Clinical Outcomes of Arthroscopic 360° Capsular Release for Idiopathic Adhesive Capsulitis in the Lateral Decubitus Position

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Purpose: To report outcomes after arthroscopic 360° capsular release in the lateral decubitus position for idiopathic glenohumeral adhesive capsulitis without manipulation under anesthesia. **Methods:** A retrospective case series of patients who underwent arthroscopic capsular release in the lateral decubitus position for idiopathic adhesive capsulitis with minimum 2-year follow-up was conducted. Patient demographics, preoperative range of motion (ROM), postoperative ROM, and the postoperative outcome scores, visual analog scale for pain, Single Assessment Numeric Evaluation, Simple Shoulder Test, and American Shoulder and Elbow Surgeons scores, were recorded. Complications and reoperations were recorded. Paired *t*-tests were used to compare preoperative and postoperative ROM, with $P < .05$. **Results:** Overall, 43 patients were identified, of whom 10 were excluded because of post-traumatic etiology. Of the remaining 33 patients, 27 (81.8%) completed a minimum follow-up of 2 years. The mean age was 54.8 with a standard deviation of 7.4 years and 78% were female, with the duration of symptoms of 16.2 ± 21.0 (range, 3-125) months. Hypothyroidism was present in 7% and diabetes present in 30%. Active forward flexion improved from 115.0° ± 21.9° to 156.2° ± 16.1° at the final follow-up (mean difference, 41.2; 95% confidence interval [33.7, 48.7]; $P < .001$). Active external rotation with the arm adducted improved from 28.1° ± 16.3° preoperatively to 56.8° ± 15.7° at the final follow-up (mean difference, 27.7; 95% confidence interval [19.1, 36.3]; $P < .001$). Significant ROM improvements were seen even as early as 2 weeks postoperatively ($P < .001$). Two patients (7%) had manipulation under anesthesia postoperatively due to early recurrent stiffness 4 to 6 weeks after arthroscopic capsular release. There were no revision surgeries or complications. **Conclusions:** Arthroscopic 360° capsular release in the lateral decubitus position for idiopathic adhesive capsulitis results in a significant early and lasting improvement in ROM, excellent functional outcomes, and low revision and complication rates. **Level of Evidence:** Level IV, retrospective case series.

Idiopathic glenohumeral adhesive capsulitis is a commonly encountered condition causing pain, lack of motion, and loss of shoulder function due to thickening and fibrosis of the capsule.[1] Although post-traumatic or postoperative adhesive capsulitis may occur, adhesive capsulitis without a precipitating factor

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is idiopathic, and is more commonly seen in those with thyroid disease, females, and diabetics.[1] The condition has been clinically divided into the freezing, frozen, and thawing stages, involving an onset of pain, loss of motion, and slow return of motion over the course of approximately 15 months.[2] Initial treatment is conservative, using physical therapy and intra-articular cortisone injections.[3,4] Long-term follow-up studies of nonoperative management have reported mixed findings, with some authors reporting up to half of the patients with residual pain and loss of motion,[5,6] whereas others claiming over 90% success.[2]

If conservative management fails, arthroscopic capsular release is classically performed in the beach-chair position.[7,8] This generally involves an incomplete capsule release and manipulation under anesthesia (MUA) to complete the inferior capsular release.[9] The inferior capsule may not be released either because of difficulty accessing this region in the beach-chair position or concerns about proximity of the axillary nerve. Advantages of arthroscopic capsular release as opposed to MUA alone include the reduced risk of iatrogenic injury including humerus fracture, brachial plexus injury, and rotator cuff tear because of the controlled capsular release.[1,10] Arthroscopic release also allows both short-term gains in motion starting at 1 week after surgery, and lasting improvements in pain and range of motion (ROM) at long-term follow-up at mean 7 years.[11,12]

Despite significant focus in the literature about pros and cons of beach-chair versus lateral position for arthroscopic instability procedures,[13,14] relatively little has been written about arthroscopic capsular release in the lateral decubitus position.[15-18] Potential advantages of lateral position include improved visualization of the inferior capsule due to the axial and lateral traction afforded by the lateral decubitus position. This has the potential to allow 360° capsular release and eliminate the need for manipulation, and ultimately, the potential complications that are commonly attributed to MUA such as humeral fracture.[19]

The purpose of this study was to report outcomes after arthroscopic 360° capsular release in the lateral decubitus position without MUA. We hypothesized that patients would have improvements in ROM and function with low rate of complications.

Methods

After institutional review board approval, we assembled a retrospective case series of patients who underwent arthroscopic capsular release in the lateral decubitus position for the diagnosis of idiopathic adhesive capsulitis between April 2010 and April 2014. Inclusion criteria were patients with diagnosis of idiopathic adhesive capsulitis who underwent arthroscopic capsular release in the lateral decubitus position without MUA. Exclusion criteria were post-traumatic or postsurgical etiology. The surgical indication was failure of nonoperative management for a minimum of 3 months including glenohumeral corticosteroid injections and physical therapy. The 2 senior authors completed all surgical procedures (A.A.R., N.N.V.).

Procedures were performed in the lateral decubitus position using interscalene block with intravenous conscious sedation as previously described.[20] ROM was assessed under anesthesia. A lateral distraction device was used (Spider 2 Limb Positioner, Smith & Nephew, Andover, MA) to position the arm in 30° of abduction and forward flexion, and the arm was prepped and draped in a usual fashion. The initial posterior viewing portal was placed off the posterolateral corner of the acromion followed by an anterior rotator interval portal established with spinal needle localization. In all cases, the capsule had hypertrophied and fibrosed and the joint volume was decreased, all of which are typical of operative findings in the setting of adhesive capsulitis.

After diagnostic arthroscopy, an anterior release of the rotator interval was performed using an arthroscopic shaver (Dyonics 4.5-mm Incisor Plus Platinum Blade, Smith & Nephew) and radiofrequency ablation device (Super Turbovac 90, Smith & Nephew) (Fig 1). The release was carried to the anterior superior capsule above the biceps tendon until the supraspinatus was visualized. Subsequently, the release was carried posterior to the subscapularis from a superior to inferior direction until the 6 o'clock position was reached (Fig 2). The authors preferred to use an arthroscopic basket punch inferiorly because of the proximity of the axillary nerve (Fig 3). Several different basket punch manufactures were used in this study. After completing the anterior release, the camera was changed to view from the anterior portal and the posterior portal was used as the working portal to release the posterosuperior capsule with an arthroscopic shaver and radiofrequency ablation device (Fig 4). Again, using a basket, the release was carried inferiorly extending to the 6 o'clock position (Fig 5). The coracoacromial ligament was not routinely released. After a complete 360° capsular release, the arm was taken out of the arm holder and gently brought through ROM including forward flexion, rotation, and abduction to confirm restoration of motion, and no manipulation was required. Postoperatively, the patient was placed into a sling for comfort only, as immediate ROM with physical therapy was begun on the first postoperative day and continued 3 to 4 times per week. A one-time interscalene block was used before surgery for pain control. Continuous passive motion devices were used for 4 to 6 hours per day for 4 weeks postoperatively with forward flexion from 0° to 90° with advancement by 5° every 30 minutes as tolerated. For patients exhibiting early recurrent stiffness at the 4- to 6-week postoperative visit, we recommend that patients undergo an MUA. This decision was made considering the patient's preoperative

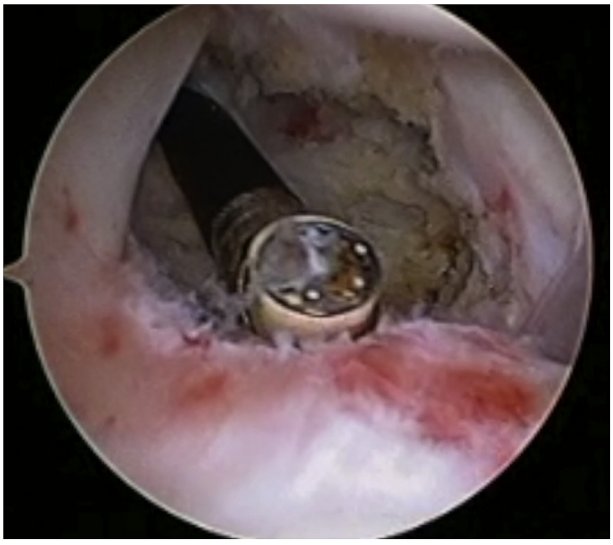

Fig 1. An anterior release of the rotator interval is performed using an arthroscopic radiofrequency ablation device (Super Turbovac 90, Smith & Nephew).

ROM, trend of motion improvement postoperatively, and in discussion with the patient and physical therapist.

Patient demographics, preoperative ROM, postoperative ROM, and the postoperative outcome scores, visual analog scale for pain, Single Assessment Numeric Evaluation, Simple Shoulder Test, and American Shoulder and Elbow Surgeons scores, were recorded. Preoperative scores were not available. ROM with active forward flexion and active external rotation with the arm adducted to the side was assessed in routine preoperative and postoperative clinic appointments. Motion assessments occurred before surgery and postoperatively at average 2, 5, 10, 18 weeks, and the final follow-up. Complications and reoperations were recorded.

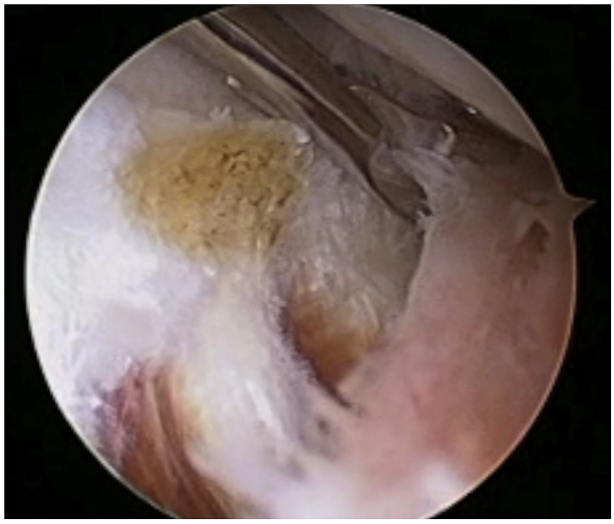

Fig 3. An arthroscopic basket punch is used to complete anteroinferior capsule release extending to the 6 o'clock position. A basket punch is used inferiorly because of the proximity of the axillary nerve.

Descriptive statistics are used to describe outcomes, including mean ± standard deviation for continuous variables and frequencies with percentages for categorical variables. Paired *t*-tests were used to compare preoperative and postoperative ROM. Student's *t*-tests were used to compare diabetic with nondiabetic patients. Statistical significance was determined by $P < .05$.

Results

Overall, 43 patients were identified who underwent arthroscopic capsular release in the lateral position

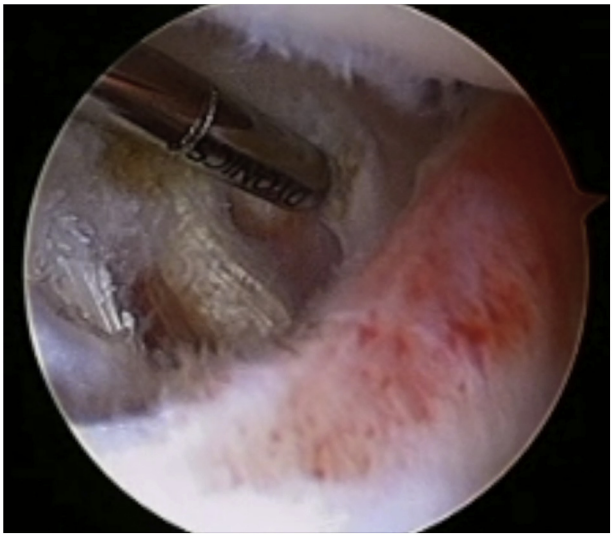

Fig 2. An arthroscopic shaver (Dyonics 4.5-mm Incisor Plus Platinum Blade, Smith & Nephew) is used to release the anterior capsule until the subscapularis is visualized.

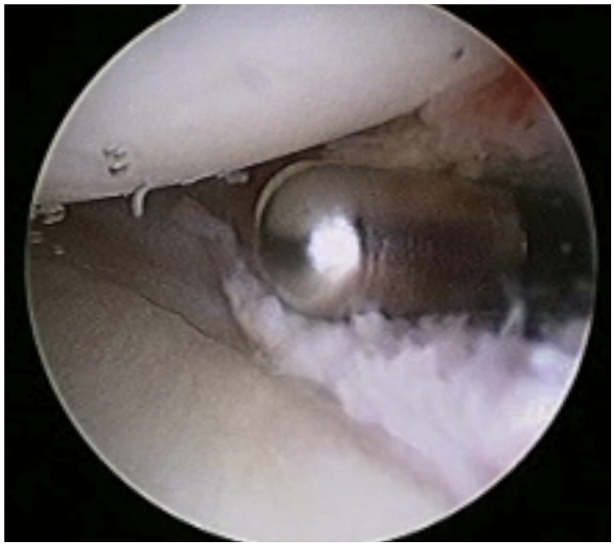

Fig 4. The posterior portal is used as the working portal to release the posterosuperior capsule with an arthroscopic radiofrequency ablation device.

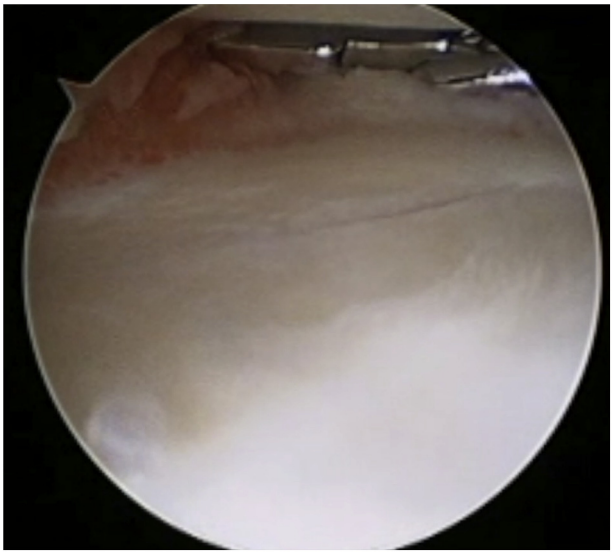

Fig 5. Using a basket, the release is carried inferiorly extending to the 6 o'clock position to complete posteroinferior release.

during the study period, performed by the 2 senior authors. Of the 43, 10 were excluded because of posttraumatic or postsurgical etiology. Of the remaining 33 patients, 27 (81.8%) were available at a minimum follow-up of 2 (mean, 3.7; range, 2-6) years.

The mean age was 54.8 ± 7.4 years and 78% were female, with the duration of symptoms of 16.2 ± 21.0 (range, 3-125) months. Hypothyroidism was present in 7% and diabetes present in 30%. Procedures were evenly split between the dominant (13 of 27, 48%) and nondominant (14 of 27, 52%) shoulders. Preoperatively, all patients underwent physical therapy and had an average of 1.8 ± 1.1 preoperative corticosteroid injections (range, 1-5). Glenohumeral injections were performed in the office without imaging guidance. One patient underwent a prior MUA without success. No patients underwent prior ipsilateral shoulder surgery. Three patients (11.1%) also received a biceps tenodesis and one (3.7%) underwent a biceps tenotomy for tenosynovitis; 15 patients received a subacromial decompression (SAD) (55.6%) along with the capsular release. No other procedures were performed during surgery.

Active forward flexion improved from 115.0° ± 21.9° to 156.2° ± 16.1° at the final follow-up (mean difference, 41.2; 95% confidence interval, [33.7, 48.7]; $P < .001$). Active external rotation with the arm adducted improved from 28.1° ± 16.3° preoperatively to 56.8° ± 15.7° at the final follow-up (mean difference, 27.7; 95% confidence interval, [19.1, 36.3]; $P < .001$). Significant improvements in ROM were seen even as early as 2 weeks postoperatively ($P < .001$ for all postoperative time points compared with preoperative) (Fig 6). There was no difference in improvement of forward flexion (48.0 ± 22.3 vs 35.6 ± 18.7; $P = .100$) and external rotation (24.6 ± 22.0 vs 30.0 ± 6.0; $P = .530$) between those who had SAD and those who did not. ROM improvements were significant in both diabetic and nondiabetic patients ($P < .001$). There was no difference in ROM improvement between diabetic and nondiabetic patients (Table 1).

Overall, final outcomes were excellent, including visual analog scale for pain of 0.2 ± 0.5, Single Assessment Numeric Evaluation 96.3 ± 4.9, Simple Shoulder Test 11.3 ± 1.2, and American Shoulder and Elbow Surgeons score 97.0 ± 4.7. All patients stated that they were able to return to their desired activities after surgery (27 of 27, 100%). Average satisfaction was a 9.9 ± 0.2 on a scale of 0 to 10 (with 10 being most satisfied and 0 being least). Two patients (7%) had manipulation postoperatively due to early recurrent stiffness 4 to 6 weeks after arthroscopic capsular release. After manipulation, these patients achieved 140° and 150° forward flexion and 45° and 75° external rotation, respectively. There were no revision surgeries and no complications (including infection, instability, fracture, and neurovascular injury). Four patients (15%) went

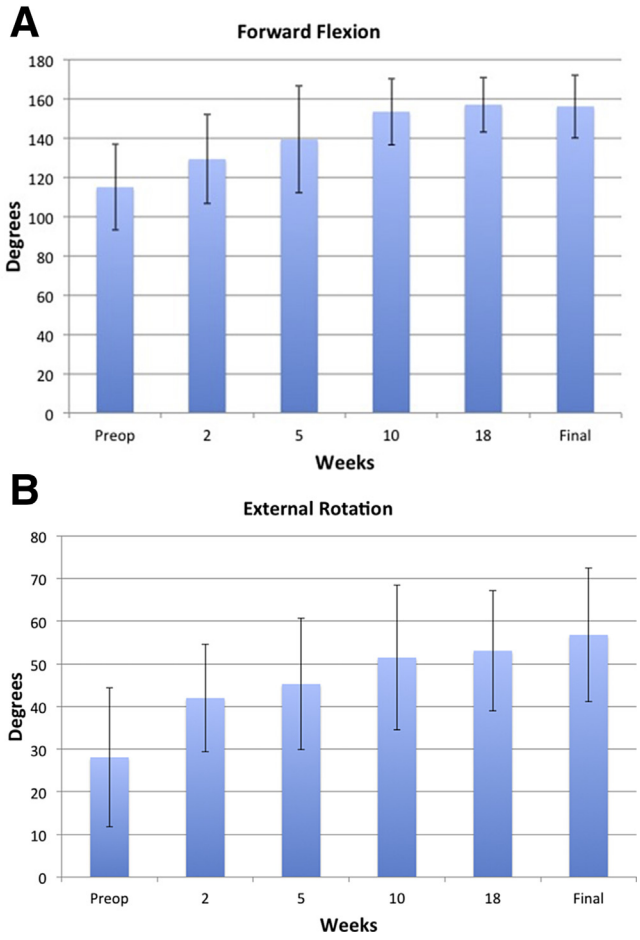

Fig 6. Postoperative improvements in (A) forward flexion and (B) external rotation with the arm in the adducted position. All results were significant at $P < .01$ for all time points compared with preoperative.

Table 1. Preoperative and Postoperative Range of Motion Scores in Diabetic and Nondiabetic Patients

	Diabetic	Nondiabetic	95% Confidence Interval	*P* Value
Preop forward flexion	116.4 ± 20.1	114.3 ± 23.1	[−14.1, 18.2]	.796
Postop forward flexion	158.6 ± 12.3	155.0 ± 17.9	[−7.2, 14.5]	.499
Improvement in forward flexion	42.3 ± 19.9	40.7 ± 22.1	[−14.2, 17.4]	.837
Preop external rotation	30.9 ± 14.5	26.7 ± 17.3	[−7.7, 16.2]	.470
Postop external rotation	57.7 ± 10.3	56.4 ± 18.0	[−8.7, 11.5]	.785
Improvement in external rotation	26.8 ± 25.7	28.1 ± 25.7	[−18.7, 16.2]	.881

on to a diagnosis of adhesive capsulitis of the contralateral shoulder, managed nonoperatively in 3 cases and with capsular release in 1 case (second shoulder was not included in study results because it did not meet minimum follow-up).

Discussion

We report outcomes of arthroscopic 360° capsular release in the lateral decubitus position for idiopathic adhesive capsulitis without MUA, finding significant early and lasting improvement in ROM, excellent functional outcomes, and low revision and complication rates. Potential benefits of performing 360° capsular release in the lateral position include ability to avoid MUA and the potential complications associated with manipulation. We feel that our technique of 360° capsular release allows us to avoid manipulation in the most cases (93%), compared with alternative techniques where manipulation is routinely performed as a part of the surgery. In addition, this technique of controlled release of the capsule rather than capsular tearing by manipulation may promote early and lasting improvements in ROM and shoulder function.

Cadaveric studies have helped shape our understanding of how the glenohumeral ligaments contribute to the stability and ultimately the stiffness of the shoulder. Brenneke et al.[21] found that anterior translation of the humeral head is primarily constrained by the coracohumeral ligament while in a neutral position, the middle and inferior ligaments help stabilize the arm in abduction, whereas the inferior and middle capsule helps with external rotation and abduction stabilization. In addition, they reported that the posterior capsule stabilizes the arm in the neutral and abduction positions when acted on by posterior tests, and the superior and inferior capsular tissues stabilize the shoulder during inferior tests while the arm is in the neutral position. The inferior ligaments also help prevent translation of the arm in abduction. When these structures thicken and fibrose, it can lead to significant restrictions in ROM.

Management of adhesive capsulitis is controversial given the natural history of the condition that tends to resolve with nonsurgical management in the most patients.[2,3,5,6] If conservative management fails, arthroscopic capsular release has been advocated to allow controlled capsular release to decrease the risks of MUA alone, including iatrogenic humerus fracture, brachial plexus injury, and rotator cuff tear.[1,7,8,10-12] A systematic review of predominantly Level IV studies found minimal differences in ROM and Constant score between arthroscopic capsular release and MUA, with a suggestion of slightly greater external rotation and abduction for capsular release and a similar complication rate.[1] Compared with the literature, our results suggest that 360° capsular release in the lateral decubitus position produces similar significant improvements in motion and excellent outcomes to the reported literature for capsular release. Barnes et al.[11] looked at clinical outcomes of arthroscopic capsular release for arthroscopic capsulitis in the beach-chair position at 24 weeks postoperatively in 140 shoulders and found that forward flexion improved to a mean of 156° ± 27° and external rotation improved to 48° ± 22°. A study conducted by Mehta et al.[15] compared outcomes after capsular release in the lateral position in diabetics and nondiabetics and found forward flexion and external rotation at 24 months after capsular release of 165.2° ± 10.8° and 58° ± 7.8°, respectively, in diabetics and nondiabetics achieving 173.2° ± 6.2° and 68° ± 8.1°, respectively. Elhassan et al.[22] compared the outcomes of arthroscopic release in the beach-chair position of different causes of adhesive capsulitis, and the idiopathic group of 41 patients achieved forward flexion of 140° (range, 90° to 160°) and external rotation of 35° (range, 0° to 60°) postoperatively at a mean follow-up of 49 months. The results of our study show similar significant improvements in motion compared with the reported literature for capsular release.

Arthroscopic capsular release has generally been described in the beach-chair position,[7,8,23] with the inferior capsule often not directly released because of difficulty with access and proximity of the axillary nerve but instead addressed with manipulation at the end of the case.[9] Some authors have reported capsular release in the lateral position,[15-18] and others have reported extending the release to the posterior capsule or to a 360° circumferential release.[11,17,24-27] Zanotti and Kuhn[28] examined the anatomic relationship between the axillary nerve, posterior circumflex humeral artery, and brachial artery and the capsule in the lateral decubitus position in frozen cadaveric models. They found that with a 360° arthroscopic release 1 cm from the glenoid labrum in the lateral arthroscopic

position, there was a safe margin between these structures and the capsule providing further evidence that capsular release in the lateral decubitus position is a safe surgical technique. Snow et al.[25] compared arthroscopic anteroinferior capsular release in the beach-chair position with and without the addition of posterior capsule release, finding no difference in outcomes by adding the posterior release. Chen et al.[17] compared anterior capsular release performed in the lateral position to 270° anterior, inferior, and posterior capsular release in a randomized fashion. They found significantly more rapid improvements in ROM within 3 months of surgery for the 270° release group compared with the anterior release group; however, there was no difference at 6-month follow-up in motion or Constant score with the 270° release group achieving a forward flexion and external rotation with the arm in 90° of abduction of 171° and 89°, respectively.[17] Our study found that arthroscopic 360° capsular release in the lateral decubitus position produces excellent outcomes with early and lasting restoration of motion, and a low rate of reoperation and complications. Future studies will be needed to prospectively compare capsular release in the beach-chair position with MUA with a 360° capsular release in the lateral position without MUA.

There is much debate on the advantages of beach-chair versus lateral decubitus positioning for arthroscopic shoulder surgery with little consensus on a gold standard technique. The lateral decubitus position with the arm abducted and a traction load applied allows greater visibility of the inferior labrum and capsule, and accentuates labral tears.[29] With improved visibility in this position, it is possible to confidently release the inferior capsule and mitigate the need for MUA to complete the release. Other advantages of the lateral decubitus position over the beach chair include better cerebral perfusion, cautery bubbles move out the field of view, and a decreased risk of hypotension and bradycardia, whereas disadvantages include a nonanatomic orientation of the glenoid, over traction of the arm can cause neurovascular injury, and the need to reach around the arm to manipulate the anterior portal.[13] An open approach to capsular release is rarely indicated and carries with it a longer recovery time, postoperative stiffness, and more challenging after recovery physical therapy.[30]

Some studies have suggested that diabetic patients may have slower improvements and ultimately inferior outcomes from arthroscopic capsular release.[15,16,18,31,32] We found no difference between diabetic and nondiabetic patients in ROM improvements, with both groups achieving early and lasting significant improvements in ROM. Both groups had excellent final outcomes, and there were no reoperations or complications in either group. A study conducted by Elhassan et al.[22] found similar results for postoperative ROM and outcomes of diabetics compared with nondiabetic patients after arthroscopic release for idiopathic adhesive capsulitis. It is possible that a more extensive release could be beneficial in diabetic patients in particular, but future studies comparing different treatments in diabetic and nondiabetic patients alike will be required to define optimal treatment algorithms.

Limitations

Limitations of this study primarily stem from the retrospective case series design. Although we had a high rate of follow-up for a consecutive series of patients, the study design did not involve comparison with arthroscopic capsular release in the beach-chair position, MUA alone, or conservative treatment. In addition, the lack of preoperative scores did not allow us to determine improvements in pain and function after surgery, and the absence of the Constant score limits us from better comparisons with other studies. SAD was performed in just over half of patients along with capsular release for patients who were felt to have concurrent subacromial impingement. Although there were no differences in improvement of forward flexion and external rotation between those who did and did not undergo concurrent SAD, this additional variable limits our ability to determine to what extent patients improved from the SAD versus the capsular release. Furthermore, the retrospective nature of the study did not enable us to obtain additional ROM parameters beyond external rotation with the arm adducted and forward flexion, because other ROM values of interest including external rotation in abduction were not routinely recorded in the medical record. The lack of difference in outcomes between diabetic and nondiabetic patients could be a result of type II error due to the relatively small sample sizes in the subgroups.

Conclusions

Arthroscopic 360° capsular release in the lateral decubitus position for idiopathic adhesive capsulitis results in a significant early and lasting improvement in ROM, excellent functional outcomes, and low revision and complication rates.

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