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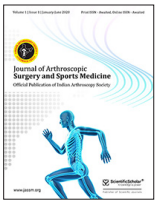

Original Article

A comparative study between arthroscopic anterior capsular release and pan capsular release among patients with adhesive capsulitis

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ABSTRACT

Objectives: Arthroscopic capsular release is a minimally invasive surgical procedure designed to relieve pain and restore mobility in patients with adhesive capsulitis, commonly known as frozen shoulder. This prospective research aims to compare two different approaches for arthroscopic capsular release in the outcome of frozen shoulder cases.

Materials and Methods: 120 patients who received capsular release surgery were the subjects of our study. Two groups were formed from the patients. Arthroscopic anterior capsular release, rotator interval release, and coracohumeral release had been performed on the first group. The second group underwent pan capsular release (including the posterior capsule), rotator interval release, with coracohumeral release. Both groups were subjected to triamcinolone intra-articular injection at the end of the procedure. On the 1st post-operative day, the patients received routine physical therapy. All patients had been monitored at 2 weeks, 6 weeks, 6 months, 1 year, 18 months, as well as 2 years using the Visual Analog Scale (VAS), as well as Constant–Murley ratings.

Results: Postoperatively, both groups exhibited statistically significant enhancement in the range of motion, VAS scores, as well as Constant–Murley scores; however, the difference was not statistically significant. All instances had no axillary nerve damage.

Conclusion: Our study confirms that pan capsular releases do not have any added advantage compared to other methods. Intra-articular steroid at the end of the procedure improves the outcome.

Keywords: Arthroscopy, Capsular release, Constant–Murley score, Frozen shoulder, Intra-articular steroid

INTRODUCTION

For patients who do not respond to conservative treatments, arthroscopic capsular release has emerged as an effective surgical option for managing shoulder stiffness – a common and often disabling condition. Compared to manipulation under general anesthesia (MUA), this technique provides direct visual control during capsular release, reducing the risk of iatrogenic injury such as fractures or soft tissue damage.[1] An additional advantage of the arthroscopic approach is the ability to simultaneously assess and treat coexisting shoulder pathologies, including rotator cuff tears or labral abnormalities, during the same procedure.

While treatments such as corticosteroid injections, physiotherapy, analgesics, and gentle manipulation can offer symptomatic relief in many cases, recent studies have demonstrated that arthroscopic capsular release is very effective and safe, particularly for patients with persistent symptoms. Advancements in surgical technique have led to improved outcomes, with several studies reporting significant reductions in pain, enhanced range of motion (ROM), as well as better shoulder function within 1st week postoperatively.[2]

The use of radiofrequency (RF) ablation probes has become more widespread in orthopedic practice, particularly in arthroscopic surgeries involving the shoulder, knee, and hip joints. One commonly used method, known as water-cooled RF ablation, employs circulating fluid to disperse heat. This cooling effect permits the use of higher RF energy levels for tissue resection while minimizing the risk of thermal injury to surrounding tissues.

Operating at moderate temperatures (typically between 40°C and 70°C), these devices generate high-energy free radicals capable of breaking molecular bonds, effectively facilitating the removal of soft tissue. RF systems are widely used in arthroscopic procedures for soft tissue coagulation, ablation, and excision.[3]

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Although capsular release has demonstrated favorable clinical results, there is an ongoing debate regarding the necessary level of release. Releasing the rotator interval – particularly around the subscapularis tendon – has been shown to improve flexion and external rotation (ER). In addition, releasing the inferior or the entire joint capsule may further enhance shoulder elevation, internal rotation (IR), and ER. However, the benefit of posterior capsular release remains controversial; while some studies advocate its use to improve IR, others argue that it offers no significant advantage over anterior release alone.[4]

In our study, patients were categorized into two groups for comparison. The first group underwent arthroscopic anterior capsular release, including rotator interval and coracohumeral ligament release. The second group received a more extensive procedure – pan capsular release (including posterior capsule release), rotator interval, and coracohumeral ligaments will also be released. The research purpose is to evaluate and compare clinical results of these two arthroscopic capsular release techniques using an RF hook probe. After the procedure, both groups received an intra-articular injection of triamcinolone to aid in post-operative recovery.

MATERIALS AND METHODS

In this prospective outcome analysis, a total of 120 patients were enrolled over 3 years at Valluvanad Hospital, Ottapalam, a tertiary care center. The study encompassed patients aged 30 years or older, possessing a body mass index of ≤35 kg/m² and classified as either physical state I or II by the American Society of Anesthesiologists. The study was carried out over a period of 2 years (June 15, 2023, to June 15, 2025).

The frozen shoulder diagnosis was determined using criteria set proposed by Zuckerman *et a*l., which comprised: (1) Gradual onset of shoulder pain, (2) Nocturnal pain, (3) Painful restriction of both active and passive elevation to less than 100° and/or ER to less than 50% of the normative range, and (4) Normal radiographic results. Clinically, all patients exhibited a global restriction of shoulder motion that interfered with activities of daily living. Magnetic resonance imaging findings revealed either an intact rotator cuff, tendinosis, or partial-thickness rotator cuff injuries affecting <50% of the tendon.

Inclusion criteria

- All participants had failed to respond to conservative management for a minimum of 3 months before undergoing surgical intervention.
- Age between 30 and 70 years.

Exclusion criteria

- Patients with coagulopathy, local infection, ipsilateral upper-limb neurological deficits, and significant comorbidities such as hepatic, renal, pulmonary, or cardiac dysfunction. Patients with obstructive sleep apnea, hypothyroidism
- Full-thickness rotator cuff tears or partial tears surpassing 50% necessitating repair, calcific tendinitis
- Traumatic bony/labral pathology
- Age below 30 or above 70 years.

Sample size

The main objective of the present study is to compare the outcome between group 1: Anterior capsular release, rotator interval release, coraco-humeral release and group 2: Pancapsular release, interval release, coraco-humeral release; hence, we took the mean difference in ER between the above-said 2 groups, which was 53.1–41.3 = 11.8 (Hagiwara *et al.*),[3] with 95% confidence limits and 80% power of the study. Sample size was calculated using the formula,

$$\text{Sample Size} = \frac{2 * [Z_{(1-\alpha)} + Z_{\beta}]^2 * (\delta)^2}{(E)^2}$$

$= 2 * (1.96+0.84)^2 * (11.8)^2/(4.3)^2$

α is the level of significance

Z is the standard normal variate for a 95% confidence interval = 1.96

Z for 80% power of the study = 0.84

E = expected precision = 4.3

Accordingly, the sample size calculated was 118.07, rounded off to 120. Hence, minimum of 120 study subjects will be taken for the study.

Based on the surgical technique used, the patients had been divided into 2 groups. Each group consisted of 60 patients.

- Group 1: Rotator interval release, anterior capsular release, and coracohumeral release
- Group 2: Coracohumeral release, rotator interval release, and pan capsular release.

Surgical techniques

After a detailed pre-anesthetic checkup, cardiology evaluation for patients above the age of 50, patients were taken up for the procedure under supraclavicular neuraxial general anesthesia and block. Patient positioned laterally with 20° of posterior tilt so that the glenoid surface is in line with the floor and the pathological shoulder on top, the involved upper limb was held in flexion of 20° and abduction of 30° and held so with a limb holder. 30 mL of normal saline is injected into the shoulder using a needle of 18 gauge. A posterior viewing portal is made, glenohumeral visualization is made utilizing an arthroscope in the posterior portal, and a high anterosuperior portal is created in direct visualization [Figures 1-5]. With the help of a needle, a RF hook probe is introduced and the release of coracohumeral ligament, rotator interval, and anterior capsule is performed

up to 6 o'clock position. In the second group of patients, an additional medial anteroinferior portal was positioned just superior to the subscapularis tendon and at the level of glenoid surface made under direct visualization with the help of a needle, a radio frequency hook probe was introduced to release the posterior and remaining inferior capsule.

After the procedure, 40 mg triamcinolone is injected into the anterior capsule.

Portals closed with 3-0 nylon stitches.

Post-operative treatment

The following day after surgery, the patients began passive shoulder mobilization. Their non-operated arm was used to demonstrate passive aided mobilization. During the inpatient stay, the qualified physiotherapist conducted therapy sessions twice a day. Following surgery, there was no sling. Following discharge on 1st post-operative day, patients were visited on days 7th, 14th, and 21st. For every patient, an antibiotic dosage of one intravenous dose was given. All patients were given a home fitness program to adhere to. On 14th post-operative day, the sutures were taken out. Subsequently, they were maintained. Clinical assessment was conducted utilizing the Constant–Murley score at consistent intervals (1 week, 3 weeks, 3 months, 1 year, and 2 years/final follow-up). Follow-up period ranged from 12 to 24 months, with an average of 18 months.

RESULTS

Patients where anterior capsular release, rotator cuff interval + coraco-humeral release were included in Group 1 and where pan capsular release, rotator cuff interval + coraco-humeral release were included in Group 2. There were 36 males and 84 females in our study, with 119 patients having right dominance. 45 patients had right-sided and 75 patients had left-sided pathology. 38 patients out of 120 were diabetic. In Group 1, the average duration of symptoms was 3.8 ± 0.98 months, while in Group 2, it was 4.1 ± 0.8 months. In our investigation, there was no statistically significant variation in the demographic information comparing the two groups [Table 1].

The VAS scores for pain, shoulder ROM, and Constant–Murley scores (CMSs) all significantly improved following surgery. Group 1's mean VAS score for pain increased from 8.4 before surgery to 1.2 at the final follow-up, whereas Group 2's improved from 8.8 to 1.1. The two groups' improvements in VAS scores did not differ significantly [Table 2].

In our study population, the mean forward elevation (FE) improved form 41.13° to 168.8°, abduction (ABD) improved from 50.96 to 166, ER improved from 12.58 to 58.4, and IR improved form 20.06 (lateral thigh level) to 64.2(T10 level) at final follow up in Group 1 and Group 2 mean FE improved form 36.4° to 169.2°, ABD improved from 48.5 to 168.9, ER improved from 32.4 to 62.8, and IR improved form 18.7 (lateral thigh level) to 66.2 (T10 level) at the final follow-up. There is no appreciable increase in ROM that is statistically significant across the two groups [Table 3 and Graph 1].

Table 1: Demographic data.

Parameter	Group 1	Group 2	*P*-value
M: F	12: 48	24: 36	0.09**
Dominance (R: L)	60:0	59:1	0.96**
Affected arm (R: L)	23: 37	22: 38	0.14**
DM	18 (M=8, F=10)	22 (M=10, F=12)	0.82**
Mean duration of symptoms	3.8±0.98 months	4.1±0.8 months	0.73*

**Chi-square test. *Students paired *t*-test, DM: Diabetes mellitus

Table 2: VAS score.

VAS score	Group 1	Group 2	*P*-value
Pre-op	8.4±1	8.8±0.7	0.76*
2 weeks	3.6±0.8	3.5±0.2	0.68*
6 weeks	3.5±1.4	3.3±0.6	0.09*
3 months	2.8±0.4	2.6±0.1	0.08*
12 months	1.2±0.4	2.2±0.2	0.06*
18 months	1.2±0.2	1.1±0.3	0.14*
24 months	1.2±0.2	1.1±0.1	0.16*

*Students paired *t*-test. VAS: Visual Analog Scale

The CMS had significant improvement in our study groups after the procedure. Constant–Murley's average score increased from 28.43 to 84.1 in Group 1 and from 26.2 to 82.6 in Group 2 at the final follow-up [Table 4].

In our study, there has been a statistically significant improvement in VAS score, ROM, as well as CMSs after surgery. In both groups, the $P < 0.05$ was considered statistically significant [Table 5].

DISCUSSION

About 2–5% of the general population suffers having frozen shoulder, another name for adhesive capsulitis, a common musculoskeletal disorder with substantial morbidity. This syndrome is characterized by a slow onset of pain, usually centered near the deltoid insertion, trouble sleeping on the affected side, and a severe restriction of ER and active and passive elevation. Radiographic imaging generally appears normal.[5,6]

Management of frozen shoulder includes both non-surgical and surgical approaches. Initial treatment typically involves conservative measures, including physical therapy, analgesics, and corticosteroid injections. These interventions are effective in approximately 60–80% of patients. However, if conservative therapy is ineffective for a patient, surgery

Table 3: ROM of the affected shoulder among groups.

ROM	Pre-op	2 weeks	6 weeks	3 months	12 months	18 months	24 months
FE							
Group 1	41.1±10.76	126.4±12.8	140.5±15.4	162.8±20.6	168.4±4.86	169.6±10.5	168.8±16.4
Group 2	36.4±7.6	124.2±9.8	136.5±10.3	158.2±15.6	166.7±6.2	168.5±6.5	169.2±11.4
P-value	0.19	0.11	0.08	0.09	0.12	0.84	0.79
ABD							
Group 1	50.9±10.09	122.1±8.4	126.8±12.6	168.6±16.2	168.9±14.2	164.2±10.9	166±12.4
Group 2	48.5±9.7	124.6±12.5	124.8±11.8	166.2±10.2	166.5±12.4	168.4±12.7	168.9±11.3
P-value	0.12	0.24	0.092	0.14	0.08	0.11	0.09
ER							
Group 1	12.58±6.7	34.9±6.2	56.8±7.8	59.1±2.6	58.6±8.09	57.4±9.1	58.4±3.8
Group 2	13.4±4.6	36.2±8.5	54.6±3.6	60.4±5.2	60.8±7.9	62.4±10.2	62.8±11.4
P-value	0.35	0.18	0.07	0.96	0.47	0.06	0.12
IR							
Group 1	20.06±9.2	38.6±6.4	54.4±6.8	60.2±10.1	64.8±8.2	62.4±10.4	64.2±8.4
Group 2	18.7±8.2	36.8±5.8	56.4±5.8	58.4±7.1	62.4±7.2	64.8±6.9	66.2±10.5
P-value	0.09	0.16	0.24	0.11	0.78	0.86	0.64

ROM: Range of motion, FE: Forward elevation, ABD: Abduction, ER: External rotation, IR: Internal rotation

Table 4: Constant–Murley score.

CMS score	Group 1	Group 2	*P*-value
Pre-op	28.43±3.64	26.2±4. 4	0.16[a]
2 weeks	54.2±4.8	57.1±3.9	0.24[a]
6 weeks	68.1±3.2	66.3±4.8	0.18[a]
3 months	74.9±5.3	72.4±5.9	0.26[a]
12 months	78.2±6.8	76.8±7.1	0.09[a]
18 months	82.6±8.7	80.2±6.7	0.11[a]
24 months	84.1±10.2	82.6±8.4	0.11[a]

[a]Students paired *t*-test. CMS: Constant–Murley score

may be an alternative. These encompass arthroscopic capsular release, open surgical release, or manipulation under anesthesia.[7,8]

In recent years, the refinement of surgical techniques has demonstrated optimistic outcomes for arthroscopic capsular release. However, there is still a lot of debate in the literature about how much capsular release is optimal. The procedure is known to improve ER and forward flexion, and several studies have suggested that supplementing the standard anterior release with more extensive techniques – such as inferior capsular release, subscapularis tendon release, or a complete (pan) capsular release – may further enhance ER and shoulder elevation. Posterior capsular release has been investigated as a method to enhance IR. Some authors advocate for an individualized approach, tailoring the extent of release based on each patient's specific pattern and degree of pre-operative motion restriction.[9-11]

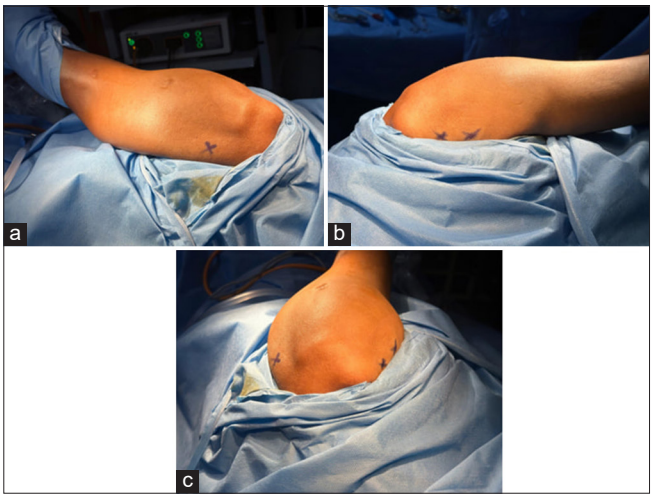


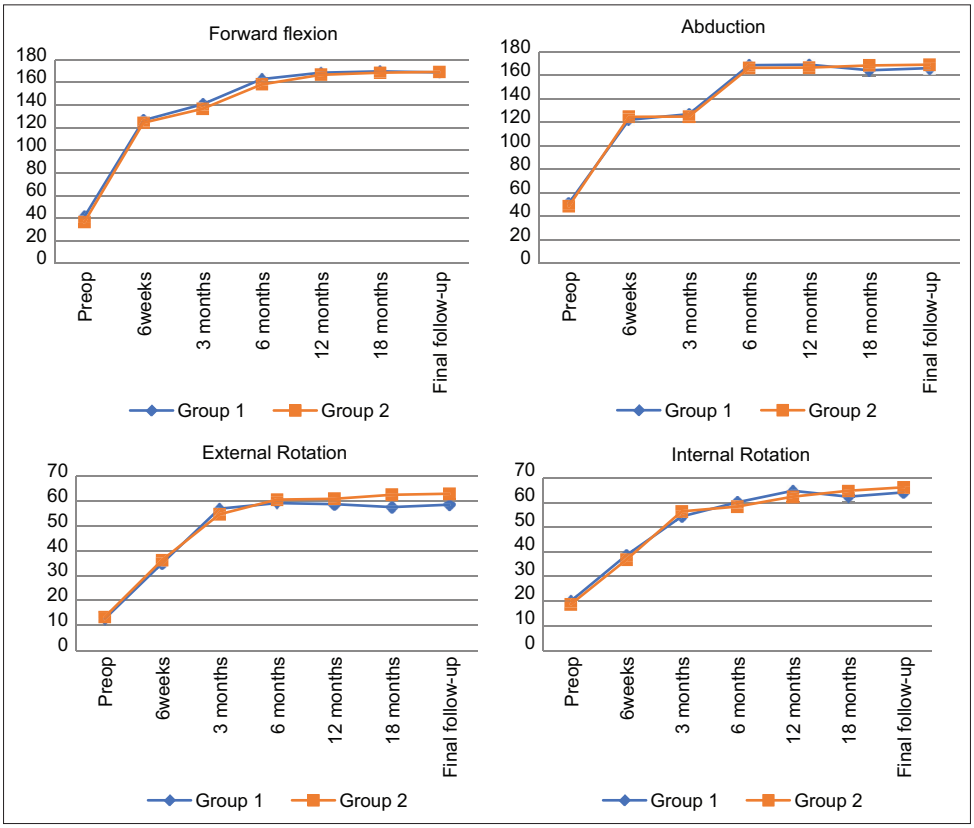
Figure 1: Positioning and portal markings. (a) Anterior portal marking, (b) posterior portal markings, (c) superior view.

This research was performed at a tertiary care facility in Kerala and involved 120 patients who received arthroscopic capsular release by a RF hook probe. This study evaluates and compares clinical outcomes of extensive arthroscopic procedures – specifically, anterior capsular release combined with coracohumeral ligament release versus pan capsular release with coracohumeral ligament release – alongside rotator interval release. Assessing whether more thorough capsular releases result in better functional outcome scores and post-operative ROM is the goal, thereby guiding clinical decision-making.

Table 5: Outcome.

Parameter	Group 1			Group 2		
	Pre-op	Final follow-up	*P*-value	Pre-op	Final follow-up	*P*-value
VAS score	8.4	1.2	<0.001*	8.8	1.1	<0.001*
Forward flexion	41.13	169.6	<0.001*	36.4	169.2	<0.001*
Abduction	50.96	166	<0.05*	48.5	168.9	<0.05*
External rotation	12.58	58.4	<0.001*	13.4	62.8	<0.001*
Internal rotation	20.06	64.2	<0.001*	18.7	66.2	<0.001*
Constant–Murley score	28.43	84.1	<0.05*	26.2	82.6	<0.05*

*Students paired *t*-test. VAS: Visual Analog Scale



Graph 1: Range of motion improvement.

All patients satisfied the inclusion criteria and granted informed consent. Patients receiving anterior capsular release together with rotator interval and coracohumeral ligament release were categorized as Group 1, while those receiving pan-capsular release along with rotator interval and coracohumeral release were classified as Group 2. The study cohort comprised 36 males and 84 females, with 119 patients being right-hand dominant. 45 patients had pathology affecting their right shoulder, while 75 cases affected their left shoulder. 38 of the individuals had diabetes. Group 1 and Group 2 experienced symptoms for an average of 3.8 ± 0.98 months and 4.1 ± 0.8 months, respectively. No statistically significant differences had been seen in demographic factors between the two groups.

Following evaluation, we found that patients' CMS, shoulder ROM, or VAS pain scores significantly improved after surgery. At the last follow-up, Group 1's mean VAS score improved from 8.4 preoperatively to 1.2, while in Group 2, it increased from 8.8 to 1.1. The difference between the two groups' improvements in VAS scores was not statistically significant, despite the fact that both groups had notable post-operative improvement.

In our study population, both groups showed improvement in mean FE, ABD, ER, and IR from the lateral thigh level to the

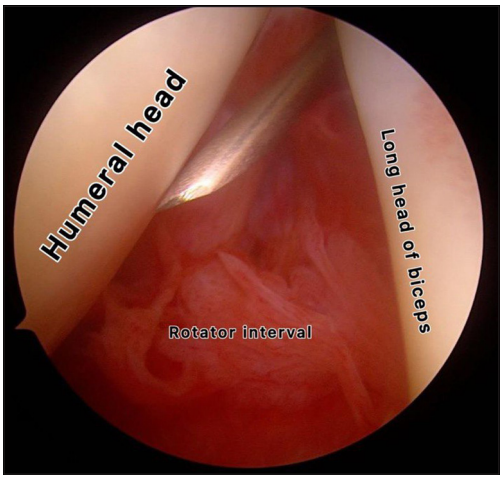


Figure 2: A high anterosuperior portal made under direct visualization with a needle, for rotator interval clearance and coracohumeral ligament release.

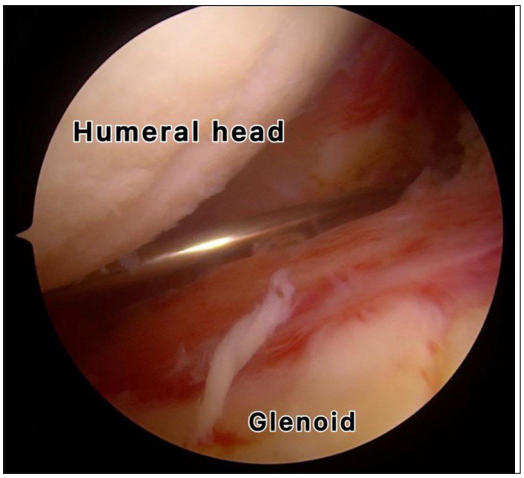


Figure 4: More medial portal, just lateral to the coracoid process along the surface of the glenoid to access the posterior and posteroinferior capsule,

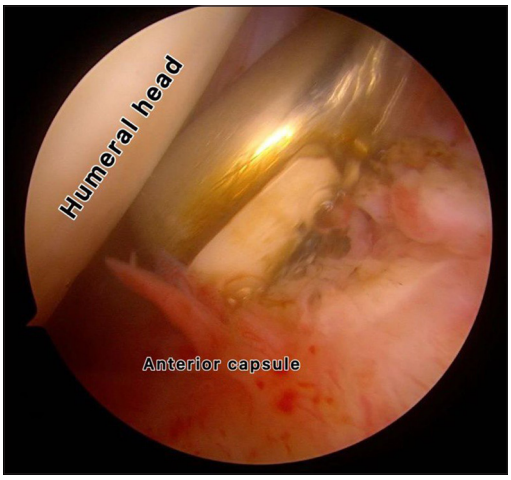


Figure 3: Release of rotator interval and CHL through anterosuperior portal

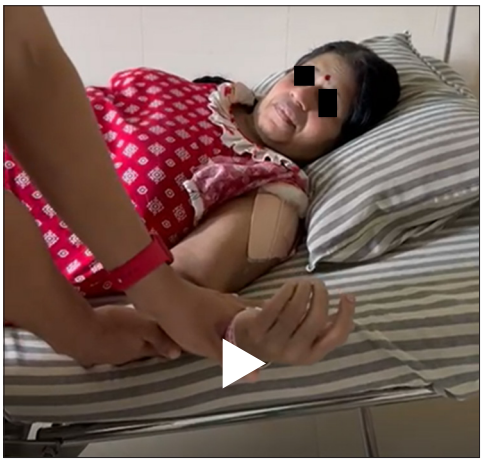
Figure 5: External rotation achieved on day 1 of surgery.

T10 vertebral level at the final follow-up. There is no statistically significant difference in the improvement of ROM between the two groups. Both study groups' CMS significantly improved after the treatment [Graph 2]. In addition, no patients in our study experienced axillary nerve injury after surgery.

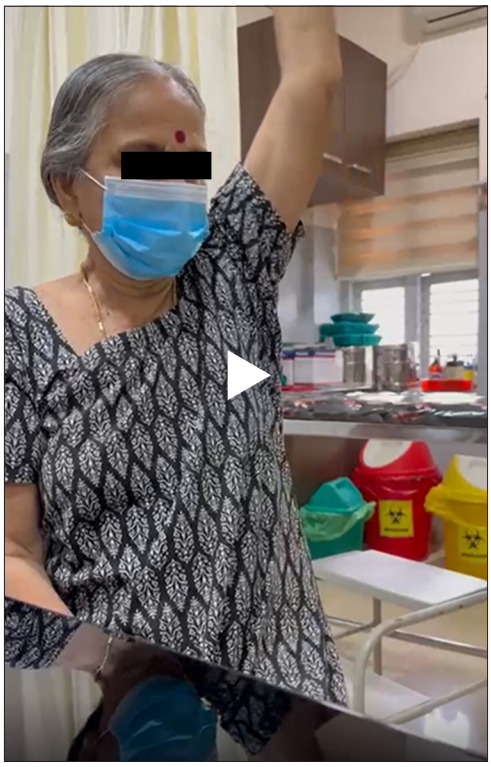
Studies have shown that releasing specific shoulder structures leads to targeted motion gains: ER improves after releasing the rotator interval, MGHL, coracohumeral ligament, and SGHL; elevation increases with anteroinferior capsule and AIGHL release; and IR benefits from posterior–superior capsule release.[12,13]

Anterior-inferior capsular release is particularly effective for addressing contractures that restrict multiple motions. It improves ROM, pain, and functional scores, and combining it with posterior release may further enhance outcomes, although some reports indicate no significant added benefit. Similarly, functional outcomes such as Simple Shoulder test (SST), American Shoulder and Elbow surgeons score (ASES), Constant, and VAS scores often do not differ between isolated anterior-inferior release and combined anterior-inferior plus posterior release. Extended capsular release, however, has been associated with more durable improvements, particularly in ER.[14,15]

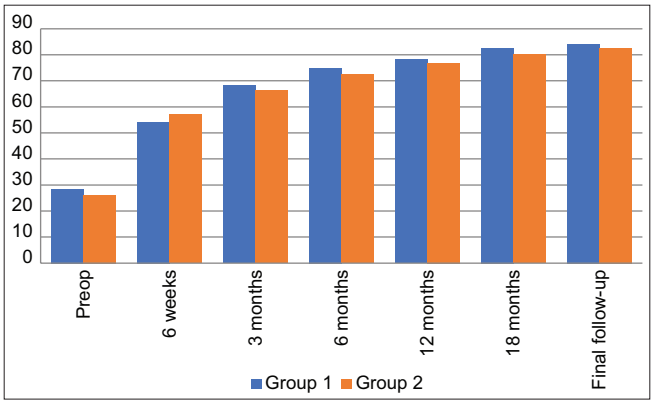
Video 1: Pre-operative video of the left shoulder showing decreased range of motion (especially external rotation) in comparison to the right shoulder. Video available at: https://doi.org/10.25259/JASSM_48_2025



Video 2: Post-operative day 1 showing significant improvement in the range of motion of left shoulder. Video available at: https://doi.org/10.25259/JASSM_48_2025



Video 3: 3 weeks followup after capular release showing good range of motion in patient 3. Video available at: https://doi.org/10.25259/JASSM_48_2025



Graph 2: Constant–Murley score.

Arthroscopic 360° capsular release, including the superior capsule, has consistently produced significant gains in all motion planes, often as early as 2 weeks postoperatively, with benefits sustained for up to 2 years. IR especially improves after posterosuperior capsule excision.

Safety concerns regarding axillary nerve injury remain minimal, with no reported cases after 360° release. Nonetheless, literature notes a small risk during inferior release, highlighting the importance of careful capsule manipulation.

Finally, no significant differences in post-operative motion or function have been observed between rotator interval release with anterior capsular release and more extensive pan-capsular release. Given the limited sample size of current studies, larger comparative trials are needed to clarify the true benefits of different surgical strategies.

More restricted surgical releases may improve functional and pain results for patients with frozen shoulder, according to previous research. However, adding posterior capsular release was associated with earlier and

Video 4: 3 weeks followup after capular release showing good range of motion in patient 4. Video available at: https://doi.org/10.25259/JASSM_48_2025

Video 5: 3 weeks followup after capular release showing good range of motion in patient 5. Video available at: https://doi.org/10.25259/JASSM_48_2025

Video 6: 3 weeks followup after capular release showing good range of motion in patient 6. Video available at: https://doi.org/10.25259/JASSM_48_2025

sustained improvements in shoulder flexion, along with enhanced IR [Videos 1-6].

CONCLUSION

This prospective observational study demonstrated that pan capsular release does not provide additional benefits in the therapy of frozen shoulder. But adding an intra-articular steroid injection at the end of the procedure significantly improves outcomes, promoting faster recovery for patients.

Author's contribution: VR and AK: Data collection and patient assessments; RTP: Statistical work.

Ethical approval: The study was an audit meant to improve patient outcomes, hence ethical board approval was not obtained.

Declaration of patient consent: The authors certify that they have obtained all appropriate patient consent forms. In the form, the patients have given their consent for their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Use of artificial intelligence (AI)-assisted technology for manuscript preparation: The authors confirm that there was no

use of artificial intelligence (AI)-assisted technology for assisting in the writing or editing of the manuscript and no images were manipulated using AI.

Availability of data and materials: Data is available at personal request to the authors.

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