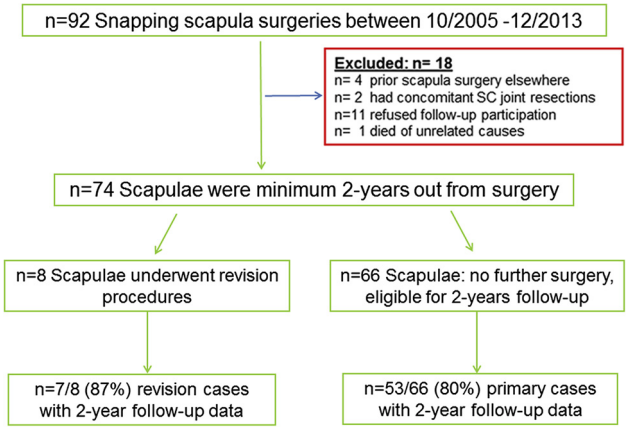

Fig 3. Patient flow diagram. (SC, sternoclavicular.)

summary (MCS). Patient satisfaction was recorded on a 10-point visual analog scale (1, very unsatisfied; 5, neutral; and 10, very satisfied). Failures were defined as patients undergoing revision partial scapulectomy or bursectomy and patients with a satisfaction rating of less than 5 (neutral).

Predictors of Outcome

Patients' age, sex, MCS score, and duration of symptoms were evaluated as possible predictors of the assessed outcome scores.

Statistical Analysis

Statistical analyses were performed with SPSS statistical software (version 11.0; SPSS, Chicago, IL). Univariate analysis was performed using an independent *t* test for normally distributed continuous variables between 2 groups; when a continuous variable was not normally distributed, the Mann-Whitney *U* test was used between the 2 groups. Changes in preoperative and postoperative scores were compared using a paired *t* test. Bivariate analysis was performed by χ^2 tests and Fisher exact tests when appropriate. Correlations were performed with either a Pearson coefficient (r) or Spearman ρ analysis depending on the normality of the data. All reported P values are 2-tailed with $P < .05$ indicating a statistically significant difference.

Results

There were 92 scapulae (83 patients) that underwent arthroscopic treatment for SSS from October 2005 to December 2013 (Fig 3). We excluded 18 cases from the study because of a history of surgery on the symptomatic scapula (n = 4), concomitant sternoclavicular joint surgery (n = 2), or refusal to participate in follow-up surveys (n = 11); in addition, 1 patient died of unrelated causes during the follow-up period, which resulted in 74 scapulae being included in the study. The mean age at the time of surgery was 33 years (range, 12-65 years), and the mean duration from onset of symptoms to surgery was 4.0 years (range, 90 days to 20.4 years).

Of the 74 scapulae, 10.9% (n = 8) failed because of recurrent pain and underwent a revision procedure at a mean of 309 days (standard deviation, 283 days). All 8 patients had undergone preoperative magnetic resonance imaging or computed tomography scans to assess for any recurrent soft-tissue or osseous pathology, and there were no cases of heterotopic ossification (Fig 4). Outcomes from these 8 failures were analyzed separately. Recurrent scarring and fibrosis were seen in all cases at the time of revision surgery.

Outcome Data

Minimum 2-year outcome data were collected on 81% of scapulae (60 of 74) with a mean follow-up

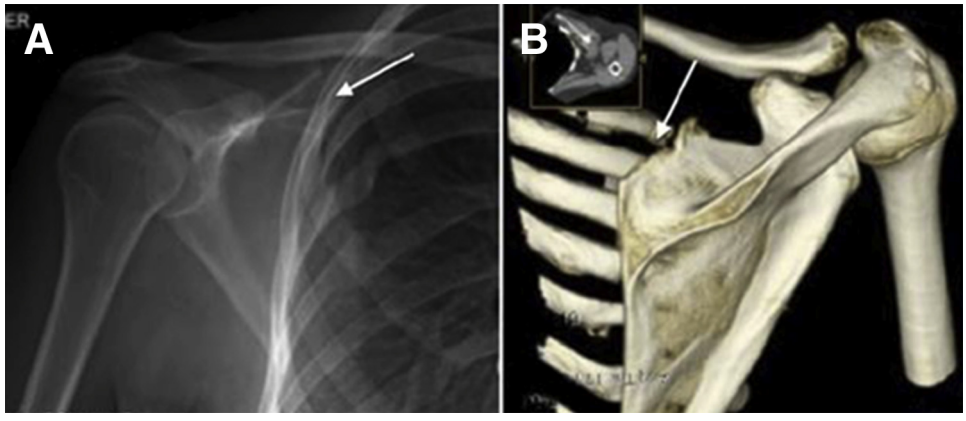

Fig 4. Anteroposterior shoulder radiograph (A) and 3-dimensional computed tomography reconstruction (B) of a right shoulder after primary arthroscopic scapuloplasty and bursectomy before the revision surgical procedure. The resected superomedial scapula angle (arrows) can be seen without heterotopic ossification. (Reprinted with permission.[9])

Table 1. Summary of Patient Outcome Scores at Minimum 2-Year Follow-up

Outcome Measure	Preoperative (Mean, −44 days; Range −239 to −1 days)	Postoperative (Mean, 3.4 years; Range, 2-7 years)	Change in Score	*P* Value
SF-12 PCS	39.2 ± 9.6	45.4 ± 11.0	6.3	.002*
SF-12 MCS	45.0 ± 11.2	49.6 ± 10.8	4.6	.023*
ASES	52.6 ± 16.6	75.8 ± 22.6	23.2	<.001*
QuickDASH	40.2 ± 16.8	24.2 ± 22.2	16.0	.001*
Median patient satisfaction	—	7 (1-10)	—	—

NOTE. Data are presented as mean ± standard deviation unless otherwise indicated.

ASES, American Shoulder and Elbow Surgeons; MCS, mental component summary; PCS, physical component summary; QuickDASH, short version of Disabilities of the Arm, Shoulder and Hand questionnaire; SF-12, Short Form 12.

*Statistically significant.

period of 3.4 years (range, 2-7 years), as summarized in Table 1. There was a significant improvement after surgery in SF-12 PCS (from 39.2 to 45.4, $P = .002$), SF-12 MCS (from 45.0 to 49.6, $P = .023$), ASES (from 52.6 to 75.8, $P < .001$), and QuickDASH (from 40.2 to 24.2, $P = .001$) scores. Overall, the median patient satisfaction rating was 7 of 10 (range, 1-10); however, 26% of patients did have a satisfaction score of less than 5.

When we compared the outcomes of patients who underwent primary versus revision procedures, there was a higher mean preoperative ASES score for patients undergoing primary surgery (54 ± 16) than revision cases (42 ± 23) ($P = .404$). At a minimum of 2 years after surgery, the final outcome scores between the 2 groups were similar ($P > .05$; Table 2).

Predictors of Outcomes

Increasing age correlated with decreased postoperative SF-12 PCS ($r = -0.42$, $P = .001$), ASES ($r = -0.35$, $P = .002$), and QuickDASH ($r = -0.41$, $P = .002$) scores. Sex was not found to be associated with outcomes. As for mental status, a lower preoperative SF-12 MCS score correlated with decreased postoperative SF-12 MCS ($r = 0.32$, $P = .033$), ASES ($r = 0.45$, $P = .002$), and QuickDASH ($r = 0.45$, $P = .002$) scores. A longer duration of symptoms before surgery correlated with lower postoperative ASES ($\rho = -0.33$, $P = .014$) and QuickDASH ($\rho = 0.34$, $P = .012$) scores. The findings among patients who had a satisfaction rating of less than 5 were not consistent, and there were no statistically significant predictors that we could identify for these patients.

Table 2. Outcomes After Primary and Revision Surgery at 2-Year Follow-up

Postoperative Outcome Measure	Primary Cases (n = 53)	Revision Cases (n = 7)	*P* Value
SF-12 PCS	45.7 ± 11.2	42.5 ± 9.5	.552
SF-12 MCS	50.0 ± 10.7	44.7 ± 12.9	.311
ASES	75.2 ± 22.7	72.2 ± 23.1	.713
QuickDASH	24.0 ± 22.1	26.8 ± 25.3	.792
Median patient satisfaction	7	7	.655

NOTE. Data are presented as mean ± standard deviation unless otherwise indicated.

ASES, American Shoulder and Elbow Surgeons; MCS, mental component summary; PCS, physical component summary; QuickDASH, short version of Disabilities of the Arm, Shoulder and Hand questionnaire; SF-12, Short Form 12.

Discussion

Arthroscopic surgery is an effective treatment for SSS in both primary and revision cases, showing significant improvements in all postoperative outcome scores at a mean of 3.4 years. Lower preoperative mental status score, longer duration of symptoms, and greater age were associated with poorer outcomes. In addition, most patients were satisfied with the surgical treatment as shown by an overall median satisfaction rating of 7 of 10.

Snapping scapula may be a dyskinetic disorder of the shoulder girdle with dynamic muscle imbalance. Recently, Merolla et al.[12] evaluated 10 patients who were treated with arthroscopic surgery after failed nonoperative management. All postoperative scores were significantly improved from preoperative scores. Although this was a small group, the results reflect similar findings to our study, showing arthroscopic surgical treatment of SSS leads to significant improvement in pain and function.

In addition to scapular pathology, SSS is characterized clinically by psychological characteristics. As hypothesized, lower preoperative mental status as measured by the SF-12 MCS significantly correlated with lower postoperative ASES scores. This result reflects the strong psychological impact of this rare and disabling disease. Although an association was found, it remains unclear whether snapping scapula causes the psychological consequences or whether the patients' underlying psychological profile has a causal effect on the development of SSS.

Results for arthroscopic treatment of SSS also seem to hold true in a younger population on the basis of a

recent study by Haus et al.[13] looking at nonoperative treatment and mini-open treatment of SSS in a pediatric population of 18 patients. Follow-up in the nonoperative group at a mean of 43.7 months resulted in an average ASES score of 90, with 75% able to return to sport. In the operative group, the mean follow-up period was 129.5 months, with a postoperative ASES score of 92.6 and no complications. There was an 83% return to sport and 100% satisfaction with surgical treatment. This study showed that surgical treatment is also very effective in a pediatric population and is largely successful after failed nonoperative treatment.

Millett et al.[9] previously studied 23 scapulae (21 patients) with SSS with a minimum 2-year follow-up. The mean age at surgery was 33 years, and the mean duration of symptoms before presentation was 2 years. Arthroscopic treatment resulted in significant improvements in outcome scores, and there were no complications after surgery. However, 3 patients (13%) underwent a revision procedure for persistent pain. Although there were significant improvements in pain and function, the rate of revision was similar to the findings of this study (10.8%). Because the cause of SSS is not specifically known, persistent symptoms after surgical treatment are also difficult to explain, given that few data are available on this subset of patients who require revision surgery. All patients who underwent revision complained of persistent pain and continued crepitation. The most common surgical finding at the time of revision surgery was fibrosis and scarring of the scapulothoracic articulation, which could account for persistent symptoms in patients more prone to excess scar formation.

Although our study shows significant improvements in patient-reported outcomes for primary and revision patients, 26% showed a satisfaction score of less than 5, which could be viewed as a functional failure. It is difficult to reconcile such findings, and the functional and clinical significance of decreased satisfaction remains elusive for this group of patients. However, these findings are not necessarily unanticipated given the results from both previously published literature and this study that show less dramatic improvement when compared with other arthroscopic procedures in the shoulder, such as rotator cuff repair.[14] These results highlight the importance of patient education and discussion of expectations before this procedure.

Limitations

This study has several limitations that are inherent in a retrospective case series evaluating a rare disorder. First, SSS is a complex, relatively rare form of pathology, and there is not a validated outcome measure to assess the scapula specifically. The ASES score and other shoulder assessment tools reflect the best available outcome measures for this particular condition. Although other concomitant pathologies about the shoulder girdle can complicate the clinical picture, we attempted to isolate outcomes to only patients with SSS and excluded all others with concomitant pathologies. Although we attempted to identify and exclude patients with any confounding shoulder pathologies through a comprehensive history, physical examination, advanced imaging, and diagnostic injections, those with subtle or intermittent pathologies cannot be excluded with complete certainty. Second, although we compared outcomes in primary versus revision cases, our analysis lacks power because of the small number of revision cases ($n = 8$). We thought it was important to compare these 2 groups because prior literature comparing outcomes between primary and revision cases for this rare disorder is limited. In addition, our results may have been affected by selection bias through lack of randomization, and the relatively small number of patients could introduce a type II error in reporting of the results. Furthermore, the differences in duration of symptoms among patients before presentation and time of surgery may have an unspecified effect on outcomes postoperatively. Unfortunately, given the rarity of SSS, randomized studies with large patient numbers are not as feasible to conduct in this patient population.

Conclusions

Arthroscopic surgery is an effective treatment for SSS in both primary and revision cases, showing significant improvements in all postoperative outcome scores at a mean of 3.4 years. Lower preoperative mental status score, longer duration of symptoms, and greater age were associated with poorer outcomes.

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