Section: Orthopaedics

Systematic Review

FROZEN SHOULDER: CLINICAL PRESENTATION AND TREATMENT STRATEGY

Pulkit Sharma[1], Sanjeev Gupta[2], Rahul Singh[3]

[1]Post Graduate, Department of Orthopaedics, GMC Jammu, India.
[2]Professor and Head, Department of Orthopaedics, GMC Jammu, India.
[3]Post Graduate, Department of Orthopaedics, GMC Jammu, India

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Corresponding Author:
Dr. Pulkit Sharma,
Email: drpulkitsharma03@gamil.Com.

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Abstract

Background: Frozen shoulder (FS) is a common shoulder disorder characterized by a gradual increase of pain of spontaneous onset and limitation in range of motion of the glenohumeral joint. The pathophysiology of FS is relatively well understood as a pathological process of synovial inflammation followed by capsular fibrosis, but the cause of FS is still unknown. Treatment modalities for FS include medication, local steroid injection, physiotherapy, hydrodistension, manipulation under anesthesia, arthroscopic capsular release, and open capsular release. Conservative management leads to improvement in most cases. Failure to obtain symptomatic improvement and continued functional disability after 3 to 6 months of conservative treatment are general indications for surgical management. However, there is no consensus as to the most efficacious treatments for this condition. We performed an electronic PubMed search on all (1559) articles mentioning 'frozen shoulder' or 'adhesive capsulitis' to understand and qualify the range of naming, classification and natural history of the disease. We identified and reviewed eight key thought leadership papers published in the past 10 years and all (27) systematic reviews published on frozen shoulder or adhesive capsulitis in the past five years.

INTRODUCTION

Frozen shoulder (FS) is one of the most common, yet challenging clinical disorder presenting to the orthopedic surgeon. It is a disease characterized by a significant decrease of active and passive range of motion (ROM) of the glenohumeral joint along with pain. The prevalence rate of FS is 2%–5%, and it occurs more commonly in women.[1,2] Along with the increase in the comorbidities and changes in lifestyle, the incidence of FS is increasing.[3,4]But, the natural course and pathogenesis of FS have not been widely investigated and are still unknown.

Epidemiology/Etiology

The most alarming of risk factors is diabetes; in this population, prevalence increases to 20%. Additionally, Milgrom et al. reported a significantly higher prevalence of AC in women with hypothyroidism compared to the age-matched regional population (21.1% versus 7.9%).[5] AC affects women more than men. Several predisposing factors have reportedly been associated with AC: hyperthyroidism, Dupuytrencontracture, breast cancer treatments, cerebral vascular disease, myocardial infarction, hyperlipidemia, and autoimmune disease.[6] Lastly AC was more prevalent in those patients with a prior episode of disease in the contra lateral shoulder.[7] AC is frequently described as progressing through four different phases.[8] The first phase is known as the painful phase where patients will develop diffuse, severe, and disabling shoulder pain, that is worse at night. During this initial phase, range of motion (ROM) is preserved and the pain is thought to be caused by synovitis. The next phase of the disease course is characterized by increasing stiffness over the next 2–9 months. The third phase is described as a global and progressive loss of ROM while pain becomes gradually less pronounced. This phase typically lasts 2–4 months. The fourth and final phase is described as a recovery phase with a gradual return of ROM that takes 5–14 months to complete.

Diagnosis

Radiographs are classically normal in patients with AC. MRI in patients with AC often reveals capsular and CHL thickening, poor capsular distension, extracapsular contrast leakage, and synovial hypertrophy and scar tissue formation at the rotator interval (Figure). MRI findings on T2fat-suppressed sequences in a study of 103 patients with AC correlated with pain intensity, ROM, and clinical stage. Anterior extra capsular edema was associated with degree of external rotation and abduction. Joint capsule edema in the axillary recess was associated with loss of external rotation. Joint capsule

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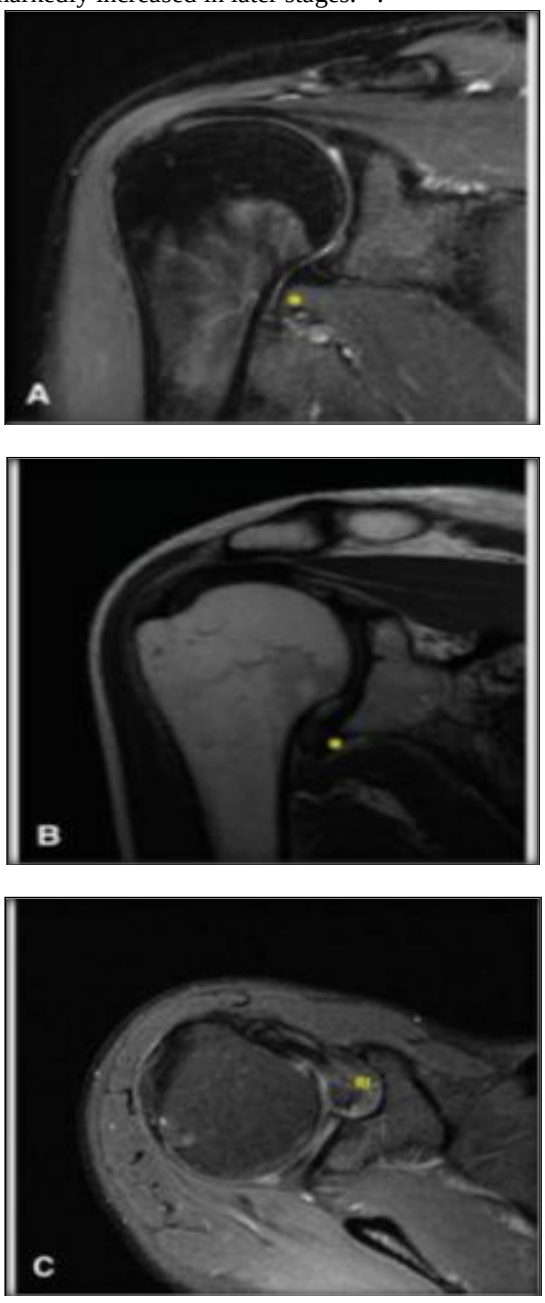
thickness was associated with pain intensity. Findings of joint capsule edema and obliteration of the subcoracoid fat triangle were more common in the early stages of AC, where as capsular thickness markedly increased in later stages.[9].



MRI evidence of adhesive capsulitis. Coronal MRI showing anormal thickness capsule in the axillary pouch(A), coronal MRI showing a thickened capsule and contracted axillary pouch(B), and axial MRI showing scarring of the rotator interval(C).* =axillary pouch/capsule ,RI=rotator interval.

CONSERVATIVE TREATMENT

Common conservative treatments include oral medication, physical therapy, exercise, steroid injection, and hydrodilatation. These initial conservative managements may be successful in up to 90% of patients. It is important to note the phase being treated because of differences in symptoms at each phase. In freezing phase (duration, 10–36 weeks), pain is most prominent. Steroid injection provides rapid pain relief, mainly in the short-term period. In frozen phase (4–12 months), pain gradually subsides but restricted ROM is predominant. In this phase, therapy should focus on increasing ROM, such as mobilization techniques or distension for which limited evidence was found. In the thawing phase (12–42 months), there is minimum pain and progressive improvement in ROM. As pain and muscular inhibition result in compensatory movements of the scapula, the role of adaptation of scapular motion could be important in managing rehabilitation in FS.

Medication:

During the initial painful freezing stages, treatment strategy is directed at pain relief. Although it is traditional to give patients nonsteroidal anti-inflammatory drugs (NSAIDs), NSAIDs alone have no effect on the natural course of FS.[10] There are no randomized controlled trials that confirm the effectiveness of NSAIDs in the specific condition of FS.

Oral administration of corticosteroid is also used in the treatment of FS. Canbulat et at.[11] reported that oral glucocorticoids (0.5 mg/kg/day methylprednisolone) in 33 FS patients improved clinical outcomes: the mean visual analog scale (VAS) score, from 6.3 initially to 0.2 at 6-month follow-up; the mean Constant score, from 28.3 initially to 94.8 at first year follow-up; the mean American Shoulder and Elbow Surgeons score, from 25.9 initially to 98.7 at first-year follow-up. In one randomized clinical trial of 40 patients performed by Lorbach et al.[12] patients with idiopathic FS were treated with an oral corticosteroid treatment regimen (20 patients) or intra-articular injection of corticosteroid (20 patients). In the patients treated with the oral regimen, significant improvements were found for pain and functional outcomes at the 4-week follow-up. However, the patients treated with an intra-articular injection showed superior results in objective shoulder scores, ROM, and patient satisfaction compared with the oral steroid group.[12]Buchbinder et al.[13] reported the results of oral prednisolone for the treatment of FS in a randomized, double-blinded, placebo-controlled study and found significant improvement in the study group at 3 weeks. As described in the previous studies, oral steroid treatment seems to provide early benefit both in terms of pain relief and functional outcomes; however, long-term benefit has not yet been established. One systematic review reported on the use of oral steroid in the treatment of FS (five trials, 179 patients). In three high-quality trials, oral steroids were compared with placebo or observation. No significant differences were found in pain in the short term and in pain and ROM in the long term.

Calcitonin is a polypeptide hormone secreted from para-follicular cells of the thyroid. Although the mechanism of action of calcitonin is not fully understood, it plays a significant role in managing rheumatoid arthritis, complex regional pain

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syndrome, fracture, and metastasis of bone tumor.[14]And it is thought to decrease the systemic inflammatory response and stimulate the release of endorphins. A double-blinded randomized clinical trial (level of evidence II) of 64 patients with FS compared intranasal calcitonin and placebo for 6 weeks. Physiotherapy and NSAIDs were administered equally to both groups. At 6 weeks, both groups had significant improvement in pain, ROM, and functional outcomes.

Physical Therapy

Physical therapy is often the first line of treatment for patients with early stages of adhesive shoulder capsulitis. Its often combined with other treatment modalities as there is limited evidence to support the use of physical therapy alone. PT remains a mainstay in the treatment of AC and early mobilization with physical therapy is almost universally recommended. There is some controversy over the technique and frequency of therapy. One study showed that only 63% of patients undergoing intensive physical therapy demonstrated improved shoulder function compared to 90% who did less intense, gentle exercises. More recent evidence suggested no difference between gentle and aggressive mobilization techniques.[15]

Recent studies have explored novel mobilization techniques. High-intensity stretch (HIS). HIS utilizes a device that can apply torque to the joint similar to that applied by a physical therapist. These devices are designed to stretch a joint at its end of ROM to permanently elongate scar tissue that formed in the joint. Patients are given HIS devices when they are not meeting treatment milestones and have reached a plateau in their recovery with standard PT. A study which observed patients with postoperative AC who were unable to reach their PT treatment goals during a standard protocol of PT, found that HIS may be a beneficial addition to their treatment regimen. Angular Joint Mobilization (AJM) has shown some promise in patients with AC and may be an effective intervention for improving shoulder pain, increasing ROM, and decreasing disability. AJM is rotational joint mobilization with joint axis shift. Joint axis shift takes into account that there is more than just the rotational movement of the glenohumeral joint and AJM therapy addresses joint axis shift that could be impaired in AC. In a recent case report a patient with AC reacted positively to AJM. Lastly, continuous passive motion (CPM) is intended to prevent the formation of scar tissue through continuous movement the joint back and forth throughout the entire ROM. The use of CPM in treating AC has had mixed results. A recent randomized controlled trial, diabetic patients with AC seemed to have positive results and benefited from treatment with CPM. Patients had improved ROM and decreased pain when compared to the control group.[16]

Corticosteroid Intra-Articular Injection

Intra-articular corticosteroid injection may offer faster and superior improvement in symptoms when compared to PO corticosteroid treatment. Intra-articular steroid injections have been shown to decrease fibromatosis and myofibroblasts in adhesive shoulders.[17] Intra-articular methylprednisolone injections have been shown to provide more rapid improvement in pain and ROM when compared to PT, ice therapy, and no treatment. There seems to be no difference between those three treatment modalities at 6 months follow up. In recent reviews exploring the effectiveness of corticosteroid injections, it was concluded that intra-articular corticosteroid injections were more effective in pain relief in the short term, but this pain relief did not sustain in the long term.[18] It was also concluded that intra-articular corticosteroid injections improve ROM both in the long and short terms. In another review of randomized clinical trials it was concluded that there was no differ-ence in outcomes between corticosteroid injection and oral NSAID drugs at 24 week follow up. Recently it was shown that there might be added benefit of image-guided corticosteroid injections but further investigation is needed.

Additionally, it was shown that when used in conjunction with other treatment modalities, intra-articular corticosteroid injections can provide additional benefit. In a recent study comparing the efficacy of a single intra-articular corticosteroid injection, a supervised physiotherapy program, a combination of the two, and a placebo in the treatment of adhesive capsulitis showed that a single injection of corticosteroid combined with a simple home exercise program was more effective than just supervised physiotherapy.[19]

Intra-articular Distention

Hydrodilation is a minimally invasive office-based technique which involves injection of fluid into the joint with the goal of distending the glenohumeral joint. The injectate usually contains a mixture of corticosteroids, anesthetics, and saline. Although it is a relatively quick procedure, hydrodilatation is not without adverse events. Notably, it can cause increased pain or joint rupture. Additionally, it is expensive when compared to other noninvasive therapies.[20] Saltychev conducted a systematic review of 12 RCTs and meta-analysis of 7 RCTs to further investigate the effectiveness of hydrodilatation. While the procedure had a significant effect on pain reduction and increase in ROM, it did not have an impact on disability level. Also, the study found the number needed to treat to be relatively high at 12; the authors deemed the clinical significance of the treatment to be low.[20]

Yoon et al. conducted a prospective randomized controlled trial of 86 patients to compare the efficacy of intra-articular injection to subacromial injection and to hydrodilatation in reducing pain and increasing passive range of motion 1 month, 3 months, and 6 months after treatment. All patients also received medical treatment with NSAIDs and a muscle relaxant and a physical therapy exercise program for the duration of the study. While the

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results for intra-articular injection and subacromial injection were similar, hydrodilatation showed better reduction in pain and increase in range of motion for 1 month and increase in functional scores for 3 months. This benefit was no longer seen at the 6 month mark. Although the study showed positive results for hydrodilatation, several limitations should be noted. All participants went through physical therapy as well as injection therapy. Because there was no control group of placebo injections, it is difficult to say whether the injection therapy was solely responsible for the stated benefits or whether it was a combination of injections and regimented physical therapy. Additionally, hydrodilatation injections contained a combination of steroids and anesthetic; thus, potential benefit could be attributed to combination therapy.

Manipulation Under Anesthesia

Manipulation under anesthesia (MUA) is reserved for patients who are refractory to conservative and minimally invasive treatment options. MUA relies on aggressive manipulation of the shoulder joint, allowing for adhesional tears and release of the inferior capsule. This forced rotation allows for movement beyond a patient's normal pain threshold that would otherwise be unmanageable with normal PT.[21] Many studies have shown notable effectiveness of MUA for AC, though the utility still remains under debate. A recent 2018 study showed that MUA caused significant improvements in pain scores, range of

motion and patient satisfaction at both 3 weeks as well as 3 months. Also a recent 2019 systematic review stated that considerable increases in range of motion and reduction in pain scores leading to an 85% patient satisfaction rate is possible with MUA.[47] Given the lack of a large randomized control trial the argument still cannot be made for or against the use of MUA for adhesive capsulitis. The timing of when patients should receive MUA has also been debated. It was thought that early intervention may lead to over-treatment in a dis-ease that could have a mild progression. It was also thought that early intervention during the inflammatory stage of the disease would be less effective and cause increased recurrence of symptoms.[22] A retrospective 2015 study showed that 6–9 months after symptom onset may be the ideal time for intervention to prevent long term complication as well as over treatment.[22] A 2017 study demonstrated that patients that have had limited success with MUA, should be offered a repeat MUA. Subsequent MUA led to significant reduction in pain scores as well as an increased range of motion. Although it is regarded as a safe procedure, MUA is not without its inherent risks. There have been incidences of capsular tear, labral detachment, hemarthrosis, glenoid/ humeral fracture as well as the risk of anesthesia. Vastamaki et al. reported that MUA in diabetic patients may be less effective than in non-diabetic patients.[22] There have also been various studies that compared the utility of MUA versus other more conservative methods. Jacobs et al. conducted a randomized control trial finding there no difference between MUA and intra-articular steroid injections with regard to reduction in pain or increase in range of motion. In addition, a 2007 randomized control trial showed that when comparing normal physiotherapy exercises to MUA no difference was noted at 3, 6 and 12 months. MUA has demonstrated utility and proven effectiveness for the treatment of AC, however when given the lack of large randomized control trials its use should be limited only when more conservative measures have failed.

SURGICAL PROCEDURE

Despite the self-limited natural history of the disease, some patients fail to achieve desired outcomes with non-operative management.[23] Factors that influence the decision on surgical management include severity and duration of symptoms as well as response to conservative treatment. General indications for surgery are persistent pain and limited motion despite a minimum 3 to 6 months of nonoperative management including medication, local injections, or physiotherapy. Levine et al.[12] reported that patients with more severe initial symptoms, younger age at the time of onset, and reduction in motion despite 4 months of compliance with therapy are most likely to require surgery.

As with the increase in patients with FS, surgical intervention for FS is common these days. The overall inci-dence of FS surgery was calculated as 2.67 procedures per 10,000 general population per year and as 7.55 for those aged 40–60 years. Management of FS amongst doctors varies substantially and is highly based on personal experience and training rather than published evidence. Operative treatment methods include MUA and arthroscopic or open capsular release. As arthroscopic capsular release (ACR) is a reliable treatment option with many advantages over open surgery, the indications of open release have decreased and open release is now rarely performed.

Arthroscopic Capsular Release

Due to complications of MUA and advances in arthroscopic techniques, ACR has become the most frequently used surgical intervention that was previously shown to confer lasting long-term improvements in symptoms ACR also allows for visual confirmation of the diagnosis as well as the ability to treat concomitant intra-articular and subacromial disease that may be contributing to the primary cause of the problem.

Recently, many studies have shown excellent results both in terms of pain relief and ROM gain with ACR. In a study by Le Lievre and Murrell.[24] 49 shoulders treated with an ACR obtained early significant improvements in ROM, pain relief, and function. These improvements were maintained at 7 years.[24] Furthermore, even when compared with other procedures such as HD and MUA, ACR had good clinical results. Gallacher et al compared the

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6-month follow-up results of HD (20 patients) for FS with ACR (19 patients). They reported that patients randomized to ACR showed a significantly higher Oxford shoulder score at 6 months than the HD group.[25]

There is a wide variation in the way ACR is carried out, ranging from partial release to a full 360º release. Also there are various debates in the literature regarding the extent of release. Several authors recommended release of the posterior capsule, and it was believed to have advantages regarding the recovery of internal rotation. On the contrary, Chen et al.[26]reported that although the ROM (abduction and internal rotation) improvement was more significant in the addition of posterior release within the first 3 months after ACR, there was no significant improvement in function or internal rotation with the addition of posterior release at mean of 28 months after surgery.

Some surgeons prefer MUA followed by ACR, which has also provided satisfactory results. De Carli et al.[27] followed up 23 patients who underwent MUA and arthroscopic arthrolysis for a minimum of 12 months and compared the results with those of intra-articular steroid injection performed in 21 patients. They found patients of MUA followed by arthroscopic surgery accomplished their goal by the 6-week follow-up, whereas in the injection group, the same result was obtained at 12 weeks. Grant et al.[28]conducted a systematic review of 22 studies that compare outcomes between MUA, capsular release, or a combination of both. Of the study participants, the median age was 52 years and 60% were women. They concluded that even though the quality of evidence available was low, there was little benefit of ACR instead of or in addition to MUA.

Overall, ACR in FS is a safe procedure with a low complication (nerve injury, chondrolysis, or instability) rate; however, caution to axillary nerve injury is needed. To prevent possible injury to the axillary nerve, some au-thors were very cautious about the inferior release. In cadaveric dissections, the teres minor branch of axillary nerve was the closest to the 5:30 and 6 o'clock position on the inferior glenoid rim. At this position, the average distance between the axillary nerve and the glenoid rim was 12.4 mm (10 to 25 mm) and the nerve lay at an average of 2.5 mm from the inferior glenohumeral ligament. The abduction-neutral position resulted in the greatest distance between the inferior glenoid and the axillary nerve.

CONCLUSION

FS, commonly encountered in general orthopedic practice, is a condition of pain and stiffness with consequent func¬tional impairment. Appropriate treatment decisions for FS require a comprehensive understanding of pathophysi¬ology, patient's systemic medical condition, functional demands, severity of symptoms, and response for nonop¬erative treatment. The majority will experience resolution when treated conservatively; thus, conservative manage¬ment should be the first option.

NSAIDs may relieve pain and reduce sleep disturbance, but they do not have a substantial effect on recovery. Oral steroid may provide rapid pain relief and ROM recovery in the short term. Physiotherapy is so widely accepted that it should be used in the conservative management of FS. When patients have the most pain, steroid injections can be beneficial in the early period of the disease (particularly, in the first 6 weeks). But longer-term results would show no difference between patients treated with steroids and control subjects. There is still debate on the appropriate steroid injection site. The HD alone appears to provide only a small, clinical benefit, and there is no evidence to suggest any superiority to other treatments.

Initial conservative management may be successful in up to 90% of patients. Patients who are regressing despite appropriate therapy are likely to require surgical intervention. MUA has been used extensively with satisfactory outcomes. However, surgeons always need to take caution to avoid iatrogenic complications and should explain the possibility of recurrence in patients with diabetes. Although the extent of additional capsule that should be released remains controversial, ACR is a reliable treatment method, with a low complication rate, for restoring function and reducing pain in patients with FS. Patients should begin progressive ROM exercises as soon as possible under the supervision of a trained therapist.

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