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Clinical Outcome after Arthroscopic Capsular Release for Adhesive Capsulitis of the Shoulder

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Background: This study was undertaken to evaluate the outcome of the arthroscopic capsular release for adhesive capsulitis of the shoulder.

Methods: This study retrospectively investigated thirty shoulders in 29 patients who presented with recalcitrant adhesive capsulitis and underwent arthroscopic treatments. Other than typical findings of adhesive capsulitis, combined pathologies in the glenohumeral joint and subacromial space were evaluated by arthroscopy. Clinical evaluations were performed using the Constant's score and ranges of motion (ROM) at preoperative, 6 months postoperatively and at the final follow-up.

Results: Our study included 17 women and 12 men with a mean age of 53.8 years (range, 34–74). Mean follow-up duration was 24 months (range, 12–40 months). Assessment of combined pathologies revealed that partial rotator cuff tear of less than 25% thickness, was most common (overall 83.3%; with bursal 57% and articular 23%). Subacromial synovitis and adhesion were also frequent (53.3%). The Constant score and ranges of motion significantly improved at the final follow-up, compared with preoperative levels. However, clinical results at 6 months postoperatively were found to be significantly inferior to those observed at the final follow-up ($p \leq 0.001$ for all factors). Functional impairment was the major complaint in 59.3% patients at the 6 months follow-up.

Conclusions: Although arthroscopic capsular release yielded favorable outcome at the mean 24 months follow-up, pain and motion limitations at 6-month postoperatively persisted in more than 50% of our patients. While combined pathologies were commonly encountered during arthroscopy, although their effects on surgical outcome in adhesive capsulitis remains unclear in this study.
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Key Words: Adhesive capsulitis; Shoulder; Arthroscopy; Capsular release

Introduction

Adhesive capsulitis of the shoulder is considered to be a self-limiting disease with no significant long-term sequelae. However, despite ongoing basic science and clinical research, the etiology, pathogenesis, and natural history of the disease are still not fully understood, and hence there is no consensus regarding the optimal treatment.[1-4] Nonoperative treatment remains the initial approach for almost all patients, and has proved to be effective.[3] Although nonoperative treatment has a reported time-course of up to 2 years, deficits in motion and pain relief are known to persist.[5,6] Patients who do not regain satisfactory range of motion (ROM) or fail to demonstrate progress after 3 to 6 months of nonoperative care are candidates for operative intervention,[3] and arthroscopic capsular release is reported to be a good surgical option.[2,7-18] Furthermore, it is suggested that morbidity duration is likely to be shortened by surgical intervention.[13,14]

However, we encountered an immediate minimal or no

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response to arthroscopic capsular release, especially in terms of pain relief. Some patients complained of minimal pain relief after the procedure whereas others indicated no increase in ROM. Furthermore, we generally observed no improvement in ROM during the early postoperative period. Since the major role of arthroscopic capsular release is prompt return to pain-free activity and normal function of the shoulder,[7,11,14,15,18] the actual efficacy of the surgery for a rapid recovery is sometimes difficult to ascertain.

This study therefore aimed to retrospectively review patients who underwent arthroscopic capsular release, and their outcome at postoperative 6 months and at final follow-up. Our null hypothesis was that clinical results would be similar at 6 months postoperative and final follow-up.

Methods

This retrospective study was performed after gaining approval from Institutional Review Board of Samsung Medical Center. Between 2005 and 2008, 49 patients with adhesive capsulitis underwent arthroscopic treatment at our institute. We included patients with idiopathic adhesive capsulitis, which is defined as an insidious onset of shoulder pain, global limitation of both active, and passive ROM (forward flexion of less than 100°, external rotation at side of 0°–20°, and internal rotation below the thoracic vertebral level)[19] and no history of major trauma, infection, or surgery around the affected shoulder. All patients were evaluated by the senior author by taking a thorough history, physical examination, and standard plain radiographs. Indication of arthroscopic treatment was persistent pain and limitation of motion that had not responded to nonoperative management for at least 6 months. The exclusion criteria for the study were: (1) stiffness after surgery, (2) stiffness after fracture, (3) stiffness associated with arthritis, (4) tumor or avascular necrosis, (5) combined rotator cuff repair, and (6) combined calcific tendinitis that was removed and repaired.

Surgical Technique

All patients underwent arthroscopic capsular release under general anesthesia, with or without a regional block (interscalene brachial plexus block), performed by the senior author. All procedures were performed in a lateral decubitus position. Manipulation was performed by applying a proximal force on the humerus to minimize torque and to rupture the capsule, in the following order: forward elevation, abduction, external rotation with abduction, internal rotation with abduction, and cross-body adduction. A 'pop' was usually heard, which subsequently resulted in a full ROM.

Arthroscopy was performed with the arm suspended at 30° of abduction, 20° of forward flexion, and longitudinal traction using 3 to 4 kg of weight (Star Sleeve Traction System; Arthrex, Naples, FL, USA). Routine diagnostic glenohumeral arthroscopy was performed, and pathological changes on the biceps, synovium, labrum, capsule, ligaments, and rotator cuff were recorded. Capsular release was initiated at the anterior aspect of the joint. Using the arthroscopic scissors, middle glenohumeral ligament and anterior band of inferior glenohumeral ligament were first resected, releasing the anterior capsule just off the glenoid rim, while preserving the labrum. During occasional use of the radiofrequency device, its tip was always oriented parallel to the anterior glenoid neck and placed between the labrum and capsular attachment. We preferred the use of an arthroscopic scissor in the inferior capsule to minimize the risk of axillary nerve injury. The radiofrequency device was not used in the axillary pouch. Resection was discontinued if visibility was inadequate or the blade of the scissor could not be visualized. Thereafter, viewing was changed to the anterior portal, with subsequent release of the posterior capsule through the posterior portal using arthroscopic scissors. The rotator interval was released with the radiofrequency device through the anterior portal. Concomitant pathologies such as partial tear of the articular surface of rotator cuff and biceps lesions were simultaneously addressed. Synovitis, bursal adhesion, hypertrophy or fraying of coracoacromial ligament observed on examining the subacromial space was followed by resection of the bursal tissues or coracoacromial ligament. Furthermore, in case of severe limitation of external rotation, release of rotator interval, including coracohumeral ligament release, was completed in this step.

An intravenous patient-controlled analgesia was used for postoperative pain control. Patients received an intravenous infusion of fentanyl 15 mg/ml combination at 1ml/hr. All patients began physiotherapy using a continuous passive motion (CPM) exercise machine on the day of surgery, and were discouraged to use a sling on the first postoperative day, and continue to use the arm for light functional tasks.[14]

Clinical Evaluation

All patients were retrospectively evaluated using data collected from medical histories, physical examination findings, operation records including arthroscopic images, and clinical scores obtained from electronic medical records. For clinical assessment, the Constant-Murley's score was determined by an independent, single observer (our shoulder physiotherapist) at every follow-up at the out-patient clinic. Passive ROMs were assessed at every visit, including forward elevation in the scapular plane, external rotation at the side, and internal rotation to the level of the spinous process. For the purpose of statistical analysis, the level of vertebrae were converted into contiguously numbered values: 1 to 12 for T1 to T12, 13 to 17 for L1 to L5, and 18 for the sacrum. Based on the Constant-Murley's score, postoperative results are rated as excellent (≥80 points), good (65 to 79 points), fair (50 to 64 points), and poor (<50 points). The aver-

age time to pain-free, daily activity after surgery was determined by applying a questionnaire during follow-up.

Statistical Analysis

All clinical results were compared between preoperative, 6 months postoperatively, and final follow-up by the paired t-test or Wilcoxon signed rank test. Clinical results were also compared between groups with respect to the presence of diabetes and thyroid disease by the chi-square test. Bonferroni correction was used for multiple comparisons. The significance level was set at $p=0.05$.

Results

Totally, 30 shoulders of 29 patients (17 women and 12 men) who met the inclusion criteria were reviewed. Mean patient age was 53.8 ± 10.2 years (range, 34–74 years), and there were 17 left shoulders and 13 right shoulders. The dominant arm was involved in 48.1% of the patients. Diabetes was diagnosed in 11 patients (37.9%) and thyroid abnormalities in 3 patients (10.3%). Mean time to surgery from symptom onset was 13.7 months (range, 6–60 months), and mean follow-up duration was 24 months (range, 1–40 months).

Arthroscopic Findings of Capsular Involvement

Intraarticular hematoma and anteroinferior capsular tears attributed to manipulation were found in all patients. The typical findings of adhesive capsulitis, hyperemic, red synovitis with thickened, fibrotic joint capsule was present in 29 of 30 cases and were classified as stage 2 adhesive capsulitis at arthroscopy.[20,21] The remaining 1 case was classified as stage 3.[20,21] Diffuse glenohumeral synovitis was observed in all stage 2 cases, particularly in the anterosuperior joint capsule; a tight, thick joint capsule was observed after capsular resection. In the stage 3 case, synovitis was not as severe, and the joint appeared less red with marked capsular adhesions. In addition, 18 cases with pancapsular inflammation involved hyperemic synovitis with adhesion at the posterior surface of the biceps tendon and in the surface of the labrum (Fig. 1). Pancapsular release, including anterior, inferior, and posterior capsules and rotator interval, was performed for 18 cases, whereas the remaining 12 cases underwent anterior, inferior and posterior capsular release.

Concomitant Pathologies

Of the 30 cases, 28 cases (93.3%) had several concomitant pathologies in the glenohumeral joint or subacromial space (Table 1); partial-thickness rotator cuff tear was the most common finding. Usually, the lesions involved less than 25% of cuff thickness, and were subjected to simple debridement (Fig. 1). Superior labral lesions were found in 14 shoulders (46.7%), where degenerative changes in the superior labrum was the main finding. Since these are usually not considered a typical pathologic superior labral anteroposterior lesion tear in younger patients,[9] they were simply debrided. Complete or partial tear of the long head of biceps tendon was found in 4 shoulders (13.3%), where the partial tear was debrided. In 3 shoulders, bursal hypertrophies, fraying of coracoacromial ligament, with or without acromial bony spur were present, suggesting subacromial impingement. Such findings were accompanied with bursal-surface partial tear of less than 25% thickness of rotator cuff. Debridement of partial tears and subacromial decompression were performed. Two shoulders had associated symptomatic acromioclavicular joint arthritis, warranting combined distal clavicle resection.

Clinical Results

At 6 months postoperatively, mean value of pain visual analogue scale (VAS) decreased by 4.0 and the Constant score increased by 28.3), as compared with preoperative levels (Table 2). ROM also improved by 28.0° in forward elevation, 5.3° in external rotation, and 4.0° vertebral levels in internal rotation.

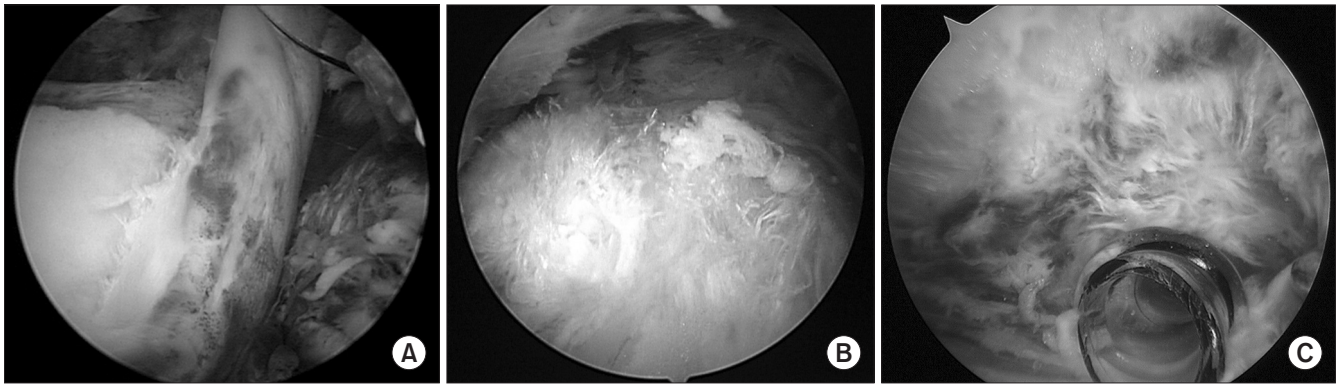

Fig. 1. Arthroscopic findings of adhesive capsulitis. Hyperemic synovitis with adhesion at the biceps tendon and the surface of the superior labrum from the posterior viewing portal in the glenohumeral joint (A), bursal-surface, partial-thickness tear of the supraspinatus tendon (B), and subacromial synovitis and adhesion (C) from the lateral viewing portal in the subacromial space.

Table 1. Concomitant Pathologies by Arthroscopy

Variable	No. of shoulder	Treatment	Comments
Partial-thickness rotator cuff tear	25 (83.3)	Debridement	- Less than 25% thickness - 17 bursal, 7 articular, and 1 intratendinous tears
Subacromial synovitis and adhesion	16 (53.3)	Subacromial space synovectomy	-
Degenerative SLAP lesion	14 (46.7)	Debridement or tenotomy of the LHBT	-
Tear of the LHBT	4 (13.3)	Debridement of partial tear	-
Subacromial impingement	3 (10.0)	Subacromial decompression	-
Acromioclavicular arthritis	2 (6.7)	Distal clavicle resection	-
No combined pathology	2 (6.7)	-	-

Values are presented as number (%).
SLAP: superior labral anteroposterior lesion, LHBT: long head of the biceps tendon.

Table 2. Summary of Clinical Scores and Ranges of Motion

Variable	Clinical score		Range of motion (°)		
	VAS	Constant score	Forward elevation	External rotation	Internal rotation[§]
Preoperative	7.3 ± 1.9	38.0 ± 19.9	103.4 ± 26.1	13.9 ± 14.9	L4–5
6 months	3.3 ± 1.4	66.3 ± 16.1	131.4 ± 19.5	19.2 ± 12.6	T12–L1
Final follow-up	1.2 ± 1.8	79.6 ± 17.0	142.8 ± 29.8	25.8 ± 18.1	T11–12
p-value*	<0.001	<0.001	<0.001	0.106	0.001
p-value[†]	<0.001	<0.001	<0.001	<0.001	<0.001
p-value[‡]	<0.001	<0.001	<0.001	<0.001	0.001

The values are presented as mean ± standard deviation.
VAS: visual analogue scale.
*Comparisons between preoperative and 6 months postoperative results.
[†]Comparisons between preoperative and final follow-up results.
[‡]Comparisons between 6 months postoperative and final follow-up results.
[§]Internal rotation is given as mean level of the spinous process.

Increases in the Constant-Murley's score, forward elevation and internal rotation were statistically significant ($p<0.001$ for Constant score and forward elevation, and $p=0.001$ for internal rotation), whereas the increase in external rotation was not significant ($p=0.106$). According to Constant-Murley's score, there were 3 excellent, 18 good, 7 fair, and 2 poor outcomes (Fig. 2).

At mean 24 months postoperatively, all clinical scores and ROMs were significantly improved compared to the preoperative levels (Table 2); mean value of pain VAS decreased by 6.1, Constant score increased by 41.6), and the ROM improved by 39.4° in forward elevation, 11.9° in external rotation, and 5.0° vertebral levels in internal rotation. All increases were statistically significant ($p<0.001$ for all variables). There were 17 excellent, 9 good, 3 fair, and 1 poor outcome (Fig. 2).

Comparison of clinical parameters at postoperative 6 months and final follow-up revealed the Constant-Murley's score and ROMs to be significantly inferior at postoperative 6 months (Table 2). According to the questionnaire responses, full recovery to pain-free daily activity was achieved at mean 7.9 ± 4.9 months postoperatively (range, 1–24 months) in 27 patients, where 12 patients (41.4%) responded that pain reduced to a satisfactory level before 6 months. Serial changes in ROMs during follow-up are documented in Fig. 3. Although a gradual increase was

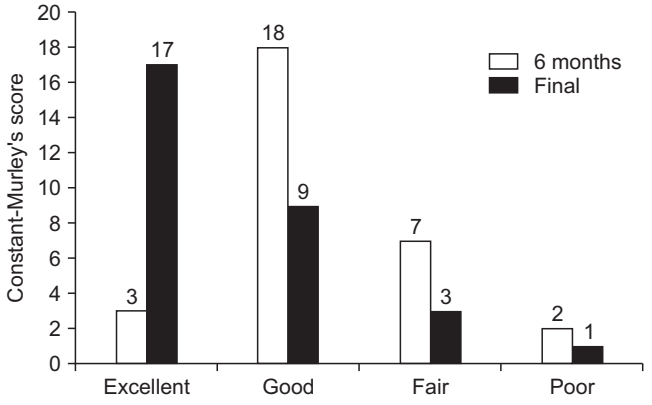

Fig. 2. Results of the Constant-Murley's score at postoperative 6-months and final follow-up.

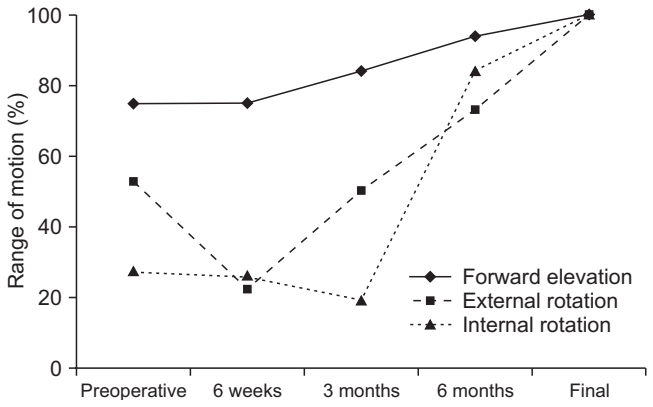

Fig. 3. Serial changes of range of motion during the follow-up. The percentages of forward elevation, external rotation, and internal rotation at each timepoint during the follow-up are shown, compared with at the values at the final follow-up indicated as 100%.

reported for forward elevation, external rotation at 6 weeks was below the preoperative level. However, it recovered at 3 months after which there was a steady improvement. Similarly, internal rotation was reduced at 3 months but improved steadily improved to more than the preoperative level.

Fourteen shoulders (46.7%) with diabetes or thyroid abnormalities showed significant improvements in clinical parameters at both 6 months postoperatively and final follow-up, as compared with their preoperative levels ($p \leq 0.001$ in all), except for external rotation at 6 months. Compared to the preoperative period, improvement of external rotation at 6 months was not significant (2.9° versus 14.1°, respectively, $p=0.487$). However, Constant-Murley's score and ROMs at both 6 months and final follow-up were not significantly different between patients with or without diabetes or thyroid diseases.

Discussion

In the present study, overall results of arthroscopic capsular release at mean 24 months of follow-up are favorable and comparable to those previously reported.[1,7-17,22-28] Pain, functional scores of shoulders, and ROMs were found to be significantly improved after surgery; 86.2% of cases obtained an excellent or good result at the final follow-up. However, most clinical parameters at 6 months postoperatively were comparably inferior to the outcomes at the final follow-up. Mean Constant-Murley's score, forward elevation, external rotation, and internal rotation at 6 months postoperatively were 83.4%, 95.1%, 74.0%, and 83.9%, respectively, of values at the final follow-up. Moreover, temporary deterioration of the motions was observed during early postoperative period, whereas pain persisted in 59.3% of the patients at 6 months postoperatively. Patients reported that despite surgical treatment, it took a mean 7.9 months to recover a pain-free level of daily activities. Another notable finding of this study was a surprisingly high incidence of combined pathologies observed in 28 of the 30 shoulders (93.3%) evaluated.

Many authors have reported rapid pain and motion improvements after arthroscopic capsular release. Watson et al.[18] reported that pain settled at a mean of 2.24 weeks (range, 4 days–8 weeks), and 33 patients (45%) experienced total symptom resolution at the initial 4-day assessment. Furthermore, the mean time required to regain ROM equal to or within 10% of the normal contralateral side was 5.5 weeks (range, 1.4–12 weeks). Nicholson[14] reported that the average time to a final pain-free ROM was 2.8 months (range, 1.6–5.8 months). Ozbaydar et al.[15] reported complaints of pain and limitation disappeared at a mean 3.5 months (range, 15 days–12 months) in 14 patients (87.5%) who were fully satisfied with the procedure. Harryman et al.[10] reported that 73% of their patients recovered excellent function within 3 months. Ide and Takagi[11] found that pain and function were significantly improved at 4 weeks, and 91% maintained a good condition for a mean of 7.5 years. Furthermore, several studies have concluded that arthroscopic capsular release enables rapid recovery, and the natural advancement of adhesive capsulitis was possibly shortened by the procedure.[7,11,14] Contrarily, Beaufils et al.[8] reported in their multicenter retrospective study that mean time to recovery was 7 months. Their cohort reported 13 months mean time between symptom onset and surgery, and 7 months mean time to recovery after the procedure, equating to a total recovery time of 20 months, which is similar to our results.

At postoperative 6 months, our results were inferior to the above-mentioned reports, though comparable to those of Beaufils et al.[8] There are several possible explanations for our inferior results. First, our patients presented with combined pathologies observed commonly during arthroscopy. Although the primary diagnosis of patients included in this study was idiopathic adhesive capsulitis, various other pathologies were also observed. Only 2 of our 30 cases had primary form of adhesive capsulitis; since the majority had associated pathologies, they could have been defined as secondary forms. Several studies have reported cases of the adhesive capsulitis with combined intraarticular or subacromial lesions detected during arthroscopic examinations.[10,25,26] Yoo et al.[19] also reported in their magnetic resonance arthrography study that 1/3rd of 81 patients with stage-2 adhesive capsulitis had partial- or full-thickness supraspinatus tear. Furthermore, some authors have suggested that the presence of minor intraarticular or subacromial disease adversely affects the prognosis of adhesive capsulitis. Ogilvie-Harris and Wiley[25] concluded that patients with an associated intraarticular pathology had a considerably greater likelihood of a poor outcome. Review of literatures revealed only one study in which a statistical analysis was performed to determine which preoperative variables (including the presence of an associated pathology) best predicted surgical outcomes. In their study, Harryman et

al.[10] demonstrated a weak correlation between patients with a calcific deposit or a partial-thickness rotator cuff tear, and their inability to recover full motion after arthroscopic capsular release. They also suggested that patients with a greater degree of persistent stiffness after arthroscopic release are more likely to have an intraarticular pathology other than capsular synovitis. However, others have argued that subacromial changes might be a secondary change of shoulder stiffness.[11]

It is still unclear whether the presence of minor intraarticular or subacromial diseases affect the prognosis of frozen shoulder. Although numerous studies on outcomes of arthroscopic capsular release for primary or secondary shoulder stiffness have been reported, little information that specifically addresses this issue is available in literature. Although valid conclusions could not be drawn from this study to determine the correlation of concomitant pathologies with adverse outcomes, our mediocre results might be related to the high percentage of combined lesions. Furthermore, patients who decided to opt for surgical treatment for adhesive capsulitis due to poor response from conservative treatments might have an accompanying pathology other than adhesive capsulitis, thereby showing poor results even after the surgical capsular release. Another reason of slow recovery in our patients may be attributed to the high proportion of patients with diabetes or thyroid afflictions. It is well known that diabetes negatively affects the clinical outcomes. Second, the majority of authors who reported rapid recovery emphasized that effective perioperative pain control and supervised physiotherapy were imperative;[13-15,29] home exercise was performed for 3 to 4 months in two of these study.[14,15] In addition, Yamaguchi et al.[29] also recommend adequate pain control after surgery to retain motion and help postoperative physiotherapy. In the present study, intravenous patient-controlled analgesia was used for pain control in most patients (29 of 30 cases), and stretching exercise using a CPM machine was performed for all patients. However, continuous supervised exercise was not uniformly performed, and the home exercise program recommended was not monitored in our patients, especially in elderly patients living in rural areas. We are of the opinion that an inadequate postoperative exercise program might be responsible for the relatively slow recovery and the sudden ROM deteriorations observed during the early postoperative period. Furthermore, it appears that this temporary decrease in ROM over the first postoperative 6 months adversely affected the subjective symptoms and patient satisfaction. It should be noted that sudden deterioration in pain and ROM during the early postoperative period has been previously reported.[9,13]

Besides the inherit weakness of retrospective design, the present study has several other limitations. First, this study did not have sufficient groups of adhesive capsulitis without other accompanying pathology for comparison. The true effect of combined pathology on surgical outcome needs to be further evaluated by between-group comparisons. Our study also has no comparison with a group that underwent conservative treatment alone. Therefore, we could not ascertain whether clinical improvement at mean 24 months follow-up was due to surgery or merely a natural improvement. However, our patients had a long duration of morbidity before surgery, and underwent surgical intervention after undergoing nonoperative treatment of minimum 6 months. Second, the postoperative management protocols adopted differed for our patients. It is generally accepted that any form of operative intervention for shoulder stiffness should be followed by intensive physical therapy,[3] and we concur that continuous, regular, and individualized postoperative exercise programs are critically important. Third, we only compared outcomes at postoperative 6 months and final follow-up in this study. The clinical results prior to 6 months might give us further information of speed and pattern of recovery at the immediate postoperative period. It is unfortunate that this retrospective study to have no complete data of pain VAS and Constant scores for that period. However, ROMs during the earlier period are shown in Fig. 3. Fourth, our study cohort was small, and 24 months of mean follow-up duration was short for evaluating long term prognosis of patients.

Conclusion

Although arthroscopic capsular release yielded favorable outcomes at mean 24 months follow-up, more than 50% of our patients experienced persistent pain and motion limitations at the 6-months postoperative follow up. Combined pathologies were commonly encountered during arthroscopy, although their effects on the surgical outcome in adhesive capsulitis remains unclear in this study.

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