2ο ΘΕΡΙΝΟ ΣΧΟΛΕΙΟ ΑΚΤΙΝΟΛΟΓΙΑΣ ΜΥΟΣΚΕΛΕΤΙΚΟΥ

"BACK TO BASICS"

29 ΙΟΥΝΙΟΥ
1 ΙΟΥΛΙΟΥ
2018
ΗΡΑΚΛΕΙΟ ΚΡΗΤΗΣ
Ibis Styles Heraklion Central

Imaging of subacromial impingement and mimickers:

MR imaging and Ultrasonography

Evangelia E. Vassalou MD,PhD

Radiologist

Department of Medical Imaging, Heraklion University Hospital

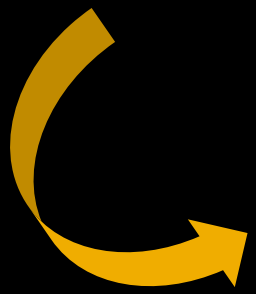
Department of Medical Imaging, Sitia General Hospital

Outline

27 min

Subacromial impingement

- Anatomy
- Definition
- Pathophysiology



Imaging investigation

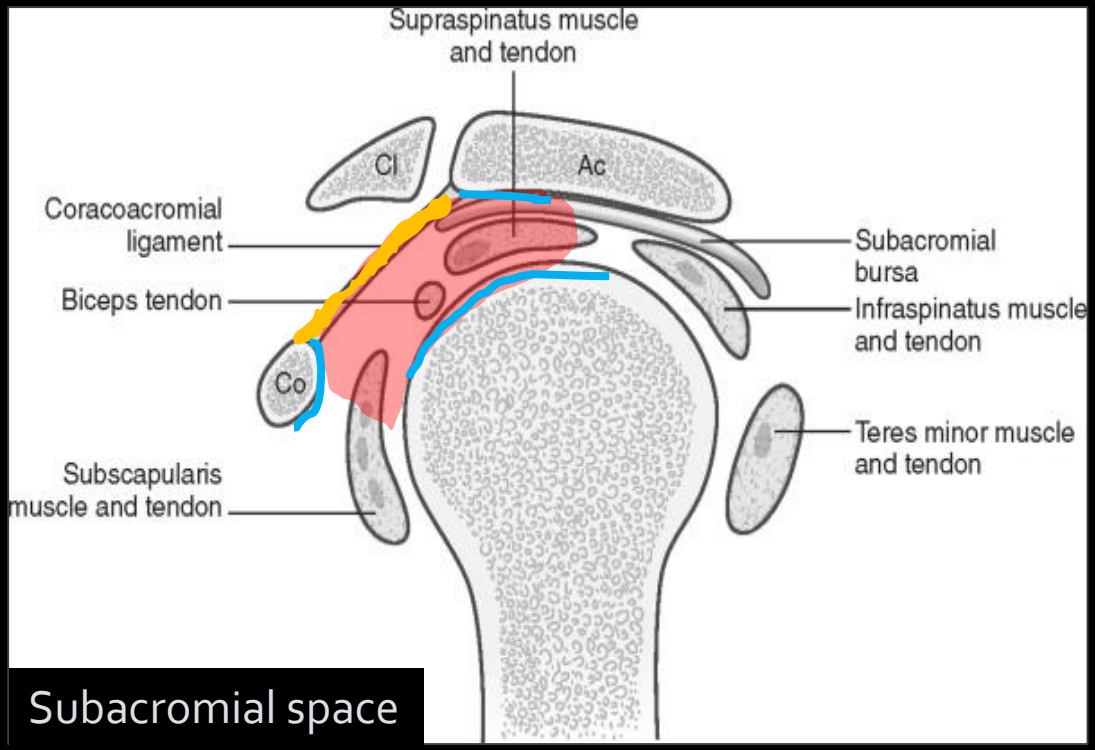
- Plain radiographs/MRI/US
  - Anatomical factors
  - RC tears
  - SA bursitis
  - Dynamic evaluation

Mimickers

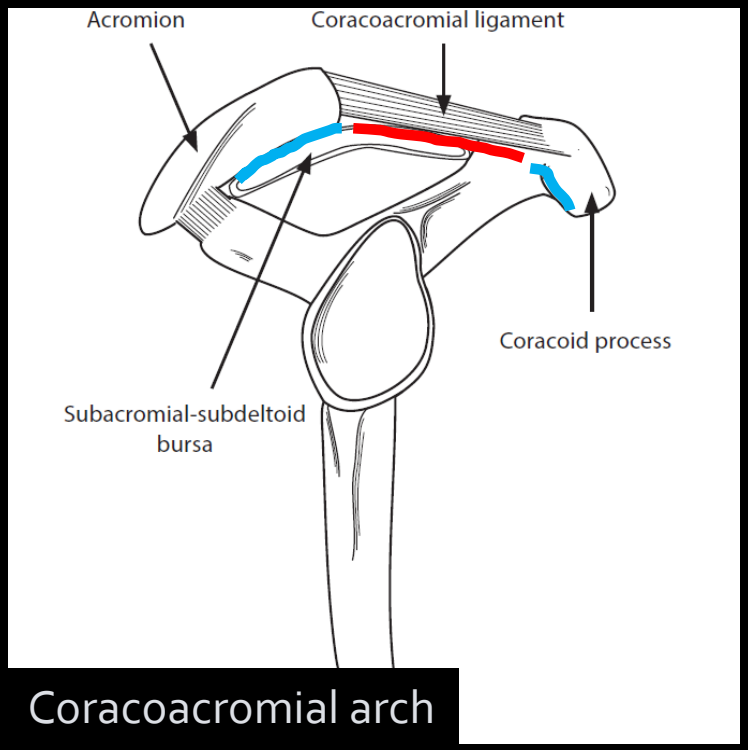
- RC calcific tendinopathy
- Adhesive capsulitis
- Postero-superior impingement
- Suprascapular nerve syndrome

Subacromial Impingement

Anatomy



Subacromial space



Coracoacromial arch

Subacromial Impingement
Definition

Clinical syndrome

pain during humeral elevation/internal rotation due to impingement of SSP/SAB in subacromial space

- most common cause of shoulder pain
  - 44-65% of shoulder disorders
- association with rotator cuff tears
- <25y to >40y
  - overhead movements
- Imaging findings ⇔ clinical correlation!

Neer CS. J Bone Joint Surg Am 1972;54:41-50
Khan Y, et al. Open Orthop J. 2013;7:347-351
Van der Windt DA, et al. Ann Rheum Dis 1995;54:959-64

Intrinsic theory

age/overuse-related RC degeneration

hypovascular zone ?

↓

RC tear

↓

superior humeral head migrati

↓

subacromial space ction

Extrinsic theory

subacromial space restriction

Anatomical factors

- Acromial shape/orientation/os acromiale
- ACJ degeneration
- Thickened CAL (coracoacromial arch)

Biomechanical f rs

- Alt kinematics
- r capsular tightness
- dic spine flexion
- ystunctional RC musculature

COMBINATION

↓

SAB/RC mechanical compression

↓

SAB/RC inflammation

↓

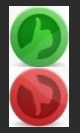
RC tendinosis

↓

RC tear

Tuite MJ. Magn Reson Imaging Clin N Am 2012;20:187-200
Khan Y, et al. Open Orthop J. 2013;7:347-351
Neer CS. J Bone Joint Surg Am 1972;54:41-50

Subacromial impingement
Imaging investigation

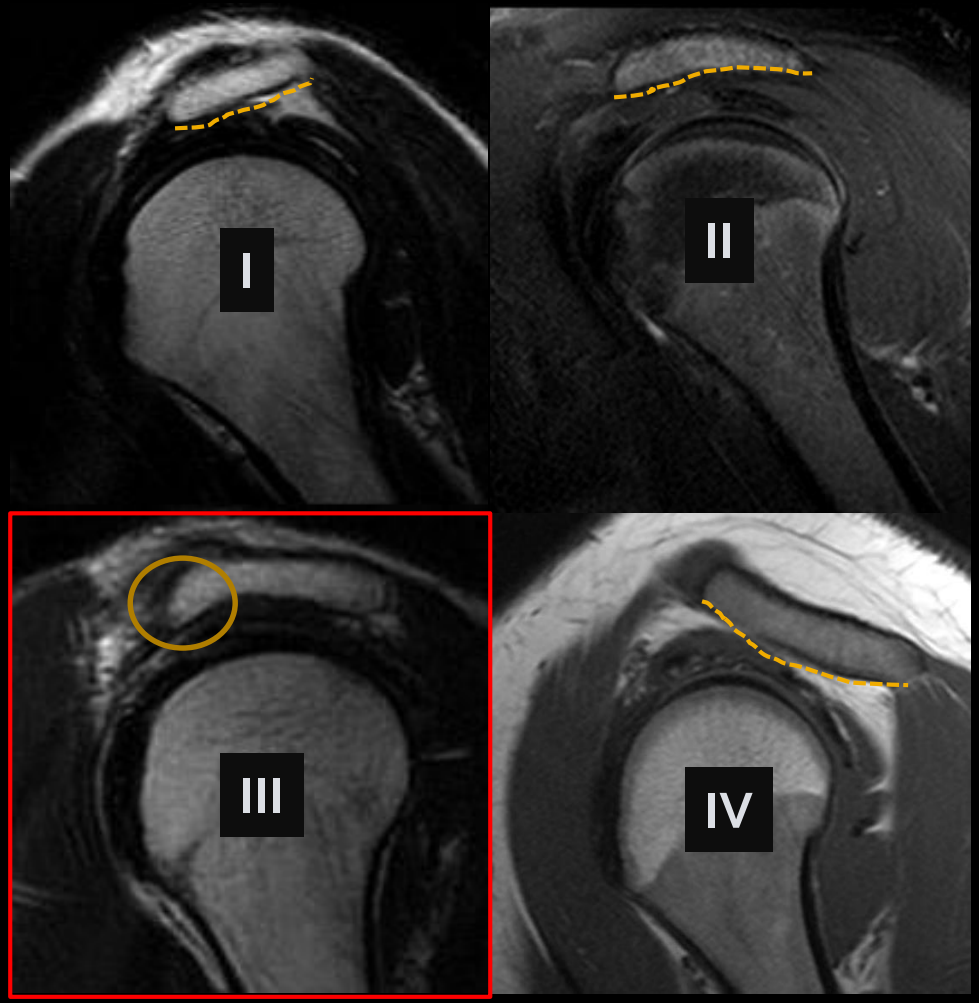
Imaging findings	MRI	US	MRA	Plain radiographs	Physical examination
Predisposing anatomical factors	+++ ←	+	+++	ACJ Acromion Reduced AHD Exclude: ▪ fractures ▪ neoplasms ▪ calcific tendinopathy	 Sensitivity Specificity
Complete RC tears	+++	+++	+++		
Partial RC tears	++	+++ ←	+++		
Muscle fatty degeneration	+++ ←	++	+		
SASD bursitis	+++	+++	-		
Dynamic evaluation	-	+++ ←	-		
Guided injection	-	+++ ←	-		

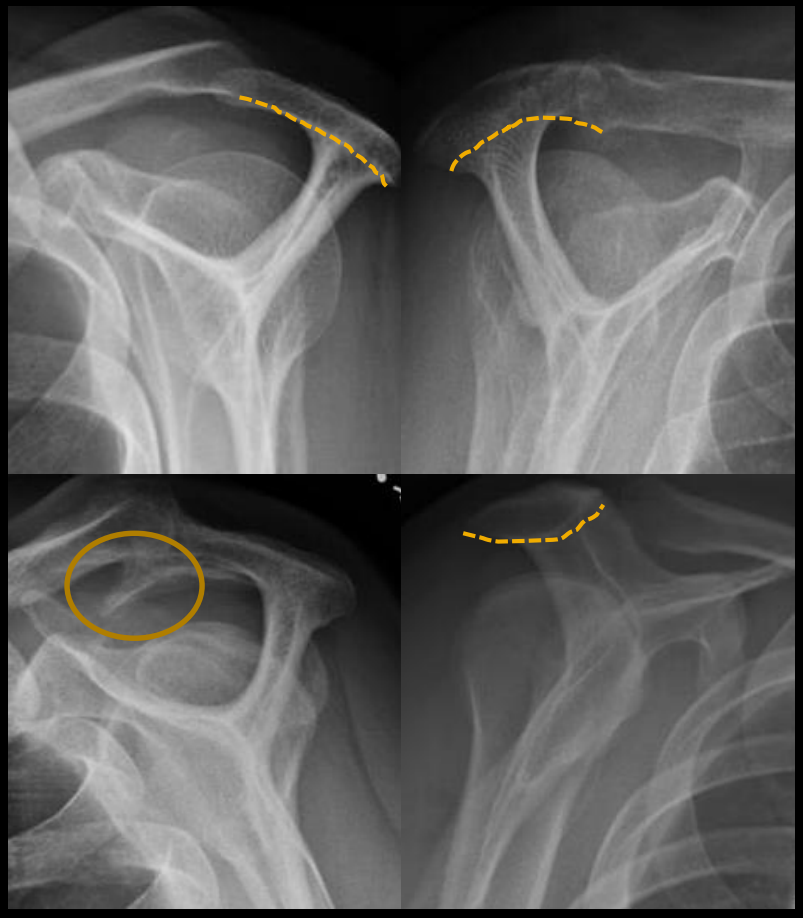
Nazarian LN, et al. Radiology 2013;267:589-95
Roy JS, et al. Br J Sports Med2015;49:1316-28
Rutten MJ, et al. Eur Radiol 2010;20:450-7
Smith TO, et al. Magn Reson Imaging 2012;30:336-46

Subacromial impingement

Anatomical factors

Acromial shape

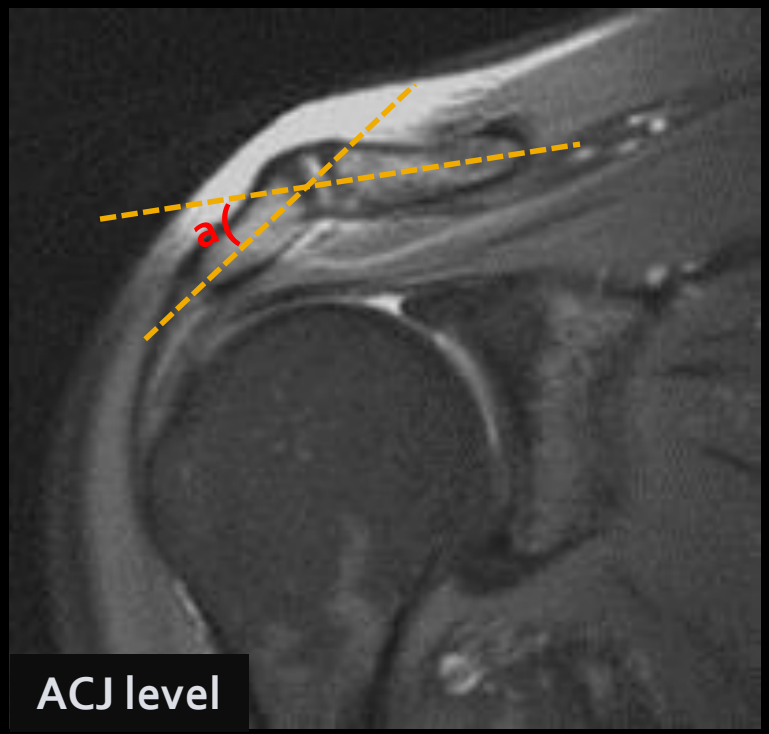




Chang EY, et al. Radiology 2006;239:497-505

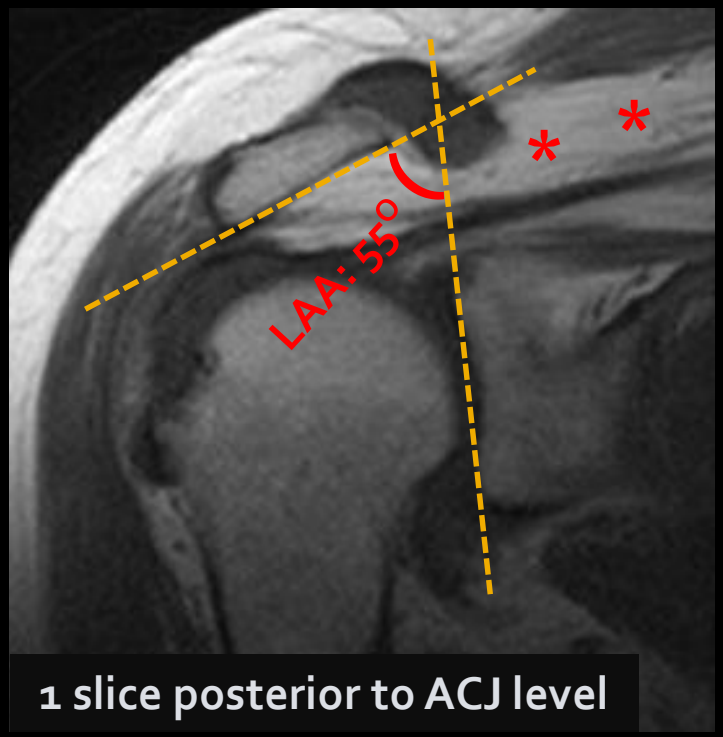
Subacromial impingement
Anatomical factors

Acromial orientation
lateral downslope



ACJ level

a > 12 degrees => lateral downsloping acromion



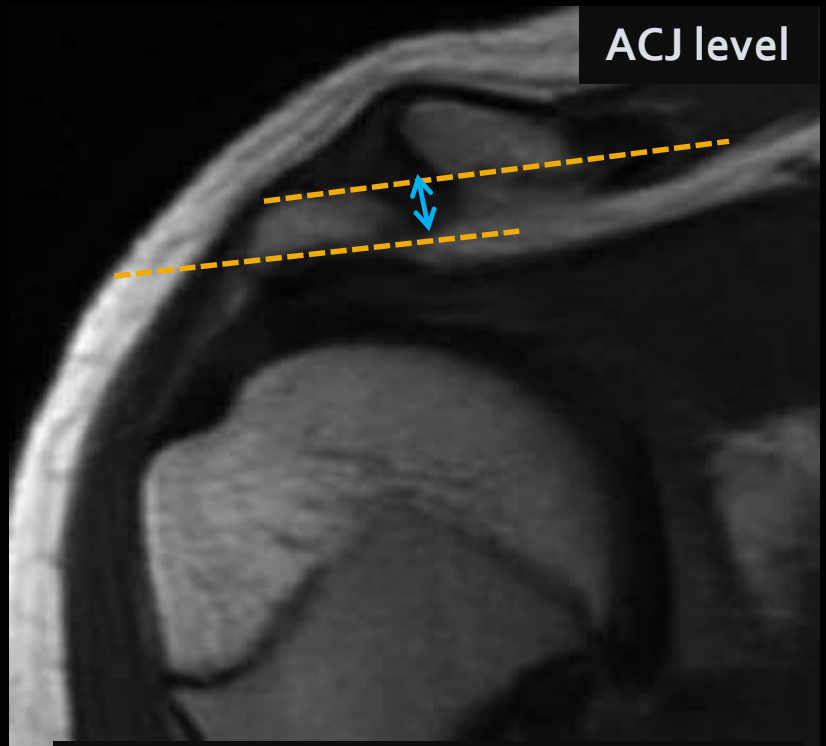
1 slice posterior to ACJ level

LAA < 70 degrees => association with RC tears

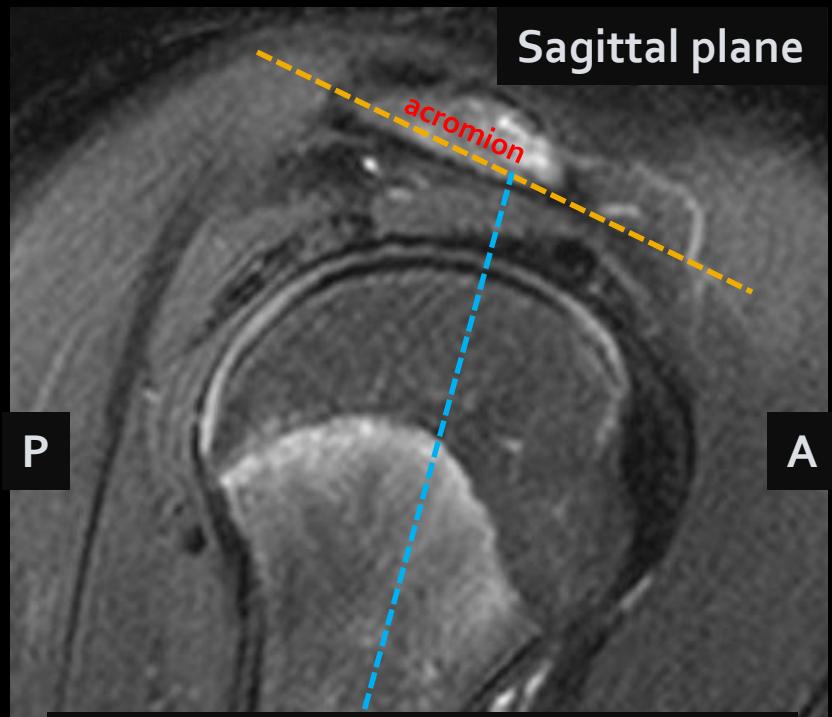
Stabler A. Springer- Verlag, 2004:121-159
Banas MP, et al. J Shoulder Elbow Surg 1995;4:454-461
Moses D, et al. J Magn Reson Imaging 2006;24:1371-7

Subacromial impingement
Anatomical factors

Acromial orientation
low lying
anterior downslope



Low lying acromion
the lowest acromial surface is below the lowest clavicular surface



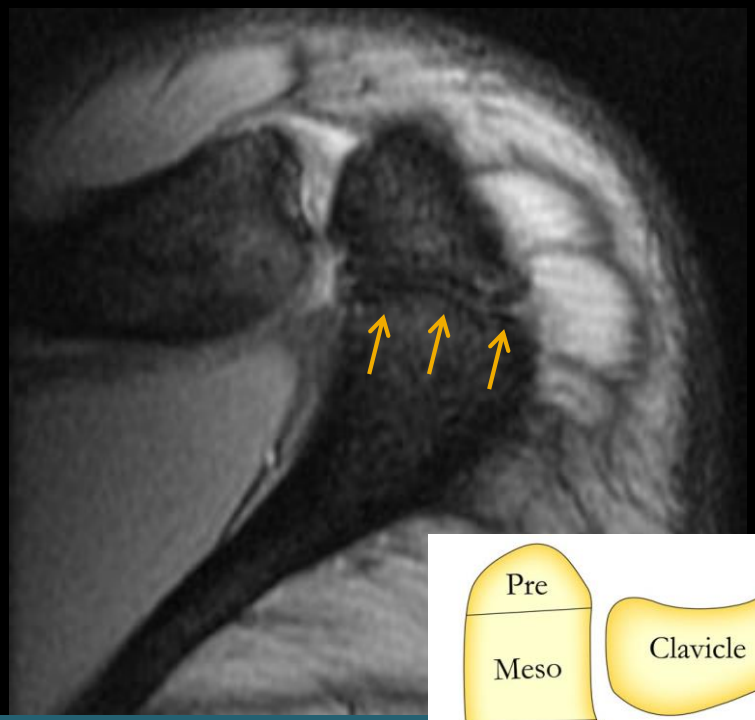
anterior downslope
the anterior acromion is more caudal related to posterior

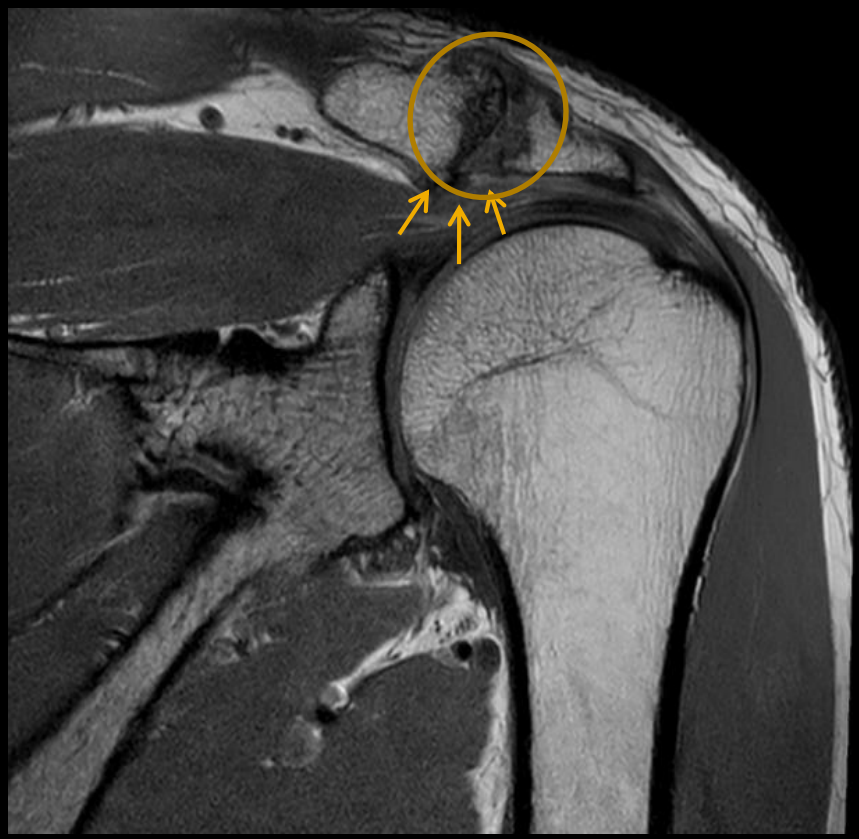
Li X, et al. PLoS ONE 2017;12:e017619
Stehle J, et al. J Shoulder Elbow Surg 2007;16:135-42
Edelson JG, et al. J Bone Joint Surg Br 1992;74:589-94

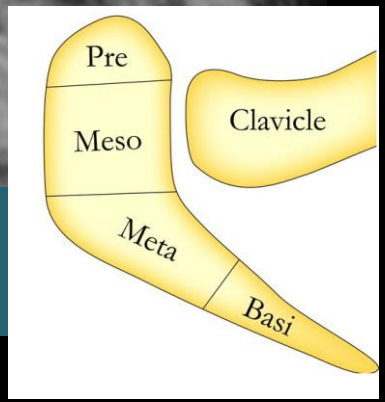
Subacromial impingement

Anatomical factors

Os acromiale
ACJ degeneration



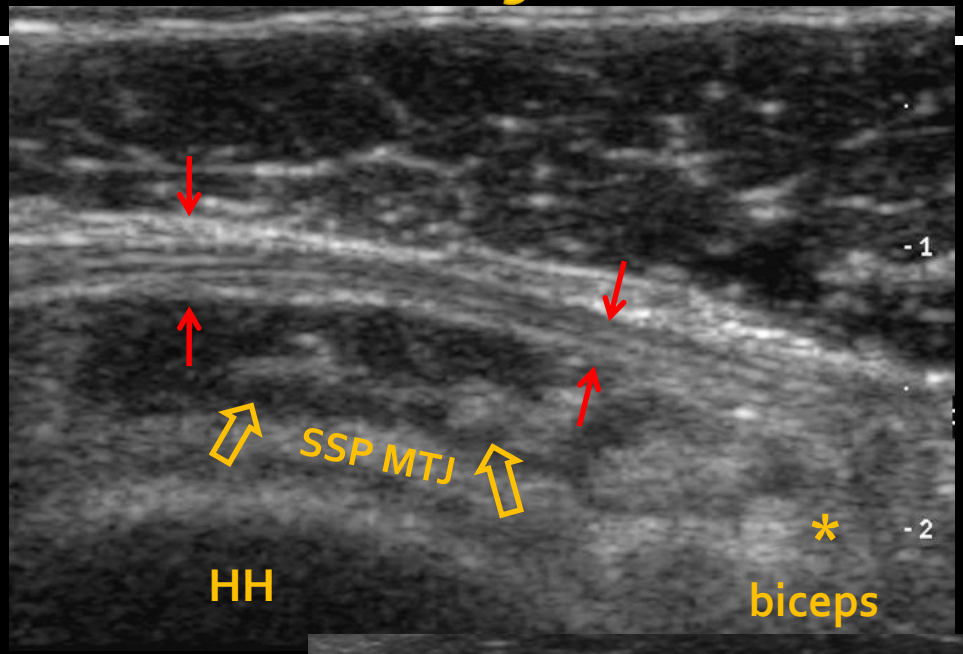


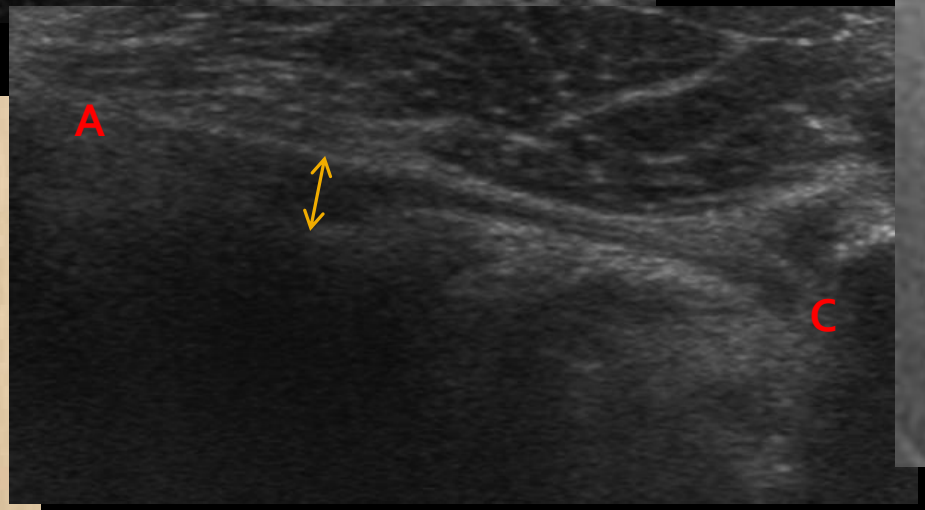


- bilateral ~ 60%
- fuse by 25y

Subacromial impingement

Anatomical factors

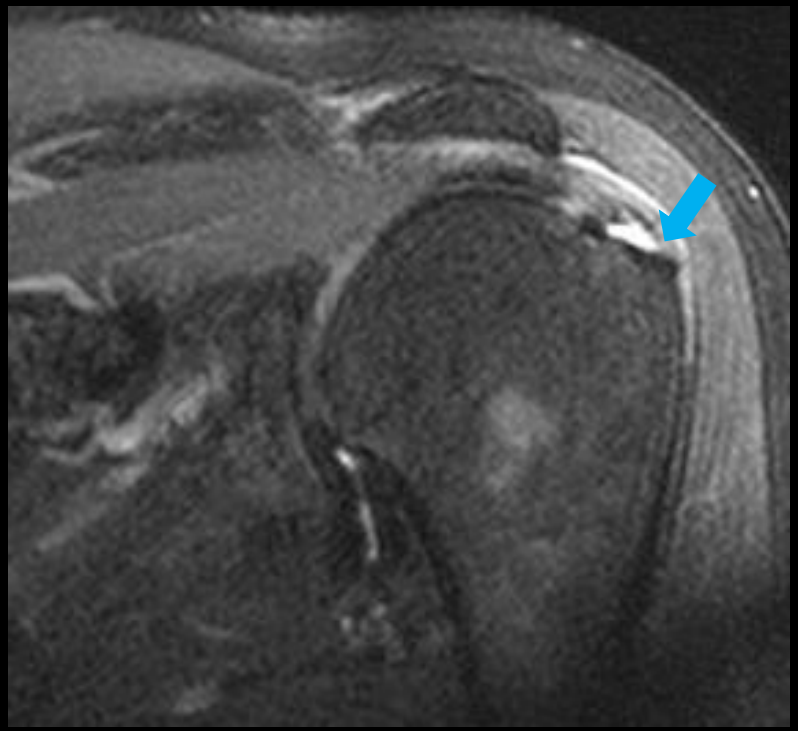


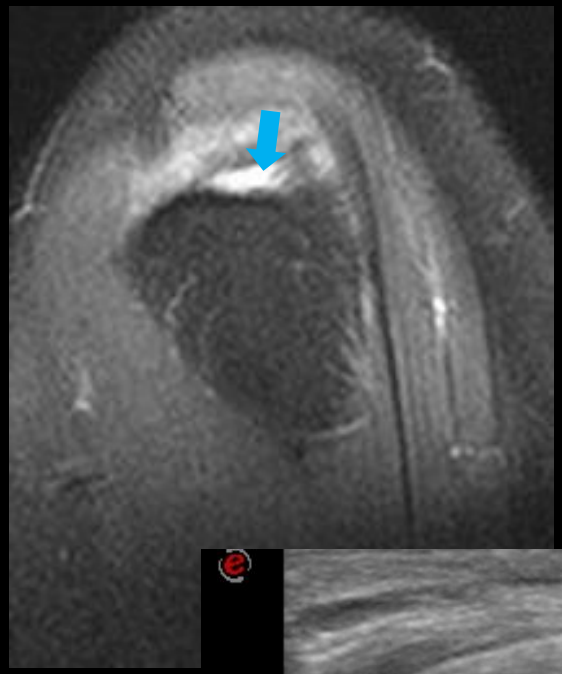


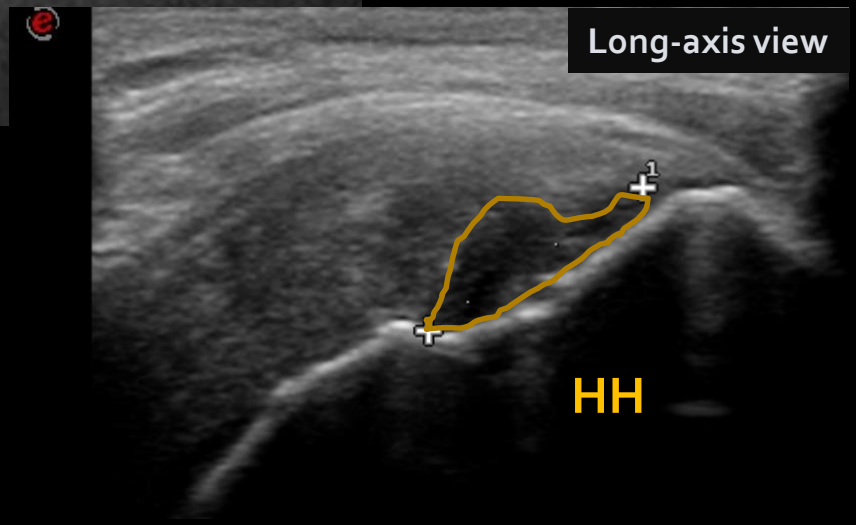
CAL

Normal: CAL < 3 mm

Subacromial impingement
Partial thickness RC tear







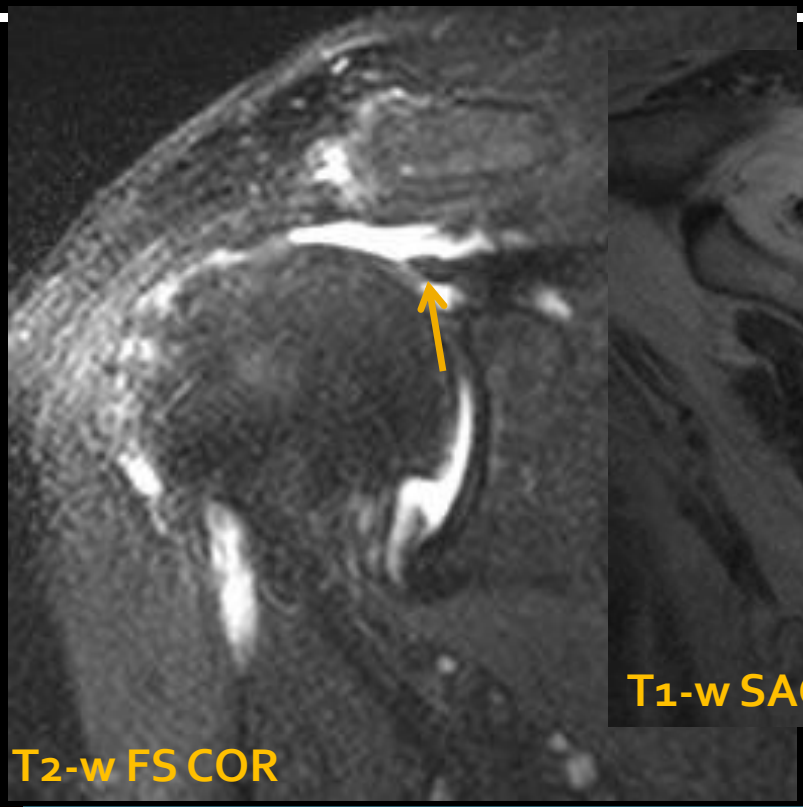
1. Articular/bursal
2. Location (anterior/middle/posterior)
3. Dimensions
   - thickness > 50%

Subacromial impingement

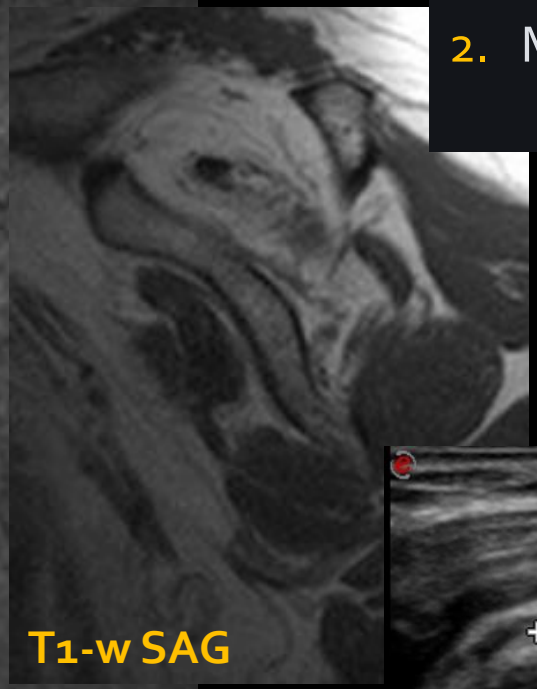
Complete RC tear

1. Tendon re
2. Muscular
   - "Gou

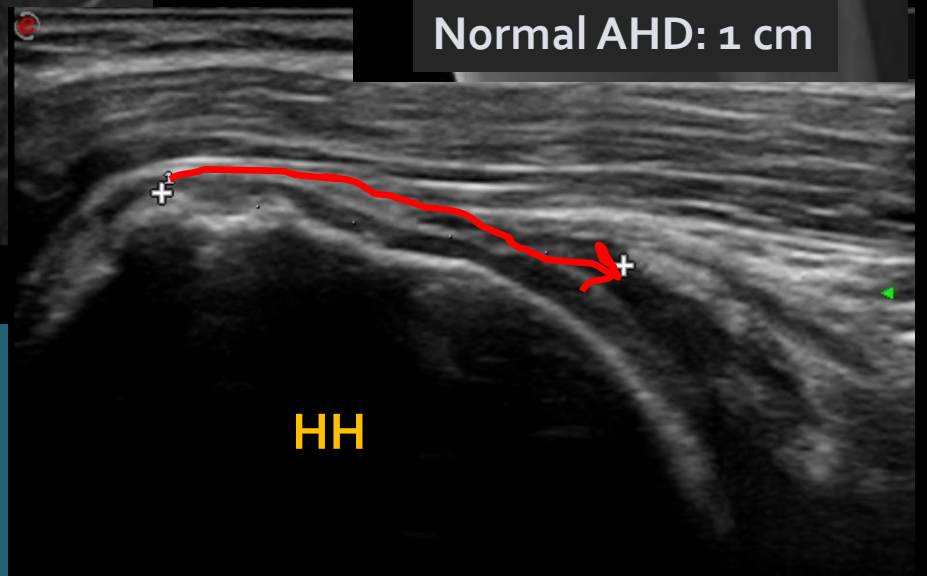
Normal AHD: 1 cm



T2-w FS COR



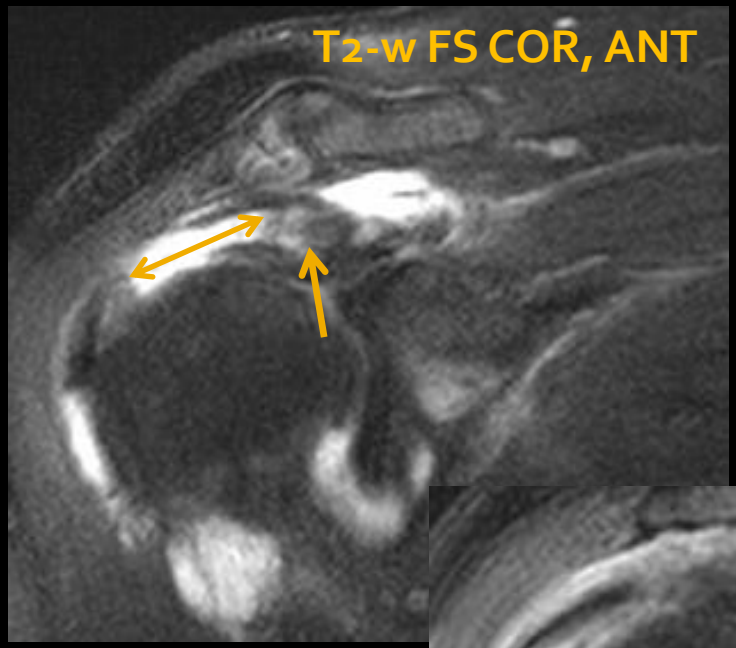
T1-w SAG



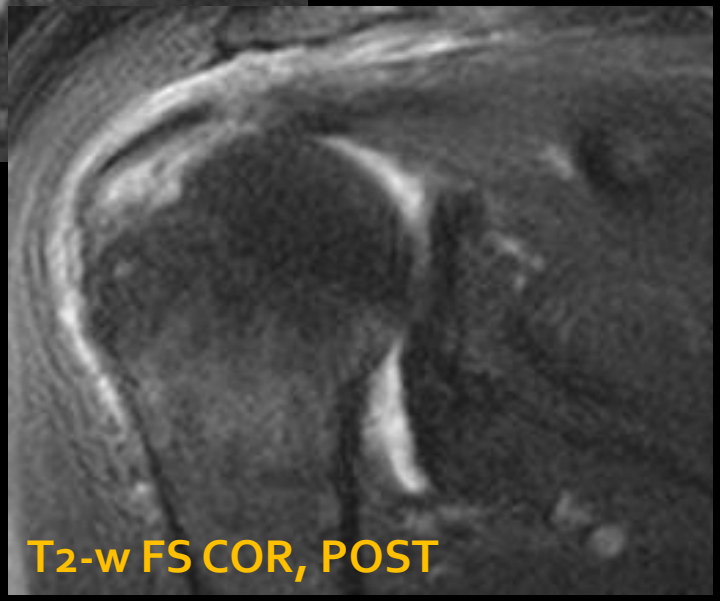
HH

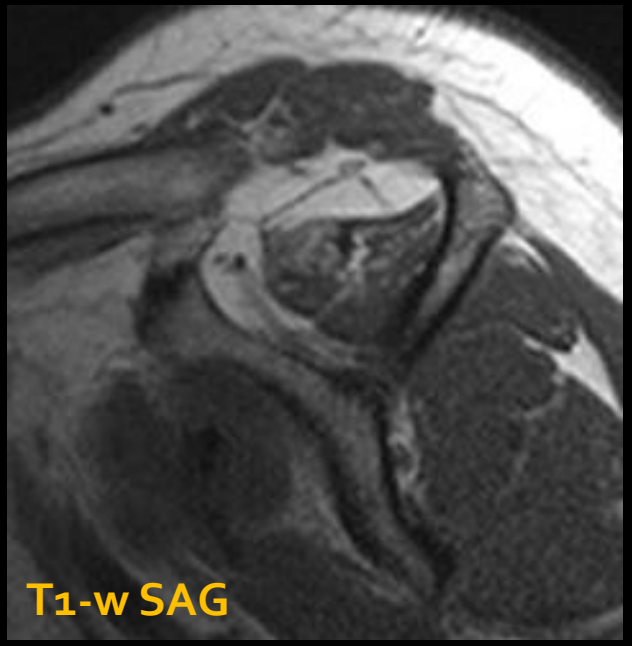
grade 0: normal muscle
grade 1: some fatty streaks
grade 2: less than 50% fatty muscle atrophy
grade 3: 50% fatty muscle atrophy
grade 4: greater than 50% fatty muscle atrophy

Subacromial impingement
Full thickness, partial RC tear



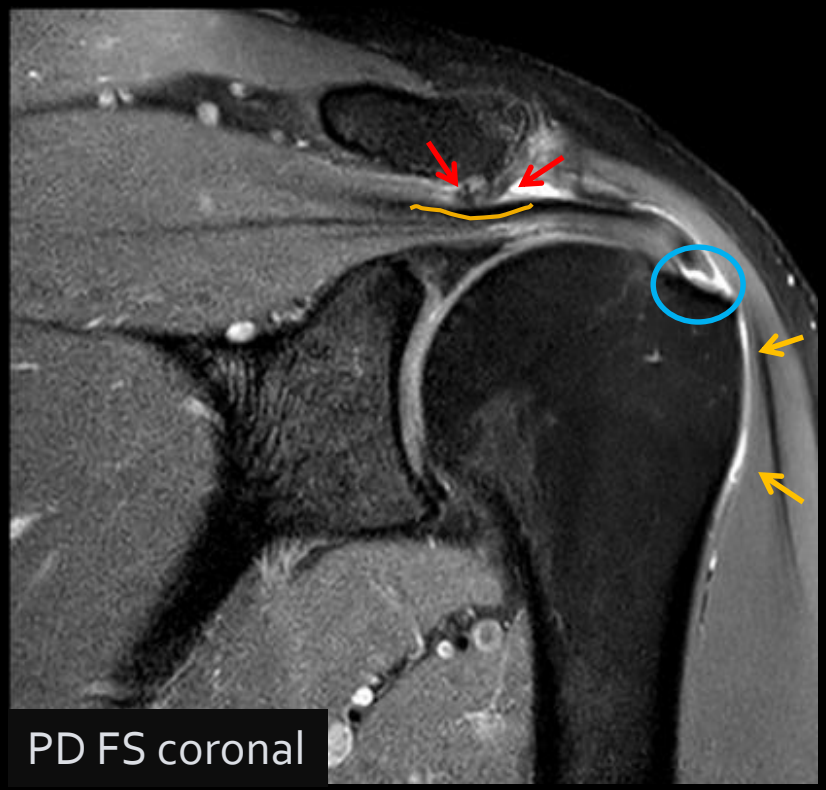
1. Dimensions
2. Tendon retraction
3. Muscular atrophy/fatty infiltration
   - "Goutallier"



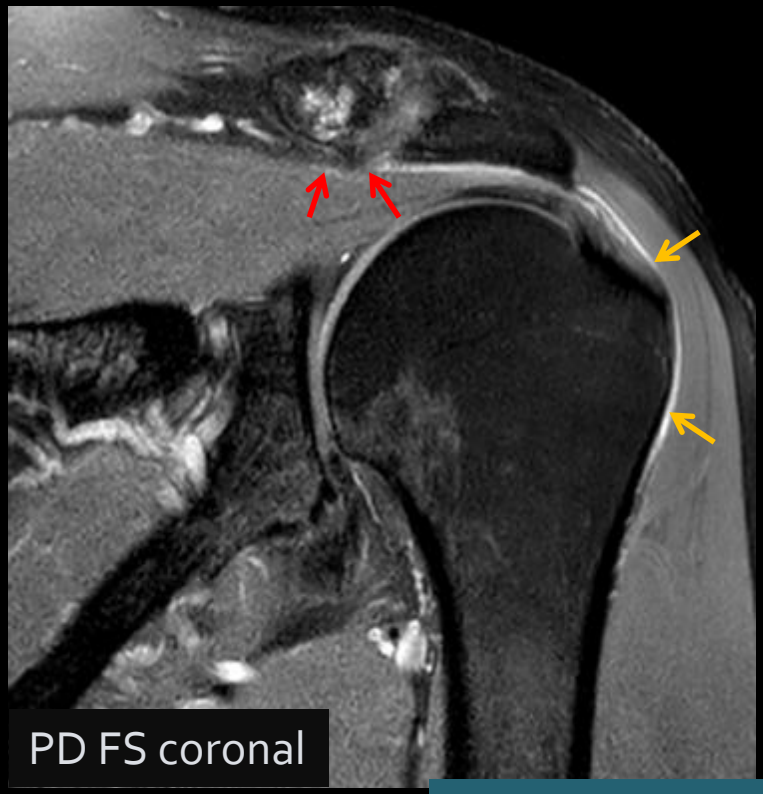


Subacromial impingement

SASD bursitis - MRI



PD FS coronal



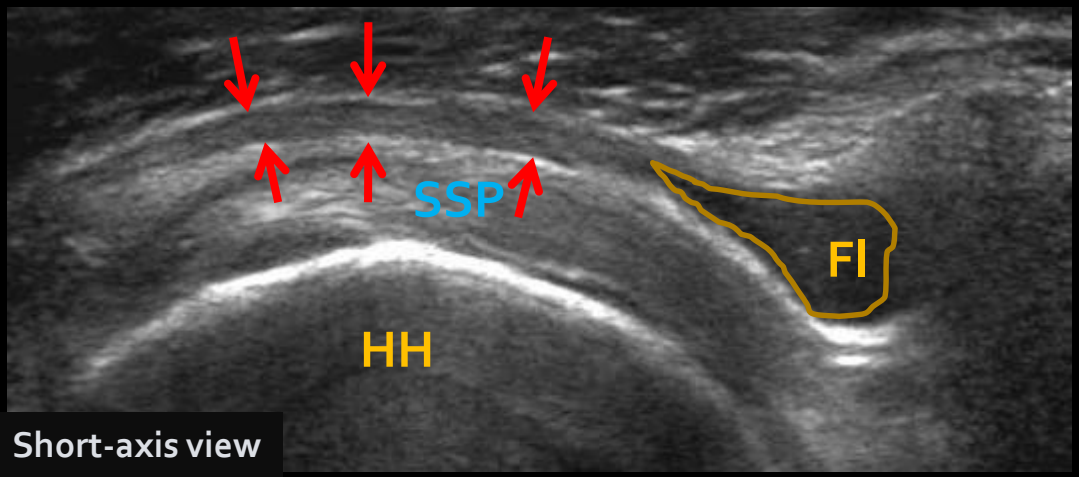
PD FS coronal

Findings

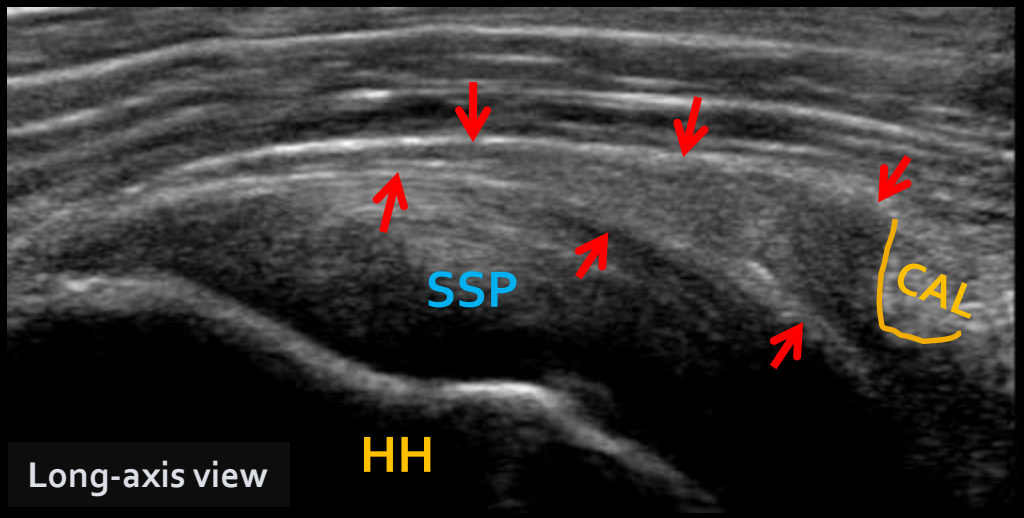
- ACJ degeneration
- SASD bursitis
- RC tear

Subacromial impingement

SASD bursitis - US



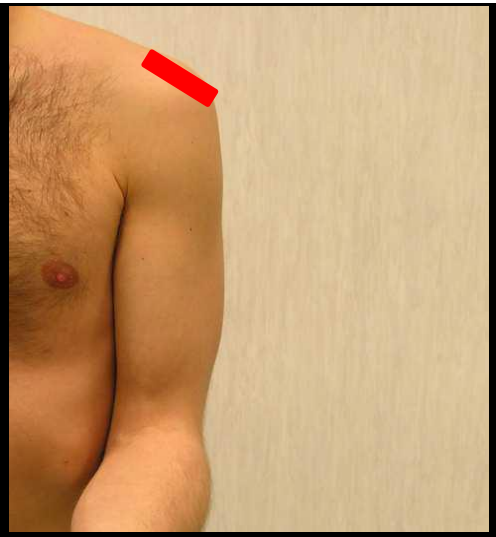
Short-axis view

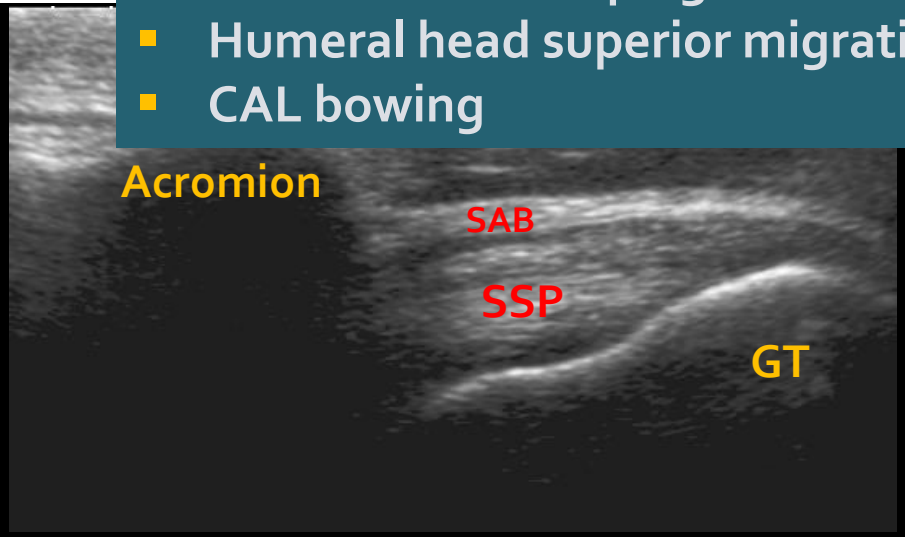


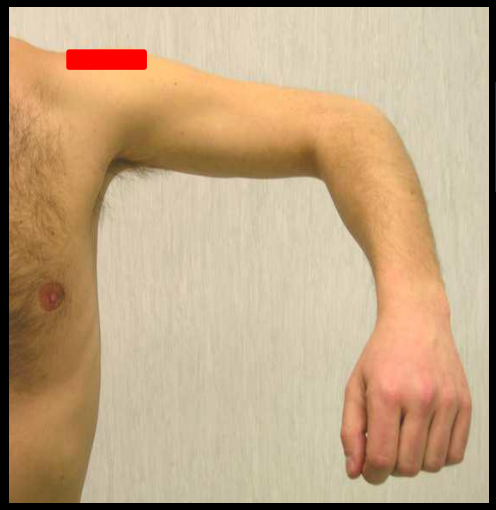
Long-axis view

Subacromial impingement
Dynamic evaluation

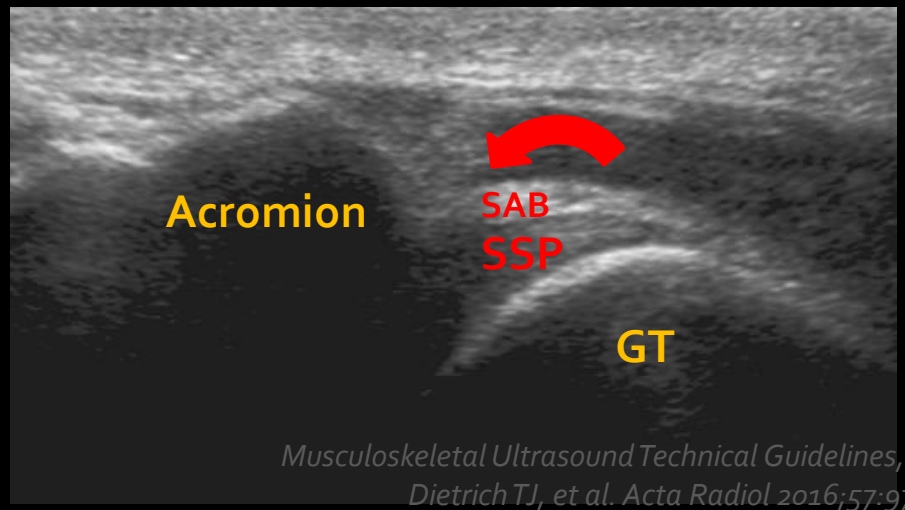
Dynamic evaluation
- Tendon/bursal impingement
- Humeral head superior migration
- CAL bowing



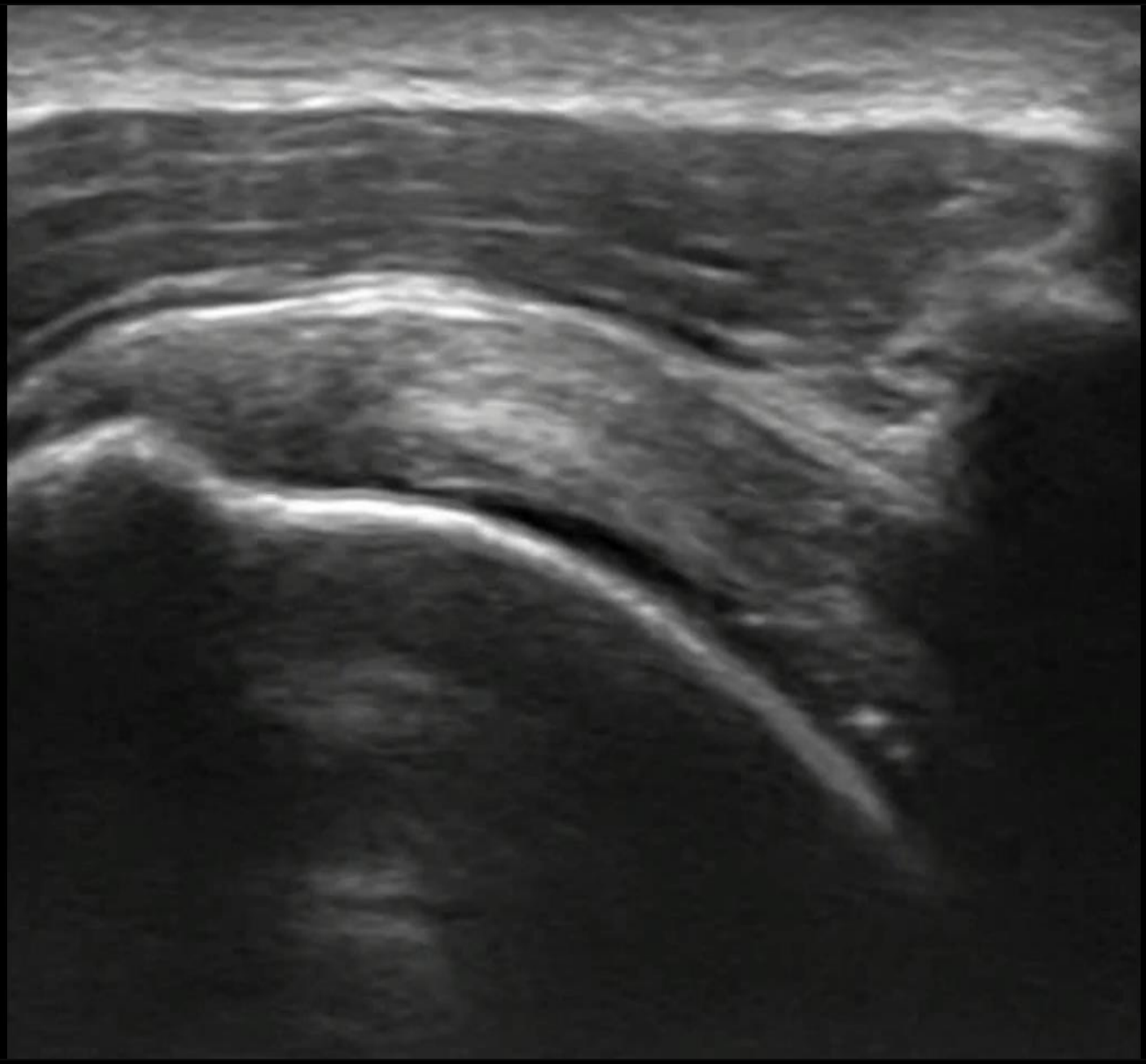


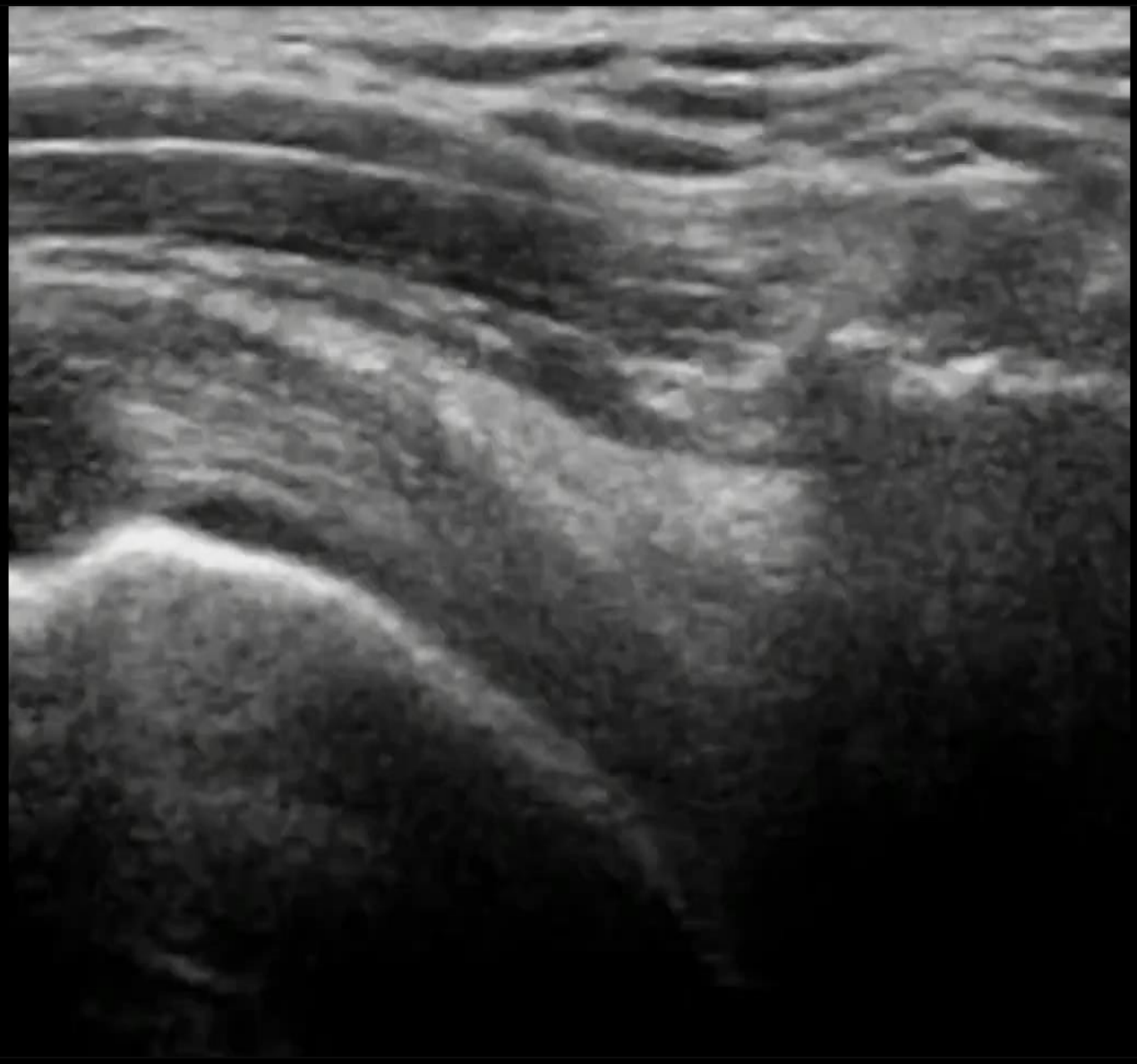


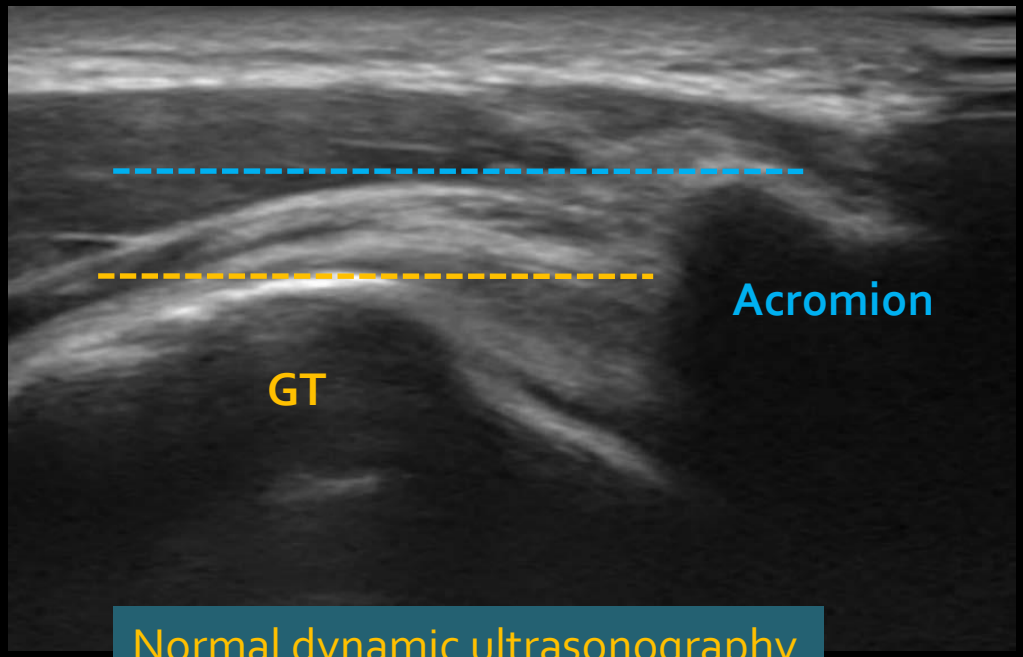
Abduction
Internal rotation



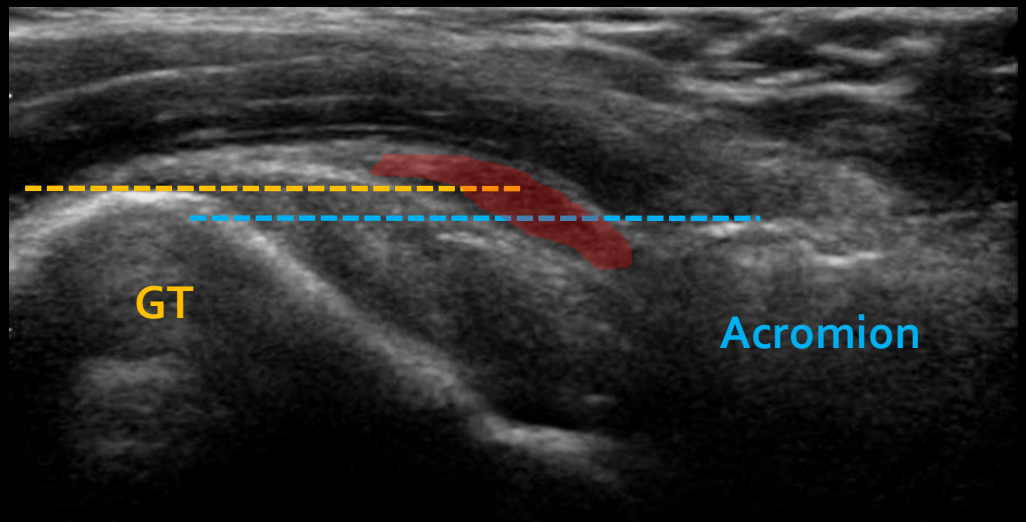
Musculoskeletal Ultrasound Technical Guidelines, ESSR
Dietrich TJ, et al. Acta Radiol 2016;57:971-977
Bureau et al. AJR Am J Roentgenol 2006;187:216-220





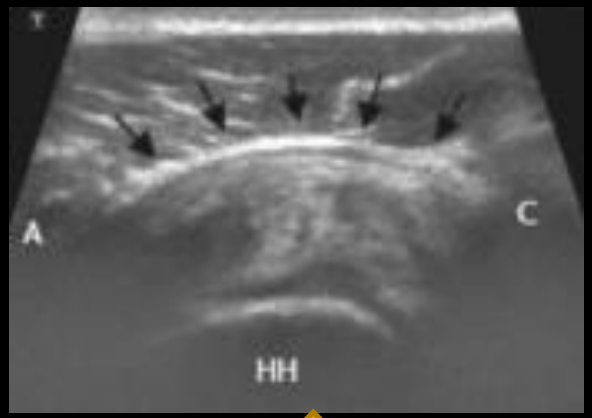


Normal dynamic ultrasonography



Dynamic ultrasonography with findings suggestive of subacromial impingement

Subacromial impingement
Dynamic evaluation -CAL



Abduction
Internal rotation

Wu CH, et al. J Orthop Res 2012;30:1430-1434

US findings

Ultrasonographic classification of subacromial impingement

Grade	Pain provocation with shoulder motion	Ultrasonographic finding
0	No	No visible anatomic impingement
1*	Yes	No visible anatomic impingement
2	Yes	Bursa or tendon impingement
3	Yes	Superior migration of the humeral head

*

- ACJ degeneration => impingement
- Biomechanical factors

Dietrich TJ, et al. Acta Radiol 2016;57:971-977
Bureau et al. AJR Am J Roentgenol 2006;187:216-220
Coombs P, et al. Sonography of the shoulder and upper arm. In Musculoskeletal ultrasound, 3rd ed., 2016;737-811

Mimickers (DD)

- RC calcific tendinopathy
- Adhesive capsulitis
- Postero-superior impingement
- Surpascapular nerve syndrome
- ACJ arthritis
- RC tears
- Cervical radiculopathy
- Glenohumeral instability
  - younger patients
    - traumatic
    - atraumatic
  - MRA

RC calcific tendinopathy

- Females 40-60y
- 50% of patients ASYMPTOMATIC !

- Etiology
  - hypoxia, microtrauma, overuse

- Location
  - Shoulder : SSP (intra/peritendinous), intrabursal

- Stages
  - pre-calcific
  - calcific (formative, resting, resorptive phases)
  - post-calcific

- Complications
  - RC tears
  - SASD bursitis
  - Intraosseous extension

Investigation

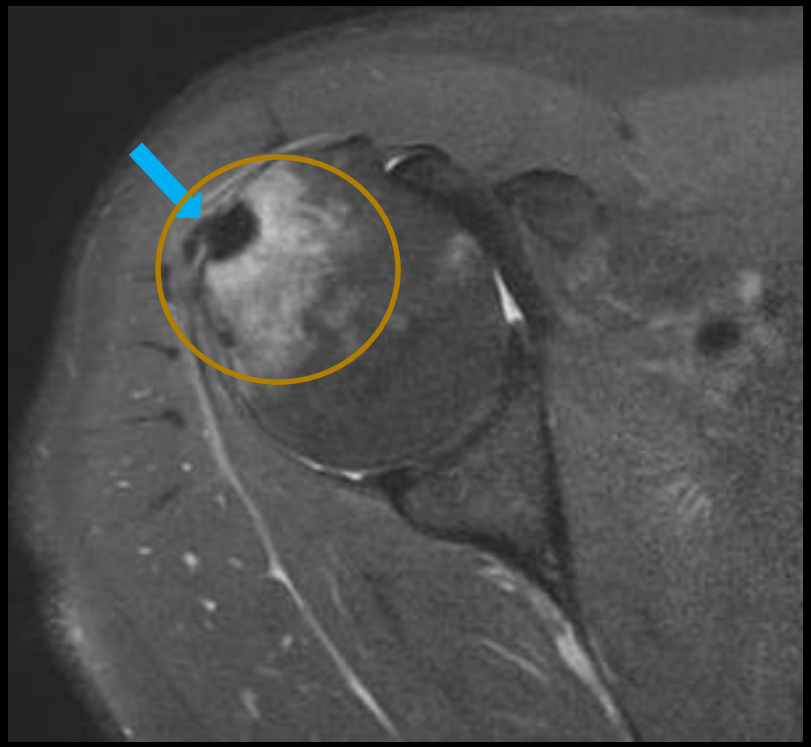
- **US**
  - deposit consistency/location
  - US-PICT
  - complications
- **MRI**
  - intraosseous extension
  - other complications
- **X-ray**

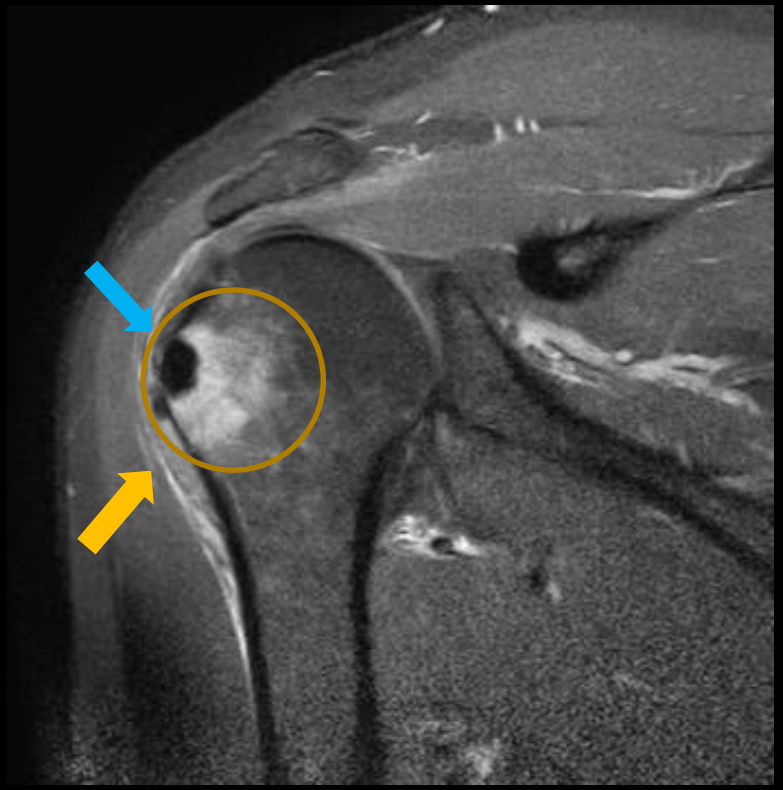
Serafini G et al. Radiology 2009;252:157-164
Merolla G et al. J Orthop Traumatol 2015; 16: 175-183

RC calcific tendinopathy

MRI

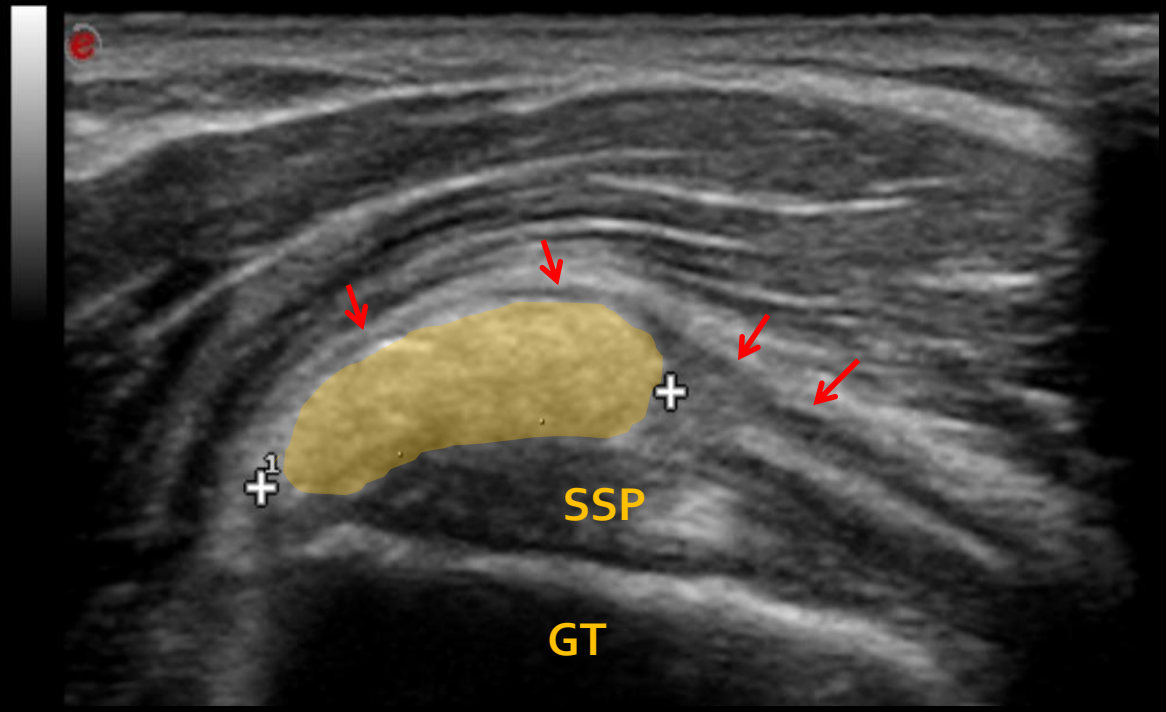
1. Calcific deposits
2. SASD bursitis
3. BME/Intraosseous extension





RC calcific tendinopathy

US

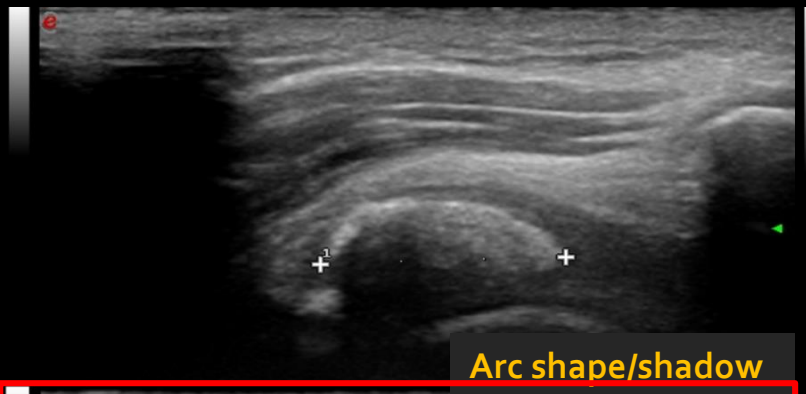


RC calcific tendinopathy

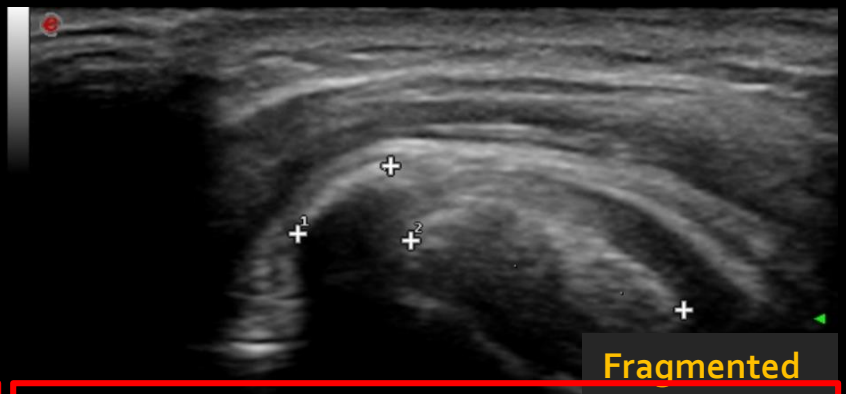
US

	Pain	Calcific Phase
Arc	+	Formative Phase
Fragmented/Punctuate	++	Formative Phase
Nodular	+++	Resting Phase
Cystic	++++	Resorptive Phase

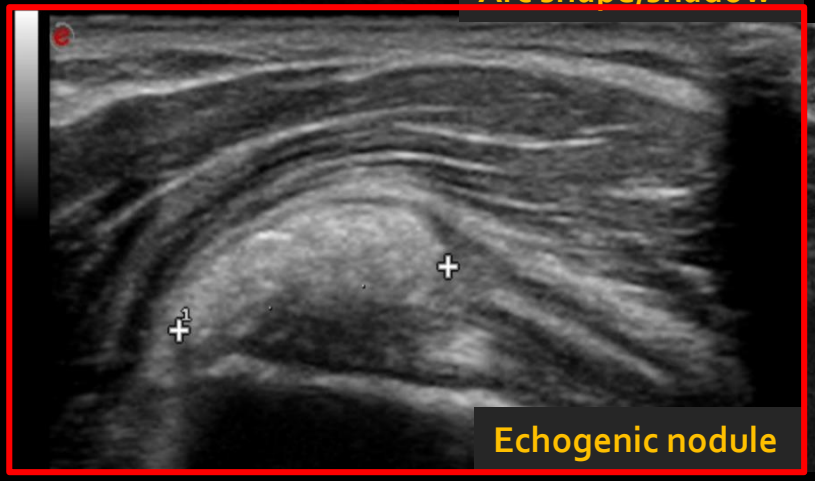
Chiou HJ et al. Rheumatology 2010;49:548-555



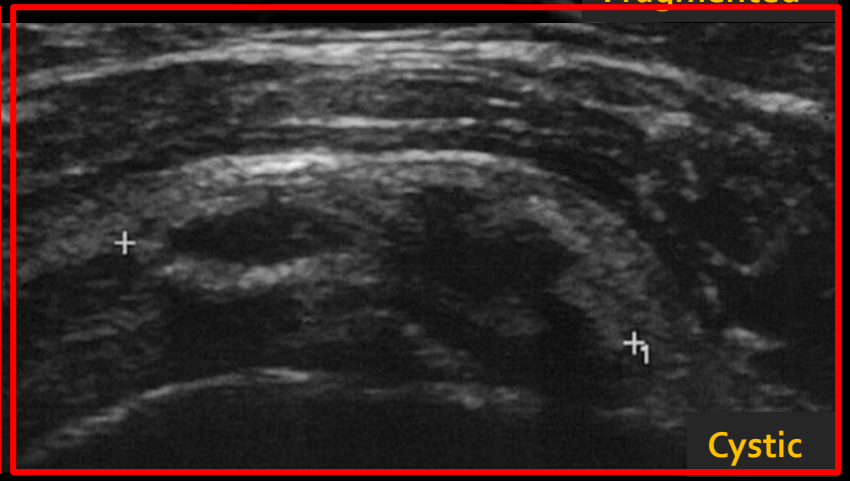
Arc shape/shadow



Fragmented

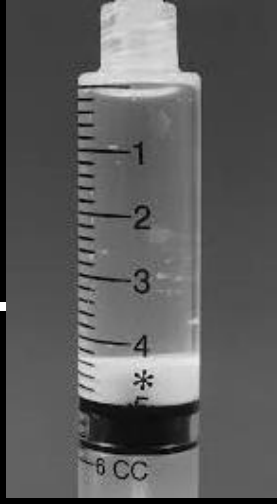


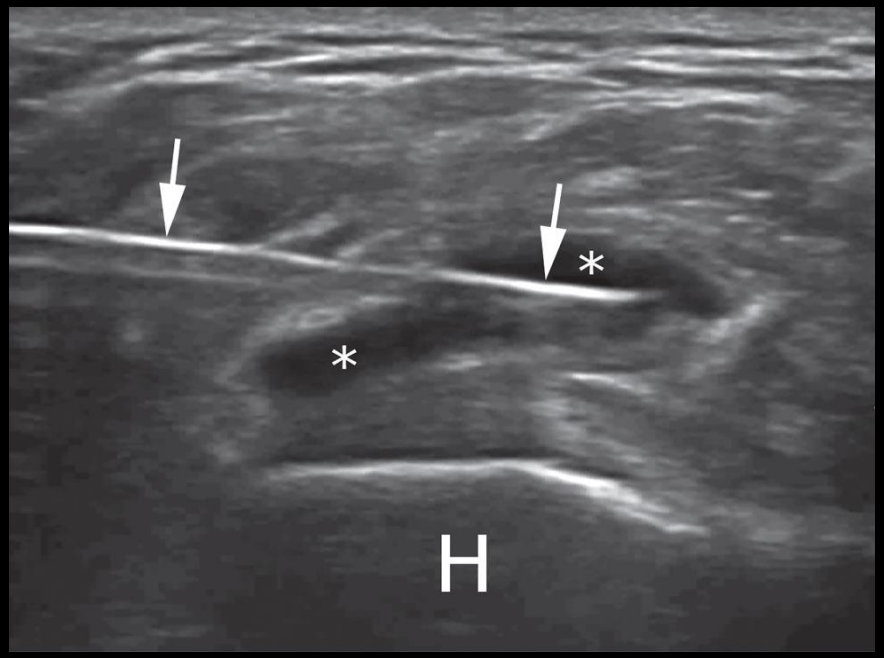
Echogenic nodule

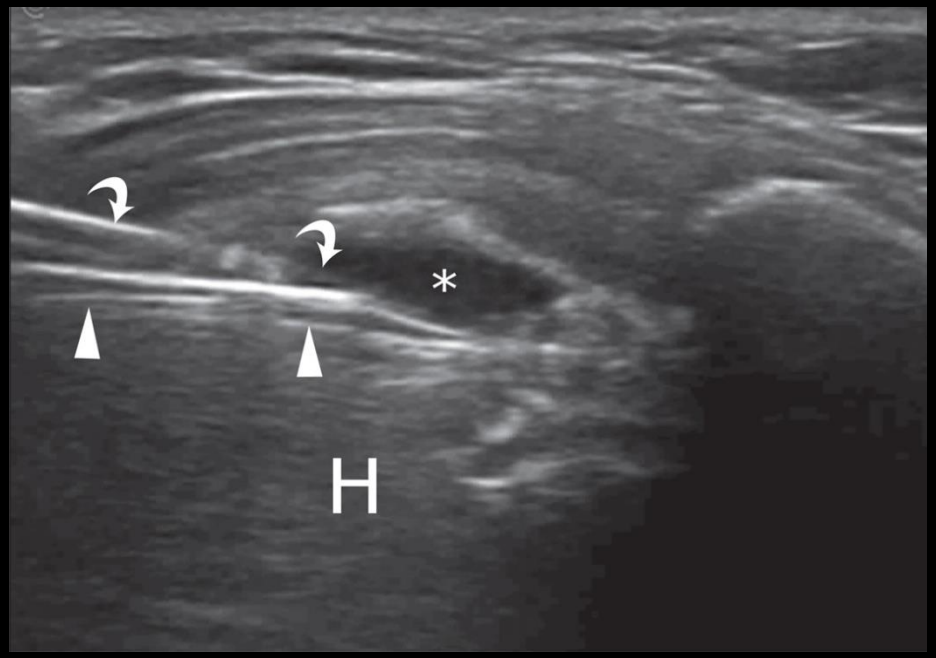


Cystic

RC calcific tendinopathy
Treatment (US-PICT)







Courtesy, Prof. Luca Sconfienza/Italy

Lanza E, et al. Eur Radiol 2015;25:2176-2183
Serafini G et al. Radiology 2009;252:157-164

Adhesive Capsulitis

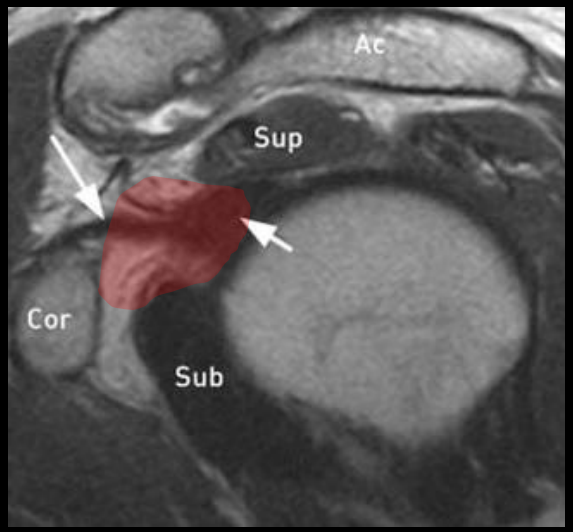
- Synovial inflammation
- Pain, restriction of range of movements
- females, 40-60 y

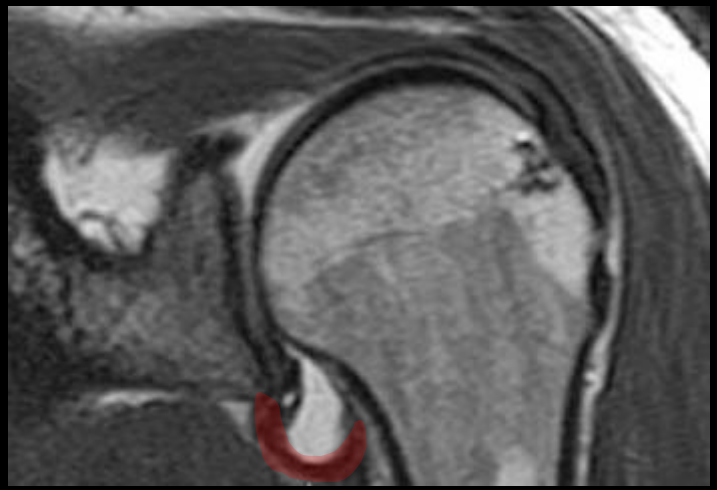
Causes

- Idiopathic
- Trauma, microtrauma
- Hormonal imbalance
- Rheumatic disease

Curr Rev Musculoskelet Med 2008;1: 180-189

Adhesive Capsulitis
Location





RC interval

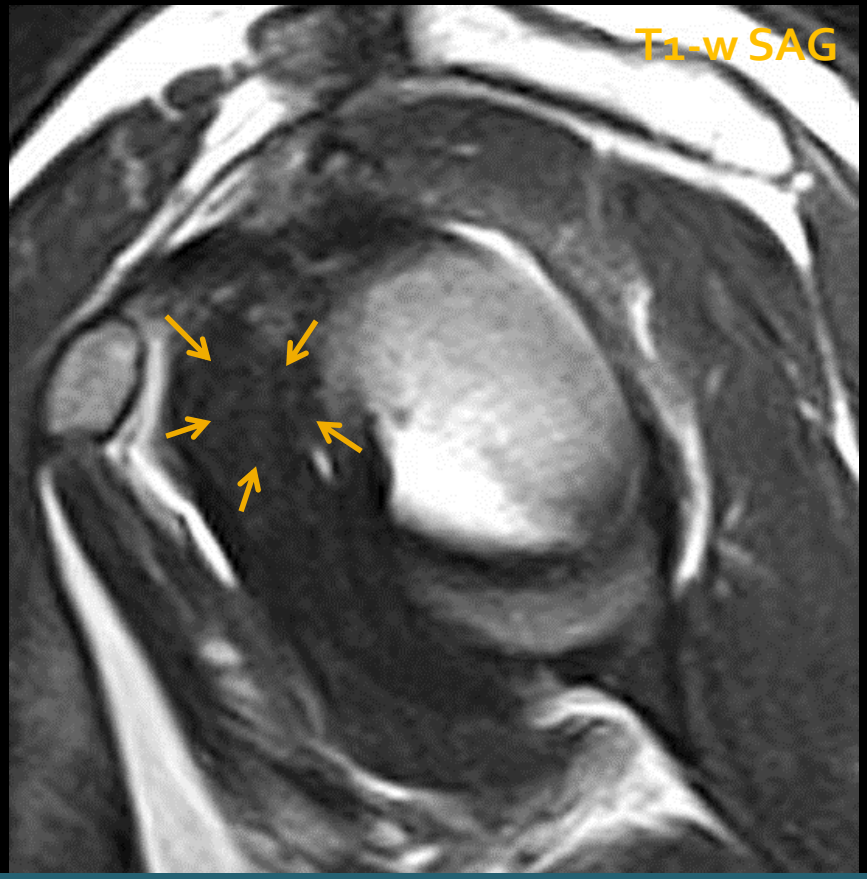
- SSP
- SSC
- Coracoid
- SGHL
- CHL

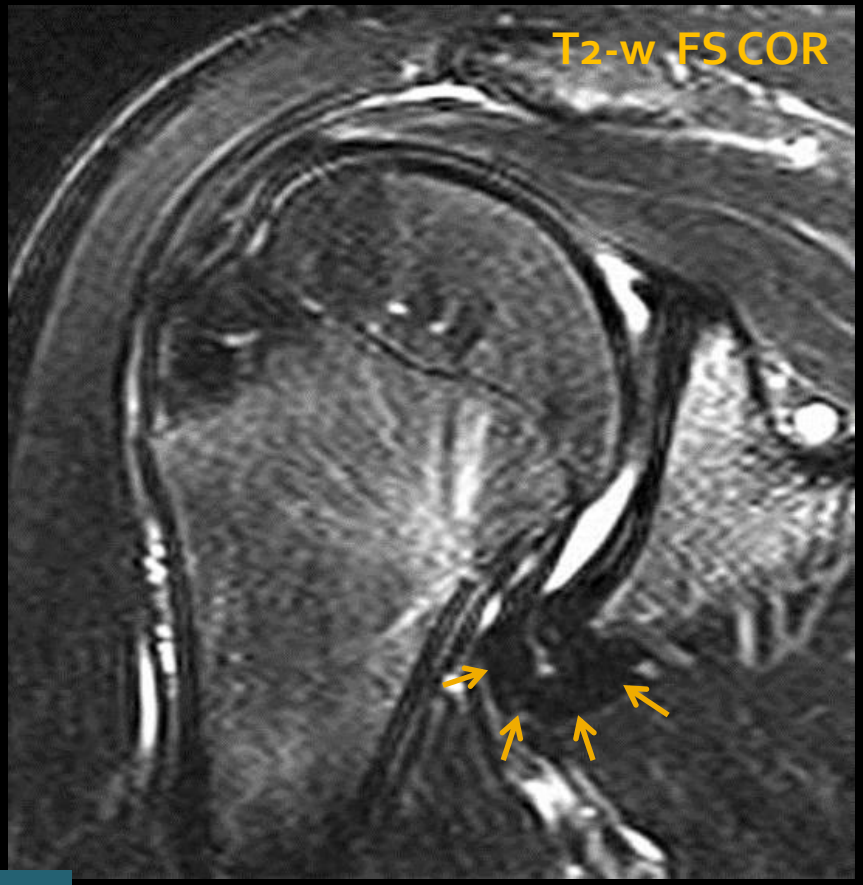
} Rotator interval capsule

- Long head biceps

Axillary recess

- IGHL
- Capsule





Imaging

Identify etiology

MRI/MRA

- Loss of fat in RC interval
- IGHL thickening (>4mm)
- RC interval/axillary pouch enhancement

Mengiardi B et al. Radiology 2004;233:486-92
Connell D et al. European Radiology 2002;12:2100-6

Postero-superior (internal) impingement

Definition

- Pain during extreme arm external rotation in abduction
  - overhead activities

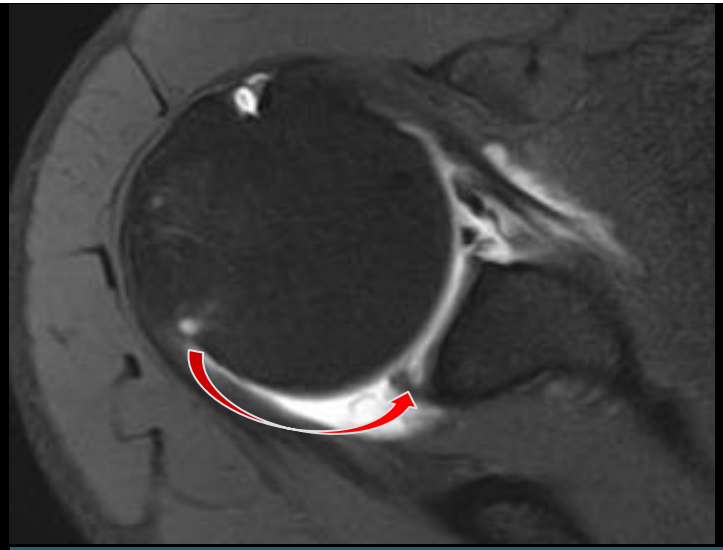
Pathophysiology

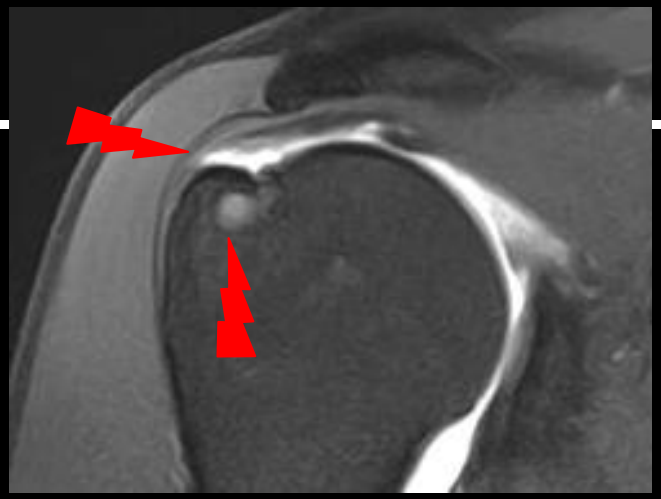
- Tight posterior GH capsule
  - posterior capsular hypertrophy => limitation of internal rotation => compromised function of the IGHL => increased risk for impingement during throwing
- Scapular dyskinesis

Giaroli EL et al. American Journal of Roentgenology AJR 2005;185:925-929

Postero-superior impingement

Imaging





Elite volley ball player, 26y

Imaging

MRA/MRI

- subcortical cysts bare area HH
- fraying/tears of postero-superior labrum
- partial tears in posterior RC
- posterior capsular thickening

Swimming, water-polo, Javelin, Volleyball, tennis

Tirman PF et al. Radiology 1994;193:431-6
Mulyadi E et al. Clin Radiol 2009;64:307-18
Giaroli EL et al. American Journal of Roentgenology AJR 2005;185:925-929

Suprascapular nerve syndrome

Causes

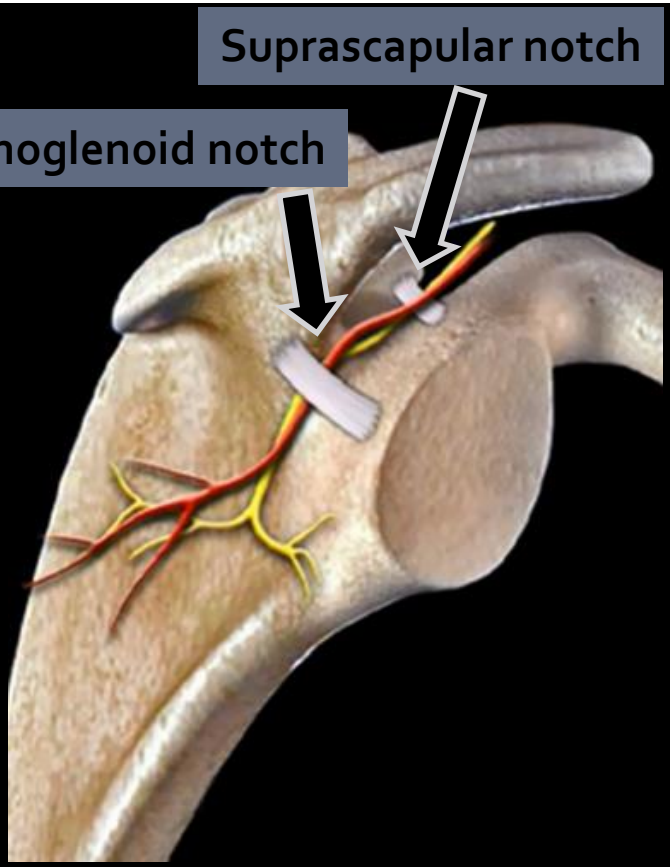
- space occupying lesions
  - ganglia, paralabral cysts, tumors
- trauma
  - direct trauma
  - traction injury (overhead activities)

Symptoms

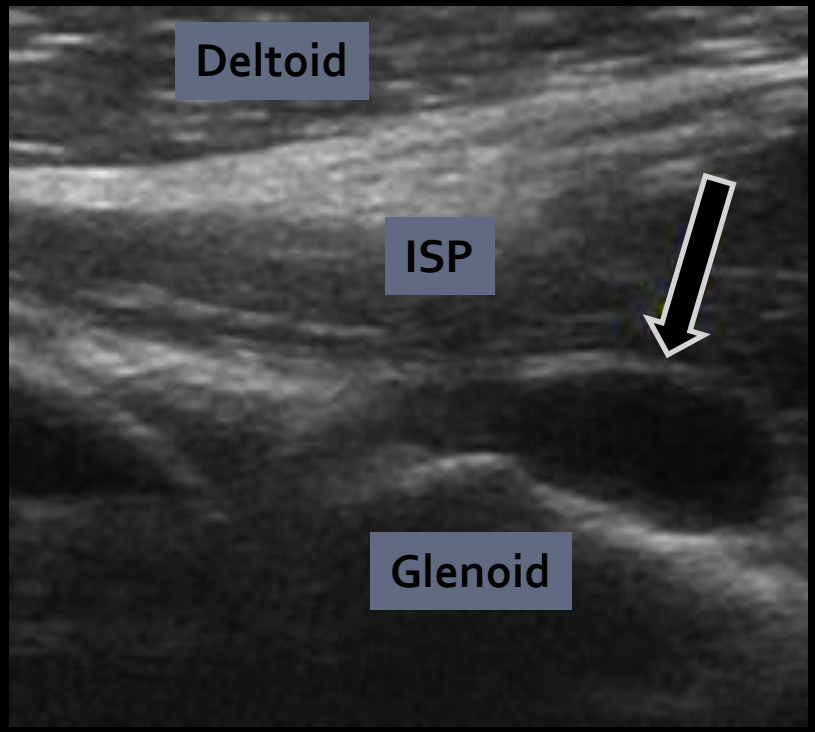
- SSP/ISP weakness
- Atrophy/pain along posterior scapula

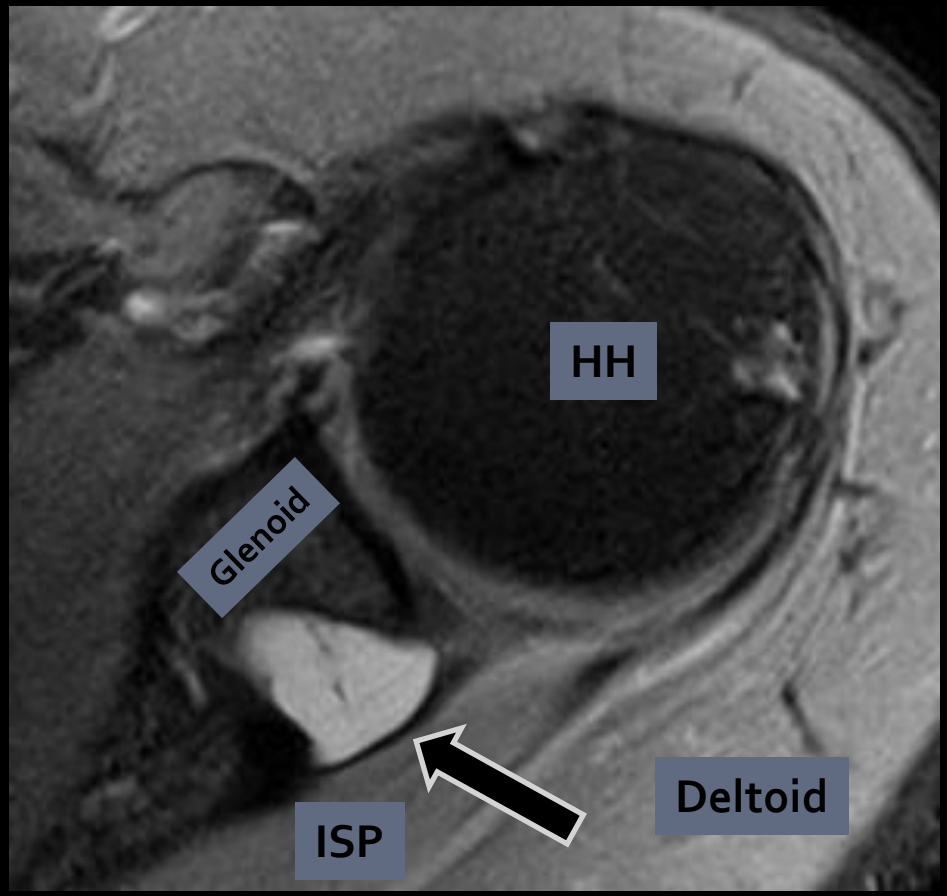
Investigation

- MRI/US
  - identify the cause
  - muscular denervation (SSP/ISP)
- EMG



Linda DD, et al. Radiographics 2010;30:1373-1400


Deltoid
ISP
Glenoid


HH
Glenoid
ISP
Deltoid

Conclusion

- Anatomy
- Pathophysiology
  - Intrinsic/extrinsic theory
- Imaging investigation
  - MRI
  - US
- Mimickers
  - RC calcific tendinopathy
  - Adhesive capsulitis
  - Postero-superior impingement
  - Suprascapular nerve syndrome

Imaging findings	MRI	US	MRA
SASD bursitis	+++	+++	-
Complete RC tears	+++	+++	+++
Partial RC tears	++	+++	+++
Muscle fatty degeneration	+++	++	+
Anatomical factors	+++	+	+++
Dynamic evaluation	-	+++	-


Thank you!