

**SHOULDER**

# Acromion morphology: Clin Orthop

Relat Res (2010) 468:1542–1550

- 6 types of Acromial spurs  
heel, lateral/anterior traction, lateral/anterior bird beak, and medial.
- Spur present in 68% [ incidence increased with age]
- The heel type was most common and detected in (56%) in the cuff tear group and in 36 patients (35%) in the control group.
- The mean acromial thickness was 8.0 mm, and the cuff tear group had thicker acromion.
- The most common heel-type spur might be a risk factor for full-thickness rotator cuff tears.

## Bigliani classification

Type I Flat acromion



Type II Curved acromion



Type III Anterior hooked acromion



# Bigliani

The flat acromion was more common (60%) than curved and hooked acromion;

There was no major difference between acromial shape and cuff tear.

The authors emphasized the morphologic features of the acromion are closely associated with rotator cuff tears. However, Hirano et al. [12] reported rotator cuff injuries and the hook-type acromion were not associated;

**Table 4.** Relationship among acromial thickness, shape, and full-thickness rotator cuff tear

Morphologic characteristics of acromion	Rotator cuff tear group (n = 106)	Control group (n = 102)	Total (n = 208)
Acromial shape			
Flat	70 (66%)	55 (54%)	125 (60%)
Curved	24 (23%)	36 (35%)	60 (28%)
Hooked	12 (11%)	11 (11%)	23 (11%)
Acromial thickness (mm)	8.3* (5.0–11.3 ± 1.46)	7.8 (5.5–10.6 ± 1.37)	8.0 (5.0–11.3 ± 1.44)

\* Significant difference between the two groups ( $p < 0.05$ ).

# Acromion thickness

- MR and CT
- Nicholson et al. [17] suggested acromial thickness is a primary anatomic structural feature and does not substantially change with age.
- Full-thickness rotator cuff tears had **thicker acromions** than patients without tears. [>8mm]

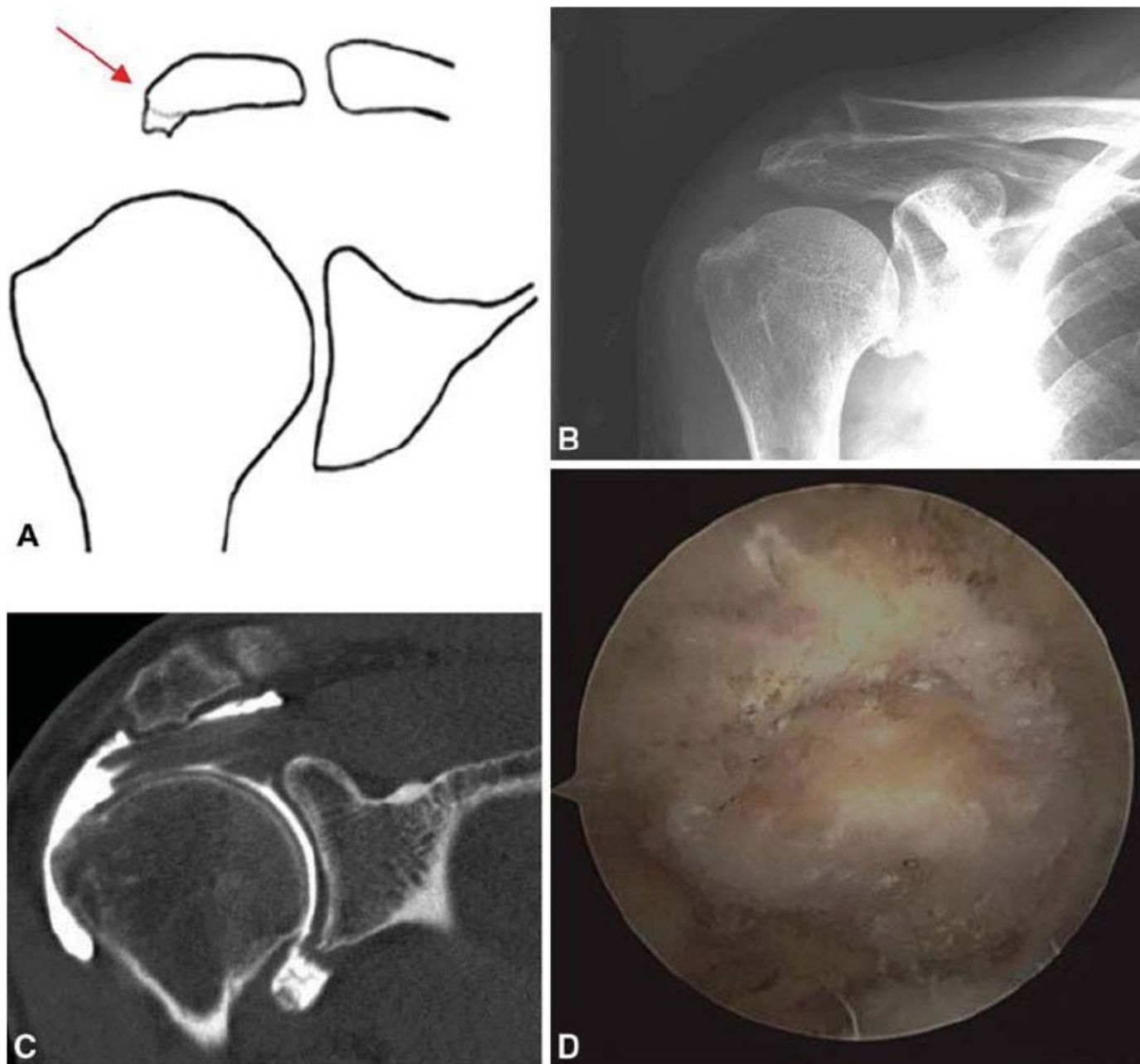
# Acromial spur

- Morphologic features of acromial spurs can be classified as heel, lateral/anterior traction, lateral/anterior bird beak, or medial type on the coronal or sagittal plane.
- The incidence of acromial spurs increased with age, and, especially heel-type spurs, were detected more frequently in patients with full-thickness rotator cuff tears.

Fig. 2A–D (A) The inferior bony projection that looks like the heel of a shoe is shown in this diagram. This kind of spur was categorized as a heel-type spur. The heel-type spur can be seen on the (B) true AP radiograph of the shoulder, and with (C) CT arthrography and (D) arthroscopy.



**Fig. 2A–D** (A) The inferior bony projection that looks like the heel of a shoe is shown in this diagram. This kind of spur was categorized as a heel-type spur. The heel-type spur can be seen on the (B) true AP radiograph of the shoulder, and with (C) CT arthrography and (D) arthroscopy.



- Clin Orthop Relat Res. 2010 Jun;468(6):1542-50. Epub 2009 Sep 4.
- **Classification and clinical significance of acromial spur in rotator cuff tear: heel-type spur and rotator cuff tear.**
- [Oh JH](#), [Kim JY](#), [Lee HK](#), [Choi JA](#).
- **Source**
- Department of Orthopedic Surgery, Seoul National University College of Medicine, Seoul National University Bundang Hospital, Seoul, Korea.
- **Abstract**
- **Acromial** spurs reportedly relate to the impingement syndrome and rotator cuff tears. We classified the morphologic characteristics of the acromion (shape and thickness) and **acromial** spurs and determined whether they correlated with rotator cuff tears. We measured **acromial** shape and thickness using simple radiography and MR arthrography or CT arthrography in 106 patients with full-thickness rotator cuff tears and in 102 patients without tears. **Acromial** spurs could be classified morphologically into six types: heel, lateral/anterior traction, lateral/anterior bird beak, and medial. We found **acromial** spurs in 142 of the 208 patients (68%), and their incidence increased with age. The **acromial spur** was more common in the cuff tear group. The heel type was most common and detected in 59 patients (56%) in the cuff tear group and in 36 patients (35%) in the control group. The flat acromion was more common (60%) than curved and hooked acromion; however, there was no major difference between **acromial** shape and cuff tear. The mean **acromial** thickness was 8.0 mm, and the cuff tear group had thicker acromion. These data suggest **acromial** spurs can be classified according to the distinct morphology, and the most common heel-type **spur** might be a risk factor for full-thickness rotator cuff tears. Level of Evidence: Level IV, diagnostic study. See Guidelines for Authors for a complete description of levels of evidence.



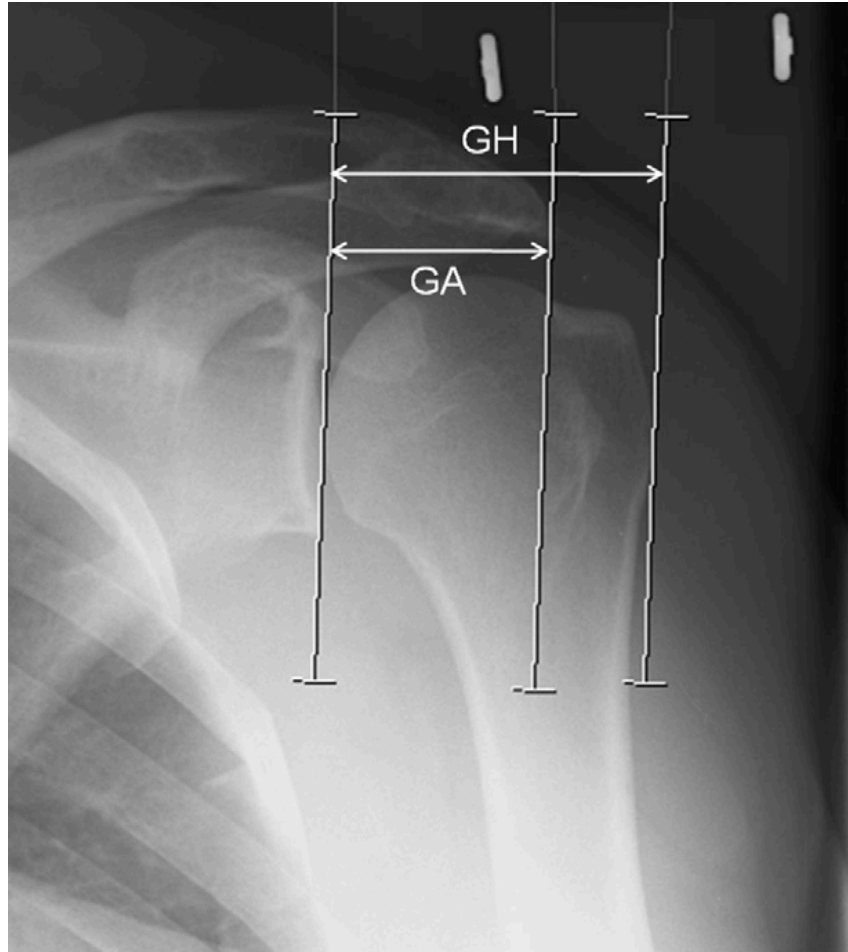
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- J Shoulder Elbow Surg. 1995 Nov-Dec;4(6):441-8.
- **Roentgenographic assessment of acromial morphologic condition in rotator cuff impingement syndrome.**
- [Kitay GS](#), [Iannotti JP](#), [Williams GR](#), [Haygood T](#), [Kneeland BJ](#), [Berlin J](#).
- **Source**
- Department of Radiology, Hospital of the University of Pennsylvania, Philadelphia, PA.
- **Abstract**
- Patients with an isolated diagnosis of rotator cuff impingement syndrome were prospectively entered into the study. Each of the 23 subjects was refractory to conservative therapy, had preoperative roentgenograms, and underwent an open acromioplasty. The roentgenograms included anteroposterior, axillary, 30 degrees caudal tilt, and supraspinatus outlet views. The roentgenograms were measured by four independent readers. The separate views were then scored for reliability, and the correlation of the measurements with intraoperative **acromial** measurements was assessed. Interobserver reliability was highest for the caudal tilt view (0.84) and lowest for the axillary view (0.09). The supraspinatus and caudal tilt views correlated significantly with distinct intraoperative measurements of **acromial spur** size. We continue to advocate the evaluation of both views for preoperative **assessment** of the **acromial spur** in the rotator cuff impingement syndrome.
- PMID

# J Shoulder Elbow Surg (2012) 21, 1289-1298



- >5 mm is significant
- Supraspinatus outlet view

# Acromial index



- The overall mean acromial index was  $0.691 \pm 0.06$

- **CUFF TEAR**

# INCIDENCE VS AGE

- Worland reported a much higher prevalence of full-thickness tearing, at 40%, over the age of 50 years.[J Shoulder Elbow Surg (2010) 19, 937-943]
- Irrespective of symptoms, the presence of a rotator cuff tear has been associated with both
- muscle atrophy and fatty infiltration. These factors have been shown by Gerber et al<sup>23</sup> to be inversely related to loss of strength in the shoulder.
- Successful repair of the cuff tear has been shown only to retard the advancement of fatty infiltration and modestly improve the degree of muscle atrophy.

# Pathogenesis of tendinosis

- Pathologic processes intrinsic and extrinsic to the tendons have been proposed as the underlying cause of rotator cuff disease, but the precise etiology is not known. Tear formation is, in part, attributable to the accumulation of subrupture tendon fatigue damage. We review the molecular, mechanical, and structural changes induced in tendons subjected to controlled amounts of fatigue loading in an animal model of early tendinopathy.
- The distinct tendon responses to low and moderate levels of loading, as opposed to high levels, provide insight into the potential mechanisms for the therapeutic benefits of exercise in the treatment of rotator cuff tendinopathy.
- The progression of damage accumulation leading to fiber rupture and eventual tendon tearing seen with higher loading illustrates the progression from tendinopathy to fullthickness tearing.
- J Shoulder Elbow Surg (2012) 21, 158-163

# Pathogenesis II

*J Am Acad Orthop Surg* 2011;19:

701-708

## **Extrinsic**

- Some believe that rotator cuff disease is due to primary extrinsic compression; 23-25 others think that the disease is generally due to intrinsic tendon degeneration,26,27
- In a study of 56 cadaver shoulders, Fealy et al<sup>36</sup> identified two distinct ligamentous bands: an anterolateral and a posteromedial band. Spurs were commonly found in the anterolateral band.

## **Intrinsic**

- Based on results of their study of this management method, Budoff et al<sup>42</sup> proposed that “primary failure of the rotator cuff most likely occurs by eccentric tension overload rather than by impingement from aberrant acromial morphology.”

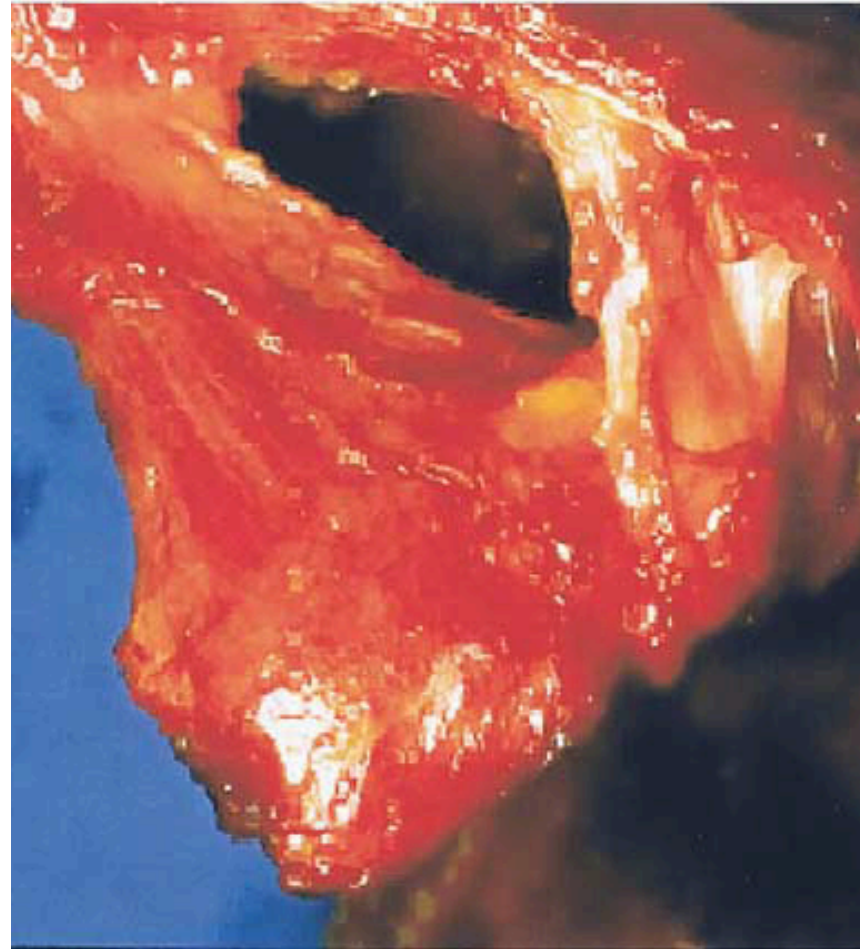
# Acromial spur

*(J Shoulder Elbow Surg 2005;14:542-548.*

- The coracoacromial ligament (CAL), normally a superior restraint against humeral translation, is frequently involved in rotator cuff impingement pathology.
- Variation exists in the morphology of the CAL. The most common configuration of the CAL was two distinct ligamentous bands that could be classified anatomically as an anterolateral band (ALB) and posteromedial band (PMB).
- The ALB commonly extended to the posterolateral aspect of the acromion. Furthermore, it frequently extended anterolaterally to the acromion, ending in a coracoacromial falx.
- Spur formation in the ALB correlated with a focal CAL that was narrower, less divergent, shorter, and thicker than a diffuse CAL that did not have a spur.
- During arthroscopic subacromial decompression, failure to visualize the anterolateral corner of the acromion adequately may result in incomplete resection of the CAL, especially if the PMB is mistaken to be the entire ligament.



- The preferential location of spurs in the ALB suggests that it is a major load-bearing structure.



- **Clinical Signs**

# Scapular dyskinesis

- Abnormal movement of the shoulder blade (scapula) is known as scapula dyskinesis. This occurs in a variety of shoulder problems.

## **Type 1 - Infero-medial scapula border prominence**

- This becomes more evident in the cocking position of overhead sports. It is often associated with tightness at the anterior side of the shoulder (in flexibility of the pectoralis major/ minor muscles)

## **Type 2 - medial border prominence**

- It is caused by fatigue of the scapula stabilising muscles (trapezius and rhomboids).

## **Type 3 - supero-medial border prominence**

- Impingement and rotator cuff injury.



# Neer/Hawkins



# Provocative tests for rotator cuff tears

- **A**, Neer impingement sign. With the patient seated, the examiner depresses the patient's scapula while the patient's arm is elevated. This test compresses the greater tuberosity against the anterior acromion and elicits discomfort in a patient with a rotator cuff tear or impingement syndrome.
- **B**, Hawkins impingement sign. This test reinforces a positive Neer impingement sign. The patient's shoulder is elevated to 90° with the elbow flexed to 90° and the forearm in neutral rotation. The arm is supported and the humerus is then rotated internally. Pain elicited with this test is indicative of a rotator cuff tear or impingement syndrome.

- **EVIDENCE BASED**



# Optimizing the Management

*J Am Acad Orthop Surg 2011;19:*

368-379

## **Recommendation 1**      **ASYMPTOMATIC FULL THICKNESS**

- In the absence of reliable evidence, it is the opinion of the work group that
- surgery not be performed for asymptomatic full-thickness rotator cuff
- tears.
- Grade of Recommendation: Consensus.
- No studies were found addressing this recommendation.
- Although there is a growing awareness that a large proportion of the
- population can have full-thickness rotator cuff tears that are Asymptomatic, we were unable to find quality



The opinion that surgery not be performed for asymptomatic, full-thickness rotator cuff

- tears was based on the following considerations.
- (1) Asymptomatic rotator cuff disease is highly prevalent in the older population.
- (2) For patients with bilateral asymptomatic shoulders, there is no reliable evidence that surgery prevents long-term clinical deterioration of a rotator cuff tear.
- (3) Postoperative healing rates are inconsistent in elderly patients, who are the patients most
- likely to have asymptomatic rotator cuff tears.
- (4) The morbidity and risks of rotator cuff repair are probably not warranted in absence of symptoms.
- (5) Currently, the primary indication for rotator cuff repair is significant pain.
- Given these considerations, it is the opinion of this work group that patients with asymptomatic full-thickness tears not be treated with surgical repair.

# Recommendation 2: CHRONIC CUFF

- Rotator cuff repair is an option for patients with chronic, symptomatic full-thickness tears:  
SURGERY
- Grade of Recommendation: Weak.
- It is addressed by one level III and multiple level IV studies.
- One level III study compared nonsurgical to surgical treatment of rotator cuff tears.<sup>1</sup> In this study, 60 patients treated without surgery (group A) were compared with 77 treated with rotator cuff repair (group B).
- 81% of the surgical patients reported excellent results, compared with 37% with nonsurgical treatment, although the authors did not report statistical significance in this comparison.
- Because this recommendation is supported by a single level III article and several level IV articles, the strength of the evidence that supports it is weak.

# EXERCISE: Recommendation 3 [3a]

- We cannot recommend for or against exercise programs (supervised or unsupervised) for patients with rotator cuff tears.
- Grade of Recommendation: **Inconclusive**.
- We found no quality evidence that demonstrated a specific impact of an exercise program, compared with the natural history of disease without other interventions.
- Similarly, we found no reliable evidence demonstrating that the efficacy of an exercise program is predicated on a specific form of education, supervision, or exercise environment.

# STERIOD Recommendation 3b

*Rheumatol Rehabil*1977;16(3):172-179.

- Grade of Recommendation: Inconclusive.
- It is based on one level II study and three level IV studies.
- One level II study found no statistically significant difference in pain or tenderness up to 6 weeks after injection of corticosteroid with lidocaine compared with lidocaine injection alone in patients with rotator cuff tears.
- Although it is logical for clinicians to consider potential adverse effects of corticosteroid injection on rotator cuff tendon biology and healing capacity with rotator cuff repair (based on general concerns across other areas of orthopaedic practice), **there was no quality evidence to guide recommendations** in this regard. Because the evidence that addresses this recommendation is weak and conflicting, the strength of this recommendation is inconclusive.

# NSAID Recommendation 3c

- We cannot recommend for or against the use of nonsteroidal antiinflammatory drugs (NSAIDs)
- We suggest that patients who have rotator cuff–related symptoms in the absence of a full-thickness tear be initially treated nonsurgically using exercise and/or NSAIDs.
- Several level II studies report the beneficial effects of exercise in decreasing pain and improving function in patients with rotator cuff–related symptoms without a full-thickness tear.
- One study reported on 24 patients undergoing an exercise program and noted significantly improved pain scores on the visual analog scale (VAS) after 8 weeks of treatment;

# Rotator cuff in < 50 Yrs

VOL 86-A · 2004: 2213

- Currently, there is no information on the long-term results of cuff repair in young patients.
- Methods: 32 who were 50 years of age or younger
- Results: There were three small, fifteen medium, six large, and five massive tears.
- **Rotator cuff repair was associated with significant long-term pain relief** ( $p = 0.0001$ ).
- However, there was no significant long-term improvement in active abduction or external rotation.
- Postoperative pain, active abduction, and external rotation did not vary significantly
- according to gender, tear size, repair type, or whether a distal clavicular excision had been performed.

- There were eleven excellent, five satisfactory, and thirteen unsatisfactory results.
- 7 shoulders had additional surgery for the treatment of a recurrent tear (five), instability (one), or osteoarthritis (one).
- Three of the five repairs that were done for the treatment of a recurrent tear were performed ten years or more after the time of the index procedure.
- Conclusions: Rotator cuff repair in young patients is associated with long-term pain relief. However, this procedure is not associated with significant long-term improvement in motion, and a large proportion of patients have an unsatisfactory
- long-term result.
- The results of rotator cuff repair in young patients appear to be less favorable than those in a mixed-age population.

# SUBSCAPULARIS

• Arthroscopy: The Journal of Arthroscopic and Related Surgery

[Volume 24, Issue 9](#) , Pages 997-1004,

- **33** embalmed shoulder girdles were examined to investigate the subscapularis tendon and the pathway of the biceps tendon.
- **Results:** Anatomically, the superior-most insertion of the subscapularis tendon was located on the upper margin of the lesser tuberosity.
- The clinical study showed that **27.4% of rotator cuff tears (119/435) had subscapularis** tendon tears. In cases with an unstable biceps tendon there was no intact subscapularis tendon.
- **Conclusions:** The trochlea-like structure was composed of the superior-most insertion, the tendinous slip, and the lateral portion of the cranial part of intramuscular tendons supporting the biceps tendon. The transverse tear of the subscapularis tendon, which included this trochlea-like structure, often leads to intra-articular dislocation of the biceps tendon.
- **Clinical Relevance:** Instability of the biceps tendon should be carefully assessed because it is associated with subscapularis tendon tears at a very high incidence.



# Degenerative Cuff:

ORTHOPAEDICS AND TRAUMA 25:1:1 [2011]

## Neer's stages of impingement (1983)

- Stage I Oedema and haemorrhage of cuff and bursa. Reversible
- Stage II Irreversible. Fibrosis and tendinitis of rotator cuff tendons
- Stage III Partial or full thickness tears of rotator cuff tendons.
- Irreversible without intervention

# EPIDEMIOLOGY

- Impingement and tears of the rotator cuff are common. 2.5% of the population of the United Kingdom seek advice for a shoulder complaint each year.
- 70% of these referrals are due to rotator cuff related pathology.
- The treatment needs to be tailored to the individual patient and is often dictated by the initial response to injections and radiological findings as well as examination findings.
- External factors, such as the prominence of the anterior-inferior acromion and the development of bony spurs extending into the coraco-acromial ligament, particularly anterior degenerative spurs.

# Pathogenesis

The specific cause of rotator cuff degeneration remains unclear.

- I Extrinsic : 3 types of acromion
- II Intrinsic  
Macnab postulated that microvascular insufficiency leads to areas of prolonged hypoxia and, as a result, degeneration.
- Uhtoff suggested microdegeneration of the collagen within tendon<sup>10</sup> and this has prompted a greater interest in intrinsic biological factors operating in the cuff.
- Muscle dysfunction: Nirschl<sup>11</sup> postulated that impingement may be due to muscle dysfunction. This occurs in athletes and overhead manualworkers secondary to overload of the supraspinatus tendon.
- When the arm is in the overhead position, the supraspinatus experiences eccentric contraction to balance the internal rotation and adduction of the arm.
- It has also been suggested that as the muscle fatigues in overuse, (i) the function of the rotator cuff to centralize the humeral head in the glenoid and (ii) proprioceptive feedback from the tendon mechanoreceptors are both diminished, and the result can be upward subluxation under the coraco-acromial arch, possibly resulting in impingement.

- Overuse: impingement due to overuse is a diagnosis of exclusion. It is more common in younger patients who partake in repetitive overhead manual work or competitive sports men and women, particularly, throwing athletes.
- In these cases, the microtrauma suffered by the tendon outweighs the microrepair.
- Degenerative tendinopathy: a study of 200 cadaveric shoulders demonstrated that all shoulders with abnormal acromial morphology (see below) demonstrated some damage to the bursal surface of the cuff. However as all tendons with evidence of degeneration did not have a corresponding acromial abnormality, the authors concluded that there must be an underlying degenerative element within the tendon.

# Occupational disease?

- In a retrospective study, 760 open rotator cuff repairs were analysed and related to the profession and occupational load. Exclusion criteria were traumatic tears and sports injuries.
- we found significantly more patients working in agriculture and forestry (6.38% versus 1.07% in Bavaria) and in the building industry (35.11% versus 13.40% in Bavaria).
- Working exposure increases the risk or leads to the clinical manifestation of rotator cuff tears.

# ? Occupational, SVENDSEN DENMARK

- To determine whether work performed with the arms in a highly elevated position is associated with alterations in the rotator cuff tendons as assessed by magnetic resonance imaging (MRI).
- 40-50 years; 192 Shoulders
- Supraspinatus tendinopathy was evidenced by MRI signal intensity changes and morphologic alterations. Infraspinatus and subscapularis tendinopathy were also assessed. Additional outcomes were acromioclavicular joint degeneration and humeral head cysts  
  
: An exposure-response relationship was found between lifetime upper arm elevation and supraspinatus tendinopathy, with an age-adjusted odds ratio of 1.27 (95% confidence interval 1.02-1.60) for a 5-month increase in the total number of full-time working months spent with the arm elevated >90 degrees .
- Work with the arms in a highly elevated position is associated with MRI-diagnosed alterations in the supraspinatus tendon. By demonstrating the first part of a possible biologic pathway, the study corroborates the work-relatedness of rotator cuff disorders.

# 3. Work-related

Int Arch Occup Environ Health. 2011 Apr;84(4):425-33

- We find an increased risk for subjects exposed to handheld vibration with an adjusted OR of 3.2 (95% CI 1.7-5.9) in the highest exposure category (16 years or more in the job with exposure), but a clear dose-response relationship is lacking.
- **CONCLUSIONS:**
- This study points to a potential etiologic role of long-term cumulative effects of work with highly elevated arms and heavy lifting/carrying on shoulder tendon disorders.\_

# Natural history of a tear:

Am J Sports Med Vol. 39, No. 4,

2011

- Rotator cuff tears are the most frequent tendon injury in the adult population. However, the natural history of nonoperatively treated full-thickness tears is poorly defined.
- 
- Methods: The authors prospectively followed patients 60 years old or younger who had a full-thickness rotator cuff tear equal to or larger than 5 mm, as diagnosed by bilateral shoulder ultrasound, and who were treated nonoperatively. At 2 to 3 years after the index ultrasound examination, a repeat ultrasound examination
- Results: At a follow-up of 2-3 Yrs, 49% of the tears (30 tears) increased in size, 43% had not changed, and 8% decreased in size. For 25% (10 shoulders ) of initially intact shoulders (41 shoulders), a new full-thickness rotator cuff tear was diagnosed.
- No correlation was found between the change in tear size and age or sex of the patient, existence of a prior trauma, size of tear at index US



- There was a correlation between the existence of considerable pain at the time of the follow-up ultrasound and a clinically significant increase.
- Conclusion:
- Full-thickness rotator cuff tears tend to increase in size in about half of patients aged 60 years or younger.
- Surgery should be initially considered in these patients to prevent a probable increase in size tear.
- Patients treated nonoperatively should be routinely monitored for tear size increase, especially if they remain symptomatic.

**PARTIAL TEAR**



# Partial tear

*(J Shoulder Elbow Surg 2006;15:271-278.)*

- The pathologic changes in the acromion were significantly milder in patients with articular side tears compared with bursal side tears.
- These observations indicate that articular side tears of the rotator cuff are mainly associated with intrinsic pathologic changes of the rotator cuff, whereas bursal side tears are associated with subacromial impingement on an underlying milder pathologic change of the rotator cuff.

# **PABST** J Shoulder Elbow Surg (2012) 21, 295-303

- PABST lesions are usually located in the far anterolateral insertional part of the supraspinatus tendon at the bursal side

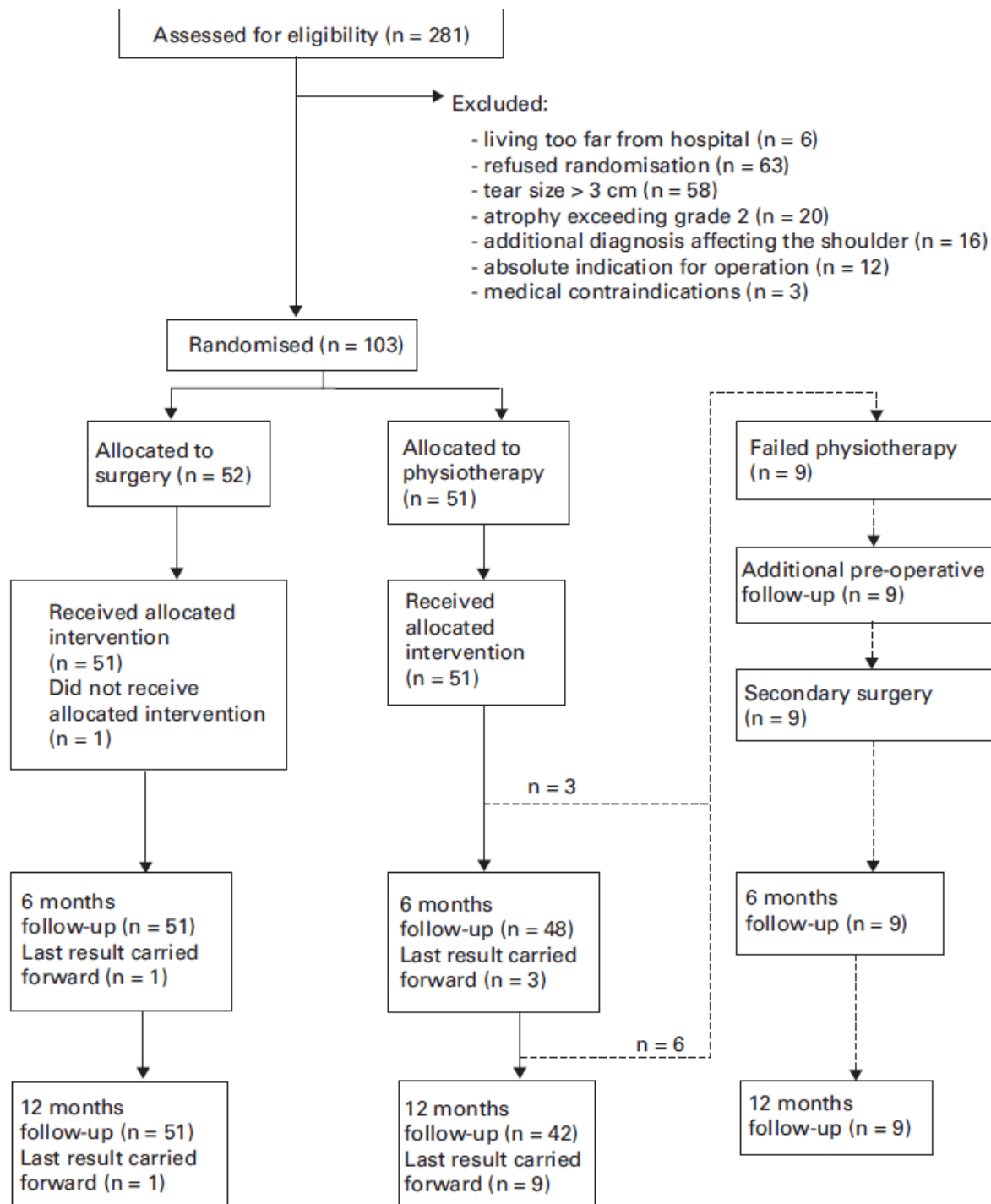
Such lesions may be overlooked sometimes because of their peculiar location.

- PABST lesions usually occur in relatively young patients, and trauma is frequently associated with acute symptom onset.
- Surgical treatment was effective for pain reduction and functional improvement.

**Small to Medium tear.**  
**Surgical Vs Physio**, *J Bone Joint Surg [Br]* 2010;92-B:83-91 •

# small isolated full-thickness tears

- In conclusion, in patients under the age of sixty-five years do not necessarily progress over time.
- Although early repair of isolated tears may be preferred by some, a delay of surgery does not necessarily affect tear reparability.
- Future research should be directed at determining which tears progress and which tears do not as well as the clinical relevance of rotator cuff tear progression.
- **J Bone Joint Surg Am. 2012;94:801-8**





- In this study larger treatment benefits in terms of outcome scores after one year were found for surgical treatment of rotator cuff tears compared to physiotherapy.
- Differences with statistical and clinical significance were demonstrated on different scoring instruments.
- At the same time, 80% non-surgically treated patients accepted the result from physiotherapy as their final treatment result
- Nine patients with insufficient effect from physiotherapy were treated effectively by secondary surgery. In the short term, both approaches can be considered in the treatment of patients with small and medium-sized rotator cuff tears but better results can be expected after primary surgical repair.

# Outcome of surgery

J Shoulder Elbow Surg (2011) 20, 591-597

- Survivorship of primary open cuff repairs [not requiring additional surgery]
- 1993 and 2004, open cuff repairs were performed in 254 patients
- Kaplan-Meier method,
- After surgery, 233 of 263 patients (89%) were contacted
- Survivorship of 94% at 5 years and 83% at 10 years. J Shoulder Elbow Surg (2011) 20, 591-597



# Subscapularis tear

# Abstract

- Is uncommon; not commonly considered as a major source of shoulder pain and dysfunction.
- Subscapularis tendon pathology can present as isolated tears; partial-thickness tears; anterosuperior tears, also involving the supraspinatus tendon; complete rotator cuff avulsion; and rotator interval lesions, in which instability of the long head of the biceps tendon may dominate
- DX
- An accurate physical examination
- MRI  
Arthroscopy  
ultrasound
- Nonsurgical management may be effective for most partial tears.
- Surgically, open repair is more frequent than use of arthroscopic techniques.
- Tears of the subscapularis tendon portend a different prognosis than do supraspinatus tendon tears, especially when the injury is acute and diagnosis is delayed.

# Demographic

- In an autopsy series, Codman reported a 3.5% incidence of subscapularis tendon tears
- DePalma<sup>8</sup> found a 20.8% incidence of partial subscapularis tears in 96 cadaver shoulders. The authors asserted that the latter finding was a major factor in the development of recurrent anterior glenohumeral instability.
- More recent studies have evaluated the presence of subscapularis tendon tears in association with tears of the superior and posterior rotator cuff.
- Frankle and Cofield<sup>10</sup> found that **subscapularis tears occurred in 8%** of patients with rotator cuff tear.
- A MRI study of 2,167 patients with rotator cuff tears found that in 2%, the subscapularis tendon was involved.
- 27% of the subscapularis tears were partial-thickness and 73% were full-thickness tears.

# Anatomy

- The subscapularis muscle is the largest and most powerful rotator cuff muscle. It arises from the anterior surface of the scapula.
- The upper two thirds of the subscapularis inserts along the lesser tuberosity; the lower one third inserts along the humeral metaphysis.
- The subscapularis has between four and six tendon slips that arise from deep within the muscle. The slips converge superiorly and laterally to the upper third of the muscle
- The coracohumeral ligament and the superior glenohumeral ligament contribute to the rotator cuff interval, which can be divided into the lateral and medial aspects.
- The lateral aspect is composed of the following four layers (superficial to deep):
  - (1) the superficial fibers of the coracohumeral ligament,
  - (2) the fibers of the subscapularis and supraspinatus tendons,
  - (3) the deep fibers of the coracohumeral ligament, and
  - (4) the superior glenohumeral ligament and joint capsule.

- The medial aspect includes two layers:  
(1) the coracohumeral ligament and (2) the superior glenohumeral ligament and joint capsule.
- The common insertion of the coracohumeral and superior glenohumeral ligaments onto the lesser tuberosity forms the “reflection pulley,” which is a ligamentous sling that stabilizes the long head of the biceps before it enters into the intertubercular groove. Tears of the upper aspect of the subscapularis tendon may be associated with subluxation or dislocation of the long head of the biceps.



# Mechanism of Injury

- Tears of the subscapularis tendon **are predominantly the result of a degenerative process**, but less commonly, traumatic injury can result in acute subscapularis tearing.
- **Acute traumatic injuries occur in a younger age** group than degenerative rotator cuff tears.
- Despite the relative rarity of traumatic acute tears of the subscapularis compared with those of the supraspinatus and infraspinatus tendons
- The most common mechanisms of injury are hyperextension and external rotation of the shoulder.<sup>1</sup> Gerber and Krushell<sup>3</sup> reported on a group of 16 patients who sustained isolated complete subscapularis tears as the result of **forced external rotation with the arm at the side**.
- However, the greatest force can be applied to the subscapularis tendon when an external rotation and abduction force is applied with the arm maximally rotated and abducted 60°.[dislocation] Neviaser
- Impingement can occur in positions of **flexion, internal rotation, and adduction**. In the Neer's impingement position, the supraspinatus and subscapularis tendons contact; in the Hawkins impingement position, the contact **primarily** involves the subscapularis tendon.

# Classification [Pfirrmann]

- Grade 1            tears involve less than one quarter of the cephalocaudal dimension of the subscapularis tendon.
- Grade 2            tears involve more than one quarter of the tendon.

Grade 3            tears

- Involvement of the superior glenohumeral and coracohumeral ligaments is recorded, as
- Well.

# Physical Examination

- 1. Anterior shoulder tenderness is more common than with supraspinatus
- 2. Patients with complete subscapularis tendon tears often have increased passive external rotation compared with the unaffected shoulder.
- 3. There is usually considerable weakness of internal rotation.

Despite this weakness, several muscles, including the pectoralis major, latissimus dorsi, and teres major, contribute to shoulder internal rotation and can compensate for loss of the subscapularis.

- Subscapularis weakness ∴ The lift-off test best isolates the subscapularis muscle as the only internal rotator
- of the shoulder in maximum exten-

- The lift-off test is accurate only when the patient has a full range of passive internal rotation and when active internal rotation is not limited by pain.
- The belly press, or Napoleon sign, refers to the position in which Napoleon Bonaparte posed for portraits. In this test, the patient presses a palm against his or her belly with the wrist in a neutral position and the elbow anterior to the thorax. In a positive test, the patient will volar flex the wrist, and the elbow will fall posteriorly as the patient harnesses the posterior deltoid to compensate for lack of the subscapularis.
- Associated biceps pathology sometimes can be demonstrated. Bennett<sup>30</sup> described a test for subluxation of the long head of the biceps. The patient's arm is brought to 90° abduction with the arm in full external rotation. From this position, the arm is passively brought to full crossbody adduction and internal rotation in an effort to bring the biceps tendon from one extreme to the other within the bicipital groove.

# Biceps +/-.

*Am J Sports Med 2010 38: 1584*

- Dynamometer was used to assess elbow flexion power, while the supination strength could not be measured with such an approach.
- Hawkins reported through isokinetic strength tests that there was no difference in supination or elbow flexion strength.
- However, others reported a 20% decrease in supination strength and an 8% to 20% decrease in flexion strength.
- Our findings suggest that suture anchor suture tenodesis of the BLHT is associated with less than 10% incidence of Popeye deformity. Surgical times and clinical results between tenotomy and tenodesis showed no statistical difference.
- Suture anchor biceps tenodesis can be a reasonable option for the treatment of biceps lesions accompanied by a rotator cuff tear.

# Result

- A Popeye deformity occurred in 4 (9%) in the tenodesis  
11 (27%) in the tenotomy group
- Mild cramping pain 2 in the tenodesis group and 4 in the  
tenotomy group
- Mean elbow flexor power Showed no difference between the 2  
• groups, with mean values of 0.92  $\pm$  0.15  
(tenodesis) and 0.94  $\pm$  0.19 (tenotomy) (P
- The ASES and Constant scores were improved in both

# Old tear

- US I line and useful
- 1.Upward head migration/tuberosity
- Burse and folding under Acromion better with US
- Technician based/dynamic/cost effective/Hospital set up
- 2. Tangent line: Line from corocoid to acromion
- Spinoglenoid ligament
- Multiple causes for impingement
- Internal impingement : bet tub and glenoid [SLAP]. With instability. Look for tight post capsule and lax anterior

# MRI Asymptomatic tear

*Acta Orthopaedica 2010; 81 (3): 361–366*

- We selected atrophy and fatty degeneration of the rotator cuff muscles as potential predictors of pain from a rotator cuff tear, on the basis of the idea of an anatomically deficient but functionally sound rotator cuff, as described by Burkhart (1993).
- Mediolateral tear > 3 cm = symptomatic



# MRI findings in symptomatic and asymptomatic tears

50 subjects with asymptomatic and 50 subjects

Tear characteristics including tear size, tear location, the condition of the long head of the biceps, atrophy, and fatty degeneration of the muscles were compared between groups.

Results Single factor logistic regression analysis showed that

- 1. Tear size exceeding 3 cm in the medial-lateral plane,
- 2. Positive tangent sign, and fatty degeneration exceeding grade 1 of the supraspinatus and infraspinatus muscles.
- The causal relationships are unclear.

Table 3. Distributions of independent variables between symptomatic and asymptomatic tear groups with results from single-factor, age adjusted logistic regression analysis. An OR of > 1 indicates a positive association between the potential predictor and symptoms

Independent variable	Dependent variable		OR <sup>a</sup> (95% CI)	p-value
	Asymp-tomatic	Symp-tomatic		
Tear size, med.–lat.				
≤ 3 cm	39	29	4 (1.5–10)	0.007
> 3 cm	11	21		
Tear size, ant.–post.				
≤ 3 cm	41	40	2 (0.5–4.2)	0.5
> 3 cm	9	10		
Tear location				
Superior-posterior	39	34	2 (0.7–4.2)	0.3
Superior-anterior	11	16		
Biceps tendon				
No tear	41	41	1 (0.4–3.5)	0.7
Tear	9	9		
Muscle atrophy <sup>b</sup>				
Grade 1 or 2	36	31	2 (0.9–5.5)	0.09
Grade 3	14	19		
Muscle atrophy (tangent sign)				
Negative	42	36	3 (1.1–9.0)	0.04
Positive	8	14		
Fatty atrophy SSP <sup>c</sup>				
Grade 0–1	41	31	5 (1.6–13)	0.004
Grade 2–4	9	19		
Fatty atrophy ISP <sup>c</sup>				
Grade 0–1	44	35	5 (1.5–14)	0.009
Grade 2–4	6	15		
Fatty atrophy SSC <sup>c</sup>				
Grade 0–1	45	41	2 (0.6–7.3)	0.2
Grade 2–4	5	9		

<sup>a</sup> age-adjusted odds ratios.

<sup>b</sup> grading according to Thomazeau et al. (1996).

<sup>c</sup> grading according to Goutallier et al. (1994).

CI: confidence interval;

SSP: supraspinatus muscle;

ISP: infraspinatus muscle;

SSC: subscapularis muscle.

# Management of the failed arthroscopic subacromial decompression

## Abstract

- Arthroscopic subacromial decompression is an effective treatment for impingement syndrome, with published success rates between 77% and 90%.
- Failure of subacromial decompression is defined as persistent pain and disability after surgery despite adequate postoperative rehabilitation.
- Potential causes of failure after subacromial decompression are varied and may include
  - 1. technical error, incorrect diagnosis, inadequate rehabilitation, or unrealistic postoperative expectations.
- A methodical approach to the patient with persistent symptoms after subacromial decompression will allow for accurate diagnosis and treatment of the underlying problem in the majority of cases.
- Sports Med Arthrosc. 2010 Sep;18(3):207-12.

# Overuse impingement in animal models

**Rotator cuff tendinosis in an animal model: role of extrinsic and overuse factors.** Ann Biomed Eng. 2002 Sep;30(8):1057-63.

- While ineffective in causing a change in supraspinatus tendon properties in animals with normal cage activity, **extrinsic compression** had a significant and dramatic effect when it was combined with overuse activity.

J Shoulder Elbow Surg. 2000 Mar-Apr;9(2):79-84. **Neer Award 1999.**

- There was an increase in cellularity and a loss of the normal collagen fiber organization consistent with what has been seen in human tendinopathy. These findings support overuse activity as an etiologic factor in the development of supraspinatus tendinopathy

# The long-term outcome of rotator cuff tendinitis-

Rotator cuff tendinitis is believed to resolve in the majority but the long-term outcome has not been well documented.

137 patients treated conservatively :  
active tendinitis in 35 individuals at a mean of 19 months  
In addition, 40 patients had residual pain  
8 developed pain due to another cause.

Early presentation and a history of overuse unrelated to occupation distinguished the 54 who had resolved from those with active tendinitis.

Dominant arm involvement was associated with a poorer prognosis (p less than 0.05).

Functional impairment occurred in 25% patients, two having lost employment.

The sizeable proportion of patients with chronic tendinitis resistant to conservative treatment suggests that rotator cuff tendinitis is not an early self-limiting condition and improvement in management is required.

- Br J Rheumatol. 1988 Oct;27(5):385-9.

# Cx Spondylosis with cuff rupture

[J Shoulder Elbow Surg (2010) 19, 937-943]

- 1. Independent prevalence: both common problems
- 2. The information in the literature on coexisting lesions is sparse
- 3. The diagnosis of the presence of both lesions is important for proper treatment.
- 4. If surgical treatment of the radiculopathy is indicated, this surgery should take priority, followed by rotator cuff repair after recovery from the cervical surgery. Outcomes from rotator cuff repair in this setting may well be inferior to the results of isolated cuff repair, but this has not yet been documented in published studies.

# Cervical radicular disease

- 1. Similar to rotator cuff disease, degenerative disk disease is age related. **Beginning in the third decade of life**, the hydration of the nucleus starts to diminish, accompanied by fissuring of the annulus.
- 2. a prevalence of cervical radiculopathy of **3.5 per 1,000** individuals.
- 4. Natural course: At long-term follow-up of 10 to 25 years, Gore et al<sup>27</sup> reported that nonoperative management was associated with complete symptom resolution in 43% of patients, partial resolution in 25%, and continued moderate to severe pain in the remaining 32%.
- In another long-term study, by Lees and Turner,<sup>38</sup> of 51 patients followed up for 2 to 19 years, 43% of the patients had only a single episode of radicular pain, 29% had mild symptoms, and the remaining 27% had more substantial symptoms.
- Surgical treatment: Rapid improvement of symptoms is typical, and prolonged relief of symptoms can be expected in approximately 70% to 90% of patients after either anterior or posterior surgery.
- ,

- Relief of arm pain and paresthesia were achieved in 96% of patients and resolution of the motor deficit in 98%.
- Arnasson et al<sup>4</sup> found that axial neck pain persisted in roughly one-half of patients irrespective of conservative or surgical treatment, but radicular symptoms responded substantially better to surgery, with over 70% of patients having improved.
- After anterior surgery, Lundsford et al<sup>40</sup> found that 77% of patients had complete relief of symptoms initially, yet 38% had recurrent symptoms at some time during the 1 to 7 years of follow-up. At a mean follow-up of 6 years after anterior discectomy and fusion
- Bohlman et al.<sup>7</sup> found that all patients had improvement or resolution of their preoperative motor deficit.
- Sensory deficits resolved in 71 of 77 patients.
- Only 6 of the 122 total patients had persistent radicular pain to any degree, but neck pain was present in 37.