

Frozen shoulder

Definitions. Am J Sports Med 2010 38: 2346

Adhesive capsulitis[Neviaser] is characterized by a painful, gradual loss of both active and passive glenohumeral motion resulting from progressive fibrosis and ultimate contracture of the glenohumeral joint capsule.

Frozen shoulder [Codman]

Variable nomenclature, inconsistent reporting of disease staging, and a multitude of different treatments have created a confusing and contradictory body of literature about this condition.

Epidemiology

- Adhesive capsulitis 2% to 5%
- The non-dominant hand is more frequently involved.
- 20% to 30% of those affected will develop the condition in the opposite shoulder.
- Twenty percent to 30% of patients will report a history of minor trauma to the shoulder, but there is no further evidence that this is a posttraumatic condition.
- Autoimmune processes have been proposed as the underlying pathophysiology

Predisposing

Diabetes mellitus: 20% of all diabetics and 36% of insulin dependent diabetes. 40% of bilateral are diabetic

Dupuytren's contractures present in 18%-50% of frozen shoulder [histology is similar Type III collagen]

Patients with cerebrovascular accident or myocardial infarction have been reported to be at increased risk.

Thyroid dysfunction, autoimmune disease

Frozen shoulder is a contracture of the shoulder joint capsule. Although the disease causes a global contracture of the shoulder joint, it appears maximal in the rotator interval area, and particularly around the coracohumeral ligament.

Clinical

TABLE 1
Stages of Adhesive Capsulitis

	Symptoms	Signs	Arthroscopic Appearance	Biopsy
Stage 1	Pain referred to deltoid insertion Pain at night	Capsular pain on deep palpation Empty end feel at extremes of motion Full motion under anesthesia	Fibrinous synovial inflammatory reaction No adhesions or capsular contracture	Rare inflammatory cell infiltrate Hypervascular, hypertrophic synovitis Normal capsular tissue
Stage 2	Severe night pain Stiffness	Motion restricted in forward flexion, abduction, internal and external rotation Some motion loss under anesthesia	Christmas tree synovitis Some loss of axillary fold	Hypertrophic, hypervascular synovitis Perivascular, subsynovial capsular scar
Stage 3	Profound stiffness Pain only at the end range of motion	Significant loss of motion Tethering at ends of motion No improvement under anesthesia	Complete loss of axillary fold Minimal synovitis	Hypercellular, collagenous tissue with a thin synovial layer Similar features to other fibrosing conditions
Stage 4	Profound stiffness Pain minimal	Significant motion loss Gradual improvement in motion	Fully mature adhesions Identification of intra-articular structures difficult	Not reported

Codman's criteria

- 1. Insidious in onset
 - 2. Pain is felt near the insertion of deltoid
 - 3. Inability to sleep on the affected side
 - 4. Painful and incomplete elevation
 - 5. Limitation of external rotation
 - 6. Restriction of both spasmodic
 - 8. Atrophy of the spinati
 - 9. No localizing tenderness
 - 10. X-rays negative except for bony atrophy
 - 11. The pain was very trying to every one of them
-
- Codman stated, 'even the most protracted cases get better, with or without treatment, in about 2 years'. It is this statement that has got into the textbooks, has become dogma, and has become established, without question, through three generations of orthopaedic surgeons.

Associations

Condition	Author	Description
Trauma/surgical		
Upper extremity trauma	Hand et al ⁴⁷	22% of patients report minor trauma to limb before symptoms
Radial neck dissection	Patten and Hillel ⁸⁵	31 of 44 patients who underwent neck dissections
Hormonal		
Diabetes	Bridgman ¹²	Incidence of 10.8% in diabetic patients and 2.3% in nondiabetic patients
	Thomas et al ¹⁰²	Incidence of 4.3% in diabetic patients and 0.5% in nondiabetic patients
	Arkkila et al ²	Incidence of 10.3% in patients with type I diabetes and 22.4% in patients with type II diabetes
ACTH deficiency	Choy et al ²⁷	Case of bilateral frozen shoulder in isolated ACTH deficiency
Thyroid disease	Wohlgethan ¹⁰⁹	Case of bilateral frozen shoulder in hyperthyroidism
	Bowman et al ¹⁰	Case of bilateral frozen shoulder in hypothyroidism
	Cakir et al ²²	10.9% incidence in patients with thyroid disease
Cardiac		
Cardiac disease	Tuten et al ¹⁰³	3.3% incidence in male cardiac surgery patients (7 of 214)
	Bridgman ¹²	10 of 14 nondiabetic patients with frozen shoulder had ischemic heart disease or hypertension
Diabetes and cardiac disease	Boyle-Walker et al ¹¹	Diabetes and heart disease more prevalent in patients diagnosed with adhesive capsulitis compared with controls
Neurologic		
Parkinson	Riley et al ⁹¹	Incidence of 12.7% in Parkinson patients and 1.7% in controls
Stroke	Lo et al ⁶³	50% incidence in patients with hemiplegic shoulder pain after first stroke
Neurosurgery	Bruckner and Nye ¹⁵	25.3% incidence in neurosurgical patients
Aneurysm surgery	Tanishima and Yoshimasu ¹⁰¹	41% of patients undergoing acute aneurysm surgery
Other		
Malignancy	Gheita et al ⁴²	9 of 60 patients with malignant disease
Hypertipidemia	Bunker and Esler ²⁰	Higher triglyceride and cholesterol levels in frozen shoulder patients vs controls
	Hand et al ⁴⁶	17% had hypercholesterolemia
Drug related	Hutchinson et al ⁵¹	12 patients treated with matrix metalloproteinase inhibitor for gastric carcinoma
	Grasland et al ⁴³	8 patients treated with protease inhibitor (indinavir)
	De Ponti et al ³²	6 patients treated with antiretrovirals (stavudine, lamivudine, indinavir)
	Bodor and Montalvo ⁹	2 cases after influenza and pneumococcal vaccine
	Freiss et al ⁴¹	2 cases after fluoroquinolones
Dupuytren	Smith et al ⁹⁷	52% of patients with frozen shoulder were found to have Dupuytren
	Degreef et al ³³	45% of patients with Dupuytren diagnosed with frozen shoulder

Important signs [ORTHOPAEDICS AND TRAUMA 25:1]

1. Painful and incomplete external rotation [four shoulder conditions that restrict external rotation are a. arthritis, b. locked posterior dislocation, c. Milwaukee shoulder d. frozen shoulder.
2. Whilst frozen shoulder shows an entirely normal radiographic appearance of the shoulder compared to other 3 causes.
3. Terminology has changed and we would now state 'limitation of active and passive movement'. The key to the puzzle is the limitation of passive movement that, in the shoulder [caused by :in arthritis, locked dislocation, Frozen shoulder]

In pragmatic terms, if the radiograph is normal and the joint shows passive restriction, then this can only be caused by contracture of the ligaments.

However the arthrogram is pathognomonic. Neviaser performed arthrograms on the shoulders of patients with frozen shoulder and showed that the capsule of the shoulder is contracted.

The joint has a diminished volume, there is absent filling of the infraglenoid recess and the subscapular recess and bicipital tunnel are obliterated in frozen shoulder.

Investigation

- 1. X ray: normal
- 2. MRI: Thickening of the joint capsule and synovium in frozen shoulder. gadolinium-enhanced dynamic MRI, which has shown an increased blood flow to the synovium.
 - Potentially useful MR findings in frozen shoulder are
 - thickening of the coracohumeral ligament and joint capsule
 - in the rotator interval.^{24,100} Capsular thickening of
 - the axillary recess is often a useful sign,³⁸
- 3. Ultrasound can show thickening of the coracohumeral ligament

- 4. Arthroscopy
- In the early stages the major finding is angiogenesis, or new blood vessel formation. This can be quite spectacular, **with fan shaped areas of blood** vessel formation, villi formation
- Within the infraglenoid recess the vessels line up in a radial fashion that we term the 'lava flow'.
- Granulation tissue that is red, highly vascular, with a villous synovium occurs in the rotator interval area.
- It is interesting that angiogenesis is a feature of diabetes, for frozen shoulder is common in diabetics.
- In the late stages the angiogenesis diminishes. The joint is less red, but thick bands of scar tissue can be found
- The superior glenohumeral ligament becomes thickened, obliterating the rotator interval. Arthroscopy confirms a contracted joint space with granulation tissue in the rotator interval area. A pattern is beginning to emerge, and it is a contracture.

Pathogenesis/Pathology

- The pathogenesis remains unclear. This condition affects the glenohumeral capsule
- The histologic features of frozen shoulder include a matrix of type I and type III collagen populated by fibroblasts and myofibroblasts that suggest the condition may be modulated by an abnormality in the production of cytokines and growth factors.¹² This inflammation cascade, driven by the abnormal cytokine production, has been implicated in the abnormal tissue repair and fibrosis that occurs. TGFb and PDGF to be elevated, and suggested that these cytokines may act as a persistent stimulus causing capsular fibrosis and the development of frozen shoulder.
- Stimulation of synovitis results in the development of a fibrotic cascade that may involve growth factors such as TGF-beta.
- Although adhesive capsulitis is described to be a self-limiting disorder, this condition can sometimes last for years. Ten percent of the patients report persistent pain
- Pathology: 'The coracohumeral ligament is converted into a tough inelastic band of fibrous tissue spanning the interval between the coracoid process and the tuberosities of the humerus. It acts as a powerful checkrein. division of the coracohumeral ligament allows early restoration of movement'. This is truly the most elegant description of a contracture of the coracohumeral ligament.

Pathology 2011

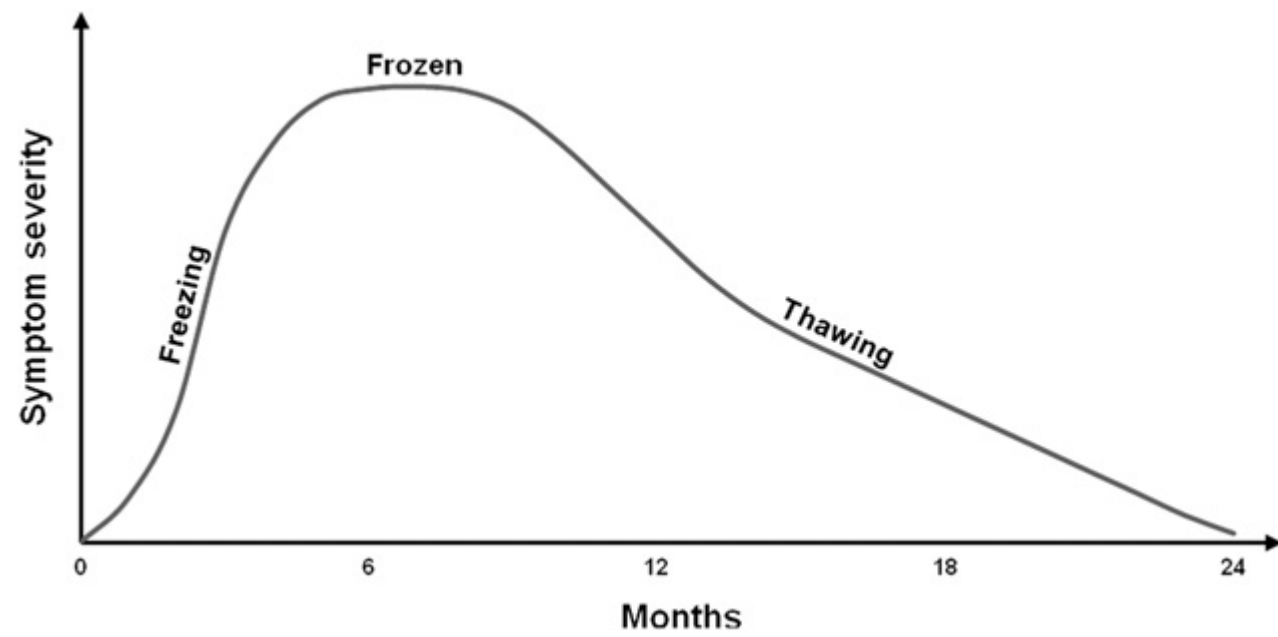
- 1. Thickened, tight glenohumeral joint capsule with adhesions obliterating the normally patulous axillary fold.
- 2. Overall joint volume is diminished. Normal shoulder joint volumetric capacity is 28 to 35 mL of injected fluid, whereas in adhesive capsulitis, the joint accepts only 5 to 10 mL.
- 3. Biopsy of the capsule demonstrates a chronic inflammatory infiltrate, absence of synovial lining, and moderate to extensive subsynovial fibrosis. Perivascular lymphocytic reactions are noted, as well.
- 4. Four stages of disease have been described based on the arthroscopic appearance
- 5. Biopsy specimens from patients in the first three stages demonstrate a clear progression from perivascular mononuclear inflammatory infiltrates to reactive capsular fibrosis, confirming an inflammatory origin. Increased levels of transforming growth factor- β and other profibrotic cytokines are present in capsular biopsy.
- 6. The inciting cause of the inflammation is unknown.

C/F: Patients typically present with pain of insidious onset of several months' duration.

- Night pain is common
- A mechanical restraint to passive motion is the hallmark of adhesive capsulitis. This finding is best appreciated on passive external rotation with the arm at the side.
- Discriminating stage 1 disease (ie, before adhesion formation) from other pathology can be difficult because the signs

MRI

- 4 mm thickening of the axillary fold on MRI :highly specific for adhesive capsulitis;Changes in the coracohumeral ligament were not a consistent feature.
- Others have reported scarring within the rotator interval to be a more common finding



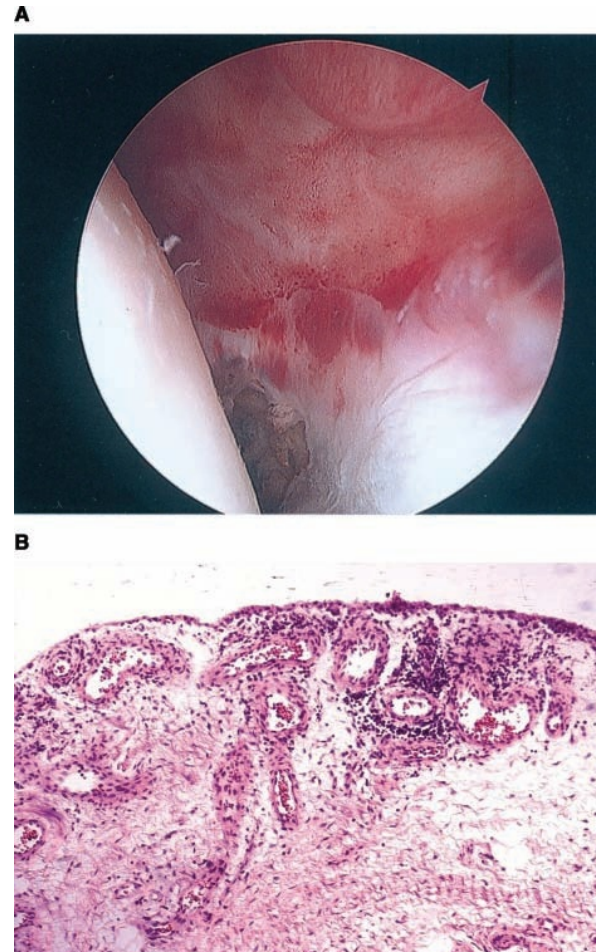
Capsulitis 4 stages: Neviaser

- Stage 1 Gradual onset of pain
Pain at night is common,
- Duration of symptoms is generally less than 3 months.
Patients may report limitation of ROM; but fully restored when pain is relieved by intra-articular L.A.
Early loss of ER with intact rotator cuff strength is a hallmark of adhesive capsulitis

Arthroscopy :
Fibrinous synovial inflammatory reaction
without adhesions or capsular contracture

Biopsy

- Hypervascular, hypertrophic synovitis; and
- Normal capsular tissue



Stage II

Stage 2

Represents : Acute synovitis + Capsular contracture, which some have called the freezing stage.

Pain persists and may be more severe, particularly at night.

Motion is restricted in Flexion, abduction, and rotations.

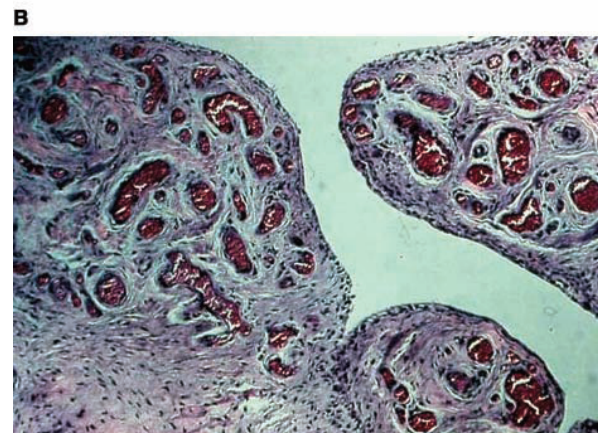
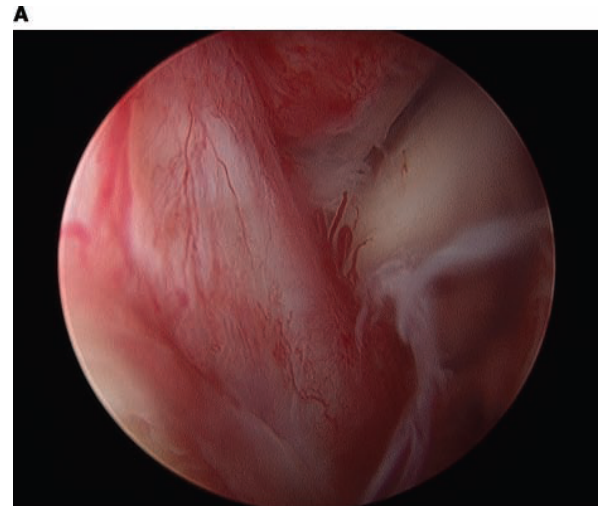
Limitation cannot be fully reversed with intra-articular anesthetic injection.

Arthroscopy

- A thickened, hypervascular synovitis : a Christmas tree appearance
- There is early loss of the dependent axillary pouch

Biopsy

Hypertrophic, hypervascular synovitis with perivascular and subsynovial scar formation is seen on capsular biopsy



Stage III

In stage 3,

The stage of maturation, also referred to as the frozen stage, the predominant patient complaint is significant stiffness.

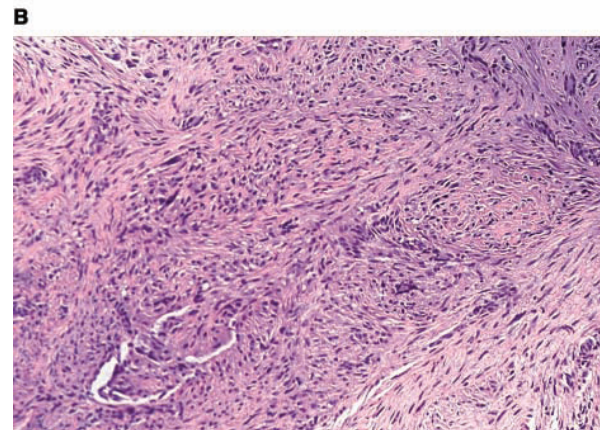
- Pain may still be present at the end of ROM
- No improvement in motion is seen with intra-articular anesthetic injection or examination
- Symptoms have typically been present for 9 to 15 months at this point.

Arthroscopy

- Loss of the axillary recess is seen on arthroscopic examination, and minimal synovitis is present

Biopsy

- Dense, hypercellular, collagenous tissue with
- a thin synovial layer exhibiting features similar to other fibrosing conditions



Stage 4,
the chronic stage,49 has also been
termed the thawing stage.

Pain is minimal, and a gradual
improvement in motion can occur.

- The amount of improvement typically
seen is controversial.
- Long-term objective assessments
demonstrate more significant motion
deficits than patients tend to self-report,
and the natural history of the disease has
not been clearly described.
- Arthroscopy demonstrates fully mature
adhesions, making identification
- of intra-articular structures difficult.

NATURAL HISTORY

ORTHOPAEDICS AND TRAUMA 25:1: 16

1. Reeves The best paper 62 patients; follow-up of 10 years.

They found that 50% still had either mild pain or stiffness of the shoulder or both.

Marked restriction of movement, when present, was most common in external rotation.

The authors concluded that complete resolution was not universal and more than half had a measurable loss of motion, although this caused little functional disability.

2. Griggs confirmed these findings and stated that 'even amongst the patients who were satisfied, a substantial number were not pain free'; 10% had mild pain at rest, and 27% had mild or moderate pain with activity. 40% of the satisfied patients had abnormal shoulder function.

3. Our own studies: showed that although 86% had an improvement in their level of pain, this did not mean that they had no pain. Only 53% had no pain, 33% had an occasional pain and 14% had marked residual

- pain.

In a level III investigation of 42 patients followed for a minimum of 40 years, Binder et al found that 5 patients had severe limitation of motion and 11 had mild limitation compared to age-matched controls.

Natural course

CORR (2012) 470:1133–1143

- The natural history of idiopathic frozen shoulder, the length of symptoms, recovery of ROM, pain relief, and function at a mean of 9 years.
- Diercks and Stevens [5] stated supervised neglect yields better outcomes than intensive physical therapy and passive stretching in patients with frozen shoulder.
- Patients in our untreated group had better pain relief, ROM, and function than patients in our nonoperative group.
- Our study and the literature shows most patients with idiopathic frozen experience resolution without any treatment. We believe it is important to be able to tell a patient with some confidence that an idiopathic frozen shoulder generally recovers well without any restriction of motion or pain.

Treatment

I NSAID Treatment: No difference with different NSAID

II Oral Steroid Treatment

- Oral steroid treatment appears to provide more rapid relief of pain compared with controls (similar to the effects seen with intra-articular steroid injection), but this benefit is not sustained at longer follow-up.

III Intra-articular Steroid Injections

- Blinded assessments of pain and range of motion showed no significant difference in shoulder range of motion between groups. Those treated with the intraarticular steroid did show a more rapid improvement in pain symptoms, but this difference was transient (2-3 weeks).
- Bulgen et al¹¹ randomized 42 patients to 1 of 4 treatment groups: (1) intra-articular injection of methylprednisolone, (2) mobilization with a physiotherapist, (3) ice treatments following proprioceptive exercises, and (4) no treatment. Those treated with steroid injections had the most marked improvement in range of motion at 4 weeks' time. At 6 months, however, there was no difference between the groups.

Role for Intra-articular steroid

J Shoulder Elbow Surg (2010) 19, 172-179

- Prospective Randomized 40 patients with idiopathic adhesive capsulitis
- Treated with an oral corticoid Rx or 3 intra-articular injections of corticosteroids. Follow-up was after 4, 8, and 12 weeks, and 6 and 12 months.
- Intra-articular injections of glucocorticoids showed superior results in objective shoulder scores, range of motion, and patient satisfaction compared with a short course of oral corticosteroids.
- The injection consisted of 5 mL of bupivacaine (0.5%), 5 mL of mepivacaine (0.5%), and 40 mg of triamcinolone. The injections were given at the beginning and at 4 and 8 weeks.

- Intra-articular injection series seem to provide faster improvement in pain reduction and patient satisfaction
- Combined with a physical therapy program beginning after 4 weeks, as primary cortisone treatment in idiopathic adhesive capsulitis of the shoulder.
- In patients with contraindications against injections, such as allergies against local anesthetics or patients who receive bloodthinning medicine, we use an oral application of corticosteroids in the described scheme.
- Significant superior range of motion for the patients treated with intra-articular injections was seen in shoulder flexion after 4, 8, and 12 weeks of follow-up and for the abduction
- after 8 weeks and 6 and 12 months of treatment. External rotation showed significant differences at 4 and 8 weeks of follow-up. Internal rotation was also superior in
- the intra-articular injections group after 4 and 12 weeks of follow-up

- Van der Windt randomized 109 patients to receive either 40-mg intra-articular injections of triamcinolone acetonide or physiotherapy 2 times per week for 6 weeks.
- A painful and stiff shoulder due to “capsular syndrome” was required for inclusion. Stage of disease at presentation and duration of symptoms were not reported.
- Patients could receive more than 1 injection but no more than 3 in the 6-week period. The group averaged 2.2 injections in the treatment period, although indications for repeat injections were not described.
- The authors reported treatment success in 77% of patients treated with injection compared with 46% of those treated with physiotherapy.

Physical Therapy

- Physical therapy is the most consistently prescribed treatment
- The level I studies by Carlette et al¹² and Bulgen et al¹¹ (described above) found no differences between patients treated with physiotherapy and no-treatment controls.
- A level III study by Diercks et al¹⁹ comparing benign neglect to intensive physical therapy would also appear to support this position. They found almost 90% of those in the “neglect group” had near normal shoulder function at 2 years as compared with 63% in the therapy group. Patients in the neglect group engaged in pendulum exercises and active exercises within their pain threshold throughout the study.
- .
- There was little difference between those who engaged in low grade mobilization techniques compared with groups using high grade techniques. Low grade is defined as movement within a pain-free zone, while high grade mobilization included movements into the stiff, painful range.

- In most series, approximately 10% of patients do not respond to the variety of nonoperative treatments
- Levine et al identified those patients who failed to improve or were worse after 4 months as most likely to fail nonoperative treatment. However, the indications for more invasive options remain highly subjective and need to be individualized to each patient.

Manipulation under anesthesia, (MUA), hydrodilation, suprascapular nerve block (SSNB),

MUA

- Professor Sir John Charnley [questionnaire to his colleagues in the BOA]; 70% said they would never perform a manipulation, as all would eventually get better, and some could be harmed.
- Andersen, Sjobjerg and Sneppen³⁷ have shown that 79% of patients with frozen shoulder are relieved of their pain, and 75% regain a near normal range of movement after manipulation.
- We have arthroscoped patients before and after manipulation to discover exactly what is happening.¹ Essentially, what we found was that elevation, or abduction, tears the capsule from the neck of the humerus, releasing the inferior capsule, and this occurs with relative ease. It is much harder to free rotation, but forced external rotation tears the coracohumeral ligament. This is an extra-articular ligament, so what is seen arthroscopically is haemorrhage in the rotator interval. Often, the coracohumeral ligament is so contracted that it will not tear and the patient is left with limitation of external rotation.
- Arthroscopic release, in the hands of the expert shoulder surgeon, has transformed the management of capsular contracture.
- Ogilvie Harris compared the results of manipulation versus arthroscopic release in their hands. Although both groups gained the same substantial improvement in range of motion the arthroscopic group had significantly better pain relief and function, to the extent that twice as many were graded excellent.

MUA

- After 6 months of refractory pain and stiffness in patients
- with primary frozen shoulder, manipulation under anesthesia
- can be considered. In this procedure, the patient can
- be placed supine or in the seated beach-chair position, and
- the shoulder is gently passively stretched in forward
- flexion, abduction, and adduction while the scapula is being
- stabilized. With the elbow at a right angle, the upper arm is
- finally gently rotated through extremes of internal and
- external rotation by use of a short lever arm. Tearing of the
- contracted capsule may be palpated and even audibly
- confirmed by the physician. Closed manipulation should
- not be attempted in more resistant cases of post-traumatic
- and postsurgical frozen shoulder because of increased risk
- of fracture.

- Kivimaki a level I study : Compare MUA Vs a home-based exercise
- 125 patients were randomized
- The MUA group had slightly better mobility at 3-month follow-up examinations with statistically significant improvement in shoulder flexion, but this was not sustained at 6 months and 12 months.
- Dodenhoff MUA in Neviaser stage II
94% of patients were satisfied at final follow-up. The most common reason for satisfaction
- was regaining the ability to do daily tasks, which most could do within days of the manipulation.
- Farrell et al²² reported on the long-term results of MUA and showed sustained improvement in both pain and motion
- For refractory loss of motion, MUA appears to be a reliable treatment.
Those who do not respond to physical therapy appear to benefit most from MUA, whereas it may not be as beneficial in less severe disease.

Arthroscopic capsular release

- Harryman and Matsen published a year later and demonstrated fantastic results. The range of motion went from 41% of the opposite side to 78% on the first postoperative day and 93% at the end of the study.
- Before surgery 6% could sleep and after 73%.
- They were the first to show the dramatic speed of recovery following treatment, which is the very thing that patients want.
- Berghs and Bunker²¹ confirmed this with a dramatic improvement on day one post surgery in 36% and 88% improvement within 2 weeks.
- Pain improved from 3.6/15 to 12.6/15 and the partial Constant Scores from 20/75 to 62/75. There
- were no complications in three of these studies, but one transient axillary neurapraxia in the Harryman study.
- Arthroscopic release appears to show great promise for it delivers what the patient wants; relief of pain, undisturbed nights and improved function.

Open release

- an incision is made from
- the clavicle to the lateral border of the coracoid. The
- deltoid is split to expose the coracohumeral ligament, and
- the ligament is excised with the arm in external rotation.
- The border of the rotator interval should be identified,
- along with the long head of the biceps. The tissue
- between the supraspinatus and subscapularis and under
- the coracoid process should be excised. Care should be
- taken to prevent iatrogenic damage to the subscapularis,
- supraspinatus, and long head of the biceps. If external
- rotation still remains tight after this release, the middle
- glenohumeral ligament, inferior glenohumeral ligament,
- and capsule can be divided as far posteriorly as possible.

Long term results:

VOLUME 94-A d NUMBER 13 d JULY 3, 2012

- Idiopathic adhesive capsulitis, or frozen shoulder >4 weeks
- At a mean follow-up of seven years (5-13 Y)
- 49 who had assessment had significant improvement with regard to pain frequency and severity, patient-reported shoulder function, stiffness, and difficulty in completing activities.

There were no complications.

- Conclusions: Patients with idiopathic adhesive capsulitis treated with an arthroscopic capsular release had early significant improvements in shoulder range of motion, pain frequency and severity, and function. These improvements were maintained and/or enhanced at seven years. In contrast to results reported for nonoperative treatment, shoulder range of motion at seven years was equivalent to that in the contralateral shoulder.

Frozen Shoulder with cuff tear

Orthopedics. 2009 Jan;32(1):22.

- 81 patients
- Stage-2 idiopathic adhesive capsulitis based on medical history and a physical examination underwent MRA.
- Magnetic resonance evaluations focused on combined pathologies other than adhesive capsulitis, especially on the supraspinatus tendon. The pathologies of supraspinatus tendon were divided into 4 categories: normal, tendinosis, partial-tears, and full-thickness tears.
- Mean patient age was 66 years and mean symptom duration was 8.9 months. There were 38 men and 43 women.
- Overall, 50 patients (61.7%):small full-thickness tears 6 (7.4%), partial-thickness tears 25 (30.9%), and supraspinatus tendon tendinosis 19 (23.5%)].
- The most common MRA finding, other than rotator cuff pathology, was the impression of adhesive capsulitis in 58 patients (71.6%). Group 2 (>60 years) showed a higher prevalence of full and partial-thickness tears ($P<.05$), however the overall prevalence of supraspinatus tendon pathologies were similar in those younger than and older than 60 years ($P=.1795$).
- Approximately 1/3 of stage-2 adhesive capsulitis patients showed some form of supraspinatus tendon tear by MRA, and <10% of patients who were considered to have idiopathic adhesive capsulitis had a full-thickness tear. Adhesive capsulitis patients older than 60 years appeared to be more likely to have a supraspinatus tendon tear.