

Current concepts of natural course and in management of frozen shoulder: A clinical overview

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Abstract

Frozen Shoulder (FS) by many specialists is still considered a benign, self-limiting condition, which usually resolves without intervention. This concept originated in the 70', stating that FS will proceed from "the freezing" phase, with the predominance of inflammation and pain to "the frozen" phase with marked stiffness in the joint and "the thawing" phase, with a progressive return to the normal Range Of Motion (ROM) and function. Nevertheless, numerous authors have recently challenged this concept, arguing that most patients with FS will never fully recover, and suffer from residual pain and loss of function. Lack of early intervention, when a patient does not improve with conservative treatment, might lead to disability. We have discussed the recent concepts in the natural course of the disease and discussed both noninvasive and surgical methods in the treatment of FS.

Introduction

Shoulder pain, along with knee and spinal diseases, is one of the most common conditions in orthopedic practice.¹ One of the most frequent diseases of this joint is Frozen Shoulder (FS), which affects 2-7% of the population, and up to 20% of diabetic patients.²⁻⁴ It was first described in 1872 by Duplay as "peri-arthritis scapulohumeral". In the 1930', the term "frozen shoulder" and the first attempt to define its diagnostic criteria was introduced by Codman.⁵

FS is also defined as Adhesive Capsulitis (AC), due to the histological picture of the disease consisting of synovitis which is followed by fibrosis evoked by a chronic inflammatory process.^{6,7} Proinflammatory cytokines (IL-1, IL-2, TNF- α , IL-6) and growth factors secreted

by immune cells together with cyclooxygenases (both COX-1 and COX-2) trigger remodeling of collagen in the matrix.⁷ The microscopic findings are corresponding with the macroscopic picture of the disease on arthroscopy, with glenohumeral joint's capsule as the main site of pathological changes.⁷ Inflammatory cascade leads to contraction of the joint capsule and restriction in both active and passive Range Of Motion (ROM), which is a characteristic feature of FS.^{8,9}

Traditionally, in the course of frozen shoulder 3 major phases can be distinguished, basing on the classification proposed by Reeves *et al.* in the '70. First of them is "painful" (freezing) stage, followed by "stiff" (frozen) and "recovery" (thawing) phase.^{10,11} Development of FS in one arm is related to an increased risk of development of the same condition in the contra-lateral arm a few years after, which occurs in 20% of patients with FS.^{6,12,13} Similarly, simultaneous bilateral involvement is found in 14% of patients, however, the condition never affects the same limb more than once.^{12,13} Nevertheless, about 1/3 of patients have some residual symptoms, and in the patients subjected to non-operative management ROM is reduced by 10-15% in comparison with the contralateral side.^{8,14} The disability resulting from FS might limit patients in their daily activities and affect their work capacity for a substantial time.^{15,16}

According to another classification, FS has been divided into primary or idiopathic, where the disease has no apparent underlying cause and secondary FS. The most common cause of secondary FS is diabetes mellitus, affecting 10-36% of these patients,^{6,17} and there is a correlation between HbA1C and FS development. These patients usually require more aggressive treatment.⁶ Other causes of secondary FS are listed in the Table 1. Hanchard *et al.* have also suggested another classification basing on the clinical presentation of the disease, distinguishing the "pain-predominant" and "stiffness-predominant" type. This classification is most useful clinically as it highlights the main ailment of a patient which facilitates the planning of patient's management.¹⁸

Aim

This paper is a general overview of the literature regarding the frozen shoulder, with the main focus on the treatment strategies and the evolution of concepts of the natural course of this condition that has occurred in recent years. It also discusses the advantages and disadvantages of dis-

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tinct management options as described in the current literature.

During a preliminary meeting with all authors, 3 key questions were formed: i) what is the optimal management for FS? ii) What factors should be taken into consideration when choosing one type of intervention over another? iii) What is known on the effectiveness of these interventions?

A search on PubMed/MEDLINE was conducted using keywords and combination of the keywords (in titles and/or abstracts): "frozen shoulder", "management", "treatment", "diagnosis", "imaging", "adhesive capsulitis", and afterwards with combination of the names of interventions we describe in the manuscript ("physiotherapy", "physical therapy", "hydrodistention" "corticosteroids OR steroids", "arthroscopy", "manipulation

under anesthesia”). All initially selected papers were independently revised two authors (MH and WK) who decided if they would be included in the review. In case of disagreement, TP decided whether they should be included.

Diagnosis

FS is diagnosed primarily basing on its clinical presentation, as there are no strict diagnostic criteria. Patients usually report localized pain with an insidious onset, sometimes preceded by minimal injury. Its intensity interferes with activities of daily living and causes sleeping disruption.¹² The ROM is restricted in multiple planes, however, most characteristic for FS is the loss of external rotation – both passive and active.^{2,12,19} Scarring from previous surgery or trauma might indicate secondary causes of pathology.² However, relying solely on clinical features of frozen shoulder in the diagnostic process requires that suspicion is confirmed by an experienced orthopedic surgeon because in up to 54% of cases primarily diagnosed as frozen shoulder are not confirmed by arthroscopic findings.¹

Usually, imaging is not required for confirmation of the diagnosis, however, it might be useful especially when the clinical picture is not clear and other pathologies are suspected, such as rotator cuff tear, joint instability or impingement.¹ X-ray should reveal a normal glenohumeral joint. However, magnetic resonance might be useful in dubious cases, as most findings suggestive of frozen shoulder are confirmed on arthroscopy.²

Management

There is no “golden standard” in the management of FS, although numerous treatment modalities are proposed. The main aim of the treatment is to resolve symptoms resulting from inflammatory processes (pain and impaired mobility) and limit the time with disability.

Traditionally it is thought that FS is a disease resolving without treatment, however, various authors have challenged this view.^{10,17,19} The concept that FS is a benign condition which resolves spontaneously was originated in the 1970s by Reeves et al.^{5,10} Wong *et al.* in their review estimated that this statement would be true to only 26% of the patients.¹⁰ According to some authors, the percentage of patients with residual symptoms might be as high as 50%.¹⁹ It is generally proposed that initial

management should consist of anti-inflammatory medication and gentle home exercises, along with physiotherapy and other non-operative interventions. In case of failure to relieve symptoms, various operative treatments might be used, such as manipulation under anesthesia, hydrodilatation, and arthroscopy.^{15,17}

Anti-inflammatory drugs

Anti-inflammatory drugs, such as Non-Steroidal Anti-Inflammatory Drugs (NSAIDs) along with rest are usually considered as a first-line treatment, however, their use does not change the natural course of the disease.¹⁷ The combination of NSAIDs with PTI is more efficient in terms of restoring normal function and reducing pain.¹¹ One study has also shown that the addition of calcitonin to this regimen might further improve the outcome after 6 weeks versus PTI and NSAIDs with placebo. However, more randomized controlled trials would be necessary to establish the role of calcitonin in the treatment of FS.

There were some trials of the use of oral steroids in the management of FS. One RCT suggested the use of oral methylprednisolone 0,5 mg/kg/d.¹⁷ Nevertheless, the use of oral steroids is associated with a risk of systemic side effects and is rather discouraged.

Corticosteroids and intraarticular injection

Intraarticular injection remains one of the most common procedures in the non-operative management of FS. Most often, steroids are used as their anti-inflammatory properties help to limit the inflammatory processes leading to fibrosis of the joint capsule.⁹ Corticosteroid injections are highly accepted by both patients and physicians

and are considered cost-effective.²⁰ Local injection to the joint cavity gives faster results than oral steroids, with minimal risk of systemic side effects.⁶ Injection of steroids was also proven to be more effective in restoring ROM, accelerating recovery and relieving pain than sole NSAIDs use.²¹ Moreover, intraarticular corticosteroid administration is also related to higher patient satisfaction and superior outcome in terms of ROM and objective shoulder scores a 4-week follow-up in comparison with oral administration.¹⁷ However, care must be taken in case of diabetic patients, as even intra-articular administration can elevate blood glucose levels for up to a week.⁶

According to Cochrane review the advantage of steroids in comparison with no treatment disappears at longer follow-up >6 weeks, but it might be beneficial in the first weeks when the pain is a predominant complaint.^{5,17,22,23} Various authors proposed different sites of injections – glenohumeral or subacromial joint or combination of both. No study has proven which site of injection is superior over another.¹⁷

Recently, platelet-rich plasma injections were proposed as an alternative to corticosteroids. In one study, PRP injection guided by ultrasound was associated with higher reduction of pain in comparison at 6 and 12 weeks, improvement in ROM and shoulder function evaluated by SPADI score at 12 weeks post-injection in comparison with steroid injection. Additionally, more patients in the PRP group (75%; n=21) were satisfied with the results of this procedure vs. the corticosteroid group (52%; n=14).⁹

Physiotherapy intervention and physical therapy

Physiotherapy’s intervention (PTI) main goal is to restore and maintain func-

Table 1. Secondary causes of frozen shoulder (Whelton, 2018, Jain 2014; Tyree 2018).^{6,12,13}

Causes
Diabetes mellitus
Trauma
Connective tissue disorders (<i>e.g.</i> Dupuytren’s contracture, Peyronie’s disease)
Shoulder arthroscopy
ACTH deficiency
Thyroid diseases
Cardiac disease
Neurological disease (<i>e.g.</i> Parkinson’s disease and stroke)
Neurosurgery
Cancer
Hyperlipidemia
Medications (<i>e.g.</i> antiretrovirals, fluoroquinolones)
Prolonged immobilization

tion of the affected shoulder. Most often it's complimentary to other non-interventional treatments (such as NSAIDs or steroids). Physical Therapy (PT), such as low-level laser and ultrasound therapy along with acupuncture, massage have shown some improvements in pain and function, but the evidence supporting their use is still limited. A Cochrane review has shown that physiotherapy alone doesn't improve the outcome in comparison with no intervention.^{3,11,12,24,25}

Hydrodistension

Hydrodistension or Hydrodilatation (HD) is a procedure where the physical force of liquid's volume is used to expand the joint cavity and disrupt capsular adhesions formed in the course of intraarticular inflammation to diminish shoulder stiffness.^{6,19,26} It should be taken into account in patients who do not improve with oral anti-inflammatory medication and PTI, or when the watchful-waiting strategy is not considered appropriate. Complications after HD are rare, but a case of septic arthritis following this procedure was described in the literature.²⁶

Posterior approach for injection is most commonly used, although recently published reports indicate that the anterior approach might lead to better results in terms of functional recovery and pain relief. One RCT demonstrated that anterior injection in the rotator interval with saline, corticosteroid, and a local anesthetic is more effective in comparison with the posterior approach in terms of pain reduction, SPADI, and ROM improvement.²⁷ Another RCT also showed that the anterior approach is more effective than the posterior or sub-acromial approach for the reduction of PAIN, and improvement in passive ROM and DASH (Figure 1).²⁸

Various regimens administered with or without local anesthetic are described by different authors: saline, contrast agents, steroids, hyaluronic acid, or air were described, with ultrasound (US) or fluoroscopy as an imaging guide.^{17,19,26} The injected volume is also highly variable, ranging from 20 mL to 90 mL. Although intuitively a capsular rupture is desirable, data from clinical studies demonstrate that it is not necessary for the procedure's success. It is postulated that the physical force exerted by liquid's volume itself inhibits myofibroblast activity, therefore is sufficient to relieve motion restriction found in FS.²⁶ The addition of steroids to saline further reduces the inflammatory process, also the inflammation resulting from stretching of the capsule during HD.¹⁹

Cochrane review from 2008 indicated that there is some proof that HD offers pain

relief and function in the short term, nevertheless, this effect diminishes after 3 months.²⁹ Wu *et al.* in their more recent meta-analysis, which included 11 high-quality randomized controlled trials, indicated that HD with steroid was superior to steroid injection alone in terms of increasing external rotation range (but not in other planes), but the difference vanished in the long-term, and there was no difference in terms of function between the two treatments. Regarding the effects of other different agents used in HD, hyaluronic acid showed a similar trend for improvement as steroid administration, but the results in the trial using air were inferior in comparison with sole steroid injection. Wu *et al.* concluded that the administration of saline with a corticosteroid using a posterior approach with the assistance of the US is a preferable regimen.¹⁹

HD can be combined with other established treatment methods to further increase its effectiveness. When considering HD and inpatient PT, one research suggested that performing HD before PT initiation might lead to better outcomes in terms of function than when PT precedes HD in a 12-week follow up ($p=0.002$), but not in terms of pain relief ($p=0.123$).⁹ Only one paper described that a combination of HD with joint manipulation provides earlier restoration of ROM and improvement in function at 6- and 12-weeks follow-up than steroid injection, but the difference at 1-year follow-up was nonsignificant. More studies are needed to establish if this strategy might further improve the outcome of patients.³⁰

Operative management

Certain patients do not fully recover from FS with conservative treatment or have residual symptoms strongly interfering

with their daily activities and work capability. If conservative treatment fails to provide sufficient symptom relief, invasive procedures might be offered to refractory patients, however, according to the authors experience, the results are not always satisfactory.

Manipulation under anesthesia

Manipulation Under Anesthesia (MUA) involves passive mobilization of the joint, which leads to the tearing of fibrous tissue of joint capsule and contracted ligaments.¹⁷ Recently, instead of general anesthesia, MUA is performed under a brachial plexus or cervical nerve block.¹⁷ Although there is no consensus in terms of optimal timing for MUA, it is usually proposed when the symptoms of FS do not sufficiently improve in the first 6-9 months with conservative management.³¹ It is justified, as at this time point the joint is no longer in the inflammatory phase, and the risk of recurrence might be lower. This should be taken into account because some authors report that the rate of recurrence ranges from 3% to 40%,^{6,17} and the procedure is related to increased risk of other complications, such as brachial plexus injury, dislocation, rotator cuff tear, and intraoperative fracture.³¹ It might not be the best option in diabetic patients, as up to 40% of patients subjected to MUA will eventually undergo surgery.⁶ In comparison with the idiopathic FS, in diabetic patients recovery of ROM is slower, and the overall result of MUA is inferior.³²

The usefulness of MUA in FS is controversial. In a 2012 review Maund *et al.* identified 4 RCTs and found no differences between MUA and different comparators (PT, steroid injection, and/or distension) in terms of function, pain, and disability at short, and even long-term follow-



Figure 1. Injection in hydrodistension procedure guided by ultrasound (in plane projection). The red line pinpoints the direction of the needle.

up.²² However, Kim *et al.* in their retrospective study have compared MUA with a more invasive arthroscopic release and demonstrated that the clinical outcomes in a follow-up up to 12 months, with only 2 patients requiring additional intervention due to symptoms reoccurrence (steroid injection at 3 and 6 months).³¹ Another group performed MUA after a mean of 8.81(±5.47) months in a group of 212 patients using Codman's paradox (rotational movement around the shoulder without any rotational movement). They observed rapid and significant improvement in ROM, pain, and function in as short as 3 weeks postoperatively, without any complications.³³

Arthroscopic capsular release

Advancement of arthroscopy enabled minimally invasive treatment for frozen shoulder, therefore diminishing the significance of MUA.^{5,17} Arthroscopic Capsular Release (ACR) also has an advantage over other treatment modalities as it allows confirmation of the diagnosis intraoperatively.^{7,17} There were numerous techniques described such as anterior capsulectomy, the release of coracohumeral ligament as well as middle glenohumeral ligaments.²⁶ Some authors also opt for full, 360° capsulectomy.¹⁷ The rate of complications is low, but the risk of damage to the axillary nerve is increased in full capsulectomy.⁵ Other complications to be considered include instability and chondrolysis.¹⁷ Contrary to MUA, the timing of the procedure and presence of diabetes mellitus might not be as important for the success of the procedure. Su *et al.* have conducted procedures both in the inflammatory phase (<6 months) and later (6 and more months since the initial symptoms), and observed similar restoration in ROM (also when comparing both diabetic and nondiabetic patients), and time interval from the surgery to free from symptoms (3.6 weeks in nondiabetic, and 3.7 weeks in diabetic patients). The difference in satisfaction from the procedure in diabetic and nondiabetic patients was non-significant (7.0 vs 7.5; p=0.9).³⁴

Other reports also demonstrate that ROM improvement and pain relief are achieved pretty fast (1-24 weeks) and are long-lasting, with the longest follow up reported at 7 years postoperatively.^{5,6,17,22} However, no good-quality RCTs are comparing ACR with other or in addition to invasive treatments such as MUA, and those available suggest a little benefit of MUA addition or performing MUA instead of ACR.²⁶ Lately, Zheng *et al.* described a combination of MUA and arthroscopic cap-

sular release which lead to an improvement in ROM and pain, but there was no control group to demonstrate if there is an additional benefit with this combination of treatments.³⁵ An undergoing UK Frozen Shoulder Trial (UK-FROST) aims to compare ACR with MUA and physiotherapy in terms of clinical and cost-effectiveness.³⁶

It is worth highlighting that rehabilitation following ACR is crucial for achieving the best possible outcome, which is also confirmed by the author's clinical experience.¹⁷

Discussion

Although FS is still commonly considered a benign, self-limiting condition, this review was challenged in the recent literature.^{10,17,19} 26-50% of patients do not fully recover and have residual symptoms.^{10,19} This is in line with the author's clinical experience, which demonstrates that many patients who could benefit from early intervention are still subjected to a "watchful waiting" strategy, which delays the onset of treatment and thereby reducing chances for a favorable outcome. The optimistic assumption that patients with FS do not require treatment could be a result of the fact that many patients adapt to functional limitations through compensation of remaining stiffness and pain.¹⁰

From all papers included by Wong *et al.* in their systematic review, none of them has supported the theory that the FS resolves with no treatment, nor that the concept of Reeve's that the disease naturally progresses through 'stiff' to 'recovery' phase. Although all have reported improvement of the ROM, function at the final follow-up in the studies included in that review (up to 44 months), it was still not within the normal ranges. Most of the improvement occurred early (reported time 12-48 months).¹⁰ Low awareness of these facts and deeply rooted old concepts of the natural course of FS might also lead to significant treatment delay because the latter might give a false sense of security for the patients, who won't seek treatment early. Besides, doctors and physiotherapists might underestimate patient's ailments, and advocate for observation, diminishing patient's chances for a positive outcome.¹⁰ This has important implications, as it suggests that early intervention initiated when a patient is not improving in the short-term may eventually prevent disability.^{10,19}

Although it's been some time since new concepts on the clinical course of FS have

appeared in the literature, our clinical experience shows that still most of the patients do not receive any treatment, or receive only conservative management including PTI, PT and non-inflammatory drugs with or without injection of steroids. Others opt for early invasive treatment consisting of MUA and ACR or their combination. According to our clinical experience, optimal treatment for FS should be considered individually, taking into account few factors such as phase of the disease, presence of comorbidities, level of capsular contraction and severeness of symptoms, if dominant arm is involved and contradictions for treatment options considered. From more invasive techniques, we often use hydrodistension where the injection is guided by ultrasound, as its both contributes to rapid relief and is highly accepted by patients. It is best to perform it in so call "freezing" and "frozen" phase. If the treatment fails to provide substantial relief, we perform ACR with or without MUA. However, none of these methods provides optimal results without rehabilitation, as distended capsule quickly recontracts, and the symptoms reemerge. Proper rehabilitation helps to achieve optimal results, minimize pain and costs for the patients.

Conclusions

Initial management of frozen shoulder consists of non-operative methods, including anti-inflammatory drugs, physical therapy, and exercises at home and under the supervision of rehabilitation specialists.

In case the conservative methods fail to provide symptom relief and ROM increase, then in both authors' experience and according to current literature intra-articular steroid injection in case pain is a predominant concern and hydrodistension for ROM restriction should be proposed to the patient. A combination of both is suitable for patients when significant pain and ROM restriction coexist.

Arthroscopy and MUA are effective methods for the treatment of frozen shoulder if non-operative management is not successful. However, our experience indicates that the results are not always aligned with the patient's expectations.

New observations demonstrate that the paradigm for frozen shoulder being a self-limiting condition is outdated, and patients with the condition would not regain full function and pain relief without any intervention; therefore, proper management might prevent disability.

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