Time Required to Achieve Clinically Significant Outcomes After Anteroinferior Arthroscopic Capsular Release for Shoulder Adhesive Capsulitis

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Background: The specific time required to reach clinically significant outcomes for patient-reported outcome measures (PROMs) after arthroscopic capsular release (ACR) for the treatment of shoulder adhesive capsulitis remains unknown.

Purposes: To determine the time required to achieve the minimal clinically important difference (MCID) and Patient Acceptable Symptom State (PASS) score thresholds after ACR for visual analog scale (VAS) for pain, American Shoulder and Elbow Surgeons score (ASES), Single Assessment Numeric Evaluation (SANE), and Constant score and to identify patient factors associated with delayed achievement of these clinical benchmarks.

Study Design: Case series; Level of evidence, 4.

Methods: A prospective analysis was performed of patients who underwent ACR for the treatment of idiopathic shoulder adhesive capsulitis between October 2019 and October2020. Patients completed PROMs preoperatively and at 1, 2, 4, 6, and 12 months postoperatively. Threshold values for MCID and PASS were obtained from previous literature for the VAS, ASES, SANE, and Constant scores.

Results: A total of 73 patients were included (mean age, 55.5 $\pm$ 9.3 years; body mass index [BMI], 26.6 $\pm$ 4.6 kg/m^2). By 1-year follow-up, the cumulative percentage of patients achieving the MCID and PASS for VAS, ASES, SANE, and Constant scores was 98.6%, 100%, 100%, and 98.6%, and 95.8%, 91.7%, 98.6%, and 84.9%, respectively. The median time required to reach the MCID thresholds for VAS, ASES, SANE, and Constant scores was 1, 1, 2, and 1 month, respectively. The median time required to reach the PASS thresholds for VAS, ASES, SANE, and Constant scores was 4, 4, 4, and 2 months, respectively. Factors associated with delayed achievement of MCID for SANE included higher BMI (hazard ratio [HR], 0.94; 95% CI, 0.88-0.99) and diabetes (HR, 0.49; 95% CI, 0.2-0.99). Age was associated with delayed achievement of the PASS for VAS.

Conclusion: Most patients undergoing ACR achieved clinically significant outcomes within a 4-month timeframe. The majority of patients reached MCID thresholds on outcome measures within 1 to 2 months and achieved satisfactory symptom states within 2 to 4 months postoperatively. By delineating the timeline of patient-perceived benefits, these results provide useful data to set appropriate expectations, guide rehabilitation, and optimize outcomes after ACR.

Keywords: shoulder; adhesive capsulitis; patient-reported outcome measures; frozen shoulder; Patient Acceptable Symptom State; minimal clinically important difference

Adhesive capsulitis affects an estimated 2% to 5% of the general population.[7] While many mild cases will resolve spontaneously over 1 to 3 years, a proportion of patients experience ongoing pain and stiffness that interferes with daily activities.[7,11] A variety of conservative and surgical treatment options have been employed to alleviate symptoms and restore function in recalcitrant cases.[16,24] Arthroscopic capsular release (ACR) has emerged as an efficacious intervention by allowing direct visualization

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and release of the contracted capsule and ligaments.[22] This has been shown to provide reliable improvements in range of motion (ROM) and shoulder function.[22]

Patient-reported outcome measures (PROMs) evaluating domains such as pain, ROM, and shoulder function are useful tools to quantify outcomes after treatment for adhesive capsulitis.[4] A previous study has demonstrated statistically significant improvements on these metrics after interventions such as ACR.[22] However, statistical significance does not necessarily reflect clinically meaningful changes that impact quality of life from the patient's perspective.[18] Concepts such as the minimal clinically important difference (MCID) and Patient Acceptable Symptom State (PASS) aim to differentiate clinically significant from merely statistically significant improvements in PROMs.[3,15,17,26] The MCID represents the minimum change in score that corresponds to a clinically meaningful improvement to the patient.[17] The PASS refers to the threshold score beyond which patients consider themselves to be well or satisfied with their condition.[17] By delineating these thresholds, clinicians can better interpret what magnitude of score change reflects a true clinical benefit that impacts patients' lives, rather than just a statistical change.

Using input from patients regarding their experiences, thresholds for these metrics have been established for various PROMs in the setting of adhesive capsulitis.[1] However, they provide limited information regarding the expected timeline of reaching clinically significant improvement. Establishing timeline data on when patients achieve MCID and PASS milestones would provide further useful context on the clinical meaningfulness of changes in PROM scores over time. Defining the temporal profile of clinically significant recovery provides useful data to inform patient expectations and guide individualized postoperative rehabilitation.[5,9,13,19,20]

The primary objective of this study was to determine the time required to achieve the MCID and PASS score thresholds after ACR for visual analog scale (VAS) for pain, American Shoulder and Elbow Surgeons (ASES) score, Single Assessment Numeric Evaluation (SANE), and Constant score. The secondary objective was to identify patient factors associated with delayed achievement of these clinical benchmarks.

METHODS

Study Population

This was a prospective cohort study performed in patients undergoing ACR for the treatment of adhesive capsulitis at a single institution between October 2019 and October 2020. The inclusion criteria for the study were as follows: adhesive capsulitis with no response to or worsening symptoms for a minimum of 12-week physiotherapy program (physiotherapy and at least 1 corticosteroid injection); age $\geq$18 years; restriction of passive motion $>30^\circ$ in $\geq$2 planes of movement; stage 2 of adhesive capsulitis (freezing stage) according to Hannafin and Chiaia[10]; and availability of radiographs and magnetic resonance imaging (MRI) or ultrasonography of the affected shoulder to exclude secondary causes of adhesive capsulitis. The exclusion criteria were secondary adhesive capsulitis, including inflammatory and infectious arthritis, partial- or full-thickness rotator cuff tear, previous surgery in the affected shoulder, and moderate-to-severe glenohumeral osteoarthritis. The study protocol was approved by the local ethics committee of our institution (IRB: 00118373), and all patients provided written informed consent to participate in this investigation.

Patient Evaluation

Pre- and postoperative evaluations consisted of a patient-based questionnaire and a physical examination performed by a shoulder specialist who did not participate in the surgery. All patients underwent shoulder radiographs and MRI for differential diagnosis. Clinical outcomes were assessed using the VAS, the Constant score, SANE, and ASES.[6,23] PROMs were collected preoperatively and at 1, 2, 4, 6, and 12 months postoperatively for analysis.

Surgical Technique

All surgeries were performed by 3 shoulder specialists (M.R., L.A.R., I.T.). Patients underwent interscalene regional anesthesia and were positioned in the beach-chair position. A standard posterior portal was utilized to initiate the ACR. An anterior portal was established under direct vision with the use of a spinal needle lateral to the coracoid process and superior to the superior border of the subscapularis. Initially, a 3.0-mm 90-hooked electrode was used to release the capsular tissue of the rotator cuff interval and the coracohumeral ligament. A release of the middle glenohumeral ligament was then performed. The anterior capsule was released below the biceps origin just off the glenoid rim, preserving the labrum in the process. The subscapularis tendon was released from the anterior capsule but was not violated. The inferior ACR was extended until the 6-o'clock position. No posterior release

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Ethical approval for this study was obtained from the Hospital Italiano de Buenos Aires (reference No. 10852).

was performed on any patient. The arthroscope was removed after the release, a gentle manipulation was performed, and the shoulder motion was evaluated.

Rehabilitation

A standardized postoperative physical therapy and rehabilitation program was implemented. Patients were discharged on the day of the surgery with a sling. They were encouraged to discontinue the use of the sling when the arm recovered from regional anesthesia and start using the operated arm for activities of daily living. All patients were subjected to the same standardized rehabilitation protocol supervised by a physical therapist 3 times per week until the end of treatment. The rehabilitation protocol consisted of 3 phases: phase 1, passive pendulum and mild ROM exercises; phase 2, active-assisted ROM exercises; and phase 3, resisted shoulder motion exercises. Progression from one phase to another depended mainly on pain and ROM improvement. Exercises conducted in the therapist's practice were accompanied by supervised daily home rehabilitation exercises.

Statistical Analysis

Continuous variables are presented as the mean ± SD or median and interquartile range according to distribution, and categorical variables are presented as absolute and relative frequencies. For the primary outcome, a time-to-event analysis was performed using Kaplan–Meier survival curves to determine the time required to achieve the MCID and PASS for each outcome measure. The threshold values utilized for MCID and PASS were obtained from a prior study that established these metrics in patients with adhesive capsulitis using both distribution-based and anchor-based methods.[1] The values were as follows: VAS for pain (MCID, 1.1; PASS, ≤2); ASES score (MCID, 8.2; PASS, ≥80); SANE score (MCID, 9.3; PASS, ≥80); and Constant score (MCID, 10.1; PASS, ≥70). For the secondary outcome, a Cox proportional hazards regression analysis was then conducted to identify factors associated with earlier or delayed achievement of MCID and PASS. The variables included in the multivariate regression model were age, sex, body mass index (BMI), smoking status, diabetes, and dyslipidemia. The statistical analysis was performed using R Foundation for Computing (v 1.0.143; R Foundation for Statistical Computing). $P < .05$ was considered statistically significant.

RESULTS

Study Population

A total of 92 patients required arthroscopic ACR for the treatment of idiopathic adhesive capsulitis during the study period. Of these, 15 patients did not meet the study criteria and 4 (5%) were lost to follow-up. Thus, complete follow-up was available in 73 patients (95% follow-up) (Figure 1). Baseline demographic characteristics are detailed in Table 1.

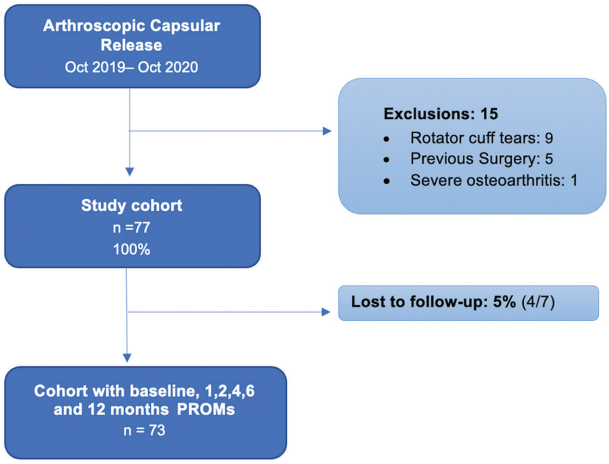

Figure 1. Flowchart of patient inclusion. Oct, October; PROMs, patient-reported outcome measures.

TABLE 1
Baseline Demographic Characteristics[a]

	Overall (N = 73)
Age, y	55.52 ± 9.3
Sex	
Male	17 (23.3)
Female	56 (76.7)
BMI, kg/m^2	26.68 ± 4.6
Smoking	
Nonsmoker	64 (87.6)
Smoker	9 (12.4)
Laterality	
Left	27 (37.0)
Right	46 (63.0)
Hypo-/hyperthyroidism	
No	52 (71.3)
Yes	21 (28.7)
Hypertension	
No	52 (71.3)
Yes	21 (28.7)
Dyslipidemia	
No	56 (76.8)
Yes	17 (23.2)
Diabetes	
No	60 (82.1)
Yes	13 (17.9)

[a]Data are presented as n (%) or mean ± SD. BMI, body mass index.

Patient-Reported Outcome Measures

Overall, VAS, ASES, SANE, and Constant scores all demonstrated significant improvement over time after ACR, with the greatest gains observed within the first 4 months and then more gradual increases thereafter (Table 2).

Achievement of MCID and PASS Thresholds

For VAS scores, a total of 72 (98.6%) patients achieved MCID and 70 (95.8%) achieved PASS at 12 months

TABLE 2
PROMs at Each Follow-up[a]

	Baseline to 1 mo	*P*	1 to 2 mo	*P*	2 to 4 mo	*P*	4 to 6 mo	*P*	6 to 12 mo	*P*
VAS	8 (1.6) to 4.3 (2.2)	<.001	4.3 (2.2) to 3.5 (2.1)	.004	3.5 (2.1) to 2.8 (1.9)	.003	2.8 (1.9) to 1.2 (1)	<.001	1.2 (1) to 1.2 (1)	.3747
VAS delta	3.6 (2.8)		0.8 (2.3)		0.6 (1.9)		1.6 (1.8)		0	
ASES	20.2 (9.4) to 62.6 (14.8)	<.001	62.6 (14.8) to 70.1 (15.3)	<.001	70.1 (15.3) to 75.7 (13.3)	.004	75.7 (13.3) to 86.3 (9.9)	<.001	86.3 (9.9) to 88.1 (9.4)	.0082
ASES delta	42.3 (16.4)		7.5 (12)		5.6 (16.4)		10.5 (12.8)		1.7 (5.6)	
SANE	38.7 (14.2) to 46.4 (14.2)	<.001	46.4 (14.2) to 59.5 (17.9)	<.001	59.5 (17.9) to 79.3 (11.9)	<.001	79.3 (11.9) to 91.6 (7.9)	<.001	91.6 (7.9) to 92.4 (7.9)	.0572
SANE delta	7.6 (11.7)		13.1 (17.9)		19.7 (17.6)		12.3 (13.6)		0.8 (3.6)	
Constant	18.6 (9.4) to 59.6 (17.5)	<.001	59.6 (17.5) to 63.8 (18.6)	.0285	63.8 (18.6) to 75.3 (14.1)	<.001	75.3 (14.1) to 85.2 (8.5)	<.001	85.2 (8.5) to 86.6 (8.3)	.0492
Constant delta	41 (2.3)		4.1 (15.9)		11.4 (1.6)		9.9 (12.6)		1.3 (5.8)	

[a]Data are presented as means and standard deviations. ASES, American Shoulder and Elbow Surgeons score; PROMs, patient-reported outcome measures; SANE, Single Assessment Numeric Evaluation; VAS, visual analog scale.

TABLE 3
Patients Achieving MCID and PASS for VAS, ASES, SANE, and Constant Scores[a]

	MCID					PASS				
PROM	1 mo	2 mo	4 mo	6 mo	12 mo	1 mo	2 mo	4 mo	6 mo	12 mo
VAS	60 (82.1)	60 (82.1)	67 (91.7)	70 (95.8)	72 (98.6)	15 (20.5)	15 (20.5)	26 (35.6)	42 (57.5)	70 (95.8)
ASES	69 (94.5)	69 (94.5)	71 (97.2)	73 (100)	73 (100)	13 (17.8)	13 (17.8)	26 (35.6)	47 (64.3)	67 (91.7)
SANE	24 (33)	24 (33)	50 (68.4)	72 (98.6)	73 (100)	1 (1)	1 (1)	15 (20.5)	53 (72.6)	72 (98.6)
Constant	69 (94.5)	69 (94.5)	71 (97.2)	72 (98.6)	72 (98.6)	27 (36.9)	27 (36.9)	42 (57.5)	62 (84.9)	62 (84.9)

[a]Data are presented as n (%). ASES, American Shoulder and Elbow Surgeons score; MCID, minimal clinically important difference; PASS, Patient Acceptable Symptom State; PROM, patient-reported outcome measure; SANE, Single Assessment Numeric Evaluation; VAS, visual analog scale.

postoperatively. For ASES scores, a total of 73 (100%) patients achieved MCID and 67 (91.7%) achieved PASS at 12 months postoperatively (Table 3). For SANE, a total of 73 (100%) patients achieved MCID and 72 (98.6%) achieved PASS at 12 months postoperatively (Table 3). For Constant scores, a total of 72 (98.6%) patients achieved MCID and 62 (84.9%) achieved PASS at 12 months postoperatively (Table 3). Overall, the timeline to achieve MCID ranged from 1 to 2 months across the outcome measures, while the time to achieve PASS ranged from 2 to 4 months (Table 4, Figures 2–5).

Factors Affecting Achievement of MCID and PASS Thresholds

Delayed achievement of MCID for SANE was significantly associated with higher BMI (hazard ratio [HR], 0.94; 95% CI, 0.88-0.99; $P = .0268$) and diabetes (HR, 0.48; 95% CI, 0.23-0.99; $P = .046$). Delayed achievement of PASS for VAS was significantly associated with increasing age (HR, 0.97; 95% CI, 0.94-1.0; $P = .0426$). Multivariate Cox regression models are shown in Tables 5 and 6.

TABLE 4
Patients Achieving MCID and PASS for VAS, ASES, SANE, and Constant Scores[a]

PROM	MCID	PASS
VAS	1 mo (1-1 mo)	4 mo (4-6 mo)
ASES	1 mo (1-1 mo)	4 mo (4-4 mo)
SANE	2 mo (2-2 mo)	4 mo (4-4 mo)
Constant	1 mo (1-1 mo)	2 mo (2-4 mo)

[a]Data are presented as median (interquartile range). ASES, American Shoulder and Elbow Surgeons score; MCID, minimal clinically important difference; PASS, Patient Acceptable Symptom State; PROM, patient-reported outcome measure; SANE, Single Assessment Numeric Evaluation; VAS, visual analog scale.

Range of Motion

The trajectory of change was comparable across measures, progressing from large improvements in the first 6 months to smaller successive improvements from 6- to 12-month timepoints (Table 7).

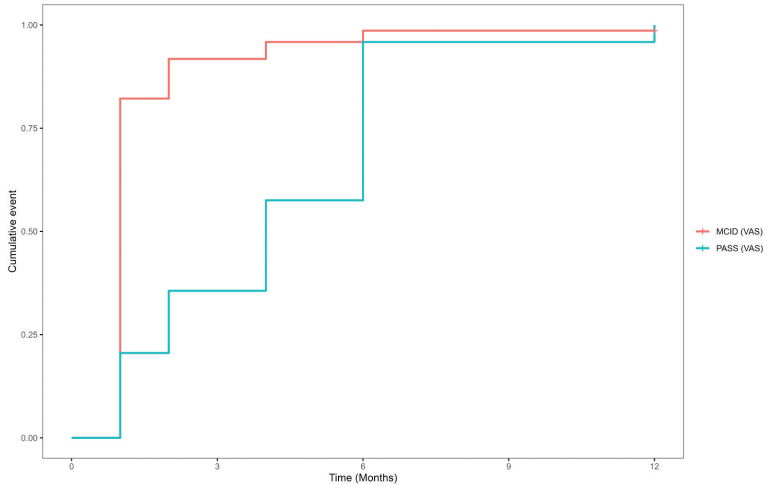

Figure 2. The proportion of the population that achieved MCID and PASS for VAS in months after arthroscopic capsular release. MCID, minimal clinically important difference; PASS, Patient Acceptable Symptom State; VAS, visual analog scale.

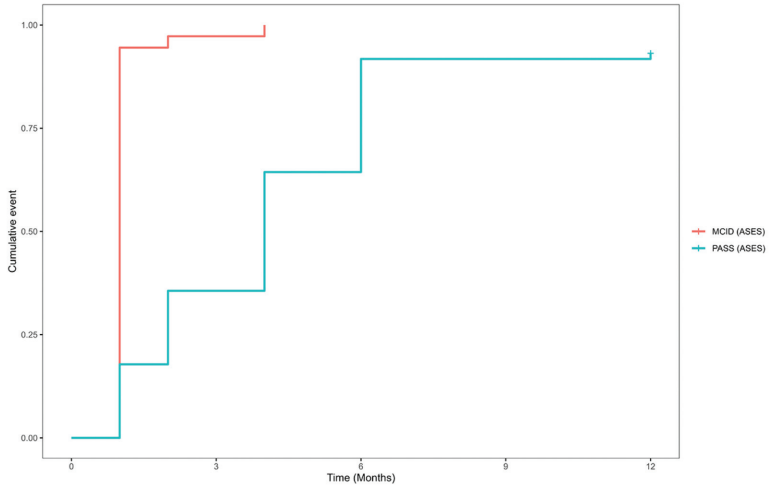

Figure 3. The proportion of the population that achieved MCID and PASS for ASES in months after arthroscopic capsular release. ASES, American Shoulder and Elbow Surgeons score; MCID, minimal clinically important difference; PASS, Patient Acceptable Symptom State.

DISCUSSION

The most important findings of this study were that patients undergoing ACR for adhesive capsulitis achieved clinically significant improvements in pain, function scores, and ROM within a 4-month timeframe after surgery. Most patients reached the MCID thresholds on measures such as VAS for pain, ASES, SANE, and Constant scores within 1 to 2 months. The timeline to achieve PASS was longer at 2 to 4 months across these outcomes. Overall, these results demonstrate that ACR facilitates timely and meaningful improvements that patients notice in their symptoms and function early after surgery. Factors such as higher BMI and diabetes were associated with slightly delayed achievement of some clinical milestones but in no way overshadow the usefulness of capsular release. Defining the temporal profile of clinically significant recovery provides useful data to guide patient expectations and direct individualized postoperative rehabilitation.

Functional outcomes have been shown to be greatly improved after ACR for adhesive capsulitis in multiple studies.[8,12,14,25] A recent meta-analysis by Wang et al[27] reported pooled improvements of 48.3 points for Constant score, 44.6 points for ASES score, and 19.3 points for University of California Los Angeles shoulder score from baseline to 12 months after ACR. These findings were similar to our results demonstrating substantial gains after ACR, with the greatest improvements seen within the first 4 months. This rapid early recovery aligns with other studies

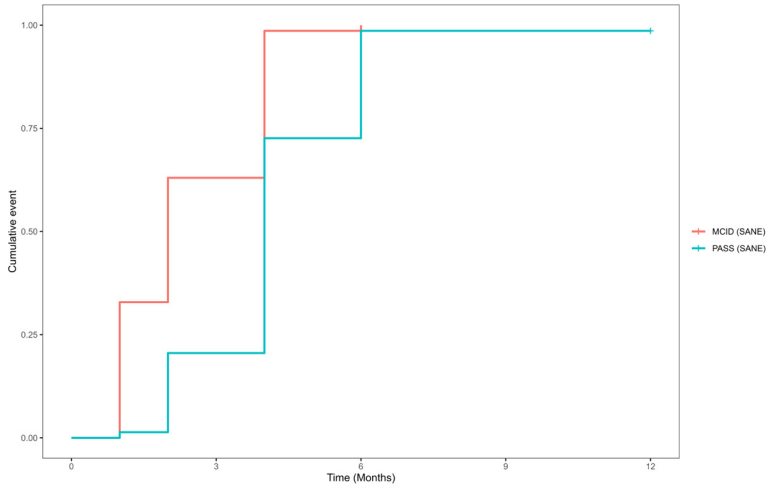

Figure 4. The proportion of the population that achieved MCID and PASS for SANE in months after arthroscopic capsular release. MCID, minimal clinically important difference; PASS, Patient Acceptable Symptom State; SANE, Single Assessment Numeric Evaluation.

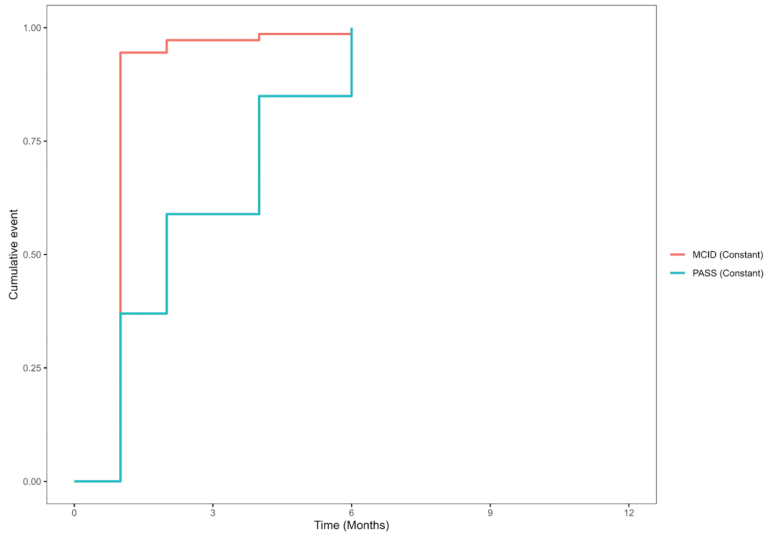

Figure 5. The proportion of the population that achieved MCID and PASS for Constant scores in months after arthroscopic capsular release. MCID, minimal clinically important difference; PASS, Patient Acceptable Symptom State.

like Ranalletta et al,[21] which showed significant improvements in Constant and ASES scores as early as 8 weeks after ACR. Barnes et al[2] also found major reductions in pain frequency and magnitude within 1 week after ACR, along with enhanced shoulder function. Our study further highlights the capacity of ACR to enable brisk functional improvements in the initial months after surgery.

Regarding shoulder ROM, our study found substantial improvements in forward flexion, abduction, external rotation, and internal rotation within the first 2 to 4 months after ACR. Forward flexion increased by a mean of 68° at 1 month and 25° at 2 months. Abduction improved by 50° at 1 month and 17° at 2 months. These early gains aligned with previous studies on ACR. Barnes et al[2] reported comparable early gains, with forward flexion increasing from 96° to 156° and abduction improving from 74° to 144° within 12 weeks after surgery. External and internal rotation also increased significantly in the first 6 to 12 weeks in their study. A meta-analysis by Wang et al[27] reported pooled increases of 82° for abduction and 77° for forward flexion at final follow-up after ACR. Ranalletta et al[21] also found sizable improvements in forward flexion, abduction, and rotations as early as 8 weeks after ACR, with gains maintained until 6 months and no significant difference thereafter. Our study further highlights the efficacy of ACR in delivering substantial improvements in shoulder ROM in the early recovery period, with most gains occurring within the first 4 months.

TABLE 5
Multivariate Cox Regression of Variables Associated With Achieving MCID for VAS, ASES, SANE, and Constant Scores[a]

	HR	95% CI	P
VAS			
Age	1.01	0.9799-1.033	.656
Sex, male	1.36	0.7636-2.414	.298
BMI	0.99	0.9278-1.047	.644
Smoking, smoker	1.61	0.743-3.497	.227
Diabetes	0.91	0.4399-1.881	.798
Dyslipidemia	0.89	0.443-1.776	.735
ASES			
Age	1.00	0.978-1.028	.827
Sex, male	0.80	0.4532-1.419	.449
BMI	1.00	0.9428-1.054	.917
Smoking, smoker	1.20	0.5624-2.55	.64
Diabetes	0.62	0.286-1.323	.214
Dyslipidemia	0.81	0.4009-1.65	.567
SANE			
Age	0.98	0.942-1.0108	.1728
Sex, male	0.82	0.4654-1.4384	.4857
BMI	0.94	0.8847-0.9926	.0268
Smoking, smoker	1.08	0.5136-2.2634	.8423
Diabetes	0.48	0.2313-0.987	.046
Dyslipidemia	1.51	0.722-3.1523	.2742
Constant			
Age	1.00	0.9796-1.031	.71
Sex, male	0.76	0.4231-1.364	.358
BMI	1.00	0.944-1.055	.949
Smoking, smoker	1.19	0.5568-2.527	.658
Diabetes	0.62	0.2869-1.326	.216
Dyslipidemia	0.79	0.3899-1.609	.519

[a]ASES, American Shoulder and Elbow Surgeons score; BMI, body mass index; HR, hazard ratio; MCID, minimal clinically important difference; SANE, Single Assessment Numeric Evaluation; VAS, visual analog scale.

TABLE 6
Multivariate Cox Regression of Variables Associated With Achieving PASS for VAS, ASES, SANE, and Constant Scores[a]

	HR	95% CI	P
VAS			
Age	0.969	0.9399-0.9989	.0426
Sex, male	1.032	0.5784-1.8412	.9152
BMI	1.0206	0.9611-1.0838	.5052
Smoking, smoker	1.8459	0.8533-3.9931	.1194
Diabetes	1.8864	0.8781-4.0521	.1038
Dyslipidemia	0.7501	0.3694-1.5232	.4263
ASES			
Age	0.9849	0.9591-1.011	.2636
Sex, male	0.7966	0.4417-1.437	.45
BMI	0.9932	0.9417-1.048	.8014
Smoking, smoker	1.9971	0.9218-4.327	.0795
Diabetes	0.6658	0.2959-1.498	.3255
Dyslipidemia	0.81	0.4009-1.65	.567
SANE			
Age	1.006	0.9765-1.036	.692
Sex, male	0.8651	0.4837-1.547	.625
BMI	1.0219	0.9648-1.082	.46
Smoking, smoker	1.4446	0.6575-3.174	.36
Diabetes	1.1149	0.5672-2.191	.752
Dyslipidemia	0.9734	0.4894-1.936	.939
Constant			
Age	0.9996	0.9732-1.027	.976
Sex, male	0.7634	0.4279-1.362	.3607
BMI	0.9754	0.9227-1.031	.38
Smoking, smoker	1.9855	0.8851-4.454	.0961
Diabetes	0.6057	0.2979-1.232	.1662
Dyslipidemia	0.7963	0.4191-1.513	.4868

[a]ASES, American Shoulder and Elbow Surgeons score; BMI, body mass index; HR, hazard ratio; PASS, Patient Acceptable Symptom State; SANE, Single Assessment Numeric Evaluation; VAS, visual analog scale.

The MCID and PASS are important metrics that differentiate clinically meaningful changes in PROMs from merely statistically significant changes.[17] For instance, Alben et al[1] calculated the MCID, substantial clinical benefit (SCB), and PASS for the Patient-Reported Outcomes Measurement Information System – Upper Extremity, Pain Interference, and Pain Intensity instruments in patients treated nonoperatively for idiopathic frozen shoulder. However, no prior studies have delineated the timeline for achieving MCID and PASS specifically after ACR in patients with adhesive capsulitis. Recent studies have evaluated the time-dependent nature of achieving MCID, SCB, and PASS after other common shoulder procedures.[5,9,13,19,20] Cabarcas et al[5] showed patients achieved MCID and PASS by 1 year after reverse total shoulder arthroplasty. Manderle et al[13] found most patients achieved MCID for various PROMs by 6 months after rotator cuff repair. In our series, on average, patients achieved the MCID thresholds within 1 to 2 months and the PASS thresholds within 2 to 4 months across all PROMs. Overall, delineating thresholds and timelines for meaningful change on PROMs allows clinicians to better calibrate expectations and interpret the clinical impact of score changes over time.

Certain patient factors have been associated with delayed achievement of clinically significant milestones after ACR. Our analysis found that higher BMI and diabetes were correlated with slower attainment of MCID for SANE score. Other studies have also identified diabetes as a risk factor for inferior outcomes and slower recovery after interventions for adhesive capsulitis.[4] A systematic review by Boutefnouchet et al[4] compared outcomes between patients with idiopathic, diabetic, and secondary adhesive capsulitis undergoing ACR. The review found that while significant improvements were seen in all groups, patients with diabetes tended to have more residual pain, reduced ROM, and inferior function scores compared to idiopathic cases. Moreover, Alben et al[1] found that the odds of achieving the MCID values were negatively affected by certain patient factors, including sex (male), higher forward elevation at presentation, greater pain scores, needing multiple corticosteroid injections,

TABLE 7
Range of Motion at Each Follow-up[a]

	Baseline to 1 mo	*P*	1 to 2 mo	*P*	2 to 4 mo	*P*	4 to 6 mo	*P*	6 to 12 mo	*P*
Forward flexion, deg	66.7 (31.2) to 134.2 (45.2)	<.001	134.2 (45.2) to 160.1 (26.8)	<.001	160.1 (26.8) to 162 (19.2)	.6352	162 (19.2) to 165.6 (22)	.2457	165.6 (22) to 171.6 (13.5)	.0747
Forward flexion delta, deg	67.5 (50.9)		24.7 (47.5)		1.9 (34.6)		3.6 (26.1)		5.9 (28)	
Abduction, deg	61.7 (30.3) to 111.5 (47.1)	<.001	111.5 (47.1) to 128.3 (42.2)	.0139	128.3 (42.2) to 137.6 (40.9)	.2063	137.6 (40.9) to 167.9 (17.1)	<.001	167.9 (17.1) to 171.6 (13.5)	.0832
Abduction delta, deg	49.5 (49.3)		16.8 (56.5)		9.3 (61.9)		30.2 (44.8)		3.7 (18.1)	
External rotation, deg	21.3 (14.1) to 51.3 (21.3)	<.001	51.3 (21.3) to 54.1 (24.6)	.4673	54.1 (24.6) to 54.4 (21.5)	.9432	54.4 (21.5) to 64.4 (23.3)	.0151	64.4 (23.3) to 66.6 (19.5)	.5384
External rotation delta, deg	30 (29.8)		2.7 (32.2)		0.2 (32.9)		10 (34)		2.2 (30.4)	
Internal rotation, deg	16.3 (13.6) to 33.8 (17.3)	<.001	33.8 (17.3) to 40.2 (18.3)	.0487	40.2 (18.3) to 46.3 (18.7)	.0741	46.3 (18.7) to 60 (13)	<.001	60 (13) to 61.6 (9.9)	.4180
Internal rotation delta, deg	17 (21.8)		6.3 (27)		6.1 (28.6)		13.6 (22.9)		1.6 (17.3)	

[a]Data are presented as means and standard deviations.

and diabetes. Diabetes significantly lowered the odds of achieving the SCB for the Patient-Reported Outcomes Measurement Information System – Pain instruments (odds ratio, 0.104; $P = .002$). The results suggest diabetes is associated with inferior outcomes and delayed achievement of clinically meaningful improvement thresholds when treating adhesive capsulitis nonoperatively. Our finding that diabetes and greater BMI prolong reaching MCID reinforces that surgeons should be aware of potentially slower initial functional gains in these patients after ACR, while reassuring them that clinically meaningful improvements are still ultimately achieved.

This study has certain limitations. First, the sample size was relatively small (n = 73), and a formal power analysis was not conducted before initiating this observational cohort study. The focus was on characterizing expected timelines for achieving milestones rather than testing a hypothesis. However, the modest sample size could impact the generalizability of applying these recovery timeframes universally. Additional studies with larger cohorts are warranted to validate and further refine benchmarks for reaching clinically significant improvements after ACR across diverse populations. Second, the follow-up schedule with intervals at 1, 2, 4, 6 months and 1 year provided limited temporal granularity. More frequent assessments, such as biweekly in the first 6 months, could better delineate the timeline of clinically significant changes. Third, inherent limitations exist in the responsiveness of the PROMs utilized as well as variability in patient interpretation of perceived improvement. Finally, factors such as surgical techniques, rehabilitation protocols, and patient compliance to therapy could influence recovery timeframes but were not accounted for.

CONCLUSION

Most patients undergoing ACR achieved clinically significant outcomes within a 4-month timeframe. The majority of patients reached MCID thresholds on outcome measures within 1 to 2 months and achieved satisfactory symptom states within 2 to 4 months postoperatively. By delineating the timeline of patient-perceived benefits, these results provide useful data to set appropriate expectations, guide rehabilitation, and optimize outcomes after ACR.

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