Limited capsular release and controlled manipulation under anaesthesia for the treatment of frozen shoulder

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Abstract

Background: In light of recent interest in the cost-effectiveness of the treatment options available for frozen shoulder, we aimed to determine the results of limited anterior capsular release and controlled manipulation under anaesthesia (MUA) in the treatment of primary frozen shoulder in terms of patient-related outcomes measure, range of motion and re-intervention rates.

Methods: This single-surgeon series included prospectively collected data on all patients undergoing capsular release with MUA from March 2011 until June 2013, with a minimum follow-up of 6 months from the index procedure. Outcome measures included pre- and postoperative Oxford Shoulder Score (OSS), range of motion and need for re-intervention.

Results: Fifty-four procedures were performed in 52 patients. Mean age 50 years (range 42 years to 59 years); male: female ratio = 11: 41. There was a highly statistically significant improvement in both pain and function modules of the OSS ($p < 0.005$) and range of motion ($p < 0.005$) at 6 months. The median postoperative score was 41 from a maximum of 48 points, with an average mean improvement of 24 points. Seventeen patients were diabetics. There was no significant difference in pre-operative and postoperative OSS or range of motion between the diabetic group and the non-diabetic groups. No patients required surgical re-intervention.

Conclusions: A combination of limited capsular release and MUA for the treatment of primary frozen shoulder is a safe and effective procedure resulting in marked improvement in pain, function and range of motion.

Keywords

adhesive capsulitis, arthroscopy, capsular release, frozen shoulder

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Introduction

Frozen shoulder is one of the most common musculo-skeletal conditions affecting the shoulder, with a prevalence of 2% in the general population.¹ The typical patient is a female between 40 years and 60 years of age.² The condition is associated with a number of systemic conditions, with diabetic patients in particular having a significant predisposition to developing frozen shoulder, with a prevalence of up to 20% in this population group.^{3,4}

The pathogenesis of the condition remains poorly understood.⁵ Restriction in range of motion results from thickening of the coracohumeral ligament, rotator interval and anterior capsule.

Frozen shoulder syndrome often runs a protracted painful and disabling course. Although classically

described as a benign condition consisting of three stages: 'freezing', 'frozen' and 'thawing', with eventual recovery, many patients proceed to long-term pain and stiffness.^{6,7}

There remains a lack of randomized controlled trials comparing treatment modalities, particularly invasive interventions.⁸ Management options include watchful waiting, corticosteroid injection, physiotherapy,

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manipulation under anaesthesia, hydrodilatation and arthroscopic capsular release.⁹

In light of recent interest in the effectiveness of the treatment options available for frozen shoulder syndrome, we aimed to review the outcomes of patients undergoing limited arthroscopic capsular release and controlled manipulation under anaesthesia (MUA) for the treatment of primary frozen shoulder syndrome for those patients where non-operative measures have failed.

Materials and methods

A total of 54 shoulders (52 patients) were consecutively enrolled in a prospective single surgeon patient-reported outcome study between March 2011 and June 2013. All patients were referred directly to the senior author (PB) and underwent detailed history and clinical examination including assessment of shoulder range of motion, and completed the Oxford Shoulder Score (OSS). Diagnosis of frozen shoulder was made by a senior consultant shoulder surgeon, based upon Codman's criteria. Patients who underwent surgery were in stage II of the disease (i.e. pain associated with reduction in range of motion, particularly external rotation, presenting within 3 months to 6 months from the onset of symptoms). All patients had failed conservative management with physiotherapy; no patient had undergone corticosteroid injection preoperatively. Patients who had frozen shoulder after a previous surgical intervention or fracture were excluded. Those patients also undergoing any concomitant procedure in addition to capsular release were excluded. All patients were followed-up for a minimum of 6 months.

Surgical technique

All procedures were performed by the senior author. A standardized surgical technique under general anaesthesia with an interscalene block was used. A beach chair position was used in all cases. Examination under anaesthesia was performed and the range of

motion recorded. Rotator interval release was performed with a P90 electrode (DePuy Mitek, Raynham, MA, USA). Anterior capsular release was performed using mechanical instruments. A mechanical instrument is an arthroscopic punch or scissors used to cut capsular tissue and create a crease or separation of tissues within the capsule. Gentle manipulation was undertaken after the procedure to complete the release and range of movement recorded. Patients were treated on a day-case basis. The standardized rehabilitation programme started on the day of surgery, and consisted of maintenance of range of movement with emphasis on gaining external rotation. Patients were followed up at regular intervals for a minimum of 6 months.

Patients underwent pre- and postoperative passive range of motion measurements (forward flexion, abduction, external rotation) and internal rotation measurements to vertebral levels by an independent observer (MN) and patient-reported outcome measure scoring using the OSS (range 0 to 48). Pre- and postoperative internal rotation was compared by comparing median vertebral level achievable. Results were statistically analyzed using Stata, version 13; StataCorp., College Station, TX, USA. Wilcoxon matched-pairs tests and Mann-Whitney *U*-tests were used for pre-post and between-group comparisons in OSS, respectively. Range of motion measures were analyzed using paired *t*-tests and unpaired *t*-tests for pre-post and between-group comparisons, respectively.

Results

Fifty-four procedures were performed in 52 patients. Median age was 50 years (range 42 years to 59 years). There were 41 females and 11 males. Seventeen patients (31%) were diabetic.

Patients were followed up for a minimum of 6 months and a maximum of 12 months.

Range of motion results are shown in Table 1. There was a highly significant improvement in range of motion ($p < 0.005$) at 6 months. Fifty-one patients (98%) achieved 160° of forward flexion at 6-month follow-up, with one patient only having 110°. Fifty

Table 1. Pre- and postoperative range of motion, statistically analyzed with paired *t*-tests.

Variable	Pre-operative median (interquartile range)	Postoperative median (interquartile range)	Mean difference (95% confidence interval)	<i>p</i> -value
Forward Flexion	40° (30° to 50°)	153° (140° to 160°)	110° (104° to 115°)	<0.0005
Abduction	30° (20° to 40°)	140° (120° to 160°)	109° (103° to 115°)	<0.0005
External Rotation	0° (0° to 0°)	40° (30° to 50°)	44° (40° to 48°)	<0.0005

Figure 1. Total Oxford Shoulder Score preoperatively and at 6-month follow-up.

patients (96%) achieved 140° of abduction at 6-month follow-up, with one patient achieving 160° and one patient limited to 90°.

The median pre-operative internal rotation level was the lumbosacral junction, which improved to the thoracolumbar junction by 6-month postoperative review.

Pre- and postoperative OSS are shown in Figure 1 and Table 2. There was a highly statistically significant improvement in both pain and function modules of the OSS ($p < 0.005$). The median postoperative score was 41 from 48 points, with an average improvement of 24 points. All patients reported return to work and normal functional activities by 6 months.

Outcomes between diabetic and non-diabetic patients were compared and are shown in Table 3. There was no significant difference in preoperative and postoperative OSS or range of motion between the diabetic group and the non-diabetic groups.

There were no post-operative surgical complications including humeral fracture. There was no requirement for surgical re-intervention. There were no cases of recurrence.

Discussion

Arthroscopic capsular release has been shown to provide good functional outcomes for frozen shoulder syndrome.^{10,11} Many studies on the subject are limited by small numbers, a lack of early outcome scores and are confounded by a patient case-mix including other co-existing shoulder pathologies that are known to affect outcomes. The largest published series used concomitant corticosteroid injection at the time of arthroscopic

release, which we consider to be a confounding factor in their study.¹¹

The present study only included patients with primary frozen shoulder, as confirmed by arthroscopic examination of the shoulder, and who had at no stage undergone corticosteroid injection. Patients were operated on during stage II of the condition, characterized by severe pain and stiffness. Statistical analysis of our results has demonstrated a highly statistically significant improvement in OSS and range of motion at 6-month follow-up. Because frozen shoulder is a condition with a natural history of eventual resolution in the majority, and which never recurs in the same shoulder once symptoms have resolved, short-term improvements in results are most important and are unlikely to worsen with time.

We found no significant difference in outcome between diabetic and non-diabetic patients in either OSS or range of motion at 6-month follow-up. Similar results were reported in the study by Smith et al.¹¹ Indeed, previous research has found no difference in outcomes between diabetics and non-diabetics treated with manipulation under anaesthesia for frozen shoulder.¹² These findings contrast with the recently published prospective study by Mehta et al. that directly compared outcomes between diabetics and non-diabetics, and reported that the results were significantly worse in diabetics 6 months postoperatively.¹³ Similar findings were reported by Cinar et al. in their retrospective review comparing results between diabetics and non-diabetics.¹⁴ Given these conflicting results, and the fact that previous histological studies have demonstrated no difference capsular pathology

Table 2. Pre- and postoperative Oxford Shoulder Scores (OSS), statistically analyzed with Wilcoxon matched-pairs tests.

Variable	Pre-operative median (interquartile range)	Postoperative median median (interquartile range)	p-value
OSS pain	3 (1 to 5)	30 (26 to 32)	<0.0005
OSS function	13 (9 to 19)	11 (9 to 12)	<0.0005
OSS total	17 (12 to 25)	41 (34 to 44)	<0.0005

Table 3. Statistical analysis of results in diabetics versus non-diabetics.

Variable	Pre-operative median (interquartile range)		Postoperative median (interquartile range)		Mean difference (95% confidence interval)	p-value
	Diabetic	Non-diabetic	Diabetic	Non-diabetic		
Forward Flexion	40° (30° to 50°)	35° (30° to 50°)	150° (140 to 160°)	160° (140 to 160°)	3.5 (to 8.6 to 15.6)	0.5657*
Abduction	20° (20° to 40°)	30° (20° to 40°)	140° (130 to 140°)	140° (120° to 160°)	4.4 (to 8.6 17.3)	0.5015*
External Rotation	0° (0° to 0°)	0° (0° to 0°)	45° (30 to 50°)	40° (40° to 50°)	7.0 (–5.4 to 19.4)	0.2635*
OSS pain	2 (1 to 3)	4 (1 to 5)	30 (23 to 31)	31 (26 to 33)	–	0.8576
OSS Function	10 (7 to 19)	13 (11 to 21)	10 (9 to 12)	11 (9 to 12)	–	0.4644
OSS Total	12 (9 to 21)	18 (14 to 26)	38 (32 to 42)	41 (36 to 44)	–	0.5917

*t-test. OSS, Oxford Shoulder Score.

between diabetics and non-diabetics,¹⁵ the effect of diabetes on outcomes following arthroscopic capsular release remains unanswered.

In addition to confirming the diagnosis, arthroscopy allows full visualization and evaluation of the shoulder anatomy. The primary pathology in frozen shoulder is a tightened and thickened coracohumeral ligament along with the rotator interval and capsule.² These structures can be accessed and divided in a controlled manner with arthroscopic instruments, with the limited use of a radiofrequency probe, minimizing damage to the articular surfaces and the subscapularis tendon. We have demonstrated, as reported in other studies, that an inferior release is not necessary to improve range of movement, especially given the risk of injury to the axillary nerve on the under surface of the inferior capsule.^{16,17} It is postulated that limited capsular release creating a stress riser in the tissues is sufficient to allow complete rupture of the capsule at the time of manipulation, although it also reduces fracture risk and the degree of surgical trauma, allowing for better postoperative pain relief, and allowing patients to commence early intensive physiotherapy rehabilitation postoperatively.

We acknowledge that the present study has a number of limitations. It is a relatively small sample

size with a follow-up limited to a maximum of 12 months. However, this is the largest study in which patients did not receive concomitant corticosteroid injection at the time of surgery. The sample size was sufficiently large to demonstrate strong statistical significance. We have previously demonstrated that patients continue to have significant improvement in patient-reported outcome scores for the first 6 months, after which rate of improvement slows down.¹⁸ Because we only included patients with primary frozen shoulder, we cannot extrapolate our results to patients with secondary frozen shoulder. However, many studies have included a case mix of patients, including those with co-existing shoulder pathologies, and have demonstrated significant improvement following capsular release.

This is the largest study in the published literature to examine the effect of arthroscopic capsular release and MUA, without corticosteroid injection, on frozen shoulder syndrome. Our results indicate that arthroscopic limited capsular release, combined with manipulation under anaesthesia, offers a safe and effective treatment for primary frozen shoulder syndrome. High-quality randomized controlled trials such as UKFROST comparing the clinical and cost effectiveness of the various treatment modalities used in the

treatment of frozen shoulder should be a priority area for future shoulder research.

Conclusions

We have been able to demonstrate significant improvement in OSS and range of motion outcome for patients undergoing a limited capsular release and a controlled MUA in isolation without the need for a secondary surgical intervention. A combination of limited release along with an MUA for the treatment of primary frozen shoulder syndrome is a safe and effective procedure resulting in marked improvement in pain, function and range of motion.

Declaration of conflicting interests

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References

- Hannafin J and Chiaia T. Adhesive capsulitis. *Clin Orthop* 2000; 372: 95–109.
- Manske RC and Prohaska A. Diagnosis and management of adhesive capsulitis. *Curr Rev Musculoskelet Med* 2008; 1: 180–9.
- Huang YP, Fann CY, Chiu YH, et al. Association of diabetes mellitus with the risk of developing adhesive capsulitis of the shoulder: a longitudinal population-based followup study. *Arthritis Care Res (Hoboken)* 2013; 65: 1197–202.
- Pal B, Anderson J, Dick WC and Griffiths ID. Limitation of joint mobility and shoulder capsulitis in insulin- and non-insulin-dependent diabetes mellitus. *Br J Rheumatol* 1986; 25: 147–51.
- Hsu J, Anakwenze OA and Warrender WJ. Current review of adhesive capsulitis. *J Shoulder Elbow Surg* 2011; 20: 502–14.
- Binder AI, Bulgen DY, Hazleman BL and Roberts S. Frozen shoulder: a long-term prospective study. *Ann Rheum Dis* 1984; 43: 361–4.
- Hand C, Clipsham K, Rees JL and Carr AJ. Long-term outcome of frozen shoulder. *J Shoulder Elbow Surg* 2008; 17: 231–6.
- Maund E, Craig D, Suekarran S, et al. Management of frozen shoulder: a systematic review and cost-effectiveness analysis. *Health Technol Assess* 2012; 16: 1–264.
- Neviaser AS and Hannafin JA. Adhesive capsulitis: a review of current treatment. *Am J Sports Med* 2010; 38: 346–56.
- Elhassan B, Ozbaydar M, Massimini D, Higgins L and Warner JJ. Arthroscopic capsular release for refractory shoulder stiffness: a critical analysis of effectiveness in specific etiologies. *J Shoulder Elbow Surg* 2010; 19: 580–7.
- Smith CD, Hamer P and Bunker TD. Arthroscopic capsular release for idiopathic frozen shoulder with intra-articular injection and a controlled manipulation. *Ann R Coll Surg Engl* 2014; 96: 55–60.
- Jenkins EF, Thomas WJ, Corcoran JP, Kirubanandan R, Beynon CR, Sayers AE, et al. The outcome of manipulation under general anesthesia for the management of frozen shoulder in patients with diabetes mellitus. *J Shoulder Elbow Surg* 2012; 21: 1492–8.
- Mehta SS, Singh HP and Pandey R. Comparative outcome of arthroscopic release for frozen shoulder in patients with and without capsular release. *Bone Joint J* 2014; 96B: 1355–8.
- Cinar M, Akpinar S, Derincek A, Circi E and Uysal M. Comparison of arthroscopic capsular release in diabetic and idiopathic frozen shoulder patients. *Arch Orthop Trauma Surg* 2010; 130: 401–6.
- Bunker TD and Anthony PP. The pathology of frozen shoulder. A Dupuytren-like disease. *J Bone Joint Surg Br* 1995; 77: 677–83.
- Berghs BM, Sole-Molins Xavier and Bunker TD. Arthroscopic release of adhesive capsulitis. *J Shoulder Elbow Surg* 2004; 13: 180–5.
- Ogilvie-Harris DJ and Wiley AM. Arthroscopic surgery of the shoulder. A general appraisal. *J Bone Joint Surg Br* 1986; 68: 201–7.
- Tan CK, Guisasola I, Singh S, Penna S, Kemp G and Brownson P. Arthroscopic capsular release: a prospective double-blind randomized study comparing two types of rehabilitation regime. A pilot study. *Shoulder & Elbow* 2009; 1: 119–22.