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# Is Pancapsular Release More Effective than Selective Capsular Release for the Treatment of Adhesive Capsulitis?

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**Background:** We assessed the effectiveness of arthroscopic capsular release for the treatment of adhesive capsulitis. Further, we tried to ascertain the clinical benefits, if any, of pancapsular release over selective capsular release, where the two differ by performing or not performing a posterior capsular release, respectively.
**Methods:** Thirty-five consecutive patients with either primary or secondary adhesive capsulitis who failed conservative treatment for more than 6 months were enrolled in the study. A total of 16 patients allocated in group 1 received a pancapsular release that comprises the release of the rotator interval, anteroinferior capsular, and the posterior capsular release, whereas 19 patients in group 2 received a selective capsular release that comprises only the release of the rotator interval release and anteroinferior capsular release. The clinical outcomes, visual analogue scale (VAS) score, Constant score, and range of motion, were assessed preoperative and postoperatively.
**Results:** In both groups, the preoperative VAS score, Constant score, and ROM showed a significant improvement by the 6-month follow-up. We found that the immediate postoperative internal rotation was significantly higher in group 1 than group 2. Despite significant differences seen between the two groups at the initial postoperative period, there were no significant differences in Constant score, VAS score, and the ROM at all the subsequent follow-ups between the two groups.
**Conclusions:** Arthroscopic capsular release for the treatment of adhesive capsulitis is very effective. However, pancapsular release did not show any advantage over selective capsular release in terms of overall clinical outcome.
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**Key Words:** Adhesive capsulitis; Pancapsular release; Selective capsular release

## Introduction

In general, adhesive capsulitis of the shoulder is conservatively treated. Conservative treatments such as drug therapy, physiotherapy, and injection-based therapy have been shown to lead to remission of the condition by 60% to 80%. However, when these methods fail surgical treatments using arthroscopy may be considered as a second-line option.[1,2] Of the arthroscopic interventions, the most common and effective approach reported to treat adhesive capsulitis is arthroscopic capsular release. And despite the existence of several studies that support its effectiveness in treating this condition, none have attempted to define the guidelines on the extent of the capsular release required for a successful outcome.[3,4] Further, some discrepancies in pre-existing findings exist between studies. A few authors have shown that to achieve enhanced internal rotation and cross body adduction in adhesive capsulitis patients, pancapsular release, which is a type of a selective capsular release that includes the release of the rotator interval, anteroinferior capsule, and additionally, the posterior capsule, should be implemented. In stark contrast, others have shown that selective capsular release alone, i.e. the release of the rotator interval and the anteroinferior capsule, gives results that are comparable to the results after posterior capsular release.[5-9]

To rule out one of the possiblility that selective capsular release alone could give clinical outcomes that are comparable to

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those of posterior capsular release for the treatment of adhesive capsulitis, we investigated whether selective capsular release and pancapsular release have any relative advantage over one another for the treatment of adhesive capsulitis in terms of the clinical outcome and range of motion (ROM).

## Methods

### Subjects of Study

In our study, we enrolled patients suffering from adhesive capsulitis who despite having had conservative treatments such as drug therapy, physiotherapy, and intra-articular steroid therapy for at least 3 to 6 months between May 2010 to January 2011 had showed persistent, non-resolution of shoulder pain and joint stiffness. Patients able to undergo capsular release and to attend up to at least the 6-month follow-up session were included in the study. We took preoperative x-rays and magnetic resonance imaging (MRI) scans of all the patients, and those revealed through MRI to have a rotator cuff tear, a Bankart's lesion, or a superior labrum anterior and posterior lesion were excluded from the study. In total, 35 patients were enrolled in the study. The average age of the patients was 56 years of age (range, 38 to 82 years), and the ratio of sex was 9 males to 26 females. Adhesive capsulitis was found on the right shoulder in 24 patients and on the left side in 11 patients. Of the 35 patients, 27 patients had suffered the condition on their dominant shoulder. We categorized the patients in terms of etiology of the frozen shoulder; as either primary or post-traumatic. Between May 2010 to May 2012, we carried out 16 operations of pancapsular release, and between June 2012 to January 2014, we carried out 19 operations of selective capsular release. For our subsequent analyses, we sub-grouped the patients into the following two groups; group 1 who received pancapsular release and group 2 who received selective capsular release.

### Surgical Methods

The surgery proceeded with the patient in a beach chair position and under general anesthesia. Preoperatively, we measured each patient's ROM (forward flexion, external rotation, and internal rotation at neutrality, etc.) before making the surgical preparations. We created a posterior portal to feed the arthroscopy through the portal and to examine the intra-articular space and assess the extent and position of the synovitis and capsular contracture. We also created an anterior portal, through which we inserted the planer and molder machine and used it to remove the hyper-proliferated synovium surrounding the rotator interval and the long head of biceps tendon. After cleaning the region out, we made an incision in the superior glenohumeral ligament using an electrocautery (ArthroCare, Sunyvale, CA, USA) all the while taking care not to induce labral injury. After the release of the rotator interval, we unveiled the coracohumeral ligament up to the base of the coracoid process and revealed the conjoined tendon. Then, we continued with the release by following the glenoid rim and sticking to the glenoid surface as much as possible thereby releasing the anterior capsule and the middle glenohumeral ligament. Finally, once we observed the muscle fiber of the subscapularis, which we arbitrarily decided as a marker of sufficient release, the electrocautery was veered posteriorally to perform the release of the inferior glenohumeral ligament and the anterior capsule in the 6'oclock direction. After the arthroscopic anterior capsular release was finished, we monitored the patients' ability to carry out forward flexion, internal rotation, and external rotation.

For the posterior capsular release, the arthroscopy was inserted from the anterior portal and the electrocautery was inserted through the posterior portal. We performed the release in the posterior-superior direction to the glenoid rim and in the 6 o'clock direction. Once again, the release was stopped when the muscle fiber of the subscapularis was observed. When working in the 6 o'clock direction, we made sure to be aware of possible axillary nerve injury (Fig. 1, 2).

Lastly, we inserted the arthroscopic tube into the subacromial space and examined this region along with the subacromial surface and the rotator cuffs. If we found a coracoacromial ligament tear, subacromial impingement syndrome, or excessive adhesion due to the subacromial bursitis, we implemented an arthroscopic decompression.

### Rehabilitation

From the next day of surgery, the patients, under patient controlled analgesia, began passive joint exercises using a rod with pulley and contineous passive movement. The same rehabilitation protocol was issued to both patient groups irrespective of the mode of surgery they had received. The aim of the rehabilitation was to achieve as much passive ROM of the joints as permitted by pain. Active exercise was commenced from the 6th week of surgery, and muscle-strengthening exercises were begun from 3 months of surgery when the patient was able to achieve all ROM of the joints under no pain.

We measured the visual analogue scale (VAS) score, Constant score, and the ROM (forward elevation, internal rotation, and external rotation) in all the patients at the preoperative, 1-day postoperative, 1-month postoperative, 3-month postoperative, and at the 6-month postoperative follow-up. We analyzed the differences in pain alleviation and ROM between the two patient groups.

### Statistical Analysis

All statistical analyses were performed using IBM SPSS Statistics ver. 21.0 (IBM Co., Armonk, NY, USA). Initially, a normality test was implemented for our comparative analysis in terms of age, follow-up duration, and prepoerative and postoperative

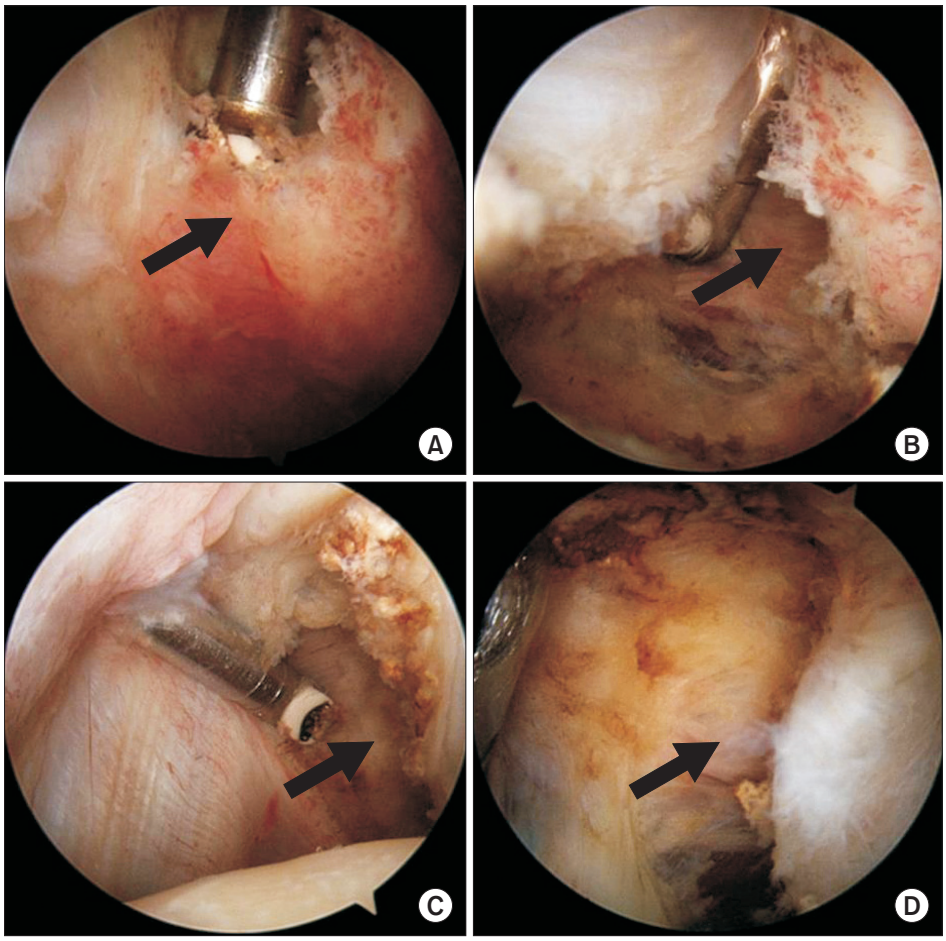


**Fig. 1.** (A) Arthroscopic electrocautery released thickened, contracted anteroinferior capsule (black arrow). (B) After complete release of anteroinferior capsule, the interval was wide open and the muscle belly of subscapularis (black arrow) could be seen. (C) Arthroscopic electrocautery released posterosuperior recess (black arrow). (D) Posteriorly muscle fibers of the infraspinatus could be seen as the thickened capsule (black arrow) was released.

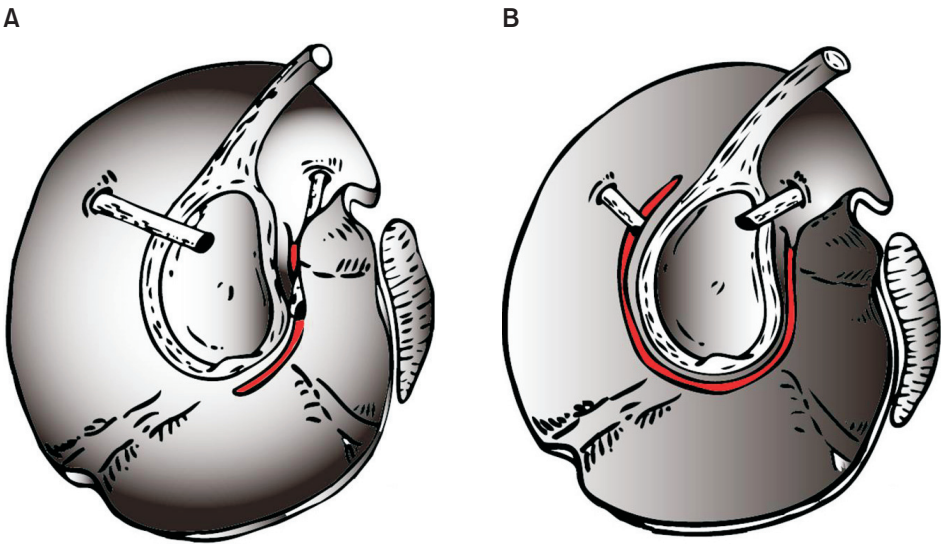


**Fig. 2.** Schematic drawings of the capsular release for the adhesive capsulitis. (A) Selective capsular release. (B) Pancapsular release.

ROM and pain intensity. If samples were shown to have normal distribution, a Student t-test was carried out, and if not, a nonparametric Mann-Whitney test was carried out. To compare the sex ratio, shoulder dominance, and diabetic status between the two groups, we used the chi-square test and the Fisher's exact test. Preoperative and postoperative changes in ROM and pain were compared between the two groups using a paired t-test for data with normal distribution and the Wilcoxon signed rank test for data without a normal distribution.

## Results

The etiologies of the 35 frozen shoulders were primary in 29 cases and post-traumatic in 9 cases. The mean follow-up period was 8.7 months. We did not find a significant difference between the pancapsular release group and the selective capsular release group in terms of age, sex, co-diabetic complications, nor preoperative ROM, VAS score, and Constant score (Table 1). In the 4 patients shown to have a coracoacromial ligament injury, subacromial impingement syndrome, or subacromial bursitis, we carried out a subacromial decompression. Further, we performed tenotomies in 11 patients who had either severe degenerative changes or fractures of the long head biceps brachii muscle.

In both patient groups, the postoperative values for VAS score, Constant score, forward flexion, internal rotation, and external rotation at 6-month follow-up improved from their respective preoperative values in a statistically significantly manner (Table 2, Fig. 3). We found that group 1 showed a statistically enhanced postoperative value in only one parameter, internal rotation, than that of group 2. Even so, this significant difference disappeared at later follow-ups (Table 3). Lastly, we did not find any significant difference between neither the VAS score nor the Constant score between the groups at all follow-up periods (Table 4).

## Discussion

In this study, the authors aimed to see the efficacy of two types of arthroscopic capsular release, pancapsular release and selective capsular release, for adhesive capsulitis of the shoulder and to elucidate if one type of release had a relative advantage over the other. In our study on 35 adhesive capsulitis patients, we could not see a significant benefit of pancapsular release over selective capsular release or vice versa for the treatment of adhesive capsulitis. But, nonetheless, we were able to show that arthroscopic capsular release for adhesive capsulitis is highly effective even when performed in patients who had already received an unsuccessful conservative management.

Adhesive capsulitis of the shoulder results in capsular contracture induced by progressive fibrosis and in severe pain with debilitating effects on the shoulder such as limited motion. The prevalence of adhesive capsulitis is around 2% to 5%.[10,11] Codman,[12] who was the first to described adhesive capsulitis, coined the term 'frozen shoulder' based on his findings of bursitis in and around the shoulder joint and of an adhered rotator cuff, which in turn induced tendinitis that spread to the subacromial space. Like Codman,[12] Neviaser[13] agreed with the pathophysiology of adhesive capsulitis being fibrosis, infection, and joint contracture, but argued that adhesive capsulitis is a more accurate term that describes the condition and pathophysiology than 'frozen shoulder'. Currently, these two terms are used interchangeably, but in light of typical symptoms of adhesive capsulitis such as joint stiffness and pain, the authors also believe that the latter term is more appropriate than the earlier alias.

**Table 1.** Preoperative Demographic Data of Patients

| Variable | Group 1 | Group 2 | *p*-value |
|---|---|---|---|
| No. of patients | 16 | 19 | |
| Age (yr) | 55.4 (41–71) | 58.9 (38–82) | 0.351 |
| Gender (male/female) | 3/13 | 6/13 | 0.667 |
| Dominant side | 13 | 14 | 0.452 |
| Diabetes | 9 | 12 | 0.830 |
| Cause (idiopathic/secondary) | 13/3 | 16/3 | 0.383 |
| Follow-up range (mo) | 8.6 (7–15) | 8.9 (7–17) | 0.834 |
| Preoperative forward flexion (°) | 108 (90–140) | 116 (90–145) | 0.152 |
| Preoperative external rotationn (°) | 3 (-10–20) | 2 (-20–25) | 0.743 |
| Preoperative internal rotation (°) | 22 (0–40) | 22 (0–40) | 0.573 |
| Preoperative visual analogue scale | 6.1 (5–8) | 6.3 (5–8) | 0.545 |
| Preoperative Constant score | 35.8 (25–48) | 33.8 (22–50) | 0.388 |

Values arepresented as number only or median (range).
Group 1: who received pancapsular release, Group 2: who received selective capsular release.

**Table 2.** Comparison between Preoperative and Postoperative Results in Both Groups

| Variable | Preoperative | 6 Months follow-up |
|---|---|---|
| Forward flexion (°) | | |
| Group 1 | 108 (90–140) | 166 (160–180) |
| Group 2 | 116 (90–145) | 163 (150–170) |
| External rotation (°) | | |
| Group 1 | 2.8 (-10–20) | 40.0 (30–60) |
| Group 2 | 1.6 (-20–25) | 42.6 (20–70) |
| Internal rotation (°) | | |
| Group 1 | 20.0 (0–40) | 51.9 (30–70) |
| Group 2 | 22.1 (0–40) | 50.5 (30–70) |
| Visual analogue scale score | | |
| Group 1 | 6.1 (5–8) | 1.2 (1–3) |
| Group 2 | 6.3 (5–8) | 1.4 (1–2) |
| Constant score | | |
| Group 1 | 35.8 (25–48) | 85.1 (75–94) |
| Group 2 | 33.8 (22–50) | 86.7 (80–94) |

Values arepresented as median (range). $p<0.001$.
Group 1: who received pancapsular release, Group 2: who received selective capsular release.

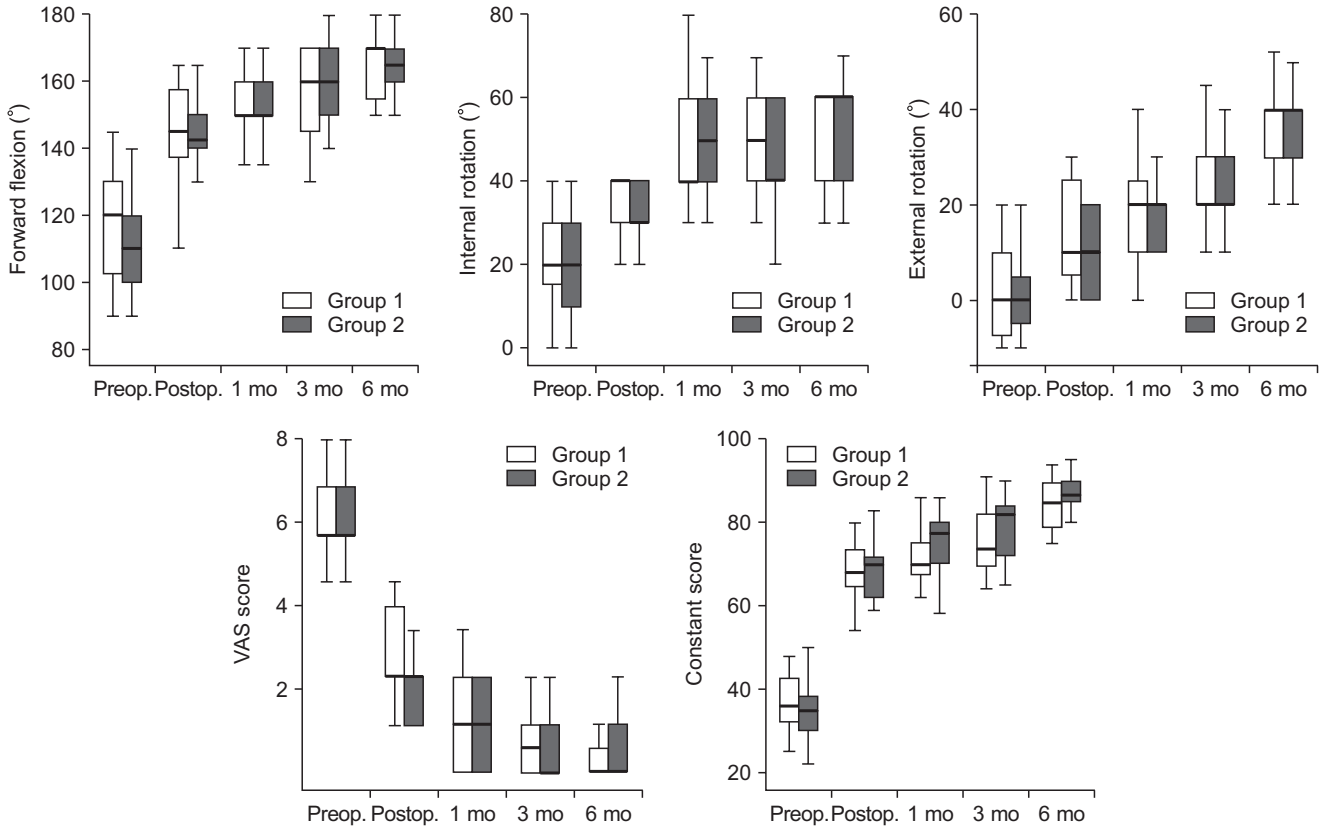


**Fig. 3.** There was highly significant improvement of range of motion (forwad flexion, internal rotation, external rotation) and functional scores (visual analogue scale [VAS] score, Constant score) 6 months follow-up in both groups. In group 1, there was significant improvement in internal rotation posteratively. However postoperative (postop.) VAS score was higher compared with group 2. There was no significant difference in Constant score, VAS score and range of motion 1 month, 3 months, 6 months follow-up between the two groups. Group 1: who received pancapsular release, Group 2: who received selective capsular release, Preop.: preoperative.

The underlying mechanism for the pathogenesis of adhesive capsulitis is unknown, but synovitis-induced expression of growth factors such as transforming growth factor-beta is known to leads to fibrosis. Further, 20% to 30% of patients with adhesive capsulitis are associated with minor injuries but whether or not they are in any way related to the pathophysiology of adhesive capsulitis is not understood.[14] Some regard this condition as a autoimmunity problem that causes degenerative lesions, but again there is no conclusive evidence to support this statement. Although a study by Bulgen et al.[15] and Rizk and Pinals[16] on HLA-B27 showed that HLA-B27 is increased in adhesive capsulitis patients more than normal patients, this increase was not statistically significant.

In general, the first line of management is a conservative one, which shows a success rate of around 60% to 80%.[1,2] If conservative management using drug therapy, physiotherapy, or injection therapy of at least 3 to 6 months shows no signs of improvement of ROM and pain, surgical methods can be reconsidered. Typical surgical methods for adhesive capsulitis are manipulation under general anesthesia or capsular release. However, manipulation may cause complications such as humeral fractures, rotator cuff tear, long head biceps brachii muscle tears, and glenoid fractures. Arthroscopic capsular release is known to be effective for adhesive capsulitis. Many papers show that pathological structures implicated in adhesive capsulitis may be the capsules surrounding the articular joints. Other implicated structures are coracohumeral ligament, axillary recess, and the subacromial space.[17-19]

Through cadaveric studies, Bowen and Warren,[20] Harryman et al.,[21] and Ovesen and Nielsen[22] found that the release of the superior and middle glenohumeral ligaments, rotator intervals, and the intra-articular subscarpularis can improve the external rotation of the shoulder, whereas release of the anteroposterior capsule or the inferior glenohumeral ligament can improve the forward flexion. Further, they also found that the release of the posterior capsule can improve the internal rotation. These results provide a basis for using arthroscopy-based capsular release as the treatment modality for adhesive capsulitis. Still, clinical studies that define or give guidelines as to the amount of capsular release is effective or required are rare, and results of which are inconsistent.

Authors who state that a pancapsular release is effective sug-

**Table 3.** Postoperative Improvement of Range of Motion

| Variable | Group 1 | Group 2 | *p*-value |
|---|---|---|---|
| Forward flexion (°) | | | |
| Preoperative | 108 (90–140) | 116 (90–145) | 0.152 |
| Postoperative | 148 (100–165) | 143 (110–165) | 0.331 |
| 1 Month follow-up | 157 (145–170) | 152 (125–170) | 0.165 |
| 3 Months follow-up | 163 (150–180) | 157 (130–170) | 0.112 |
| 6 Months follow-up | 166 (160–180) | 163 (150–170) | 0.162 |
| External rotation (°) | | | |
| Preoperative | 3 (-10–20) | 2 (-20–25) | 0.743 |
| Postoperative | 10 (0–20) | 15 (0–30) | 0.125 |
| 1 Month follow-up | 17 (10–30) | 21 (10–40) | 0.116 |
| 3 Month follow-up | 21 (10–40) | 24 ( 10–45) | 0.280 |
| 6 Month follow-up | 40 (20–60) | 43 (30–50) | 0.448 |
| Internal rotation (°) | | | |
| Preoperative | 20 (0–40) | 22 (0–40) | 0.573 |
| Postoperative | 43 (20–60) | 34 (20–60) | 0.037 |
| 1 Month follow-up | 44 (30–70) | 47 (30–80) | 0.510 |
| 3 Month follow-up | 43 (20–60) | 49 (30–70) | 0.209 |
| 6 Month follow-up | 52 (30–70) | 51 (30–60) | 0.747 |

Values arepresented as median (range).
Group 1: who received pancapsular release, Group 2: who received selective capsular release.

**Table 4.** Pain Relief of Patients Who Had Arthroscopic Capsular Release

| Variable | Group 1 | Group 2 | *p*-value |
|---|---|---|---|
| Visual analogue scale | | | |
| Preoperative | 6.1 (5–8) | 6.3 (4–8) | 0.388 |
| Postoperative | 3.5 (2–5) | 2.9 (2–4) | 0.069 |
| 1 Month follow-up | 2.2 (1–4) | 2.2 (1–3) | 0.937 |
| 3 Months follow-up | 1.6 (1–3) | 1.4 (1–3) | 0.288 |
| 6 Months follow-up | 1.2 (1–2) | 1.4 (1–2) | 0.139 |
| Constant score | | | |
| Preoperative | 35.8 (25–48) | 33.8 (22–50) | 0.388 |
| Postoperative | 68.6 (54–80) | 69.3 (59–83) | 0.796 |
| 1 Month follow-up | 72.6 (65–86) | 74.8 (58–86) | 0.386 |
| 3 Months follow-up | 76.9 (64–91) | 78.4 (65–90) | 0.594 |
| 6 Months follow-up | 85.1 (75–94) | 86.7 (80–94) | 0.374 |

Values arepresented as median (range).
Group 1: who received pancapsular release, Group 2: who received selective capsular release.

gest that because posterior-superior capsule contracture limits cross body adduction and internal rotation at abduction, a posterior capsular releases leads to an enhanced internal rotation postopertively.[4-7] Nicholson[5] showed good clinical outcomes in 68 patients with adhesive capsulitis after arthroscopic pancapsular release, and proposed that for an enhanced postoperative internal rotation, performing a posterior capsular release is recommended. Another study carried out Ide and Takagi[6] on 44 patients with adhesive capsulitis showed a successful outcome after pancapsular release.

Conversely, when Snow et al.[8] and Chen et al.[23] compared the results of pancapsular release that includes a posterior capsular release with those of selective capsular release for adhesive capsulitis, they did not find a significant difference in terms of internal rotation. Similarly, the study by Kim et al.[9] on 75 patients with adhesive capsulitis found that the mode of surgery, posterior capsular release or anterior capsular and rotator interval release, did not affect the postoperative pain or ROM. Thus, these authors concluded that when performing an arthroscopic capsular release a release of the posterior region is unnecessary.

In this study, we found that the extent of the arthroscopic capsular release did not affect the clinical success of the treatment. All the showed a satisfactory outcome of surgery allowing us to conclude that in case where conservative methods are ineffective surgery methods are effective second-line of options. At the final follow-up, in agreement with the studies by Snow et al.[8] and Kim et al.,[9] we found that the postoperative ROM and pain between patients of different treatment groups did not show a significant difference. Interestingly, at a day postoperation, we found that the angle of internal rotation was significantly higher in patients who received pancapsular release than those who received selective capsular release. However, the significance disappeared at later follow-ups. The explanation for the significant increase in internal rotation at 1 day postoperation in patients may be as according to Jerosch's hypothesis[3] that posterior capsular contracture may be the most important pathological factor in adhesive capsulitis and inhibits internal rotation of the shoulders, and thus releasing this would contribute to the enhancement of ROM. However, further confirmative studies are needed as this significant difference is no longer seen at later follow-ups.

At the final follow-up, we did not find a significant difference in neither VAS score nor Constant score between the two groups. However, a day postoperation, we found that the VAS score was higher in the pancapsular release group than the selective capsular release group. We believe the reason for this elevated score is that with greatercapsular release there may be greater tissue damage, such as unintentional damage of the subscapularis fibrotic tissue underneath the thin posterior capsule that may lead to surgery-related pain.

Through this study, we found that although a temporary benefit of pancapsular release over selective capsular release was seen in terms of the internal rotation, this benefit was no longer

applicable at later follow-ups. Further, we found that the pancapsular release was associated with an increase in postoperative pain. Our finding supports the notion of many researchers that the main pathological region in adhesive capsulitis lies in the anterior and anterior-inferior capsular regions such as the coracohumeral ligament, the rotator interval, and the axillary recess rather than the posterior capsular region. Especially, since we found that at least by the final follow-up the extent of capsular release does not have an effect on the clinical outcome, there is no benefit in carrying out a pancapsular release.[24,25)]

There are limitations to this study. First, we carried out the surgeries in two bulks in terms of the type of surgery, thus allocating the patients into the treatment-type according to the order they were hospitalized rather than taking into consideration the extent of hypertrophy in either of the anterior or the posterior capsule. Even though the patients in each group received the same diagnoses of adhesive capsulitis, the extent of hypertrophy which may vary within group was not segmented and the same surgery was applied disregarding this. In this study, some patients had severe shoulder stiffness due to hypertrophy of both their anterior and the posterior capsules. These patients received a posterior articular capsule release. It may be interesting to see if a similar clinical outcome can be achieved when such patients do not receive a posterior capsular release despite the presence of hypertrophy in that region. Secondly, since our study encompassed only a small sample, potential false negative data or type II error may mean a clinically significant finding may have gone unnoticed. Thus, prospective studies including a greater number of cases are needed, and those differentiating the extent of hypertrophy in the anterior and posterior capsules and assessing their effect on the outcome of capsular release are required.

## Conclusion

Arthroscopic capsular release for adhesive capsulitis of the shoulder is an effective treatment method that gives satisfactory clinical outcome. In this study, we found that pancapsular release had no relative advantage over selective capsular release to achieve good clinical outcomes for the treatment of adhesive capsulitis.

## References

1. Hannafin JA, Chiaia TA. Adhesive capsulitis. A treatment approach. Clin Orthop Relat Res. 2000;(372):95-109.
2. Shaffer B, Tibone JE, Kerlan RK. Frozen shoulder. A long-term follow-up. J Bone Joint Surg Am. 1992;74(5):738-46.
3. Harryman DT 2nd. Shoulders: frozen and stiff. In: The American Academy of Orthopedic Surgeons, eds. Instructional course lectures. Vol. 42. Rosemont, IL: The American Academy of Orthopedic Surgeons; 1993. 247-57.
4. Warner JJ, Allen A, Marks PH, Wong P. Arthroscopic release for chronic, refractory adhesive capsulitis of the shoulder. J Bone Joint Surg Am. 1996;78(12):1808-16.
5. Nicholson GP. Arthroscopic capsular release for stiff shoulders: effect of etiology on outcomes. Arthroscopy. 2003;19(1):40-9.
6. Ide J, Takagi K. Early and long-term results of arthroscopic treatment for shoulder stiffness. J Shoulder Elbow Surg. 2004; 13(2):174-9.
7. Jerosch J. 360 degrees arthroscopic capsular release in patients with adhesive capsulitis of the glenohumeral joint--indication, surgical technique, results. Knee Surg Sports Traumatol Arthrosc. 2001;9(3):178-86.
8. Snow M, Boutros I, Funk L. Posterior arthroscopic capsular release in frozen shoulder. Arthroscopy. 2009;25(1):19-23.
9. Kim YS, Lee HJ, Park IJ. Clinical outcomes do not support arthroscopic posterior capsular release in addition to anterior release for shoulder stiffness: a randomized controlled study. Am J Sports Med. 2014;42(5):1143-9.
10. Pearsall AW, Speer KP. Frozen shoulder syndrome: diagnostic and treatment strategies in the primary care setting. Med Sci Sports Exerc. 1998;30(4 Suppl):S33-9.
11. Noël E, Thomas T, Schaeverbeke T, Thomas P, Bonjean M, Revel M. Frozen shoulder. Joint Bone Spine. 2000;67(5):393-400.
12. Codman EA. The shoulder: rupture of the supraspinatus tendon and other lesions in or about the subacromial bursa. Boston, MA: T Todd Company; 1934.
13. Neviaser JS. Adhesive capsulitis of the shoulder. J Bone Joint Surg Am. 1945;27(2):211-22.
14. Rodeo SA, Hannafin JA, Tom J, Warren RF, Wickiewicz TL. Immunolocalization of cytokines and their receptors in adhesive capsulitis of the shoulder. J Orthop Res. 1997;15(3):427-36.
15. Bulgen DY, Binder A, Hazleman BL, Park JR. Immunological studies in frozen shoulder. J Rheumatol. 1982;9(6):893-8.
16. Rizk TE, Pinals RS. Histocompatibility type and racial incidence in frozen shoulder. Arch Phys Med Rehabil. 1984;65(1):33-4.
17. Ozaki J, Nakagawa Y, Sakurai G, Tamai S. Recalcitrant chronic adhesive capsulitis of the shoulder. Role of contracture of the coracohumeral ligament and rotator interval in pathogenesis and treatment. J Bone Joint Surg Am. 1989;71(10):1511-5.
18. Pollock RG, Duralde XA, Flatow EL, Bigliani LU. The use of arthroscopy in the treatment of resistant frozen shoulder. Clin Orthop Relat Res. 1994;(304):30-6.
19. Watson L, Dalziel R, Story I. Frozen shoulder: a 12-month clinical outcome trial. J Shoulder Elbow Surg. 2000;9(1):16-22.
20. Bowen MK, Warren RF. Ligamentous control of shoulder stability based on selective cutting and static translation experiments. Clin Sports Med. 1991;10(4):757-82.
21. Harryman DT 2nd, Sidles JA, Harris SL, Matsen FA 3rd. The role of the rotator interval capsule in passive motion and stability of the shoulder. J Bone Joint Surg Am. 1992;74(1):53-66.

22. Ovesen J, Nielsen S. Anterior and posterior shoulder instability. A cadaver study. Acta Orthop Scand. 1986;57(4):324-7.
23. Chen J, Chen S, Li Y, Hua Y, Li H. Is the extended release of the inferior glenohumeral ligament necessary for frozen shoulder? Arthroscopy. 2010;26(4):529-35.
24. Uitvlugt G, Detrisac DA, Johnson LL, Austin MD, Johnson C. Arthroscopic observations before and after manipulation of frozen shoulder. Arthroscopy. 1993;9(2):181-5.
25. Wiley AM. Arthroscopic appearance of frozen shoulder. Arthroscopy. 1991;7(2):138-43.