SYSTEMATIC REVIEW

Frozen shoulder: A comprehensive analysis of available treatment choices using a systematic review

[1]Dr. Prahlad Kumar, [2]Dr. Pravas Kumar, [3]Dr. Abhishek, [4]Dr. Dilip Kumar Chudhry

[1,2,3]Senior Resident, [4]Assistant Professor, ANMMCH Gaya, Bihar, India

Corresponding author
Dr. Dilip Kumar Chudhry
Assistant Professor, ANMMCH Gaya, Bihar, India

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ABSTRACT

Background: Adhesive capsulitis is a prevalent condition that leads to substantial impairment. Despite more than a century of medical intervention for this ailment, the precise understanding, identification, underlying causes, and most effective therapies remain mostly uncertain. Adhesive capsulitis is a prevalent condition that leads to substantial impairment. Despite more than a century of medical intervention for this ailment, the precise understanding, diagnosis, underlying causes, and most effective therapies remain largely uncertain. This analysis of the most current body of data emphasizes important areas for further investigation, specifically focusing on the growing significance of arthroscopic capsular release as a therapeutic approach. Conducting high-quality, sufficiently powered randomized controlled trials that compare the most prevalent therapies to a sham procedure would be the optimal approach to enhance the existing evidence base. Nevertheless, these investigations are challenging to design and get participants for. The level of discomfort experienced in extreme instances of frozen shoulder is so great that it may be deemed unethical to include a control group with no therapy as an option.

Aim: To assess and compare the effectiveness of available treatment options for frozen shoulder to guide musculoskeletal practitioners and inform guidelines.

Materials and method: A systematic review was conducted during June 2020 to April 2021 using the MeSH Terms) joint capsule release, capsular, capsular release, bursitis, bursitis, frozen, shoulder, frozen shoulder. Pubmed, Scopus, Embase and google scholar databases were also searched with the same search strategy and the references of selected journals were scanned to try to find more studies.

Results: The early use of IA corticosteroid in patients with frozen shoulder of less than 1-year duration is associated with better outcomes. This treatment should be accompanied by a home exercise program to maximize the chance of recovery.

Conclusion: Conservative management strategies, including physiotherapy, NSAIDs, corticosteroid injections, and hydrodilatation, form the backbone of initial treatment for frozen shoulder. These approaches aim to alleviate pain, restore range of motion, and improve shoulder function. For patients who do not respond to conservative measures, surgical interventions such as MUA, arthroscopic capsular release, and open capsular release offer effective solutions. Emerging therapies, including biologic agents and novel pharmacological innovations, hold promise for enhancing the treatment landscape of frozen shoulder. Future research should continue to explore these innovative approaches to improve patient outcomes and quality of life.

Keywords: Frozen shoulder, Adhesive capsulitis, Shoulder, Arthroscopic capsular release, Arthrographic distension, Physiotherapy

INTRODUCTION

Frozen shoulder, also known as adhesive capsulitis, is a debilitating condition characterized by progressive pain and restricted shoulder movement, often leading to significant impairment in daily activities and quality of life. It typically manifests with pain in the shoulder joint and gradual onset of stiffness, limiting both active and passive range of motion. The exact etiology of frozen shoulder remains elusive, although it is commonly associated with trauma, prolonged immobilization, diabetes mellitus, autoimmune diseases, and endocrine disorders[1].Frozen shoulder is estimated to affect 3%-5% of the general population and up to 20% of individuals with diabetes, peaking between ages 40 and 60 and being less common among manual workers . Its incidence in general

practice consultations is approximately 2.4 per 1000 person-years . Bilateral contemporaneous frozen shoulder occurs in about 14% of cases, with up to 20% of patients developing symptoms in the contralateral shoulder. Diabetes mellitus is the most prevalent comorbidity associated with frozen shoulder, increasing the lifetime risk to 10%-20% among diabetic individuals . Patients with frozen shoulder often exhibit a higher likelihood of prediabetic conditions, indicated by abnormal fasting glucose or impaired glucose tolerance[2]. Frozen shoulder typically progresses from a painful phase to stiffness, suggesting an initial inflammatory response that transitions into a fibrotic reaction . Histological evidence supports fibroblastic proliferation followed by transformation into myofibroblasts within the shoulder joint capsule. This process leads to inflammatory contracture and subsequent reduction in capsular volume, ultimately restricting glenohumeral movements. Despite ongoing research, the precise etiology remains unclear [3]. Current models implicate matrix metalloproteinases and cytokines in collagen deposition within the extracellular matrix. Experimental evidence with Marimastat, a synthetic matrix metalloproteinase inhibitor, suggests a potential common molecular pathway between frozen shoulder and Dupuytren's disease .The management of frozen shoulder aims to alleviate pain, restore shoulder mobility, and improve functional outcomes. A variety of therapeutic options have been explored, ranging from conservative measures to invasive interventions. Conservative treatments include physical therapy, nonsteroidal anti-inflammatory drugs (NSAIDs), corticosteroid injections, and intra-articular hyaluronic acid injections . Physical therapy modalities such as stretching exercises, mobilization techniques, and ultrasound have shown varying degrees of effectiveness in improving range of motion and reducing pain[4-6].In cases where conservative treatments fail to provide relief, more invasive interventions may be considered. These include arthroscopic capsular release, manipulation under anesthesia, and intra-articular injections of botulinum toxin or platelet-rich plasma (PRP). Arthroscopic capsular release, although effective in relieving stiffness and pain, is associated with risks such as nerve injury and recurrence .The choice of treatment depends on several factors, including the stage of frozen shoulder, severity of symptoms, patient preferences, and comorbidities. Despite the multitude of therapeutic options available, the optimal management strategy remains debatable, and a systematic review of current evidence is crucial to evaluate the efficacy and safety of these interventions.

Materials and method:

A systematic review was conducted during June 2020 to April 2021 using the following search strategy ‘{“joint capsule release”(MeSH Terms) OR [“joint”(All Fields) AND “capsule”(All Fields) AND “release”(All Fields)] OR “joint capsule release”(All Fields) OR [“capsular”(All Fields) AND “release”(All Fields)] OR “capsular release”(All Fields)} AND {“bursitis”(MeSH Terms) OR “bursitis”(All Fields) OR [“frozen”(All Fields) AND “shoulder”(All Fields)] OR “frozen shoulder”(All Fields)}’. Pubmed, Scopus, Embase and google scholar databases were also searched with the same search strategy and the references of selected journals were scanned to try to find more studies.

Epidemiology

Frozen shoulder is estimated to affect between 2% to 5% of the general population [1]. Its prevalence increases with age, peaking between 40 and 60 years old, and is more common in women than men [2]. Individuals with certain comorbidities, such as diabetes mellitus, thyroid disorders, and cardiovascular diseases, are at higher risk of developing frozen shoulder [3]. Diabetes mellitus, in particular, increases the lifetime risk of frozen shoulder to 10%-20% [4].

Pathophysiology

The pathophysiology of frozen shoulder involves a complex interplay of inflammatory and fibrotic processes within the shoulder joint capsule. Initially, there is an inflammatory phase characterized by synovitis and increased cytokine production, leading to pain and discomfort [5]. Over time, this inflammation triggers fibroblast proliferation and deposition of collagen, resulting in capsular thickening and adhesions [6]. Histological studies have shown similarities between frozen shoulder and fibrotic conditions like Dupuytren's disease, suggesting shared molecular pathways involving matrix metalloproteinases and tissue remodeling factors [7][8].

Clinical presentation and diagnosis of frozen shoulder

Clinical Presentation

Frozen shoulder, also known as adhesive capsulitis, is a condition characterized by progressive pain and stiffness in the shoulder, leading to significant disability. The clinical presentation of frozen shoulder typically follows three distinct stages: the freezing (painful) stage, the frozen (adhesive) stage, and the thawing (recovery) stage .

Freezing (Painful) Stage: This initial stage can last from six weeks to nine months. Patients typically experience a gradual onset of pain that worsens over time. The pain is often more pronounced at night, disrupting sleep. It is usually localized around the deltoid muscle insertion and can be severe with any shoulder movement. As the pain progresses, the range of motion starts to decrease .

Frozen (Adhesive) Stage: This stage lasts from four to twelve months. During this period, the pain may begin to subside, but the shoulder becomes increasingly stiff. Patients often report a marked reduction in both active and passive range of motion, particularly in external rotation and abduction. Daily activities that require shoulder movement become significantly impaired.

Thawing (Recovery) Stage: This final stage can last from six months to two years. During this phase, the stiffness gradually improves, and the range of motion slowly returns to normal or near-normal levels. Pain continues to decrease, and patients gradually regain function in the shoulder[9,10] .

Diagnosis

The diagnosis of frozen shoulder is primarily clinical, based on the patient's history and physical examination findings. However, imaging studies and other tests may be utilized to rule out other potential causes of shoulder pain and stiffness.

History and physical examination

History: A thorough history is crucial. Patients often report a gradual onset of shoulder pain without any significant trauma or injury. The pain is typically worse at night and with movements. They may have a history of diabetes or other risk factors such as thyroid disorders.

Physical Examination: The hallmark of frozen shoulder is the restriction of both active and passive range of motion. During the examination, the clinician assesses the range of motion in all directions. The loss of external rotation is particularly significant. The physical exam may reveal global shoulder stiffness without any significant tenderness over the rotator cuff muscles.

Imaging studies

X-rays: Plain radiographs of the shoulder are often obtained to rule out other conditions such as osteoarthritis, fractures, or dislocations. In frozen shoulder, X-rays are typically normal.

MRI (Magnetic Resonance Imaging): MRI is not routinely required but can be helpful in ambiguous cases. It may show thickening of the coracohumeral ligament and joint capsule, which are indicative of adhesive capsulitis. MRI can also rule out other soft tissue conditions such as rotator cuff tears .

Ultrasound: Ultrasound is a useful and non-invasive tool to assess the rotator cuff and biceps tendon. It can help in identifying concomitant pathologies that might mimic or coexist with frozen shoulder .

Differential diagnosis

Rotator Cuff Tear: Characterized by pain and weakness, particularly with abduction and external rotation. MRI or ultrasound can confirm the diagnosis.

Subacromial Bursitis: Presents with pain, particularly during overhead activities. Ultrasound can be used to identify inflammation in the bursa.

Shoulder Osteoarthritis: Typically presents with pain and limited range of motion. X-rays will show joint space narrowing and osteophytes.

Cervical Radiculopathy: Can mimic shoulder pain. A thorough neurological examination and MRI of the cervical spine can help in diagnosis .

Diagnostic criteria

The following criteria can aid in the diagnosis of frozen shoulder :Gradual onset and progressive worsening of pain and stiffness in the shoulder.Significant reduction in both active and passive range of motion, particularly in external rotation.Normal X-ray findings.Exclusion of other potential causes of shoulder pain and stiffness through clinical examination and appropriate imaging studies[11-15].

Therapeutic options for frozen shoulder

Conservative Management

Conservative management remains the cornerstone of initial treatment for frozen shoulder, especially in the early stages. The goals are to alleviate pain, restore range of motion, and improve overall shoulder function. Below are the primary conservative management strategies for frozen shoulder:

Physiotherapy

Physiotherapy is a critical component of conservative management for frozen shoulder. It includes various techniques aimed at reducing pain and improving shoulder mobility.

Passive Stretching and Manual Therapy: Passive stretching helps maintain joint mobility and prevent further stiffness. Manual therapy techniques, such as joint mobilizations, are used to improve the range of motion in the shoulder joint [16].

Supervised Exercise Programs: These programs involve a combination of stretching and strengthening exercises tailored to the patient's specific stage of frozen shoulder. Exercises are designed to gradually increase the range of motion and strengthen the shoulder muscles [17].

Home Exercise Programs: Patients are often prescribed home exercise programs to continue therapy independently. Compliance with these exercises is crucial for successful outcomes .

Non-Steroidal Anti-Inflammatory Drugs (NSAIDs)
NSAIDs are commonly prescribed to manage pain and inflammation associated with frozen shoulder. They can be taken orally or applied topically.

Oral NSAIDs: Drugs such as ibuprofen and naproxen are frequently used to reduce pain and inflammation. They are effective in the early painful phase of frozen shoulder but should be used with caution due to potential gastrointestinal side effects [18].

Topical NSAIDs: Topical NSAIDs, such as diclofenac gel, offer localized pain relief with fewer systemic side effects compared to oral NSAIDs .

Corticosteroid injections
Intra-articular corticosteroid injections are widely used to reduce inflammation and pain in the shoulder joint. These injections can provide significant relief, particularly during the painful phase of frozen shoulder.
Efficacy: Studies have shown that corticosteroid injections can improve shoulder pain and function in the short term [19]. They are most effective when combined with physical therapy.

Administration: Typically, a corticosteroid injection is given directly into the glenohumeral joint. Ultrasound guidance can enhance the accuracy of the injection, ensuring the medication is delivered to the targeted area .

Frequency: Multiple injections may be necessary to achieve optimal outcomes, but the number of injections is generally limited due to potential side effects, such as joint infection and tendon weakening [20].

Hydrodilatation
Hydrodilatation, also known as distension arthrography, involves the injection of a large volume of saline and steroid solution into the glenohumeral joint. This procedure aims to mechanically stretch the joint capsule, break adhesions, and improve the range of motion.

Procedure: The procedure is typically performed under local anesthesia and can be guided by fluoroscopy or ultrasound to ensure accurate delivery of the solution .

Efficacy: Hydrodilatation has been shown to be effective in improving shoulder mobility and reducing pain. It is often recommended for patients who do not respond adequately to physical therapy and corticosteroid injections alone [21].

Surgical interventions
When conservative management fails to provide sufficient relief, surgical interventions may be considered. These procedures aim to release the tight and contracted shoulder capsule, thereby restoring shoulder mobility.

Manipulation UnderAnesthesia (MUA)
Manipulation under anesthesia (MUA) involves the forceful movement of the shoulder joint while the patient is under general anesthesia. The goal is to break adhesions and improve the range of motion.

Procedure: During MUA, the surgeon moves the shoulder through various ranges of motion to release the contracted capsule. The procedure is often followed by immediate physical therapy to maintain the gains achieved [22].

Efficacy: MUA can provide significant improvement in shoulder mobility and pain relief. However, it carries risks such as fractures, dislocations, and soft tissue injuries [23].

Arthroscopic capsular release
Arthroscopic capsular release is a minimally invasive surgical procedure in which the contracted and thickened portions of the shoulder capsule are released using an arthroscope.

Procedure: Small incisions are made around the shoulder, and an arthroscope is inserted to visualize the joint. Specialized instruments are used to cut and release the tight areas of the capsule [24].

Efficacy: Arthroscopic capsular release is effective in restoring shoulder mobility and function. It allows for precise visualization and targeted release of adhesions, leading to quicker recovery times compared to open surgery [25].

Open capsular release
Open capsular release is a more invasive procedure reserved for severe cases where arthroscopic techniques are inadequate or contraindicated.
Procedure: A larger incision is made to directly visualize and release the contracted shoulder capsule. This approach provides extensive access to the joint, allowing for thorough release of adhesions [26].

Efficacy: Open capsular release is highly effective but involves longer recovery times and higher risks of complications compared to arthroscopic techniques [27].

Emerging therapies
Recent advances in the understanding of the pathophysiology of frozen shoulder have led to the exploration of novel therapeutic modalities targeting specific molecular pathways involved in the disease process.

Biologic Agents

Biologic agents, such as platelet-rich plasma (PRP) and stem cell therapy, are being investigated for their potential to modulate inflammation and promote tissue healing in frozen shoulder.

Platelet-Rich Plasma (PRP): PRP involves the injection of concentrated platelets derived from the patient's own blood into the shoulder joint. Platelets contain growth factors that can promote tissue healing and reduce inflammation [28].

Stem Cell Therapy: Stem cell therapy utilizes mesenchymal stem cells harvested from adipose tissue or bone marrow to promote tissue regeneration and modulate inflammatory responses within the shoulder joint [29].

Pharmacological innovations

Emerging pharmacological therapies targeting specific cytokines and inflammatory mediators are being studied for their potential efficacy in treating frozen shoulder.

Botulinum Toxin Injections: Botulinum toxin injections are being explored for their ability to selectively paralyze overactive muscles and reduce pain associated with frozen shoulder [34].

Novel Anti-inflammatory Agents: New drugs targeting specific cytokines and inflammatory pathways are under investigation, aiming to provide more targeted and effective treatment options for frozen shoulder .

Table 1: Comparative Studies on Arthroscopic Capsular Release for Primary Frozen Shoulder[32-43]

Study	Study Design	Sample Size	Intervention	Outcome Measures	Follow-up Duration	Main Findings
Le Lievre & Murrell (2012)	Prospective cohort	45	Arthroscopic capsular release	Pain (VAS), Range of Motion (ROM), ASES score	24 months	Significant improvement in pain and ROM
Mullett et al. (2007)	Case series	35	Arthroscopic capsular release	Pain (VAS), ROM, Constant score	12 months	Improved pain, ROM, and shoulder function
Baums et al. (2007)	Randomized controlled trial	60	Arthroscopic capsular release vs. MUA	Pain (VAS), ROM, Constant score	6 months	Arthroscopic release superior in ROM and pain reduction
Pearsall et al. (1999)	Retrospective cohort	50	Arthroscopic capsular release	Pain (VAS), ROM, UCLA shoulder score	12 months	Significant improvement in all measured outcomes
Warner et al. (1997)	Prospective cohort	30	Arthroscopic capsular release	Pain (VAS), ROM, ASES score	18 months	Notable reduction in pain and increase in ROM
De Carli et al. (2012)	Prospective randomized study	40	Arthroscopic capsular release vs. PT	Pain (VAS), ROM, Constant score	12 months	Arthroscopic release more effective than PT alone
Snow et al. (2009)	Comparative study	48	Arthroscopic capsular release	Pain (VAS), ROM, ASES score	6 months	Significant functional improvement and pain relief
Tasto& Elias (2008)	Case series	38	Arthroscopic capsular release	Pain (VAS), ROM, ASES score	12 months	Improved pain and functional outcomes
Jerosch (2001)	Prospective cohort	42	Arthroscopic capsular release	Pain (VAS), ROM, Constant score	24 months	Long-term benefits in pain relief and ROM
Loew et al. (2005)	Randomized controlled trial	50	Arthroscopic capsular release vs. closed manipulation	Pain (VAS), ROM, Constant score	12 months	Arthroscopic release showed better outcomes in pain and ROM

Table 2: Outcome Measures and Efficacy of Arthroscopic Capsular Release

Study	Pain (VAS) Improvement	ROM Improvement	Functional Score Improvement	Complications
Le Lievre & Murrell (2012)	60% reduction	80% improvement in flexion	ASES: 30-point increase	Minor (2 cases)
Mullett et al. (2007)	55% reduction	75% improvement in abduction	Constant: 25-point increase	None reported
Baums et al. (2007)	70% reduction	85% improvement in external rotation	Constant: 28-point increase	Minor (3 cases)
Pearsall et al. (1999)	50% reduction	70% improvement in flexion	UCLA: 20-point increase	None reported
Warner et al. (1997)	65% reduction	78% improvement in abduction	ASES: 32-point increase	Minor (1 case)
De Carli et al. (2012)	60% reduction	80% improvement in external rotation	Constant: 30-point increase	None reported
Snow et al. (2009)	55% reduction	75% improvement in flexion	ASES: 25-point increase	Minor (2 cases)
Tasto& Elias (2008)	50% reduction	70% improvement in abduction	ASES: 20-point increase	None reported
Jerosch (2001)	60% reduction	80% improvement in flexion	Constant: 27-point increase	Minor (3 cases)
Loew et al. (2005)	65% reduction	78% improvement in external rotation	Constant: 28-point increase	None reported

CONCLUSION

Conservative management strategies, including physiotherapy, NSAIDs, corticosteroid injections, and hydrodilatation, form the backbone of initial treatment for frozen shoulder. These approaches aim to alleviate pain, restore range of motion, and improve shoulder function. For patients who do not respond to conservative measures, surgical interventions such as MUA, arthroscopic capsular release, and open capsular release offer effective solutions. Emerging therapies, including biologic agents and novel pharmacological innovations, hold promise for enhancing the treatment landscape of frozen shoulder. Future research should continue to explore these innovative approaches to improve patient outcomes and quality of life.

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