



# A literature review of the treatment options for Idiopathic Adhesive Capsulitis of the Shoulder

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## Abstract

**Goal:** Systematic review of current therapeutic options for Idiopathic Adhesive Capsulitis of the shoulder (IAC).

**Materials and Methods:** Research carried out in the MEDLINE / Pubmed database using MeshTerms: “adhesive capsulitis”, “frozen shoulder”, “treatment”. The articles in Portuguese or English published were selected, after which non-relevant articles were excluded based on the title, reading of the abstract and full article.

**Results:** Physical therapy has proven to be beneficial, either isolated or concomitantly with other therapeutic approaches. Options like capsular distention, manipulation under anesthesia and arthroscopic surgery have reported good results, especially in refractory cases. No significant benefits were found with the use of oral corticosteroids, NSAIDs or acupuncture. New treatment options are currently being tested with promising results.

**Conclusions:** There are several effective options for the treatment of Adhesive Capsulitis. In the early stages, conservative measures should be chosen, with special emphasis on physical therapy within the limits of pain associated with low-dose intra-articular injection of corticosteroids. In refractory cases, more invasive treatment options should be suggested namely capsular distention and manipulation under anesthesia.

**Keywords:** Adhesive Capsulitis; Frozen Shoulder; Diagnosis; Treatment

## Introduction

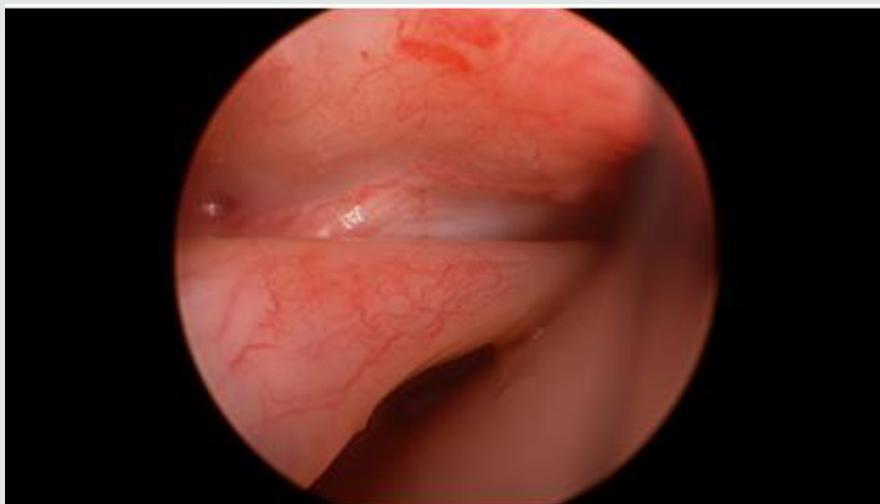
Adhesive capsulitis is a pathology characterized by a spontaneous onset of insidious and diffuse pain in the shoulder associated with progressive restriction of active and passive motion of the glenohumeral joint [1]. Almost 150 years after its first description, it remains an uncertain entity. The proper terminology, used for the first time in 1945, is also controversial, since this condition is related to the contraction and thickening of the glenohumeral capsule, in particular the coracohumeral ligament in the rotator's interval [1, 2]. The disease is classified as primary and secondary. The primary entity has an unknown etiology and will be addressed in this review [3]. Secondary adhesive capsulitis is caused by an event or triggering condition such as trauma,

surgery or a systemic condition such as diabetes mellitus, thyroid abnormalities, etc. [2]. Diabetes mellitus has the most established connection, with an estimated incidence of adhesive capsulitis in 20% of this population [4]. The prevalence of this pathology in the general population is believed to be 2-5%. However, it is believed that the true prevalence is actually inferior and difficult to determine, not only because vague and insidious symptoms lead to numerous diagnostic errors, but also because most studies include specific comorbidities with a greater incidence of IAC than within the general population [2, 3, 5, 6].

This pathology occurs mainly between the 4th and 6th decade of life and is thought to be more frequent in women [7]. Some

argue that it affects the non-dominant side more often and that in about 20-30% of cases it recurs on the contralateral shoulder, usually in the first 5 years after the resolution of the primary condition [1, 3, 7-10]. Although considered a benign condition, with a self-limiting pattern and resolution within 2 to 3 years, it is estimated that 20-50% of the cases continue with mild to moderate pain and restricted movement over a period of up to 10 years [4, 11]. The etiology of adhesive capsulitis also remains uncertain and theories vary. However, the evidence points to a chronic inflammatory response with subsequent capsular fibrosis that possibly involves increased deposition of cytokines such as TGF- $\beta$ , PDGF, TNF- $\alpha$  and IL-1 [1-3, 7]. There are also studies that advocate an association with Dupuytren's contracture that may involve the same abnormalities. The changes found include: contraction and fibrosis of the coracohumeral ligament, thickening and fibrosis of the rotator's interval, contraction of the anterior and inferior capsule, decrease in joint volume, obliteration of the axillary recess

and neovascularization [2, 3]. The evolution of this pathology can be divided into three phases. The acute initial phase (freezing phase) is characterized by the insidious appearance of diffuse pain and restriction of the range of motion of the glenohumeral joint, which lasts for about 10 to 36 weeks (Figure 1). In the second phase (frozen phase), for about 4 to 12 months, the pain slightly decreases but the movement restriction continues, with almost total loss of external rotation. In the resolution phase (thawing phase) there is spontaneous progressive improvement in the range of motion and resolution of pain. This last phase has an average duration of 30 months (12 to 42 months) [3, 6-8]. Numerous studies have attempted to determine which treatment is the most effective for adhesive capsulitis. However, currently, despite the various options, there is still no consensus among the authors regarding the most advantageous treatment and at what stages of the disease it should be performed [4, 12, 13]. Most of the evidence is inconclusive due to the precarious methodology of the studies [14].

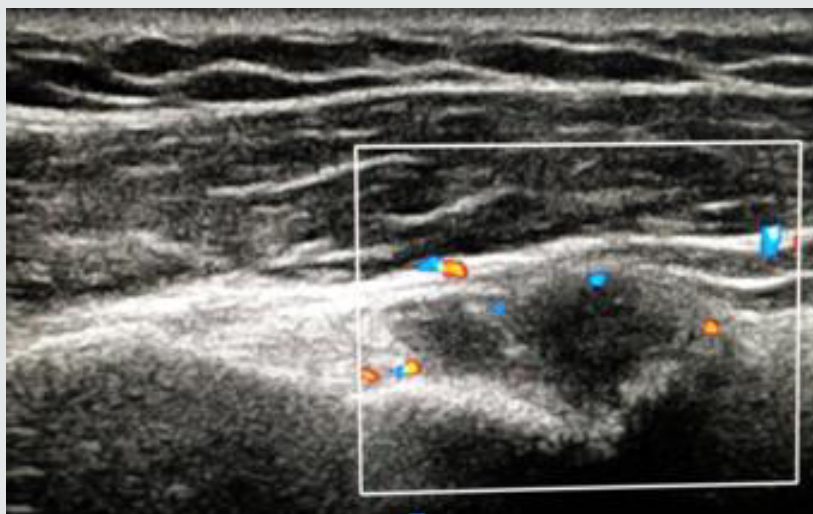


**Figure 1:** Arthroscopy - signs of synovitis and tenosynovitis characteristic of phase 1 of adhesive capsulitis

## Diagnosis

There is no standard diagnostic method for this condition, which is based on clinical examination, exclusion of differential diagnosis, normal radiographic appearance and findings on ultrasound, magnetic resonance imaging (MRI) and arthrographic magnetic resonance imaging (arthroMRI) [2, 15]. The early diagnosis of adhesive capsulitis is extremely important since it allows the institution of therapy before the progression of thickening and contracture of the capsule observed in advanced stages [15]. Clinically, an insidious diffuse pain with at least four weeks that interferes with the activities of daily life should be investigated. Night pain is also common, with the patient complaining of more severe pain while sleeping on the affected side. Painful restriction of active and passive motion of the glenohumeral joint is also frequent, with special emphasis on external rotation (more than 50% of

restriction) and elevation (less than 100°) [1, 3]. Radiographs do not normally show any changes, except for a slight periarticular osteopenia of the humeral head and neck, which can occasionally be found [1, 3, 7, 15]. The most important role of radiography is the possibility of ruling out other pathologies such as calcifying tendinitis of the rotator cuff, osteoarthritis, avascular necrosis or fractures that can also cause painful movement restriction and be misdiagnosed as adhesive capsulitis [15, 16]. For a more accurate diagnosis, ultrasound, MRI or ArthroRM are usually necessary [15]. With the use of ultrasound, the diagnosis can be suspected by a thickening of the structures in the rotator's interval, namely of the coracoumeral ligament, and restriction of the motion of the supraspinatus tendon during abduction. With echodoppler, synovial inflammation can be readily detected (Figure 2), which has advantages when compared with MRI and ArthroMRI since it is less expensive, faster, more dynamic and easily accessible [2, 3, 15].



**Figure 2:** Echo-doppler – rotator's interval with characteristic hyperemia of synovial inflammation.

MRI is an effective non-invasive diagnostic tool, not only for cases where this condition is suspected, but also provides information that can help the surgeon differentiate between the different stages of the disease [3,15,17]. Although it is not diagnostic, some argue that the degree of capsular thickening, measured in the axillary recess, can be correlated with the clinical stage of adhesive capsulitis [16]. Among other findings, several characteristics of this condition can be seen: thickening of the coracohumeral and capsular ligament in the rotator's interval and axillary recess (greater than 4 mm) and obliteration of the subcoracoid space by the thickened capsule

(Figure 3). Thus, MRI allows for early diagnosis, determining the pathophysiological stage and ruling out differential diagnosis [15]. ArthroMRI allows for visualization of basic disease characteristics, namely the thickening of the coracohumeral ligament and the capsule, possibly with greater precision than the MRI, but also to detect decreased joint volume [1,3,15]. However, some claim that both MRI and ArthroMRI, despite the useful findings, are not indicated as a means of diagnosis for adhesive capsulitis and should only be used as a method of excluding other intra-articular pathologies [3].



**Figure 3:** MRI - Capsular thickening in the axillary recess.

## Treatment

A great variety of therapeutic options are available for the treatment of adhesive capsulitis. During the early stages, where pain predominates, treatment should be directed towards pain relief and patients should be advised to limit activities according to their tolerance [7]. The secondary objective is to improve the range of motion [4] and restore the ability to perform the daily activities.

## Conservative Treatment

Conservative treatment, such as physical therapy, is recommended in the freezing phase [4, 6]. Most patients will recover with this initial management [16, 18, 63]. The conservative approach has a wide range of modalities, with well documented results.

## Physiotherapy

Isolated physiotherapy is a widely accepted treatment option, which can also be used as a complement to other therapeutic modalities [1, 3], with some reports considering it to be crucial for success [4]. Currently, various techniques are used, such as the application of moist heat, strengthening exercises, stretching and manual exercises [7, 19, 20]. Several studies have compared these modalities with different conclusions, making it difficult to determine which is the most beneficial [4, 9,20]. Most studies in which comparisons were made between two interventions did not detect significant differences between the techniques [21]. In several investigations, the techniques of high and low grade glenohumeral mobilization were compared, with significant improvement after 12 months for both approaches. Some authors concluded that the intensive approach was significantly more effective in restoring mobility and reducing disability [20-22]. In contrast, others argue that the amount of force applied should be adjusted to the patient's condition, limited to their tolerance, because if excessive force is applied, it can produce extreme pain, periarticular injury or abandonment of treatment, thus, one should opt for prolonged progressive low-load stretches, a method considered safe and effective [7, 9, 23].

In a study with level I evidence, the effectiveness of three different physical therapy modalities was compared: group physiotherapy, individual physiotherapy and home exercise program. Not only was there a greater degree of symptomatic improvement in the shoulder, but also better anxiety control with group physiotherapy. There were also benefits in relation to cost-effect and self-management in this group. However, standard physical therapy remains a good alternative and has been shown to be significantly better than unsupervised home exercises [6]. In another study with level II evidence in which regular physical therapy was compared with a new contraction technique, the new approach demonstrated greater recovery of the function of the glenohumeral joint when compared to the group of normal physical therapy. However, further studies are needed to validate this

conclusion [24]. Some authors advise a Multimodal Care program that includes mobilization, shoulder orthoses and stretches with strengthening exercises, which appears to be beneficial for symptomatic relief, although the evidence seems limited [25, 26].

Horst, et al. compared structural-oriented (conventional) physical therapy with an activity-oriented physiotherapeutic treatment, concluding that therapy based on performing activities appears to be more effective for pain reduction and the ability to perform daily life activities than conventional treatment methods [64]. When compared to ad initium arthroscopy, physical therapy produces similar results, but without surgical aggression and with a better cost-benefit ratio [27]. Lamplot, et al. in a level III cohort study [57] found a decrease in the need of a second intra-articular injection in the patients who underwent physical therapy following the first injection, underlining the major role of physiotherapy in the treatment of IAC.

## Intra-Articular Injection of Corticosteroids

Corticosteroids have been administered to the glenohumeral joint in several ways, namely anterior, lateral and / or posterior approach [4, 28]. Although clinically it is common practice to use an injection via an anterior or posterior approach, studies comparing different techniques have not found significant differences in the improvement of pain or range of motion [11, 29]. Cho, et al. [60] in a randomized trial study found that the efficacy of corticosteroid injection into the subacromial space in IAC was inferior to intra-articular injection up to 12 weeks. However, a combination of injection sites had an additive effect on the benefits in the internal rotation angle There is no agreement regarding the optimal dose of intra-articular corticosteroids. Yoon et al. did not detect a significant difference between the low (20 mg) or high (40 mg) dose groups, indicating, due to its side effects, the preferential use of low dose corticosteroids for the treatment of adhesive capsulitis [30].

A limitation of the use of intra-articular corticosteroids is the fact that blind injections can be inaccurate in about 60% of cases. The current use of ultrasound or fluoroscopy-guided injection can overcome this problem [8, 16]. It has been shown in several studies that this practice improves accuracy and results compared to the "blind-technique" [3, 31]. There is evidence that the initial corticosteroid injection can reduce pain and improve range of motion in the short term and that its benefit can be increased in the short and medium term when these injections are followed by physical therapy [11, 21, 57]. Kraal et al. in a two center, randomized controlled trial, found that additional physiotherapy after corticosteroid injection improves ROM and functional limitations in early-stage IAC up to the first three months, underlining the good results of these techniques combined [61].

When compared as isolated treatments, there is strong evidence in benefit of corticosteroid injection in the short term (4-6 weeks), compared to isolated physical therapy, but not in the long

term [11, 22, 30, 32, 33]. In a study that compared the injection of corticosteroids and the benefit of isolated intra-articular analgesics, significant improvements were found with the administration of corticosteroids [22]. Hettrich et al. showed that corticosteroid injections decreased fibromatosis and myofibroblasts in the shoulders with IAC [58]. On the other hand, some studies conclude that this form of treatment has results similar to isolated physical therapy or more invasive treatments such as MUA and arthroscopy [29, 32, 34], confirming the high degree of controversy surrounding this disease.

### Echography-Guided Capsular Distension

Ultrasound-guided interventions have several strong points like the lack of radiation and the possibility of real time visualization of the needle's trajectory. This technique has advantages when compared to fluoroscopy, CT and MRI since these are less practical, more time consuming and involve radiation or a specific needle [35]. One of the modalities of capsular distention is based on the use of hyaluronic acid. The ideal time between injections is one week and the effects are usually seen after the second injection [36]. In a study comparing this approach with the injection of corticosteroids, it was found to be more effective in favor of distension with hyaluronic acid in passive external rotation ( $10^0$ ) at 2 and 6 weeks, with no significant differences in pain relief or in function recovery. This study also concluded that this approach is a good alternative to intra-articular injection of corticosteroids and can be especially useful in patients with diabetes mellitus or contraindicated to the use of corticosteroids [37]. Calis et. al. also concluded that this approach is effective in the treatment of adhesive capsulitis when compared to isolated corticosteroid injection, physical therapy and exercise [36]. Ultrasound-guided capsular hydrodistension is a procedure that aims to distend the capsule contracted by increasing pressure by injecting large amounts of sodium chloride into the glenohumeral joint [9]. There is evidence that it provides relief from pain and improves range of motion, especially when it is followed by physical therapy [29, 38]. Other studies have found that saline distension with or without concomitant corticosteroids are more effective than MUA, describing better results after 6 months with this procedure, with less risk, and resulting in a higher level of satisfaction on the part of patients. However, the effects do not seem to persist beyond 6-12 weeks [9, 29, 39, 40].

### Arthrographic Capsular Distension

This technique can be performed with sodium chloride, local anesthetic, steroids, contrast or air. It should be reserved for patients who do not improve despite physical therapy [22]. It is also considered a good therapeutic option for rapid symptom relief. Better results were observed when followed by physical therapy [38]. There was no significant difference in the efficacy of capsular distention with or without corticosteroids in most investigations

[39, 41]. However, Rysns et al. when comparing distension with corticosteroid injection with placebo saline injection to determine whether the results were due only to the increase in volume, found a significant improvement with the concomitant use of corticosteroids [32].

### Extracorporeal Shockwave Therapy

The use of Extracorporeal Shock Wave Therapy (ESWT) in the treatment of several shoulder diseases, namely in calcific tendinopathy of the rotators cuff, is well documented. Several studies evaluate its usefulness in IAC, with positive effects such as a quicker return to daily activities and quality-of-life improvement [66, 67], at least in the short-term. El Naggar, et al. compared the effectiveness of radial extracorporeal shock-wave therapy versus ultrasound-guided low-dose intra-articular steroid injection in diabetic patients, concluding that in the short-term follow-up ESWT was superior to a low-dose intra-articular steroid injection in improving function and pain in diabetic patients with shoulder IAC [68], therefore validating it as an alternative to steroid injections in diabetic patients with this pathology. This particular usefulness of ESWT in diabetic patients has also been documented in other studies [69, 70]. Many prospective randomized trials are underway to further validate ESWT as a treatment option in IAC, especially in the diabetic population.

### Other

Oral non-steroidal anti-inflammatory drugs, although widely used in the initial / inflammatory phases for pain relief in the short term, did not prove their benefit when compared with placebo [3, 7, 9]. Prednisone at a dose of 40 to 60 mg / day for two to three weeks provides faster relief of symptoms in the short term, but their effects are not significant after 6 weeks and there is no evidence that they shorten the duration of disease [28]. Some studies have concluded that there may be a moderate short-term benefit with acupuncture associated with exercise [22], however the usefulness of this therapeutic approach remains undetermined [21]. Calcitonin is a polypeptide hormone secreted from parafollicular cells of the thyroid that has been used for pain control in several pathologies. Although its pathophysiology is not totally clear, it is thought to diminish the inflammatory response and increase endorphins' release [71, 72]. Rouhani, et al. in a double-blinded randomized controlled trial compared intranasal calcitonin versus placebo for 6 weeks and found great improvement of shoulder pain, ROM, and functional scores in the calcitonin group [71]. Currently the dose recommendation is 200 U (1 puff) daily [73]. Regarding future approaches, Badalamente, et al. [53, 54] published two papers evaluating the applicability of extra-articular collagenase injections in the anterior shoulder capsule. In a placebo controlled double-blind RCT, they found improvements in shoulder motion, functional score and pain control in the collagenase group in their 1.8 years

follow up. In a randomized pilot study comparing subcutaneous adalimumab with local corticosteroids, Schydrowsky et al. found no benefits with the anti-TNF agent in the treatment of frozen shoulder [55]. These new treatment approaches for IAC must undergo further investigation, but, if developed, could also play a role in the management of other arthrofibrosis [56].

### Surgical Treatment

Surgical treatment of adhesive capsulitis is considered after failure of conservative treatment. It is estimated that 10% of patients do not respond to non-invasive treatment [25, 26]. There are no defined guidelines for this transition. However, regardless of the chosen conservative treatment, a surgical approach is only considered after about 6 months of non-surgical treatment without clinical improvement [3, 4, 8, 12, 16, 42]. Its benefit in refractory / severe adhesive capsulitis is proven and well documented [43], and some studies have found that in patients with high risk factors such as diabetes mellitus, and those who suffer chronic symptoms or bilaterally affected, early surgery is beneficial [65]. In a recent questionnaire to health professionals, only 3% recommended surgical treatment in the acute phase, while 47% recommended it in the second and third stages of the disease [4]. Surgical treatments should be complemented with an appropriate physical therapy scheme [63]. Some advocate the initiation of immediate postoperative physiotherapy, with light isometric exercises after 1-2 weeks and isotonic exercises in the following 2-3 weeks. Ideally the range of motion without complete restriction should be achieved in 12 to 16 weeks [4].

### Manipulation Under Anesthesia

This procedure involves stabilizing the shoulder blade with flexion, abduction and adduction, followed by maximum internal and external rotation. Some studies advocate good results with this technique, mainly in terms of range of motion [44], others have not found significant differences in comparison with other treatments [45]. There is modest evidence of the benefit of MSA in relieving pain and recovering mobility when followed by physical therapy [46]. However, some authors have not found significant differences in the improvement of pain, function, disability or range of motion in the short, medium or long term between isolated MUA and exercise-associated MUA when compared to physical therapy alone [21, 45]. When compared with arthroscopy, better results were observed with arthroscopic distention at 6 months [21]. However, more recently, Schoch et al. in a study with the largest series of patients undergoing surgical treatment of adhesive capsulitis with a direct comparison between MUA, MUA/Capsular release (CR), and CR alone, found significant improvement of the ROM in all surgical modalities, however, the MUA group had the greatest external rotation, postoperatively [59]. MUA has been associated with several intra-articular iatrogenic complications such as humeral fracture, glenohumeral dislocation, brachial plexus injury,

rotator cuff injury and hemarthrosis [4, 46, 47]. Nonetheless, some argue that these lesions have no clinical relevance or that they can be minimized by performing the technique properly [44, 47]. Others advise that this procedure should be avoided in patients with osteoporosis, osteopenia or previous MUA recurrence [46]. Another limitation of manipulation is the fact that stretching the tissues can cause severe pain after the end of the anesthesia effect, leading to delays in recovery [8].

### Arthroscopy

Arthroscopy allows the distension of the glenohumeral joint to be combined with a series of other procedures, such as adhesions release, opening of the rotator's interval, circular capsulotomy and section of the coracohumeral ligament. This procedure must be followed by physiotherapy [2]. Several studies have supported the role of this approach as safe and effective in the treatment of adhesive capsulitis [27, 48, 49]. Several authors support the use of arthroscopy, claiming that, in addition to the good results obtained, it makes it possible to deepen and confirm the diagnosis by a complete assessment of the shoulder joint during the procedure [4, 8]. Some, on the contrary, argue that currently the evidence does not support the use of this technique [50], underlining the prevalent controversy in the treatment of this pathology. Recent investigations have not shown greater benefits in range of motion with more extensive release of the capsule (anterior release vs. Anterior plus posterior release) [9, 62]. Sivasubramanian et al. made a systematic review and meta-analysis which suggests that less extensive releases may result in better functional and pain scores. The addition of a posterior release appears to increase early internal rotation, but doesn't maintain that benefit over time. No benefit was found with the complete 360 release [62]. Some authors suggest that arthroscopic distension can be associated with concomitant manipulation, with improved outcomes [8]. In a study comparing arthroscopy plus manipulation against isolated intra-articular corticosteroid injection, both approaches were effective in improving pain and range of motion. However, the objectives were achieved sooner by the group that underwent arthroscopy (6 weeks vs 12 weeks) [51]. Grant, et al. compared arthroscopic distention with MUA finding a small benefit in favor of arthroscopy alone or in association with manipulation, advising this technique due to the lower number of complications [52]. On the other hand, Jerosch et al. concluded that this therapy has a greater benefit in reducing pain and improving movement, even in the long term, being a valuable, more precise, controlled option with fewer complications than manipulation [12].

### Open Surgery

Surgical treatments have changed from open to arthroscopic procedures and, therefore, the open technique, although effective, has fallen into disuse [4]. It is rarely used nowadays, but may be beneficial in cases refractory to MUA and arthroscopy [9].

## Conclusion

Idiopathic adhesive capsulitis is an extremely painful and limiting pathology of the shoulder, which, despite the abundant published literature, remains controversial in many aspects. Its etiology is unknown, but synovial inflammation of the glenohumeral joint and subsequent progressive capsular fibrosis is believed to occur. The correct diagnosis of this condition is a crucial step in patient orientation. Although the diagnosis is mostly clinical, ultrasound, MRI and ArthroMRI have gained increasing importance, as they more accurately allow ruling out other conditions. Despite the various therapeutic options available, there is still no global consensus among authors regarding the most appropriate approach for the treatment of IAC of the shoulder and there is a need for high-level, definitive evidence to elaborate definitive approach guidelines. Initially, conservative measures should always be chosen, with the majority of patients recovering with non-surgical treatment. There is evidence that demonstrates the effectiveness of physical therapy, being considered by many authors as an essential component of treatment. Corticosteroid injection is an effective form of treatment, especially when guided by ultrasound, with evidence of its benefit in the short, but not long term (after 6 weeks). Lower dosages have been advised in order to minimize its possible adverse effects. ESWT is gaining popularity in the treatment of diabetic and refractory cases, with many studies underway to further validate its importance. Calcitonin and collagenase are two relatively new approaches to the disease, with promising results. Ultrasound-guided capsular distention with hyaluronic acid appears to be useful in the treatment of adhesive capsulitis, being mainly suitable in patients with Diabetes Mellitus or in those with contraindications to corticosteroids. Hydrodistension is an effective method, with results similar to MUA, but with a lower rate of complications, although its effect does not seem to last beyond 6-12 weeks. Arthrographic capsular distention is considered a good option for rapid pain relief, especially in cases refractory to physical therapy. Oral corticosteroids, while providing short-term pain relief, do not appear to shorten the duration of the disease. The association of corticosteroid injection guided by ultrasound with physiotherapy, demonstrated a statistically significant improvement, being advocated by many as the ideal approach for early stages.

Surgical treatment should be reserved for cases with unsatisfactory results with conservative approaches, that is, after about 6 months without clinical improvement. Regardless of the surgical therapeutic option, it should be followed by rehabilitation physiotherapy.

MUA and arthroscopy are effective in the treatment of idiopathic adhesive capsulitis, especially in severe and complicated cases. MUA, although very popular in the past, has recently gained some skepticism because of the frequently associated complications.

## Conflict of Interest and Funding

Nothing to declare.

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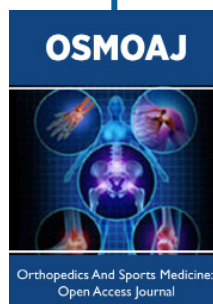
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