FROZEN SHOULDER

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**Terminology**

**Duplay** = “peri-arthritis scapulohumerale” (1896)

**Codman** = “frozen shoulder” (1934), a condition characterized by pain and reduced range of motion in the affected shoulder

**Neviaser** = “adhesive capsulitis” (1945, prearthroscopic era), chronic inflammation and fibrosis of the joint capsule

…although arthroscopic examination would support the term “fibrotic capsulitis” with the absence of adhesions
Definition

..., Condition difficult to define, difficult to treat and difficult to explain from the point of view of pathology...

Codman 1934

ASES: Frozen shoulder is

- a condition of uncertain cause
- characterized by spontaneous onset of pain
- with significant restriction of both active and passive range of motion
Classification

Frozen shoulder

TERTIARY
- postoperative
- post-fracture

PRIMARY (idiopathic)

SECONDARY (known disorders)

Systemic
- diabetes mellitus
- hypothyroidism
- hyperthyroidism
- hypoadrenalism

Extrinsic
- cardio-pulmonary disease
- cervical discopathy
- cerebrovascular accident
- humerus fractures
- Parkinson’s disease

Intrinsic
- rotator cuff tendinitis
- rotator cuff tears
- biceps tendinitis
- calcific tendinitis
- AC joint arthritis
Conditions associated with adhesive capsulitis

<table>
<thead>
<tr>
<th>Condition</th>
<th>Author</th>
<th>Description</th>
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<tbody>
<tr>
<td>Trauma/surgical</td>
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<tr>
<td>Upper extremity trauma</td>
<td>Hand et al&lt;sup&gt;47&lt;/sup&gt;</td>
<td>22% of patients report minor trauma to limb before symptoms</td>
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<tr>
<td>Radial neck dissection</td>
<td>Patten and Hillel&lt;sup&gt;85&lt;/sup&gt;</td>
<td>31 of 44 patients who underwent neck dissections</td>
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<tr>
<td>Hormonal</td>
<td></td>
<td></td>
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<tr>
<td>Diabetes</td>
<td>Bridgman&lt;sup&gt;12&lt;/sup&gt;</td>
<td>Incidence of 10.8% in diabetic patients and 2.3% in nondiabetic patients</td>
</tr>
<tr>
<td></td>
<td>Thomas et al&lt;sup&gt;102&lt;/sup&gt;</td>
<td>Incidence of 4.3% in diabetic patients and 0.5% in nondiabetic patients</td>
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<tr>
<td></td>
<td>Arkkila et al&lt;sup&gt;2&lt;/sup&gt;</td>
<td>Incidence of 10.3% in patients with type I diabetes and 22.4% in patients with type II diabetes</td>
</tr>
<tr>
<td>ACTH deficiency</td>
<td>Choy et al&lt;sup&gt;27&lt;/sup&gt;</td>
<td>Case of bilateral frozen shoulder in isolated ACTH deficiency</td>
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<tr>
<td>Thyroid disease</td>
<td>Wohlgethan&lt;sup&gt;109&lt;/sup&gt;</td>
<td>Case of bilateral frozen shoulder in hyperthyroidism</td>
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<td></td>
<td>Bowman et al&lt;sup&gt;10&lt;/sup&gt;</td>
<td>Case of bilateral frozen shoulder in hypothyroidism</td>
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<td></td>
<td>Cakir et al&lt;sup&gt;12&lt;/sup&gt;</td>
<td>10.9% incidence in patients with thyroid disease</td>
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<tr>
<td>Cardiac</td>
<td></td>
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<tr>
<td>Cardiac disease</td>
<td>Tuten et al&lt;sup&gt;103&lt;/sup&gt;</td>
<td>3.3% incidence in male cardiac surgery patients (7 of 214)</td>
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<td></td>
<td>Bridgman&lt;sup&gt;12&lt;/sup&gt;</td>
<td>10 of 14 nondiabetic patients with frozen shoulder had ischemic heart disease or hypertension</td>
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<td>Diabetes and cardiac disease</td>
<td>Boyle-Walker et al&lt;sup&gt;11&lt;/sup&gt;</td>
<td>Diabetes and heart disease more prevalent in patients diagnosed with adhesive capsulitis compared with controls</td>
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<tr>
<td>Neurologic</td>
<td></td>
<td></td>
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<tr>
<td>Parkinson</td>
<td>Riley et al&lt;sup&gt;91&lt;/sup&gt;</td>
<td>Incidence of 12.7% in Parkinson patients and 1.7% in controls</td>
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<tr>
<td>Stroke</td>
<td>Lo et al&lt;sup&gt;63&lt;/sup&gt;</td>
<td>50% incidence in patients with hemiplegic shoulder pain after first stroke</td>
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<tr>
<td>Neurosurgery</td>
<td>Bruckner and Nye&lt;sup&gt;15&lt;/sup&gt;</td>
<td>25.3% incidence in neurosurgical patients</td>
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<tr>
<td>Aneurysm surgery</td>
<td>Tanishima and Yoshimatsu&lt;sup&gt;101&lt;/sup&gt;</td>
<td>41% of patients undergoing acute aneurysm surgery</td>
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<tr>
<td>Other</td>
<td></td>
<td></td>
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<tr>
<td>Malignancy</td>
<td>Gheita et al&lt;sup&gt;42&lt;/sup&gt;</td>
<td>9 of 60 patients with malignant disease</td>
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<td>Hyperlipidemia</td>
<td>Bunker and Esler&lt;sup&gt;20&lt;/sup&gt;</td>
<td>Higher triglyceride and cholesterol levels in frozen shoulder patients vs controls</td>
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<td>Drug related</td>
<td></td>
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<td></td>
<td>Hand et al&lt;sup&gt;66&lt;/sup&gt;</td>
<td>17% had hypercholesterolemia</td>
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<td></td>
<td>Hutchinson et al&lt;sup&gt;51&lt;/sup&gt;</td>
<td>12 patients treated with matrix metalloproteinase inhibitor for gastric carcinoma</td>
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<td></td>
<td>Grasland et al&lt;sup&gt;43&lt;/sup&gt;</td>
<td>8 patients treated with protease inhibitor (indinavir)</td>
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<td></td>
<td>De Ponti et al&lt;sup&gt;32&lt;/sup&gt;</td>
<td>6 patients treated with antiretrovirals ( stavudine, lamivudine, indinavir)</td>
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<td></td>
<td>Bodor and Montalvo&lt;sup&gt;9&lt;/sup&gt;</td>
<td>2 cases after influenza and pneumococcal vaccine</td>
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<td></td>
<td>Freiss et al&lt;sup&gt;41&lt;/sup&gt;</td>
<td>2 cases after fluoroquinolones</td>
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<td>Dupuytren</td>
<td>Smith et al&lt;sup&gt;97&lt;/sup&gt;</td>
<td>52% of patients with frozen shoulder were found to have Dupuytren</td>
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<td>Degref et al&lt;sup&gt;13&lt;/sup&gt;</td>
<td>45% of patients with Dupuytren diagnosed with frozen shoulder</td>
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Pathogenesis

Synovial inflammation and capsular fibrosis with the involvement of cytokines (TGF-b, platelet-derived growth factor, IL-1b, TNF)

Histology shows a vascular, collagenous tissue with high cellularity, (fibroblasts and myofibroblasts). The fibroblastic process is similar to Dupuytren disease

Patients treated with a synthetic matrix metalloproteinase inhibitor for gastric carcinoma had high rates of frozen shoulder and Dupuytren disease, suggesting that abnormal expression of matrix metalloproteinase inhibitors is involved in the pathogenesis of the disease.
Classification

3 phases, Reeves, Scand J Reumatology, 1975

Phase I = pain with progressive stiffness (2-9 months)

Phase II = progressive stiffness with contractions (4-12 months)

Phase III = recovery, motion gradually improves (12-42 months)
Classification

4 stages, Hannefin & Chiaia, Clin Orthop 2000

Stage I = ‘painful stage’: pain with movements, but no loss of motion (3 m)
- Arthroscopy: diffuse synovitis of the anterosuperior capsule

Stage II = ‘freezing stage’: pain and ↓ range of motion (3-9 m)
- Arthroscopy: diffuse synovitis

Stage III = ‘frozen stage’: minimal pain except at extremes (9-15 m)
- Arthroscopy: thickened, fibrotic capsule with no hypervascularity

Stage III = ‘thawing stage’: minimal pain an improve of motion (15-24 m)
- Arthroscopy: almost normal
Pathology- Predisposing factors

- Intra-articular breakdown of the biceps tendon
- Contracture of the subscapularis
- Autoimmune basis (↑ HLA B27, ↓ IgA, ↑ CRP)
- Active trigger points
- Neurological dysfunction (like RSD syndrome)
- ↑ serum lipid levels (triglyceride & cholesterol)
- Endocrine disorders (diabetes mellitus)
- Trivial trauma (especially after prolonged immobilization)
- Psychological factors
Pathology- Predisposing factors

Active trigger points

Trigger points are locally tender, hyperirritable foci located in the skeletal muscles or fascia, related to a zone of referred pain when they are stimulated.

The subscapularis trigger point exert an influence on the sympathetic vasomotor activity, leading to hypoxia of the periarticular tissues. The hypoxia leads to local proliferation of fibrous tissue about the shoulder capsule, resulting in the clinical picture of frozen shoulder.

Travel JG & Simmons DG, 1983
Pathology- Predisposing factors

Endocrine disorders (diabetes mellitus)

Incidence of about 10.8%, instead of 2.3% in the general population

Abnormal glucose tolerance in 28% of patients with frozen shoulder

Excessive glucose concentration in diabetic patients can lead to a faster rate of collagen glycosylation and cross-linking in the shoulder capsule, restricting shoulder range of motion. This collagen cross-linking may also be responsible for the higher incidence of Dupuytren contractures and trigger finger in diabetic patients.

Thyroid disorders, hypoadrenalism, corticotropin deficiency
Psychological factors

Certain personality structure? (periarthritic personality)

- patients unable to tolerate pain
- expect others to get them well
- refuse to contribute to their management

Physiological characteristics must be considered as a secondary factor in the management of these patients
Epidemiology

- 2% cumulative risk for at least one episode of FS
- Between forth and fifth decade of life
- More common in women
- Non-dominant extremity is usually involved
- Bilateral involvement occurs in 6-50% but only 14% simultaneously
- Among diabetic patients bilateral involvement is present in 77%
- The same shoulder is rarely involved again with FS
Clinical evaluation

**History**

Pain is critical in FS and is expressed at night, with dressing and daily activities as with common use of the arm.

Early on patients describe an intense burning pain compared to a dull fullness during the contracting stage.

Patients report difficulties to put on a coat or fastening a bra.

Most significant loss of motion is with external rotation.

Sharp pain at the endpoint of restricted shoulder motion.

Specific medication: barbiturates, antituberculosis agents, protease inhibitors (for HIV treatment).
Clinical evaluation

**Physical examination**

- Commonly confused with RC pathology
- Typically pain on palpation at deltoid, deep capsule anteriorly
- Loss of active or passive range of motion
- Pain present at the extremes of motion
- Complete evaluation of cervical spine
- Lidocaine injection test – no improvement
Clinical evaluation

Physical examination

- Limited Forward Elevation
- Limited External Rotation
- Limited Internal Rotation
- Limited Cross Body Adduction

[Diagrams showing various physical examination positions and movements]
Clinical evaluation

Differential diagnosis

• Osteoarthritis
• Avascular Necrosis
• Rotator Cuff Disease
• Cervical Radiculopathy
• Biceps Tendinitis
• Subacromial Bursitis
• Thoracic Outlet Syndrome
• Brachial Plexopathy
• Humeral Fracture
• Tumor
Clinical records of 34 patients (age > 40) with malignant shoulder tumors and those of 505 patients (age > 40) with shoulder pain and stiffness were reviewed. 9/34 tumor patients, (26%) had been initially misdiagnosed with FS syndrome. Among 505 patients with shoulder pain and stiffness, 4 (0.8%) were diagnosed later as having malignant tumors. In 10 patients, initial misdiagnosis as frozen shoulder syndrome did cause a significant delay to reach the correct diagnosis as malignant tumors.
Imagine studies

Complete set of radiographs (AP in internal and external rotation, axillary and supraspinatus outlet view) to exclude other pathology. In FS usually x-rays are normal, disuse osteopenia maybe present.

Technetium bone scan exhibits increase uptake (hypervascularity).

Ultrasound can show thickening of coraco-humeral ligament.

Shoulder arthrography:
- decreased joint volume (10-12 ml, instead of – 15 ml normally)
- lack of filling of the axillary fold & subscapular bursa
Imagine studies

MRI or MRI-arthrography is currently no helpful to diagnose FS

- significant thickening of coracohumeral ligament and rotator interval
- complete obliteration of subcoracoid triangle (between CH and coracoid)
- increased thickness of the inferior capsule
- Decreased filling ratio of the axillary recess

Helpful to identify concomitant pathology
Laboratory studies

Are usually normal

ECR and CRP are usually elevated

Glucose tolerance, lipid panel

Rheumatoid factor and antinuclear antibody

Thyroid and autoimmune disorders
Treatment

General principles

Goal of treatment is relief of pain and restore motion and function.

Avoid misdiagnosis of other shoulder pathology.

Surgery addressing other pathology may dramatically worsen the pain and stiffness of frozen shoulder.

Individualized program of rehabilitation based on severity and chronicity of patients' symptoms.

Non-steroidal anti-inflammatory agents, oral corticosteroids, corticosteroids injections, transcutaneous electrical nerve stimulation (TENS) etc.
Treatment

Options

Non-operative treatment - Benign neglect

Capsular distention (Brisement)

Manipulation under anaesthesia

Arthroscopic capsular release

Open release

Acupuncture therapy, botulinum injections
Non-operative treatment

Exercise protocol

Indicated in patients with less than 6 months of stiffness

Active-assisted ROM exercises plus gentle passive stretching

Better 5-6 times per day lasting 10-15 minutes

Daily bar charts to document progress

Constant reassurance to promote continue compliance
Sixty-four (90%) of the patients reported satisfactory outcome. Seven (10 percent) were not satisfied and five (7 percent) underwent manipulation and/or arthroscopic capsular release.

Despite the significant improvements and the high rate of patient satisfaction, there were still significant differences in the pain and motion of the affected shoulder when compared with those of the unaffected, contralateral shoulder.
In the patients treated with supervised neglect, 89% had normal or near-normal painless shoulder function (Constant score 80) at the end of the observation period. In contrast, of the group receiving intensive physical therapy treatment, only 63% reached a Constant score of 80 or higher after 24 months.
Capsular distension or Brisement

Distension of the capsule:
- with contrast as part of an arthrogram
- with injection of saline and local anaesthetic such as hydraulic distension
- with water during arthoscopic release

Better to performed in patients who had failed conservative treatment and are in Hannafin stage II with early loss of motion before the capsule become thickened
In the performance of diagnostic arthrography, we observed a clinical improvement of painful symptoms.

The analysis of the outcome observed in 200 joint distensions showed that, in 85% of cases, the results were satisfactory, with the disappearance of painful symptoms after 45 days and an almost complete recuperation of the range of motion of the shoulder.
Manipulation under anaesthesia

Mainstay of interventional methods

Usually after failed physiotherapy for 3 to 6 months

Wait until pain is present only at the extremes of ROM

Better with combined general and regional anesthesia

Gentle, controlled fashion with the patient supine

Avoid in elderly osteoporotic patients

No significant difference with use of corticosteroids

Risk for fractures, dislocation of the head, RC injury, SLAP lesions and nerve injuries
Arthroscopic capsular release

3 basic components:

Anesthesia (general? & interscalene block)

Manipulation (before, during or after)

Arthroscopic release

- rotator interval division (CHL and anterosuperior capsule)
- anterior capsule over subscapularis (MGL)
- inferior capsule (risk for axillary nerve)
- superior and posterior capsular release
<table>
<thead>
<tr>
<th>Study</th>
<th>Year</th>
<th>Procedure</th>
<th>Patients</th>
<th>Follow-up</th>
<th>Results</th>
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<tbody>
<tr>
<td>Arthroscopic and coracohumeral ligament Snow et al&lt;sup&gt;98&lt;/sup&gt;</td>
<td>2009</td>
<td>Anterior + inferior release vs anterior, inferior, and posterior release</td>
<td>48</td>
<td>5 mo</td>
<td>No difference with addition of posterior release</td>
</tr>
<tr>
<td>Musil et al&lt;sup&gt;72&lt;/sup&gt;</td>
<td>2009</td>
<td>RI, CH ligament, S/M/AIGHL release, anterior GH joint capsule</td>
<td>27</td>
<td>115</td>
<td>46 mo</td>
</tr>
<tr>
<td>Elhassan et al&lt;sup&gt;37&lt;/sup&gt;</td>
<td>2010</td>
<td>Idiopathic and post-traumatic stiffness have better outcomes than postsurgical stiffness</td>
<td></td>
<td>14 idiopathic</td>
<td>48.5 mo</td>
</tr>
<tr>
<td>Cinar et al&lt;sup&gt;28&lt;/sup&gt;</td>
<td>2010</td>
<td>Release of subscapularis and capsule</td>
<td></td>
<td>14 diabetic</td>
<td>60.2 mo</td>
</tr>
<tr>
<td>Liem et al&lt;sup&gt;62&lt;/sup&gt;</td>
<td>2008</td>
<td>Reliable improvement in arthroscopic release with gentle manipulation</td>
<td>22</td>
<td>53 mo</td>
<td>MUA, followed by arthroscopic release, is effective for resistant cases</td>
</tr>
<tr>
<td>Baums et al&lt;sup&gt;5&lt;/sup&gt;</td>
<td>2007</td>
<td>Arthroscopic release</td>
<td>30</td>
<td>36 mo</td>
<td>MUA, followed by arthroscopic release, is effective for resistant cases</td>
</tr>
<tr>
<td>Castellari et al&lt;sup&gt;25&lt;/sup&gt;</td>
<td>2004</td>
<td>Arthroscopic release + intra-articular pain catheter</td>
<td>23</td>
<td>42 mo</td>
<td>Arthroscopic release yields rapid relief of pain and improvement in function</td>
</tr>
<tr>
<td>Yamaguchi et al&lt;sup&gt;111&lt;/sup&gt;</td>
<td>2004</td>
<td>Arthroscopic release</td>
<td>25</td>
<td>14.8 mo</td>
<td>19/20 achieved near complete ROM without pain</td>
</tr>
<tr>
<td>Klinger et al&lt;sup&gt;59&lt;/sup&gt;</td>
<td>2002</td>
<td>Arthroscopic release</td>
<td>36</td>
<td>18 mo</td>
<td>Safe and effective, no complications</td>
</tr>
<tr>
<td>Holloway et al&lt;sup&gt;49&lt;/sup&gt;</td>
<td>2001</td>
<td>Arthroscopic release</td>
<td>50</td>
<td>20 mo</td>
<td>Less improvement in subjective scores in postoperative stiffness compared with post-traumatic and idiopathic</td>
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<tr>
<td>Bennett&lt;sup&gt;5&lt;/sup&gt;</td>
<td>2000</td>
<td>Arthroscopic release</td>
<td>31</td>
<td>&gt;18 mo</td>
<td>30/31 retained intra-operative ROM gain, no difference in primary vs secondary stiffness</td>
</tr>
<tr>
<td>Watson et al&lt;sup&gt;107&lt;/sup&gt;</td>
<td>2000</td>
<td>Arthroscopic release</td>
<td>73</td>
<td>12 mo</td>
<td>11% with recurrent pain/stiffness</td>
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</table>
Release of rotator interval stops when CA ligament is viewed from posterior

Anterior capsule release

posterior capsule release
P.G. 56 y old, 5 months of physical therapy, MUA and anterior-inferior release, Constant score 84 at 16 months follow-up
We have shown an overall rapid significant improvement following arthroscopic capsular release for primary and secondary frozen shoulder.

There was no significant difference in the overall outcome with the addition of a posterior release.
74 consecutive patients with refractory frozen shoulder underwent arthroscopic capsular release and were divided into 2 groups randomly. The release of anterior capsular structures, including the anterior band of the IGHL, was performed in group 1. In group 2 the release extended inferiorly and posteriorly.

In this broad group of patients with recalcitrant adhesive capsulitis, the addition of the posterior capsular release did not improve patient function or ROM over anterior capsular release alone at 6 months.
Retrospective review of 115 patients, mean 9 months of physiotherapy

3 groups of stiffness: post-traumatic (26 patients), postsurgical (48 patients), and idiopathic (41 patients).

At a mean follow-up of 46 months, the overall subjective shoulder value in all groups improved from 29% to 73% and the age- and gender-adjusted Constant score improved from 35% to 86%.

Constant score was significantly lower in the postsurgical group compared with the idiopathic and post-traumatic groups.
Open release

Reserved for patients who have failed manipulation and/or arthroscopic release

FZ in the setting of shoulder arthroplasty

Offers direct visualization, but increase postop pain which interfere with physiotherapy

Release include:

- subacromial and subdeltoid adhesions
- CHL and rotator interval
- perilabral capsular release
- subscapularis release and lengthening
424 outpatients with chronic shoulder pain (CSP) >6 weeks and an average pain score of VAS >50 mm, who were randomly assigned to receive Chinese acupuncture (verum), sham acupuncture (sham) or conventional conservative orthopaedic treatment (COT)

Chinese acupuncture is an effective alternative to conventional standard therapy in chronic shoulder pain. Fifteen Chinese acupuncture treatments over 6 weeks are more effective than conventional standard therapy with NSAIDs and physiotherapy.
Possible mechanisms of BTX in treatment of FS

Through inhibition of neurotransmitter release

Through inhibition of C-fiber nociceptive transmission

Through inhibition of fibrosis

The analgesic effect can be expected to last longer than steroid injection. The use is generally safe with minimal side effects. Preliminary results in intra-articular use showed promising outlooks.