Treatment of adhesive capsulitis: a review

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Summary

Adhesive capsulitis is a condition "difficult to define, difficult to treat and difficult to explain from the point of view of pathology". This Codman's assertion is still actual because of a variable nomenclature, an inconsistent reporting of disease staging and many types of treatment. There is no consensus on how the best way best to manage patients with this condition, so we want to provide an evidence-based overview regarding the effectiveness of conservative and surgical interventions to treat adhesive capsulitis.

Key words: adhesive capsulitis, frozen shoulder, review, conservative treatment.

Introduction

Primary adhesive capsulitis (AC) is a shoulder condition characterized by a gradual and painful loss of both active and passive range-of-motion (ROM) in all planes of glenohumeral joint, especially external rotation[1], resulting from progressive fibrosis and contracture of the glenohumeral joint capsule. Duplay[2] in 1872 was the first author who described this condition as "periarthritis". In 1934 Codman[3] used the term "Frozen shoulder" to define a gradually developing condition, characterized by pain near the deltoid insertion, inability to sleep on the affected side, painful and restricted elevation and external rotation and a normal radiological appearance. In 1945 Neviaser defined this condition "Adhesive capsulitis" in order to underline the inflammatory pathogenesis and fibrosis[4]. Later histologic studies confirmed the presence of fibroblasts and chronic inflammatory cells which seep in joint capsule of the shoulder.[5] The current consensus definition of the American Shoulder and Elbow Surgeons is: "condition of uncertain etiology characterized by significant restriction of both active and passive shoulder motion that occurs in the absence of a known intrinsic shoulder disorder"[6,7].

AC occurs in 2% to 5% of the population[8]. It is more frequent in women aged between 40 and 60 years[9] and in about 20-30% of cases this condition is bilateral[7]. Many pathological disorders can be associated with AC as diabetes mellitus[10,11], thyroid dysfunctions[12,13], Dupuytren contracture[14], cardiorespiratory and autoimmune diseases[15]. Predisposing conditions have been investigated as prolonged shoulder immobility secondary to trauma or surgery, cardiovascular disease and Parkinson's disease[3,6]. There are also evidences that protease inhibitors used for antiretroviral therapy have been associated with the development of AC[7].

AC has been classified as primary and secondary. Primary AC is characterized by global capsular inflammation and fibrosis which occurs without any known precipitating cause. Secondary AC instead includes many conditions causing shoulder stiffness, such as calcific tendinopathy (CT), rotator cuff tears (RCT), glenohumeral or acromion-clavicular arthritis and previous shoulder trauma or surgery[16,17]. It is very important to identify these disorders because the treatment will be addressed to sorted out the primary cause before treating stiffness.

Even the natural history of AC is still debated in the literature. Primary AC is usually a self-limited pathology which resolves spontaneously by two to four years[18], but some Authors described functional limitations, persistent pain and weakness at long time follow-up[19,20].

Neviaser et al.[21] and Hannafin et al.[22] identified 4 stages of this condition, which have been correlated with clinical examination and histological features (Tab.1). The first stage is the painful phase, which is characterized by a gradual onset of symptoms. Symptoms persists for less than 3 months and consist of an aching pain referred to the deltoid insertion and inability to sleep on the affected side. Patients may report a mild limitation of ROM which invariably resolves with the administration of local anesthetic. The arthroscopic view, confirmed by biopsies, shows an hypertrophic, vascularized synovitis without adhesions or capsular contracture. The second stage is also called the "freezing stage"[23]. Symptoms continues since 3 to 9 months and are characterized by nocturnal pain moreover when the patients lying on the affected side, furthermore a significant loss of both active and passive ROM is referred. Arthroscopic view shows a thickened ipervascular synovitis. Histology shows perivascular and subsynovial scar formation with deposition of disorganized collagen fibrils and a hypercellular appearance, but no inflammatory infiltrates have been found. In

STAGE	SYMPTOMS	LENGTH OF SYMPTOMS	HISTOLOGICAL FEATURES
Painful phase	Aching pain and moderate limitation of ROM	Less than 3 months	Synovitis and capsular hypertophy
Freezing stage	Severe pain and reduction of ROM	3 to 9 months	Ipervascular synovitis. Disorganized Collagen deposition
Frozen stage	Stiffness is predominant. Pain may be present	9 to 14 months	Dense and hypercellular collagenous tissue
Thawing stage	Minimal pain and a gradual improvement of ROM	15 and 24 months	Not investigated

Table 1. Clinical and histological stages of AC.

stage number 3, the "frozen stage"[23], symptoms persists since 9 to 14 months. The shoulder stiffness is predominant and pain may still be present at the end of motion or at night. Arthroscopic examinations demonstrates patchy synovial thickening and loss of axillary recess; biopsy shows dense, hypercellular collagenous tissue. The last stage is the "thawing stage"[23]. It is characterized by minimal pain and a gradual improvement of ROM due to capsular remodeling. This stage occurs between 15 and 24 months. Arthroscopic and histological correlation has not been investigated.
The diagnosis of AC is usually clinical. X-ray of the shoulder reveals no pathological changes, but they are important to exclude other causes of shoulder pain such as CT, glenohumeral or acromion-clavicular osteoarthritis. Sometimes osteopenia of disuse can be observed. Magnetic resonance imaging (MRI) and MR arthrography may show thickening of the coraco-humeral ligament and joint capsule in the rotator interval, loss of axillary recess, obliteration of subcoracoid fat (subcoracoid triangle sign) which are characteristic findings in AC[24]. Despite their value these imaging techniques are not initially indicated to diagnose AC, but they can be used to rule out other intra-articular pathology.

Treatment

There is no consensus regarding the best treatment for AC. Many different conservative treatments and invasive procedures have been described (Tab. 2 and 3). The recognition of the clinical stage of disease must to be addressed in the way to decide the kind of treatment required.

Nonsteroidal anti-inflammatory drugs (NSAIDs)
Despite their widespread use, there is no evidence in literature to support the effectiveness of NSAIDs for the treatment of AC. A systematic review of the literature showed significant improvement of symptoms in patients treated with NSAIDs compared with placebo[25]. But the scientific quality of the studies analyzed provides questionable clinical evidence. The use of NSAIDs at earlier inflammatory stages of the disease may provide short-term pain relief[26,27].

Oral steroid treatment
Four randomized controlled trials (RCT) have been identified in literature[28-31]. The last was performed by Buchbinder et al.[31] in 2004. The authors compared a short course of prednisolone to placebo concluding that oral steroids appear to provide significant short-term benefits in pain relief, ROM and function but the effect may not be maintained beyond six weeks.

Intra-articular steroid injections
Intra-articular corticosteroid injection are widely used for AC. Intra-articular corticosteroid injection has showed to provide faster improvement compared to oral route[32]. All patients were submitted to active exercise and passive joint mobilization treatment. Unluckily the small number of patients and the short follow up is the limitation. Lorbach et al.[33] compared intra-articular injections of glucocorticoids with oral corticosteroids in a well conduced prospective RCT. All patient started, four weeks after the first corticosteroid administration, an exercise program supervised by a physiotherapist twice a week and home exercise twice a day within a pain-free ROM. They concluded that the use of corticosteroids in the treatment of AC led to fast pain relief and improved ROM, and that intra-articular injections of glucocorticoids showed superior short-term results compared to oral corticosteroids. Three high quality RCTs[34-36] compared steroid injections with placebo, supervised physiotherapy and intra-articular sodium hyaluronate injection. All trials showed significant benefit of intra-articular injections on pain and shoulder disability at short term follow-up. No differences were found beyond 3 months between treatments. The combination of steroid injection with physiotherapy appeared more effective than physiotherapy or steroid injections alone in the recovery of ROM.

Sodium hyaluronate intra-articular injection
Sodium hyaluronate injection into the glenohumeral joint appear to be an increasing therapeutic option. Its effectiveness has been investigated in three RCTs[34,37,38]. A systematic review of Literature[39] published in 2011, showed that intra-articular sodium hyaluronate injection significantly improves pain and ROM at short-term follow-up, and a statistically significant improvement of Constant-Murley Scores (CMS) was also found. Isolated intra-articular hyaluronate injection has significantly better outcomes than control, while it showed equivalent outcomes compared to intra-articular corticosteroid injection, but with fewer side effects. Rovetta et al.[37] compared patient treated with intra-articular injections of sodium hyaluronate plus steroid and exercise to patients treated with intra-articular corticosteroid injections alone and exercises. They found better results in treatment group than control. Moreover intra-articular hyaluronate injection seems to have chondroprotection property and improve the quality of the synovial fluid[40].
Mobilization and physiotherapy
The first prospective RCT was performed by Bulgen et al.[41] in 1984. Forty-two patients were divide into four groups, and the Authors assessed the effect of mobilization (11 patients), mobilization and ice- pack (12 patients), intra-articular corticosteroid injection (11 patients) and no treatment (8 patients). They found just a few differences between patients treated with physiotherapy and no treated controls. More recently Griggs et al.[42] concluded that patients with phase-II idiopathic AC can be treated successfully with shoulder-

Table 2. Studies of conservative treatment for AC.

Authors	Year	Study	Level of evidence	Management	Number of shoulders	Follow-up	Results
Buchbinder et al.[31]	2004	RCT	II	Prednisolone vs. placebo	50	12 weeks	Good
Widiastuti-samekto et al.[32]	2004	RCT	II	Intraarticular steroid injection and physiotherapy vs. oral steroid and physiotherapy	26	2 weeks	Excellent
Calis et al.[34]	2006	RCT	I	Sodium hyaluronate injection vs. intraarticular steroid injection and physical therapy	95	3 months	Poor
Carrete et al.[35]	2003	RCT	II	Intraarticular corticosteroid injection and physiotherapy vs intraarticular corticosteroid injection alone, physiotherapy alone and placebo	93	12 moths	Good
Ryans et al.[36]	2005	RCT	II	Intraarticular corticosteroid injection and physiotherapy intraarticular corticosteroid injection alone, placebo injection and physiotherapy, placebo	78	16 weeks	Excellent
Lorbach et al.[33]	2010	RCT	II	Oral corticosteroids vs. intraarticular corticosteroid injection	40	12 moths	Excellent
Rovetta et al.[37]	1998	RCT	II	Intraarticular sodium hyaluronate and corticosteroid injection vs corticosteroid injection	30	6 months	Good
Takagishi et al.[38]	1996	RCT	II	Intraarticular sodium hyaluronate vs corticosteroid injection	20	5 weeks	Good
Bulgen et al.[41]	1984	RCT	II	Intraarticular corticosteroid injection, mobilization, ice therapy, placebo	42	8 months	Poor
Griggs et al.[42]	2000	Prospective not randomized	III	Supervised stretching-exercise program	77	22 months	Good
Tanaka et al.[47]	2010	RCT	II	joint mobilization and home self-exercise	120	24 months	Excellent
Dicrkes et al.[43]	2004	Prospective not randomized	III	Intensive physiotherapy vs. gentle physiotherapy	77	24 months	Poor
Vermeulen et al.[44]	2006	RCT	II	High-grade mobilization techniques vs gentle mobilization techniques	100	12 months	Good
Johonson et al.[45]	2007	RCT	I	Anterior vs posterior glide mobilization technique	20	Not reported	Excellent
Stergioulas[49]	2008	RCT	II	low-power laser therapy (LLLT) vs placebo	63	16 weeks	Good
Leung et al.[50]	2008	RCT	II	Deep heating plus stretching vs superficial heating plus stretching or stretching exercises alone	30	4 weeks	Excellent
Dahan et al.[51]	2000	RCT	II	Supivacaine suprascapular nerve block vs placebo	34	1 month	Poor
Jones et al.[52]	1999	RCT	I	Suprascapular nerve block vs intra-articular corticosteroids	30	12 weeks	Good
Buchbinder et al.[55]	2004	RCT	I	Arthrographic distension with saline and corticosteoird vs placebo	48	3 months	Good
Khan et al.[56]	2005	RCT	I	TENS and infra-red radiation alone vs physical therapies and intra-articular corticosteroids	40	8 weeks	Good

Table 2. Studies of conservative treatment for AC.

Jacobs et al.[57]	1991	RCT	II	Distension only vs, steroid only or steroid with distension	47	3 months	Poor
Corbeil et al.[58]	1992	RCT	II	Arthrographic distension and corticosteoird vs nondistensive arthrography and corticosteoird	45	3 months	Poor
Gam et al.[59]	1998	RCT	II	Distension and steroid vs steroid alone	22	12 weeks	Good
Kiwimaki et al.[60]	2007	RCT	II	MUA vs exercise program	125	12 months	Poor
Quaraishi et al.[61]	2007	RCT	I	MUA vs hydrodilatation	36	6 months	Poor
Farrel et al.[63]	2005	Case series	III	MUA	26	15 years	Excellent

Table 3. Studies of operative treatment for AC.

Authors	Year	Study	Level of evidence	Management	Number of shoulders	Follow-up	Results
Baums et al.[68]	2007	Retrospective study	V	Arthroscopic release	30	2 years	Good
Cinar et al.[69]	2010	Retrospective comparative study	III	Arthroscopic release in idiopathic AC vs diabetic AC	28	5 years	Good
Ogilvie-Harris et al.[71]	1995	Retrospective comparative study	III	Arthroscopic release vs MUA	40	5 years	Excellent
Snow et al.[72]	2009	Retrospective comparative study	III	Anterior and inferior arthroscopic capsular release vs posterior release	48	5 months	No difference
Ozaki et al.[73]	1989	Retrospective study	IV	Open release	17	7 years	Good

stretching exercises program. Furthermore stretching exercises should be continued for three months, after that more aggressive physiotherapy or invasive management should be considered.

The frequency and the technique with which the mobilization should be performed is still debated. In a level III study, Diercks et al.[43] compared intensive physical therapy program, including active and passive exercises with stretching beyond the pain threshold to exercises within the pain limits. They found that exercises within the pain limits was superior than intensive physical therapy and passive stretching with regard to functional outcome and speed of recovery. In fact 89% of patients treated with exercises within the pain limits reached a Constant score of 80 or higher compared to 63% of patients treated with intensive physical therapy. In contrast, Vermeulen[44] found that high-grade mobilization technique was more effective than low-grade mobilization technique (within the pain limits) in increasing mobility and functional ability. However all patients improved significantly with both treatment strategies and only a minority of outcome measures reached statistical significance. Johnson et al.[45] compared anterior versus posterior glide mobilization. They concluded that a posteriorly directed joint mobilization technique was more effective than an anteriorly directed mobilization technique for improving external rotation after three treatment sessions. A retrospective cohort study[46] of more than 2.000 patients affected by AC found that both manual shoulder mobilization techniques and self-exercise like stretching and home programs are effective for the treatment of AC. Self-exercises twice[47] daily appeared instead superior than shoulder mobilization by a physiotherapist twice a week.

The efficacy of physiotherapy interventions for shoulder pain and dysfunction have been evaluated by a Cochrane Review[48]. Unfortunately many pathologies of the shoulder such as rotator cuff tears, calcific tendinopathy, AC, anterior gleno-humeral instability have been considered. Laser therapy was demonstrated to be more effective than pla-

cebo for AC[48]. It was confirmed more recently by Stergioulas[49]. Low-level laser treatment seemed to be more effective than placebo respect to pain but not respect to ROM. So the Author concluded than lower-level laser therapy did not affect the underlying capsular pathology and adhesion. Leung et al.[50] conducted a RCT which demonstrate that addition of deep heating to stretching exercises produces a greater improvement in pain relief, and leads to improved performance in daily living activities and in range of motion, more than superficial heating. However there is no evidence that physiotherapy alone is of benefit for AC[48]. Ultrasound, massage, iontophoresis, and phonophoresis not only seems to be no effective for the treatment of AC, but they seems to reduced the likelihood of a favorable outcome. So their use have been discouraged by some Authors[46].

Suprascapular nerve block

The suprascapular nerve provides nerve supply to muscles of the shoulder girdle, and to the shoulder joint. Local anaesthetic blocks of suprascapular nerve are used to treat painful shoulder conditions such as adhesive capsulitis.

A double-blinded randomised controlled trial[51] compared three suprascapular blocks with bupivacaine at weekly intervals with placebo. Suprascapular nerve block gave significantly more pain relief than placebo at 1 month follow-up. No improvement in ROM was noted. This study present also several limitations, as the high dropout rate and the short-term follow-up. Therapeutic effects of suprascapular nerve blocks were compared to intra-articular corticosteroid injections by Jones et al.[52] They found a statistical significant improvement in both groups, but case group showed better results regarding pain relieve and ROM at 3 months follow-up. The authors concluded that suprascapular nerve block could be used in primary care with good results. The standard suprascapular nerve block technique using needle tip guided by superficial bony landmarks was compared with suprascapular blocks administered under the guidance of electromyography[53]. After one hour, the electromyography technique produced significantly more pain relief and better range of motion than the standard technique. Ultrasound-guided placement of a perineural catheter to provide continuous suprascapular nerve block have also been proposed in a case report[54]. The continuous nerve block catheter allowed pain relieve and to start a mobilization program.

Arthrographic distension

Arthrographic distension is a procedure based on the injection of a saline solution or corticosteroids into the shoulder joint to break up the adhesions that might limiting the movement of the shoulder and causing disability. Buchbinder et al.[55] compared arthrographic distension with steroid and saline versus placebo. Case group had significantly greater improvement at three weeks follow up compared to participants in the placebo group regarding ROM, pain and disability. Another RCT compared arthrographic distension with steroid and saline associated with physical therapy to physical therapy alone[56]. Distension followed by physiotherapy was more effective than physiotherapy alone to reduce pain and improve ROM at 8 weeks. Three RCT compared distension with corticosteroid injections. Two of these, conducted by Jacobs[57] and Corbeil,[58] reported no difference between distension and injection regard pain and ROM. Only one study[59] reported significant improvement in range of motion and lowered analgesic use in the arthrographic distension group, but no difference in pain or function between groups.

Mobilization under anesthesia (MUA)

MUA is commonly used when conservative treatments have failed, but its effectiveness for the treatment of AC is controversial. Kivimäki[60] examined the effect of MUA in patients with adhesive capsulitis in a blinded randomized trial with a 1-year follow-up. In this study MUA was compared to a home exercise program. They found no differences between these two treatment options in terms of shoulder pain or working ability. Small differences in the range of motion were detected favoring the manipulation group at 3 months follow up, but this was not sustained at 6 months and 12 months. Quraishi et al.[61] assessed the outcome of MUA and hydrodilation in 36 patients with adhesive capsulitis. The VAS and the Constant score of control group were significantly better than those of MUA group at 6-month follow-up. On the other side, Dodenhoff et al.[62] showed that manipulation under anesthesia can provide early improvement of shoulder function and that it is generally a safe procedure. They prospectively assessed 39 shoulders in 37 patients who were diagnosed with primary adhesive capsulitis. Farrell et al.[63] reported excellent results in 70% of patients treated with MUA at 15 years follow up, but the limitations of this study were the small sample and the high percentage of patients lost at follow-up.

There is no consensus also about the safety of MUA because many iatrogenic lesions have been reported. Hemarthrosis, capsular tears, glenioid labral detachments, SLAP lesions, glenohumeral ligament ruptures, rotator cuff's tendon tears, humeral neck fracture and glenoid fracture have all been reported[64,65]. Actually there is no evidence that MUA is better than daily mobilization exercises[66]. Moreover, MUA should not be used in case of history of fracture or dislocations, moderate bone loss, and in patients with adhesive capsulitis associated with insulin-dependent diabetes[67]. Poor outcomes and frequent recurrences have been reported in patient with diabetes after MUA[61].

Arthroscopy

Many studies confirmed the effectiveness of arthroscopy in treatment of recalcitrant adhesive capsulitis. Baums et al.[68] in a prospective study showed a great improvement in pain, ROM and shoulder function in patients with resistant adhesive capsulitis treated with arthroscopic release. Cinar et al.[69] compared results of arthroscopic capsular release in patients with primary AC to patients with AC and insulin-dependent diabetes. They confirmed the effectiveness of procedure in both groups but the diabetic patients had poorer results in terms of ROM and Constant Score. Elhassan et al.[70] showed that patients with idiopathic and post-traumatic shoulder stiffness have better outcomes than patients with postsurgical stiffness. In a level III study Ogilvie-Harris et al.[71] compared arthroscopic release with MUA. They stated that arthroscopic release has supplanted MUA as treatment of choice for resistant adhesive capsulitis because it ensures more significant and rapid improvements in motion

and pain with lower risk of complications.
It is unclear the extent in which capsule should be released and which structures should be involved in release. Many authors release only the rotator cuff interval and the contracted coracohumeral ligament with excellent results. The aim of recent study[72] was to assess the overall effectiveness of arthroscopic capsular release and to determine if the combination of anterior and posterior capsular release had more benefit than only anterior release. The authors showed that a more extensive release is not related with a greater improvement in ROM. However further studies are necessary.

Open release
Many studies have confirmed the effectiveness of the open release in treatment of resistant AC. Ozaki et al.[73] performed open release in 17 patients who had recalcitrant chronic AC. They found that the main cause of restricted glenohumeral movement was the contracture of coracohumeral ligament and rotator interval. Release of contracted structures relieved pain and restored motion of the shoulder in all patients.

Rehabilitation protocols
Many treatment options for AC have been reported but there is no consensus on the best management. Although these methods appear effective they have not been tested with class I studies.
Neviaser and Hannafin proposed a stage based treatment protocol in their review[74]. In the first stage the goal of therapy is the control of inflammation and the relief of pain. This can be obtain with an intrarticular steroid injection mixed with lidocaine, cryotherapy, TENS. Education, activity modification and gentle range of motion exercises are prescribed. In stage 2 it is important to minimize capsular adhesions and restrictions of motion with passive joint glide, home exercises and active exercises in the plane of the scapula. In stages 3 and 4 the aim is to treat the marked loss of motion and abnormal scapulohumeral mechanism. Aggressive stretching is the cornerstone of the therapy in this phase. As the ROM is restored, the strengthening of the rotator cuff muscles begins. Patients who have failed nonoperative treatment were submitted to arthroscopy capsulotomy. The posterior capsule is included in the release. At the end of procedure they perform a manipulation to assure adequate release. Also Favejee[75] think that treatment should be based on the stage of the pathology and they proposed a similar therapeutic algorithm. Kelley et al.[76] consider extremely important to verify the patient's irritability before deciding on treatment. Patients with high irritability should be treated with short-duration, relatively pain free stretching and low grade joint mobilization to avoid exacerbation of pain and inflammation. The use of intra-articular steroid injection helps to turn off the inflammatory process. As the level of irritability is reduced, more intense stretching and mobilizations near the end range can be performed. Patients who have recalcitrant symptoms and disabling pain may respond to manipulation under anesthesia or arthroscopic release. In 2005 Iannotti et al.[77] proposed an algorithm to diagnose and treat adhesive capsulitis. They proposed that AC should be treated non-surgically first. In the first stage of the disease provocative activities should be avoided. For pain control NSAIDs, opioids or steroid/hyaluronate intra-articular injections have been used. In case of loss of motion, a stretching program, pendulum motions, active-assisted and passive mobilizations have been used to restore joint mobility. Finally muscle strengthening exercises were performed.

Discussion

The goal of this study was to provide an overview concerning evidence for the effectiveness of interventions to treat AC. Unfortunately there is no consensus about the management of this pathology and it probably depends on the lack of high level study.
NSAIDs are widely prescribed for the treatment of AC, even if there is a lack of evidence to support their effectiveness. They can be used during early inflammatory stage to provide short-term pain relief, but more research is needed to assess their role. Oral steroids appear to provide significant short-term benefits but their effect may not be maintained beyond six weeks. Furthermore treatment with oral steroids for a long period involves long-term systemic side effects. A valid alternative is represented by intra-articular steroid injections. They seem to provide better results than oral steroid treatment[33] with lower risk of side effects. Intra-articular injections may be more efficacious in the early stages of disease when the inflammatory processes are predominant and there is not a significant capsular contracture. However this finding has yet to be proven with higher level studies. There is evidence for the effectiveness of intra-articular steroid injections for pain in the short term and moderate evidence in the medium term. There is no evidence for its effectiveness on ROM, and no differences were found also between steroid injections and manipulation[78]. A small number of RCTs of sodium hyaluronate intra-articular injection are published in literature. It seems to provide a significant improvement in pain severity and a significant benefit on function and disability[79]. Unfortunately there is insufficient evidence to make conclusion about the effectiveness of sodium hyaluronate injection for the treatment of AC and further studies are needed. Mobilization and physiotherapy are often prescribed to prevent capsular contracture and improve shoulder range of motion. Gentle stretching and home exercise program within the pain threshold seem to provide better results than more intensive mobilization programs, even if there insufficient evidence to make conclusions about the most effective physiotherapy[79]. Regarding physical therapy, there is a good evidence for the effectiveness of laser therapy and deep heating especially if applied as adjuvant to other treatment modalities like mobilization techniques or exercise programs[9]. Suprascapular nerve block seems to be useful to reduce pain in the short and mid-term follow-up compared with acupuncture, placebo or steroid injections[78]. Hydrodilatation of shoulder joint has been recommend by some Authors for patients with adhesive capsulitis resistant to conservative treatment[61]. It seems to provide better results and lower risk compered to MUA. However few RCTs are published in Literature and they involved few

patients. MUA has also been proposed for refractory pain and stiffness. The results of manipulation have mostly been reported to be excellent also in the long term, but comparative studies have shown equivocal benefit when compared with hydrodilation or home exercises therapy. Than the high risk of side effect that discourage its use[64,65].

Surgical options for treatment of AC have been proposed. The most popular treatment of resistant AC is arthroscopic release. It has been considered useful also to confirm the diagnosis, to exclude other significant pathologies, to classify the stage of the disease. The advantage of this technique is its ability to perform precise, selective capsular releases in a very controlled manner.

Open release is the last chance for the most resistant forms of adhesive capsulitis for patients who failed arthroscopy and closed manipulation. These cases are fortunately rare. Unfortunately, open release is associated with open procedures complications such as prolonged recovery, post-surgical stiffness, increased post-operative pain that can inhibit early mobilization.

We think that treatment of AC should be based on the stage of the disease, on patient characteristics and that an individual rehabilitation program should be proposed. We also think that is very important explain to patients that "normal" is not the expected outcome and the restoration of pre-injury shoulder function is not the goal of treatment. In the first phase is important to reduce pain and preserve shoulder functionality is mandatory. NSAIDs or intra-articular steroid injections are indicated, paying attention to not exceed 4 weeks of treatment. We prefer to use intra-articular sodium hyaluronate injection to improve pain and ROM. Better results have been proved with the addiction of stretching and exercises program within the pain threshold. For this purpose hydrotherapy represents a valid treatment alternative. It offers the possibility, by reducing the force of gravity, to perform a more natural and less stressful movement on the joints. Water also helps in relaxing muscles in order to facilitate movements. Laser therapy has been used with statistically significant reduction of pain and disability compared to placebo[78]. In the freezing stage is extremely important to prevent and reduce the formation of adhesions. This can be obtained through an exercise program that includes passive mobilization, active exercises carried out in mild scapular plane, daily home exercises and self made mobilization. We use cane or pulleys to improve internal and external rotation. The length and intensity of exercise should be based on the threshold of pain of the patient. In stage 3, the frozen stage, a significant shoulder stiffness is predominant and the aim of therapy is the treatment of the marked loss of ROM. It is extremely important to correct the compensatory movements and restore a proper dynamic shoulder joint. The mainstay of treatment in this phase is represented by physiotherapy. The control of pain is important to increase the intensity, duration and frequency of exercises. Prolonged low-load stretching and end range mobilization can be prescribed. To improve shoulder external rotation posteriorly directed joint mobilization technique is more effective than an anteriorly directed mobilization technique[45]. The addition of deep heating to stretching exercises and mobilizations can produce a greater improvement in ROM trough the relaxation of the surrounding musculature[50]. As the ROM increase, a program of strengthening exercises of the scapular muscles and rotator cuff muscles is indicated. In stage 4 the aim of the treatment is restoring the normal function of the shoulder. In addition to strengthening exercises, proprioceptive exercises are prescribed in order to correct the compensatory movements and restore a proper dynamic shoulder joint. More aggressive approach can be proposed for patients refractory after 6 months of conservative treatment. Arthroscopic release alone or in combination with manipulative treatment appears to provide better results.

Conclusions

There are few evidences to draw firm conclusion about the best management of patients with AC and its treatment remains controversial. Treatment should be should be based on the stage of the disease and on patients characteristics. The first approach should be conservative while surgical option should be considered for patients refractory to conservative treatment. Although there are several treatment options, it would seem that the best treatment has yet to be discovered and further studies are needed.

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