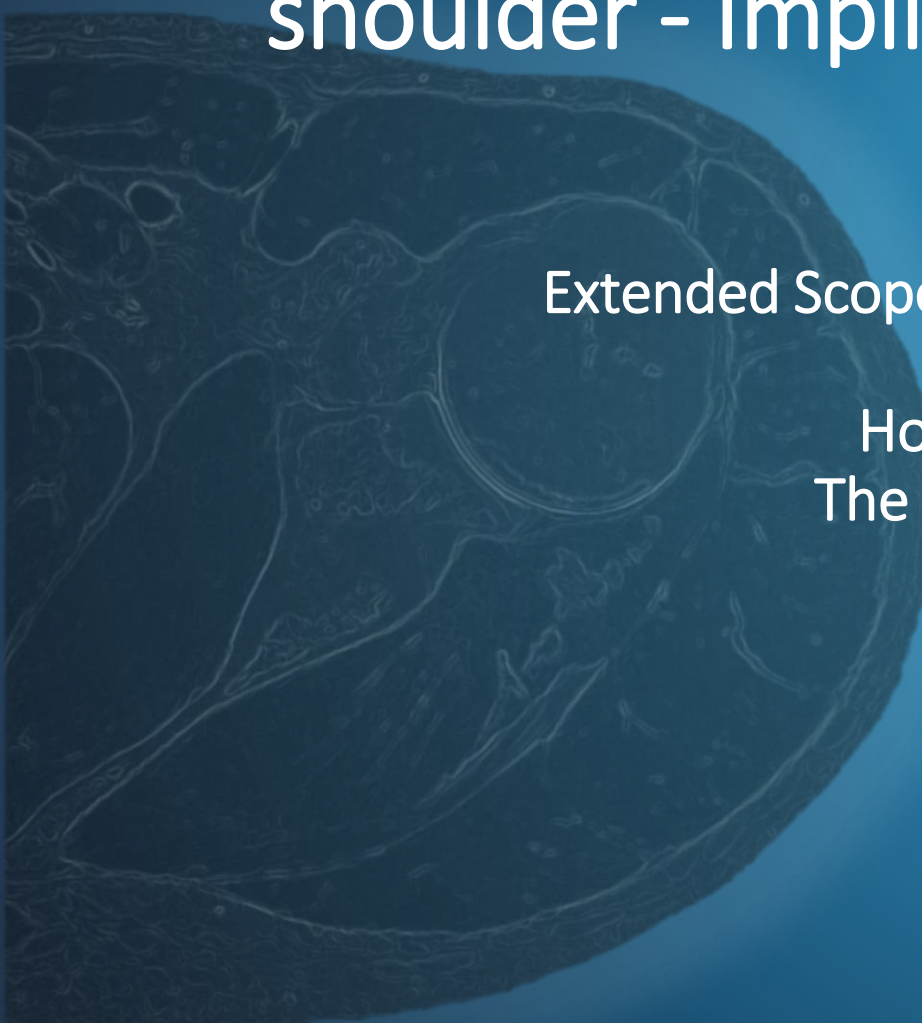


Clinical reasoning and ultrasound imaging of the shoulder - Implications for the patient journey

Stuart Wildman
Extended Scope Physiotherapist and MSK Sonographer

Homerton University Hospital
The Royal Surrey County Hospital

13th April , Odense

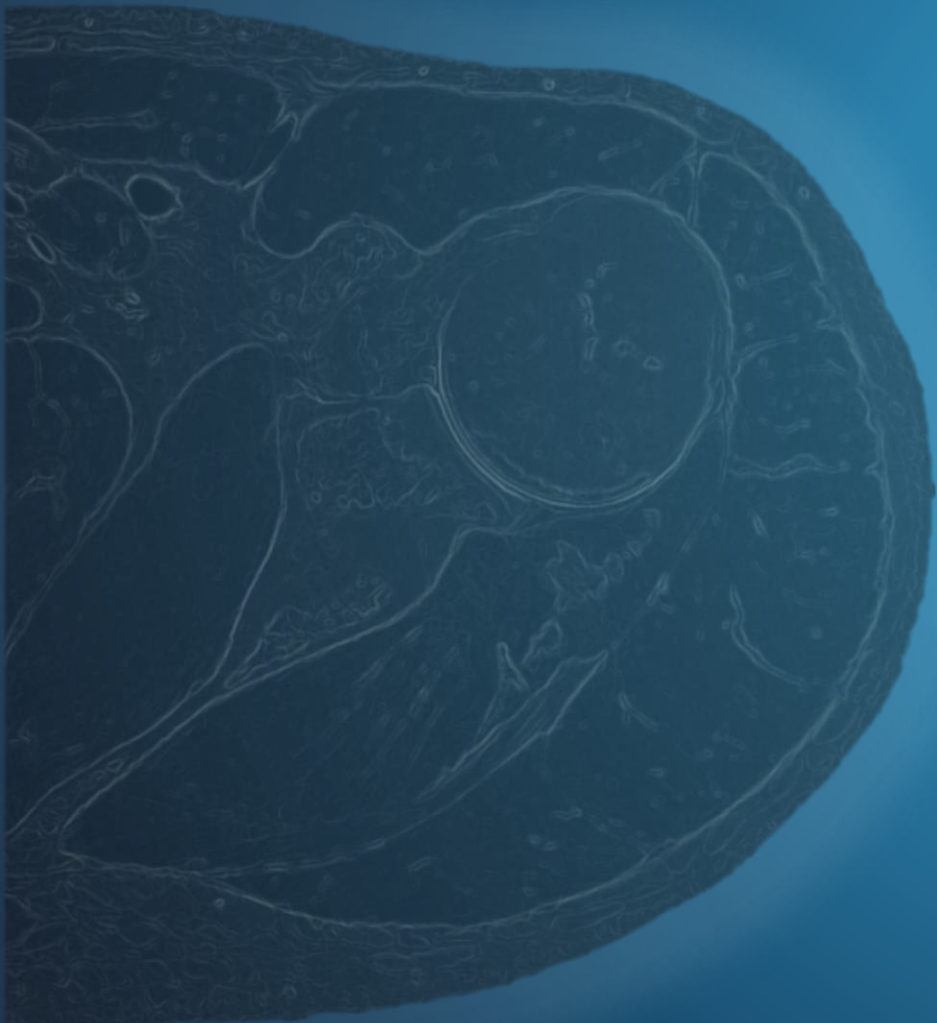


Stuart Wildman

Extended Scope Physiotherapist and MSK Sonographer



- Extended Scope Physiotherapist and Musculoskeletal Sonographer at Homerton Hospital since 2008, Radiology list x2 at Royal Surrey County Hospital.
- PG Cert/CASE MSK Ultrasound
- Represent Chartered Society of Physiotherapy on CASE committee for ultrasound education in the UK.
- Member of the Exec committee for ACPOMIT (Association of Chartered Physiotherapists in Orthopaedic Medicine and Injection Therapy) and EPADU (Electrophysical and Diagnostic Agents SIG)
- Founder and Director of The Ultrasound Site Ltd



How many of you use
diagnostic ultrasound
around the shoulder?

Why are we all here?

Trying to make sense of the role of US for shoulder complaints..

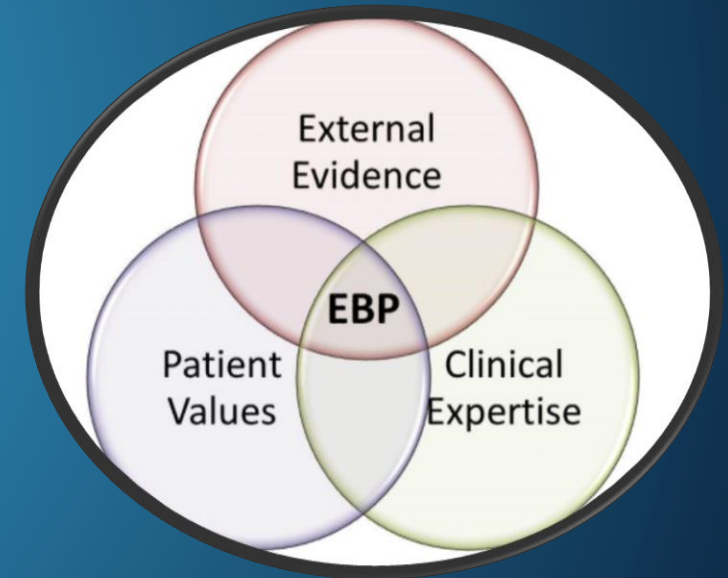


How are we using imaging as part of patient management?

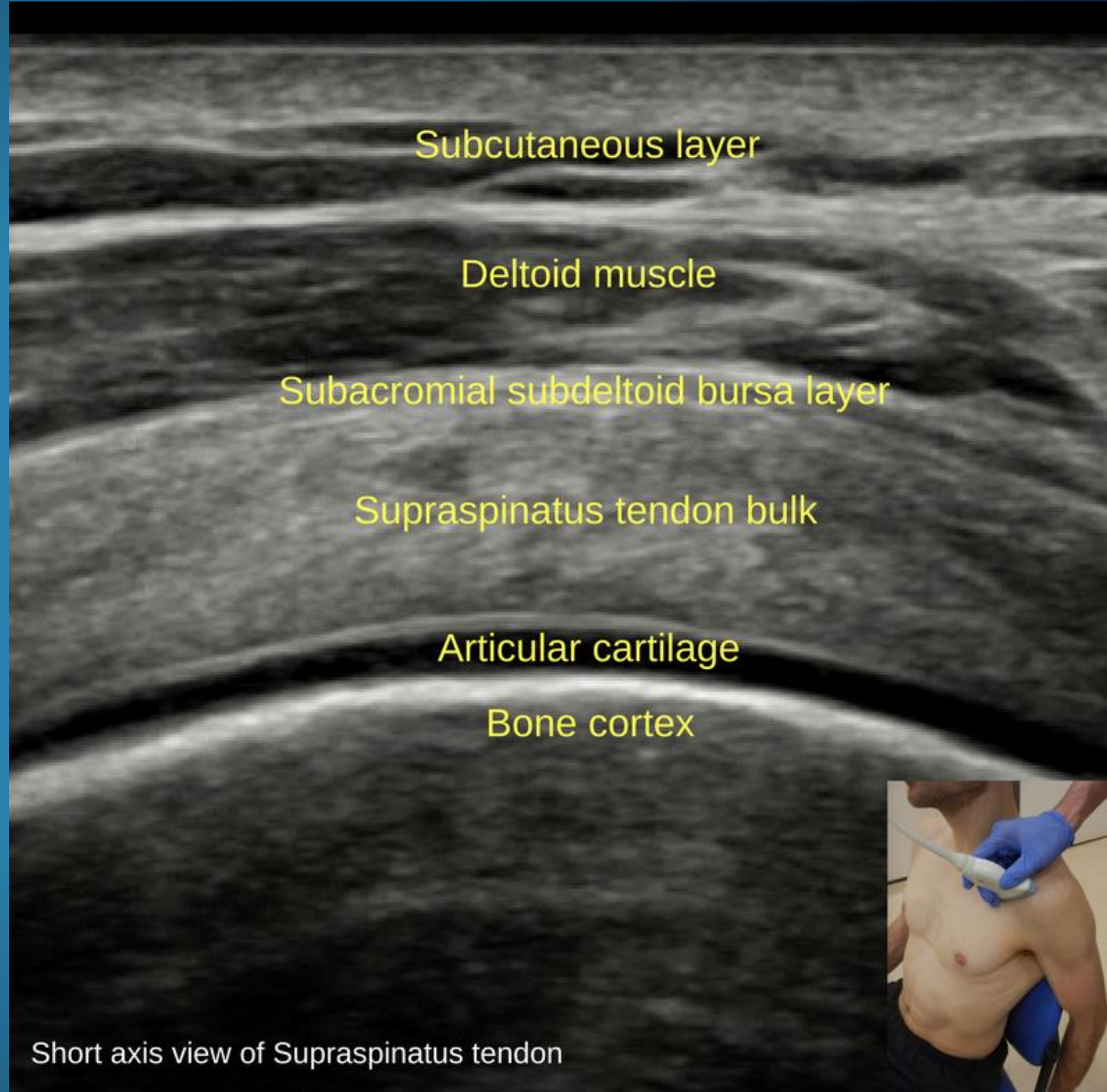
Are we using imaging appropriately?

How is it impacting patient management?

Lots of questions to be answered!



What can we see on ultrasound around the shoulder region?



Subcutaneous layer

Deltoid muscle

Subacromial subdeltoid bursa layer

Supraspinatus tendon bulk

Articular cartilage

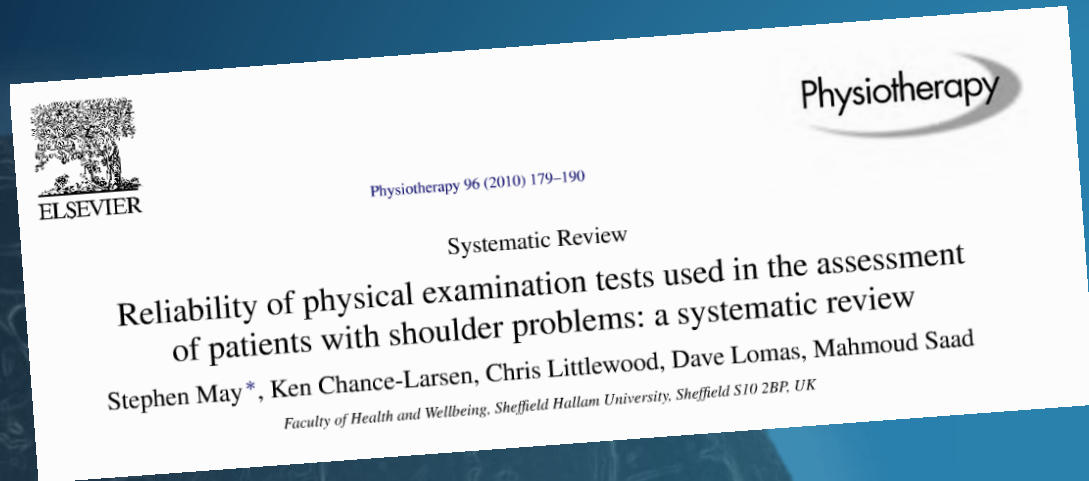
Bone cortex



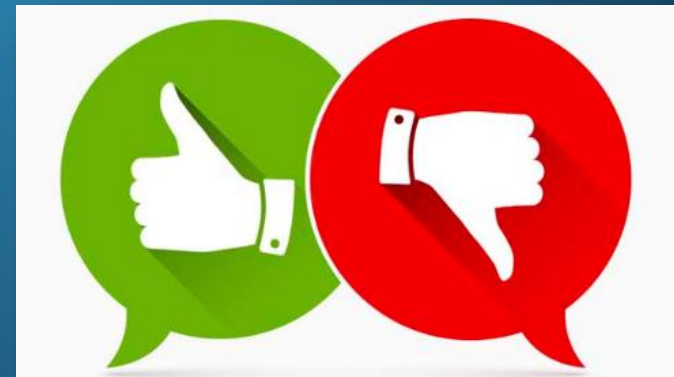
Short axis view of Supraspinatus tendon

Clinical challenge... 'diagnosis'

Easy answer over here?!



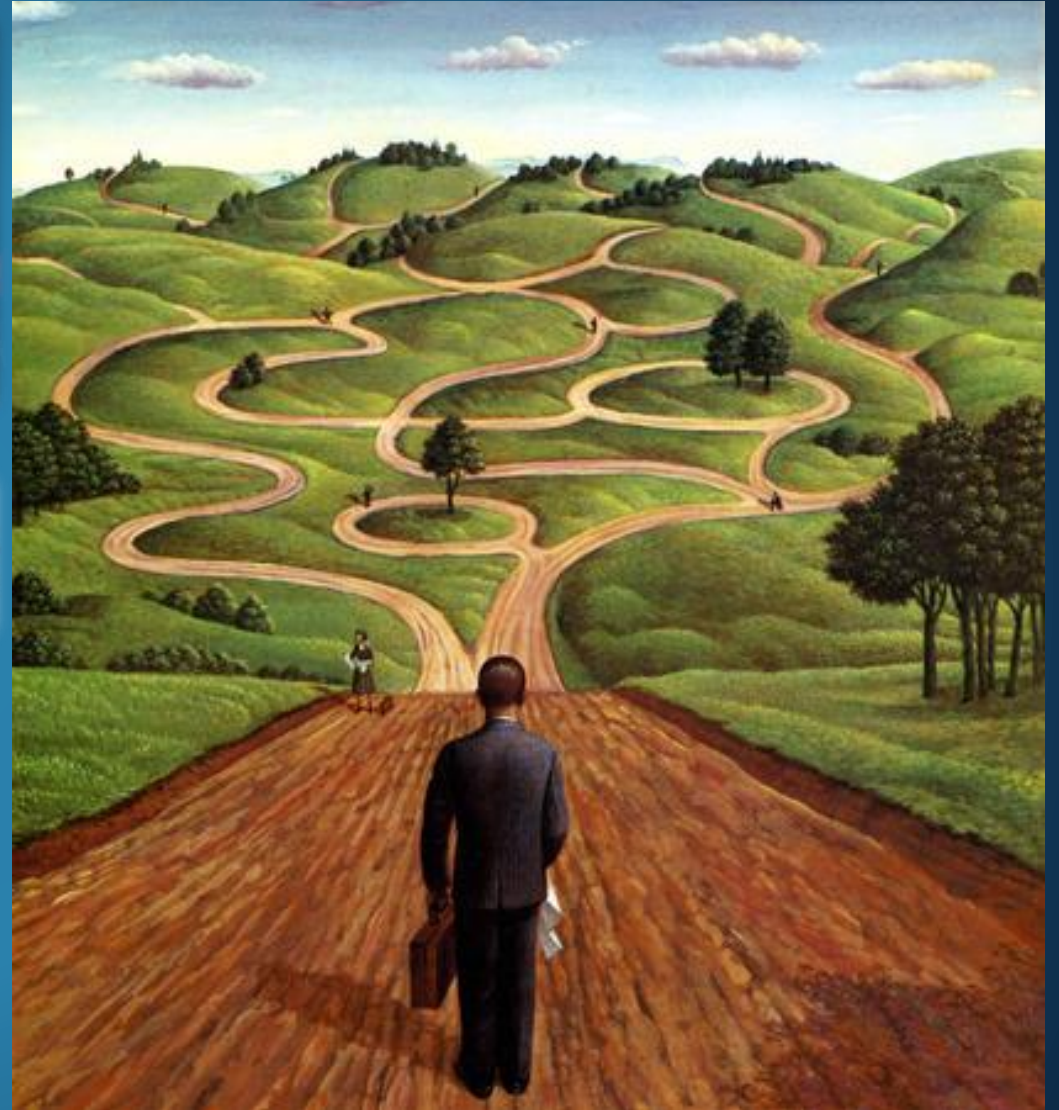
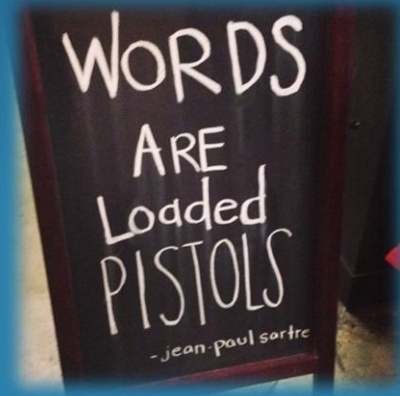
'No consistent evidence that any examination procedure used in shoulder assessments has acceptable levels of reliability'



The shoulder pain patient journey is never simple..

Previous beliefs, experiences, and being informed of multiple and often conflicting 'diagnoses' can impact your encounter with the patient!

Consider the person as a whole!



OPEN ACCESS

Psychological factors are associated with the outcome of physiotherapy for people with shoulder pain: a multicentre longitudinal cohort study

Rachel Chester,^{1,2} Christina Jerosch-Herold,¹ Jeremy Lewis,³ Lee Shepstone⁴

RACHEL CHESTER^{1,2}, CHRISTINA JEROSCH-HEROLD¹, JEREMY LEWIS³, LEE SHEPSTONE⁴

What does it add to the discussion?

Shoulder Ultrasound

- Tempelhof et al (1999) - 23% of 411 volunteers had rotator cuff tears. Increasing frequency with age.
- Girish et al (2011)
- Avg age 56.
- Approx 50 shoulders
 - SASD bursal thickening (78%), ACJ OA (65%), Supraspinatus tendinosus (39%)

What is the prevalence of imaging-defined intra-articular hip pathologies in people with and without pain? A systematic review and meta-analysis

Joshua J Heerey,¹ Joanne L Kemp,¹ Andrea B Mosler,² Denise M Jones,¹ Tan Richard B Souza,³ Kay M Crossley¹

Is finding asymptomatic pathology a new thing?

Copyright 1990 by The Journal of Bone and Joint Surgery, Incorporated

Abnormal Magnetic-Resonance Scans of the Lumbar Spine in Asymptomatic Subjects

A PROSPECTIVE INVESTIGATION*

BY SCOTT D. BODEN, M.D.†, DAVID O. DAVIS, M.D.†, THOMAS S. DINA, M.D.†, NICHOLAS J. PATRONAS, M.D.‡, AND SAM W. WIESEL, M.D.§, WASHINGTON, D.C.

From the Departments of Orthopaedic Surgery and Radiology, George Washington University Medical Center, Washington

OsteoArthritis and Cartilage (2005) 13, 181–186
© 2004 OsteoArthritis Research Society International. Published by Elsevier Ltd. All rights reserved.
doi:10.1016/j.joca.2004.11.001

Osteoarthritis and Cartilage | **ICRS** International Cartilage Repair Society | **OARSI** OSTEOARTHRITIS RESEARCH SOCIETY INTERNATIONAL

Abnormalities identified in the knees of asymptomatic volunteers using peripheral magnetic resonance imaging¹

K. A. Beattie B.Sc.†, P. Boulos M.D., F.R.C.P. (C)‡, M. Pui M.D., F.R.C.P. (C)§, J. O'Neill M.D., F.R.C.P. (C)||, D. Inglis Ph.D.¶, C. E. Webber Ph.D.# and J. D. Adachi M.D., F.R.C.P. (C)‡

† Department of Medical Sciences, McMaster University, Hamilton, ON, Canada
‡ Department of Medicine, St. Joseph's Healthcare, McMaster University, Hamilton, ON, Canada
§ Department of Radiology, Hamilton Health Sciences, McMaster University, Hamilton, ON, Canada
|| Department of Radiology, St. Joseph's Healthcare, Hamilton, ON, Canada
¶ Department of Engineering, McMaster University, Hamilton, ON, Canada
Department of Nuclear Medicine, Hamilton Health Sciences, Hamilton, ON, Canada

FOOT & ANKLE INTERNATIONAL
Copyright © 2012 by the American Orthopaedic Foot & Ankle Society
DOI: 10.3113/FI.2012.0543

Prevalence of Interdigital Nerve Enlargements in an Asymptomatic Population

Panagiotis D. Symeonidis, MD, PhD; Lukas D. Iselin, MD, PhD; Neil Simmons, MD, MBBS; Shaun Fowler, MD, MBBS; George Dracopoulos, MBBS, FRACS; Peter Stavrou, MD, FRACS
Adelaide, Australia

Be aware of asymptomatic findings

- terminology, impact on treatment
- eg conservative/invasive

Rotator cuff related shoulder pain (RCSP)

Ultrasound findings and clinical impact

Bursal findings, rotator cuff tendon changes – defects, calcification.

Where does this leave us?

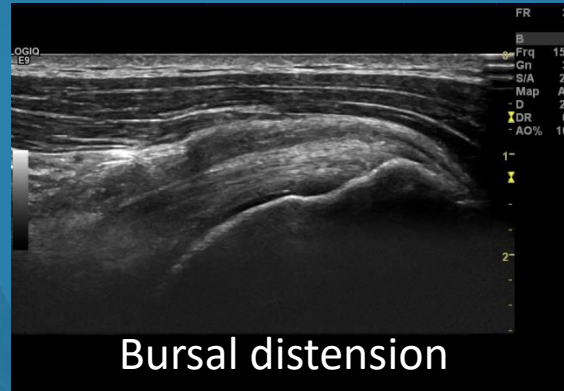
#keepitrelevant



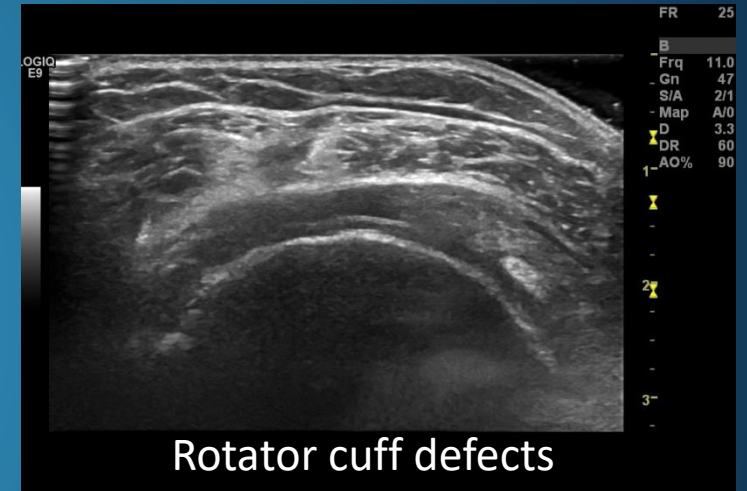
The painful shoulder and ultrasound findings.. What does it all mean?!



Calcific tendinopathy



Bursal distension



Rotator cuff defects

What contributes to it?



Tendon sheath/joint effusions

When is it significant?

Are there clinically significant US features?



Aims today...

- **INFORM** you on aspects you should consider to support best practice when using shoulder ultrasound – anecdotal, literature based and a balanced approach to a clinical scenario.
- **HIGHLIGHT** areas for future work, consideration and development
- **GET YOU THINKING ABOUT YOUR PRACTICE!**



Bursitis – How do we report it? How is thickness measured?

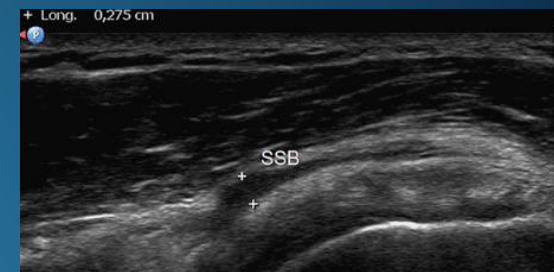
Original article

Assessment of calcific tendonitis of rotator cuff by ultrasonography:
Comparison between symptomatic and asymptomatic shoulders

Benoit Le Goff*, Jean-Marie Berthelot, Pascale Guillot, Joëlle Glémarec, Yves Maugars

Rheumatology Unit, Hôtel-Dieu, Nantes University Hospital, Nantes, France

Widest point in long and short axis, neutral arm position. Compared to contralateral side. Considered effusion/bursitis if 2mm+



Original research

The relationship between subacromial bursa thickness on ultrasound and shoulder pain in open water endurance swimmers over time



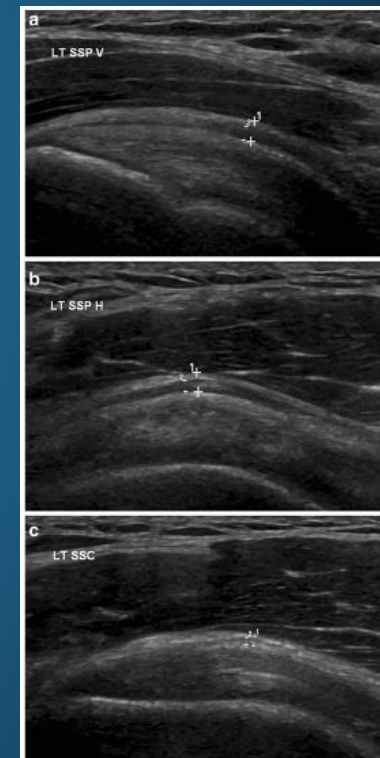
G. Couanis^{a,*}, W. Breidahl^b, S. Burnham^c

^a Sport Exercise Movement, Australia

^b Perth Radiology Clinic, Australia

^c CSIRO, Preventative Health Flagship, Mathematics, Informatics and Statistics, Australia

Bursa thickness was measured in the longitudinal plane of supraspinatus.



Probe perpendicular to humeral head.

On each view the maximal depth of fluid in the bursa (represented by a hypoechoic/anechoic stripe) was identified and measured

Dynamic ultrasound of the subacromial–subdeltoid bursa in patients with shoulder impingement: a comparison with normal volunteers

Ahmed A. Dagher · Paul A. Sookur · Sachit Shah · Martin Watson

What is shoulder bursitis?



THEULTRASOUNDSITE
PASSION • DEDICATION • INNOVATION

How would you report this bursa? Normal or abnormal?



What is normal and abnormal?

EXTENDED REPORT

Standard reference values for musculoskeletal ultrasonography

W A Schmidt, H Schmidt, B Schicke, E Gromnica-Ihle

Ann Rheum Dis 2004;63:988-994. doi: 10.1136/ard.2003.015081

Range of Normal and Abnormal Subacromial/Subdeltoid Bursa Fluid

Eric A. White, MD,*† Mark E. Schweitzer, MD,† and Andrew H. Haims, MD§

Bursa extends from (medially) the coracoid to (laterally) approx 3cm below greater tuberosity

Normal appearance as a thin uniform 0-2mm hypoechoic layer of fluid or synovium surrounded by hyperechoic bursal wall and peribursal fat layers.

Some fluid reported in 5-85% of cases mean 0.5mm (range 0.1-2.7mm) Rarely asymptomatic if >3mm (Schmidt et al 2004, White et al 2006, Tsai et al 2006)

Eric White et al (2006) concluded that normal bursal fluid rarely measured over 2 mm and tended to be located more posteriorly. Their study concluded that fluid in its excess of 3 mm would be highly suspicious of pathology especially if medial to the ACJ and when fluid is seen in the bursa anterior to the humerus.



Do bursal appearances correlate with pain?

- Bursal gathering/bunching on active abduction movement does not correlate with pain (Daghir et al, 2012).
- Tsai (2006) found increased bursal thickness in the symptomatic side compared to asymptomatic
- Significant association between bursal thickening and pain (Le Goff et al 2010)
 - 17 of 57 (29%) symptomatic shoulders but in none of the asymptomatic shoulders.
- Couanis et al (2014) endurance swimmer's changes in bursal thickening indicates the bursa normally thickens in response to 'load' or friction therefore acute changes in bursal thickness are different from chronic changes and that bursa are likely to be thicker in more active individuals

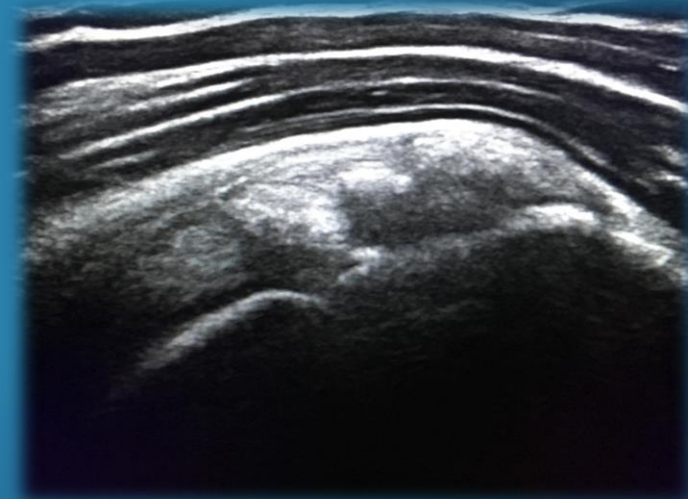
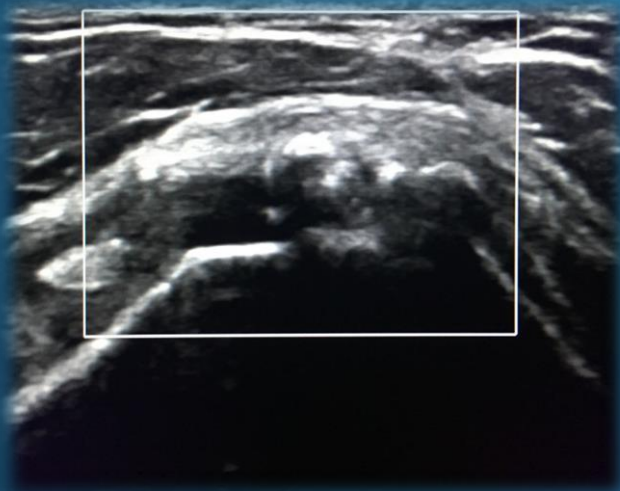


How can we determine if bursal distension is isolated or related to other findings? Impact on relevance of findings..
E.G Bursal thickening and related to cuff defect or joint effusion.



What does calcification on ultrasound actually look like?


- Calcific deposit is seen as a hyperechoic focus, with or without posterior acoustic shadowing (Louwerens et al, 2015)
- Echogenic focus with or without posterior acoustic shadowing (Sansone et al, 2015)



Calcific RC tendinopathy...how common is it in shoulders?

- 17.3% had calcification on ultrasound, in a sample of 604 female shoulders (Sansone et al, 2015)
- 21.5% had calcification on radiographs, in a sample of 1219 shoulders (Lowerens et al, 2015)

J Shoulder Elbow Surg (2015) ■, 1-6



ELSEVIER

JOURNAL OF
SHOULDER AND
ELBOW
SURGERY

www.elsevier.com/locate/ymse

Prevalence of calcific deposits within the rotator cuff tendons in adults with and without subacromial pain syndrome: clinical and radiologic analysis of 1219 patients

Jan K.G. Louwerens, MD^{a,*}, Inger N. Sierevelt, MSc^a, Ruud P. van Hove, MD^b, Michel P.J. van den Bekerom, MD^c, Arthur van Noort, MD PhD^b

Calcification present in 42.5% of symptomatic shoulder and 7.8% of asymptomatic shoulder
Significant correlation between calcification and pain

MORE PREVALENT IN SYPTOMATIC SHOULDERS – RELEVANCE?



THEULTRASOUNDSITE
PASSION • DEDICATION • INNOVATION

Calcific rotator cuff tendinopathy

– US appearances and the relevance...

DOES SIZE MATTER?!

- Sig. difference in the median size of the deposit between the asymptomatic (0.42 cm) and the symptomatic group (1.16 cm) (Louwerens et al, 2015).
- Symptomatic shoulder calcifications significantly larger than asymptomatic (Aina et al, 2001)
- No relationship between pain and dimensions of the calcification (Sansone et al, 2015)...small calcifications (with a diameter <1 cm) do not correlate with shoulder pain.

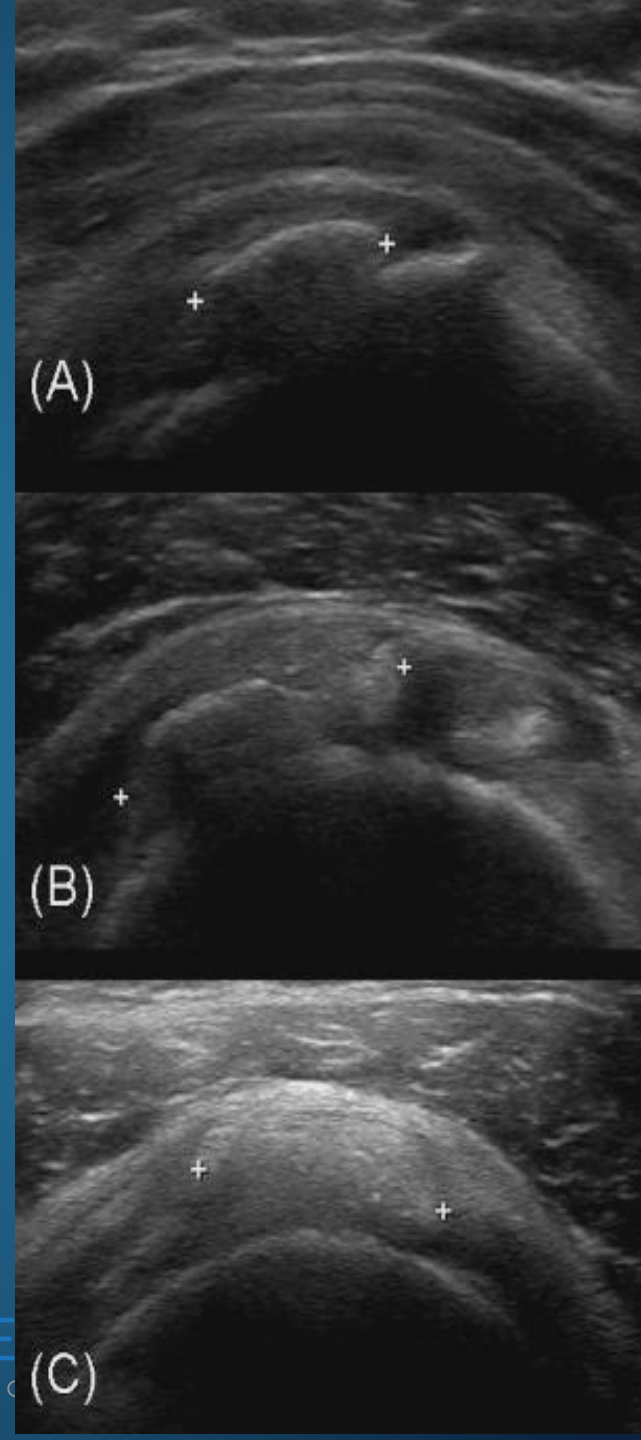
BUT.....

THE APPEARANCE..

- Fragmented or punctate plaques (B) were significantly more frequent in symptomatic shoulders than in asymptomatic shoulders. (Le Goff et al, 2010) and spontaneous resolution (Chiou et al, 2001).

BUT.....

- No aspect of morphology was correlated to pain (Sansone et al, 2015)



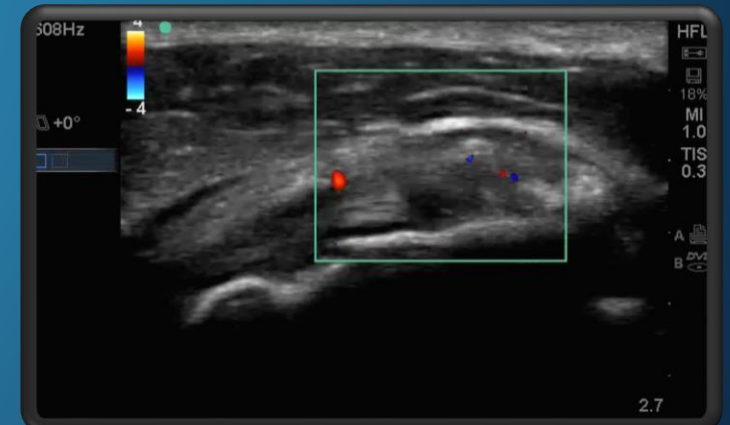
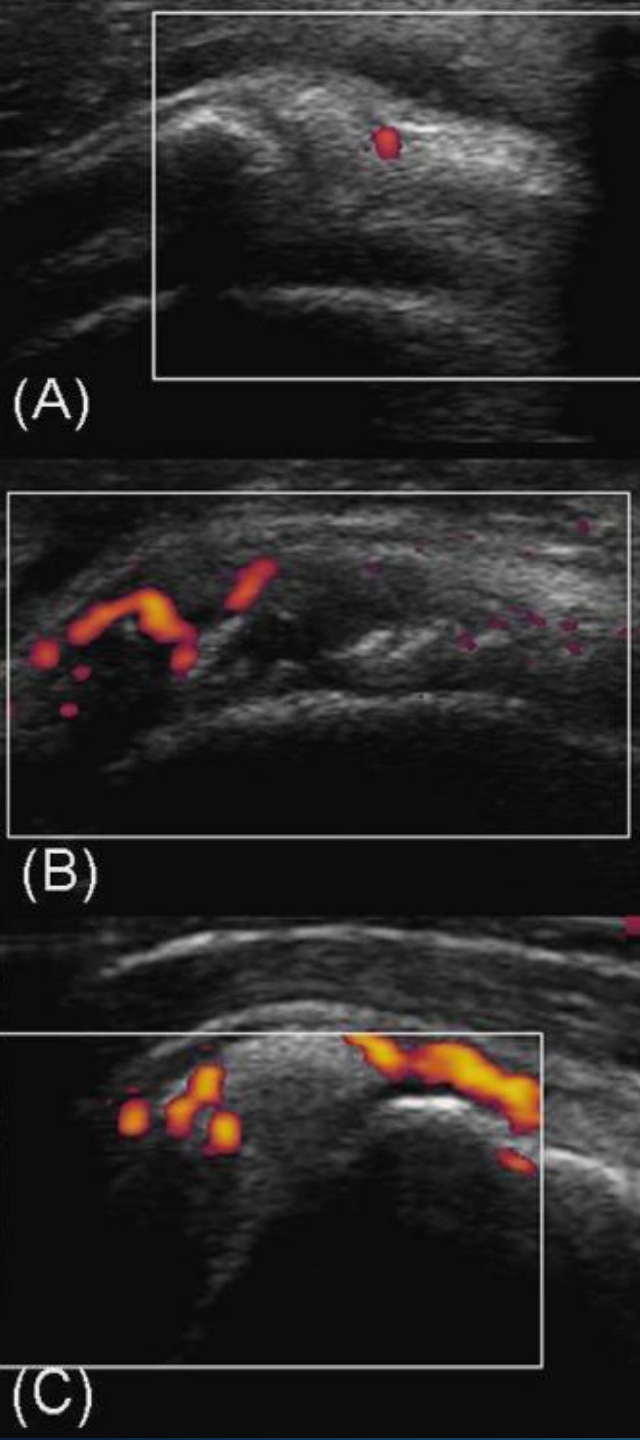
Can doppler play a role in determining the significance?

- +ve Power Doppler signals were obtained for 21 of the 57 symptomatic shoulders (36%), 6 grade 1(a/29%), 10 grade 2 / (b/48%), 5 grade 3 (c/23%) and for none of the 24 asymptomatic shoulder
- +ve Power Doppler was associated with nocturnal pain and more common in larger calcifications

	Power Doppler positive (n = 21)	Power Doppler negative (n = 36)	p value
Mean VAS score (mm)	58	54	NS
Mean onset of pain (month)	8	19	0.04
Nocturnal pain	16 (76%)	16 (44%)	0.03
Morphology			
Arc-shaped	4 (19%)	11 (31%)	NS
Fragmented	14 (67%)	21 (58%)	NS
Nodular	3 (14%)	4 (11%)	NS
Longitudinal size (cm)	1.93	1.46	0.03
Transverse size (cm)	1.49	1.33	NS
Bursal thickening	7 (33%)	10 (28%)	NS

Statistically significant results appear in bold.

Le Goff et al (2010)



Is the doppler related to the calcification?

BMC Musculoskeletal Disorders



Research article

Open Access

The prevalence of neovascularity in patients clinically diagnosed with rotator cuff tendinopathy

Jeremy S Lewis*^{1,2,3}, Syed A Raza⁴, James Pilcher⁴, Christine Heron⁴ and Jan D Poloniecki⁵

‘This study demonstrated that neovascularity does occur in subjects with a clinical diagnosis of rotator cuff tendinopathy and to a lesser extent in asymptomatic shoulders. In addition, the findings of this investigation did not identify an association between the presence of neovascularity; and pain, duration of symptoms or shoulder function.’

Is doppler related to underlying tendinopathy??

RED HERRING ALERT



THERE'S SOMETHING FISHY GOING ON!

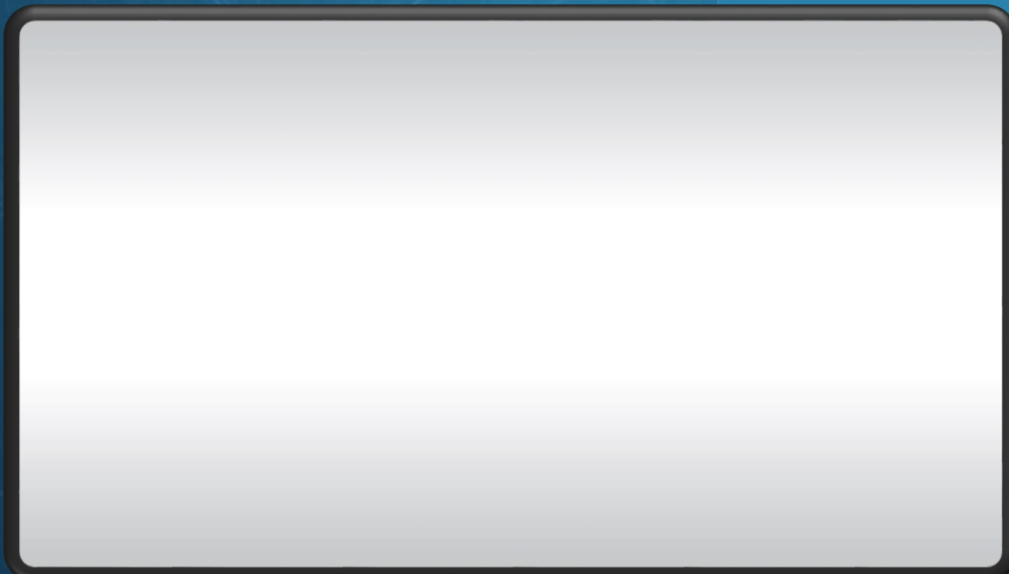


THEULTRASOUNDSITE

PASSION • DEDICATION • INNOVATION

Can we correlate dynamic ultrasound findings and pain reproduction?

- Appears no evidence supporting or refuting this aspect
- Can we modify movement patterns and correlate?
- Anecdotal experience....



Can we accurately diagnose rotator cuff defects using ultrasound?

Clinical Radiology 66 (2011) 1036–1048

Contents lists available at ScienceDirect

Clinical Radiology

journal homepage: www.elsevierhealth.com/journals/crad



ELSEVIER



Original Paper

Diagnostic accuracy of ultrasound for rotator cuff tears in adults: A systematic review and meta-analysis

T.O. Smith^{a,*}, T. Back^b, A.P. Toms^c, C.B. Hing^d

^a Department of Physiotherapy, University of East Anglia, UK

^b Department of Physiotherapy, Norfolk and Norwich University Hospital, London, UK

^c Department of Radiology, Norfolk and Norwich University Hospital, London, UK

^d Department of Orthopaedic Surgery, St George's Hospital, London, UK



ELSEVIER

European Journal of Radiology 68 (2008) 174–179

EJR
EUROPEAN JOURNAL OF RADIOLOGY

www.elsevier.com/locate/ejrad

Ultrasonography of symptomatic rotator cuff tears compared with MR imaging and surgery

Anastasia N. Fotiadou^{a,c,1}, Marianna Vlychou^{a,2}, Periklis Papadopoulos^{b,3},
Dimitrios S. Karataglis^{b,4}, Panagiotis Palladas^{c,5}, Ioannis V. Fezoulidis^{a,*}

^a Radiology Department, University Hospital of Larissa, Mezourlo 41110, Larissa, Greece

^b University Orthopaedic Clinic, G. Papanikolaou Hospital, Exochi 32100, Thessaloniki, Greece

^c Radiology Department, G. Papanikolaou Hospital, Exochi 32100, Thessaloniki, Greece

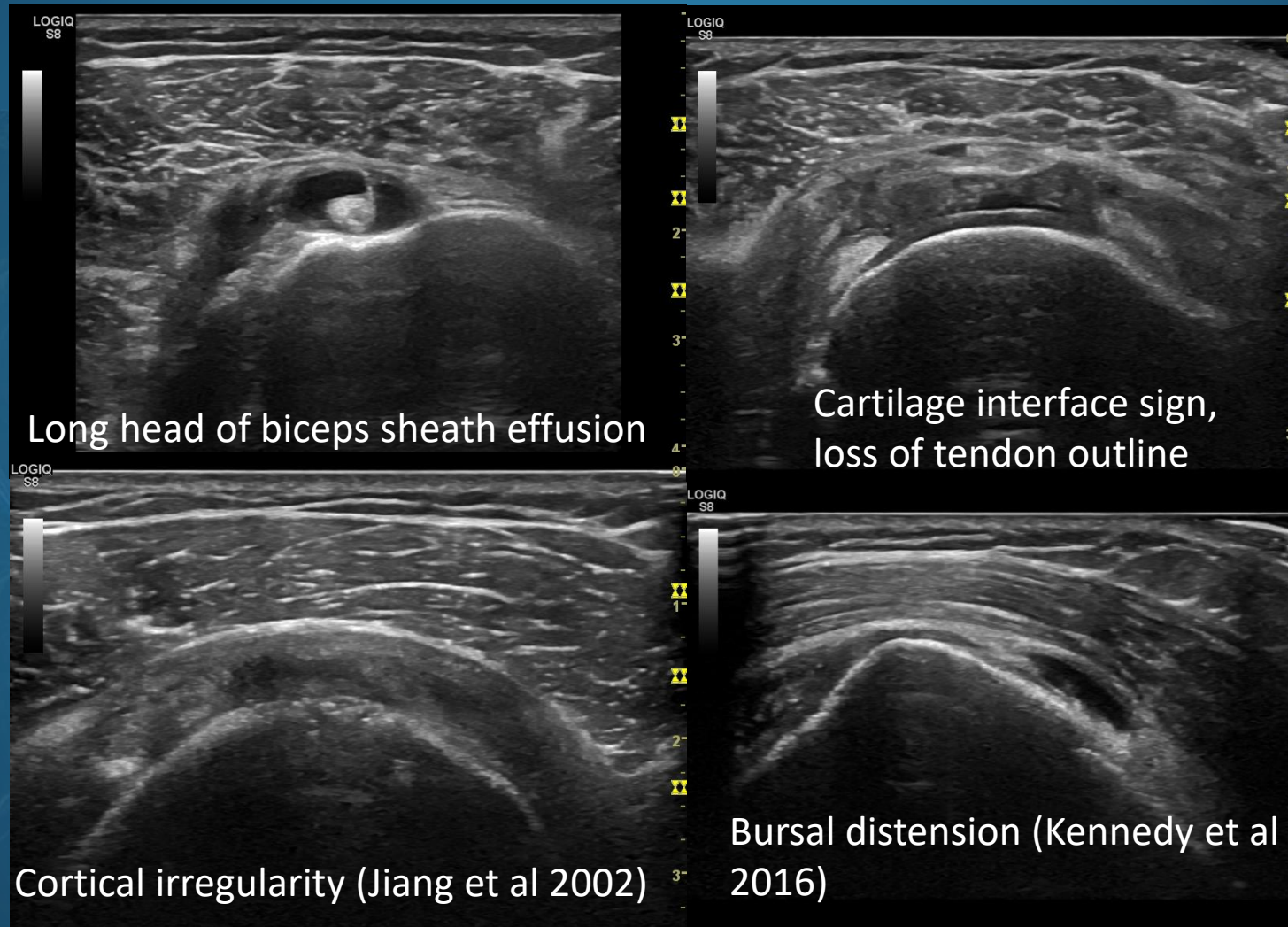
Received 22 May 2007; received in revised form 3 November 2007; accepted 6 November 2007

‘Sensitivity and specificity. The diagnostic test accuracy of ultrasound is superior for the detection of full-thickness compared to partial-thickness cuff tears. Further study assessing the effect of transducer frequency is warranted’
(Smith et al, 2011)



THEULTRASOUNDSITE
PASSION • DEDICATION • INNOVATION

Indirect signs of rotator cuff defects?



Prevalence of full thickness rotator cuff 'defects'

Original Article

Prevalence of symptomatic and asymptomatic rotator cuff tears in the general population: From mass-screening in one village

Hiroshi Minagawa^a, Nobuyuki Yamamoto^b, Hidekazu Abe^c, Masashi Fukuda^d,
Nobutoshi Seki^c, Kazuma Kikuchi^c, Hiroaki Kijima^c, Eiji Itoi^{b,*}

^aJoto Orthopedic Clinic, Akita, Japan

^bDepartment of Orthopaedic Surgery, Tohoku University School of Medicine, 1-1 Seiryō-machi, Aoba-ku, Sendai 980-8574, Japan

^cDivision of Orthopaedic Surgery, Department of Neuro and Locomotor Science, Akita University School of Medicine, Akita, Japan

^dMatsunami General Hospital, Gifu, Japan

664 residents, bilateral ultrasound on all participants (21.7% of the total pop.)

Symptomatic rotator cuff tears accounted for 34.7% of all tears and asymptomatic tears for 65.3%.

The prevalence of asymptomatic rotator cuff tears was one-half of all tears in the 50s, whereas it accounted for two-thirds of those over the age of 60.

J Shoulder Elbow Surg (2010) 19, 116-120



ELSEVIER

JOURNAL OF
SHOULDER AND
ELBOW
SURGERY

www.elsevier.com/locate/jymse

Prevalence and risk factors of a rotator cuff tear in the general population

Atsushi Yamamoto, MD*, Kenji Takagishi, MD, PhD, Toshihisa Osawa, MD, PhD,
Takashi Yanagawa, MD, PhD, Daisuke Nakajima, MD, Hitoshi Shitara, MD,
Tsutomu Kobayashi, MD, PhD

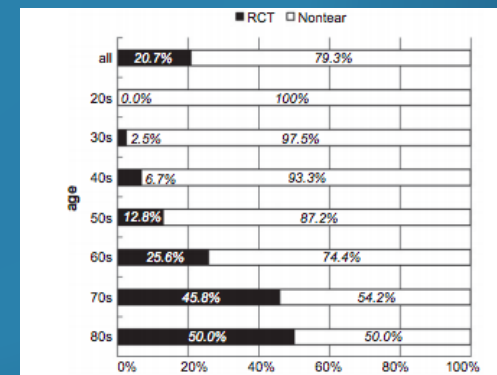


Figure 1 The percentage of the "RCT group" and "Nontear group" in each generation, the RCT group included of 20.7% of all subjects and the prevalence increased with age.

40s 6.7% and 93.3%
50s 12.8% and 87.2%
60s 25.6% and 74.4%



THE ULTRASOUNDSITE
PASSION • DEDICATION • INNOVATION



ELSEVIER

REVIEW ARTICLE

A systematic review and pooled analysis of the prevalence of rotator cuff disease with increasing age

Teun Teunis, MD, Bart Lubberts, BSc, Brian T. Reilly, BSc, David Ring, MD, PhD*

Orthopaedic Hand and Upper Extremity Service, Massachusetts General Hospital-Harvard Medical School, Boston, MA, USA

JOURNAL OF
SHOULDER AND
ELBOW
SURGERY

www.elsevier.com/locate/jymse



Are rotator cuff defects common in different populations?

- Abnormalities are more common with age in asymptomatic patients and in the general population, in symptomatic patients, and after shoulder dislocation.
- Abnormalities can therefore be difficult to isolate as the primary symptom generator.
- Future studies to determine the positive and negative predictive value of various diagnostic tests, **we need consensus on the reference standard for a symptomatic abnormality.**



THEULTRASOUNDSITE

PASSION • DEDICATION • INNOVATION

Do features of atraumatic FTT correlate with pain levels?

793

COPYRIGHT © 2014 BY THE JOURNAL OF BONE AND JOINT SURGERY, INCORPORATED

Symptoms of Pain Do Not Correlate with Rotator Cuff Tear Severity

A Cross-Sectional Study of 393 Patients with a Symptomatic Atraumatic Full-Thickness Rotator Cuff Tear

Warren R. Dunn, MD, MPH, John E. Kuhn, MD, MS, Rosemary Sanders, BA, Qi An, MS, Keith M. Baumgarten, MD, Julie Y. Bishop, MD, Robert H. Brophy, MD, James L. Carey, MD, MPH, G. Brian Holloway, MD, Grant L. Jones, MD, C. Benjamin Ma, MD, Robert G. Marx, MD, MS, Eric C. McCarty, MD, Sourav K. Poddar, MD, Matthew V. Smith, MD, Edwin E. Spencer, MD, Armando F. Vidal, MD, Brian R. Wolf, MD, MS, and Rick W. Wright, MD, on behalf of the MOON Shoulder Group

In conclusion, patients who present with shoulder pain without a history of an injury and with MRI evidence of a rotator cuff tear present a dilemma to physicians as the literature lacks high-level evidence to help us make decisions regarding appropriate treatment. In this large cross-sectional

393 subjects, Full thickness defect, atraumatic, 72% Supraspinatus
Median age 61.1 years old.

Greater pain associated with increased comorbidities, lower education and race.

Characteristics of the defect were not associated with pain levels



THEULTRASOUNDSITE
PASSION • DEDICATION • INNOVATION

What about younger patients? <40

Rotator cuff tears in young patients: a different disease than rotator cuff tears in elderly patients

Alexander L. Lazarides, BSc^a, Eduard Alentorn-Geli, MD, MSc, PhD, FEBOT^b, J.H. James Choi, MD^b, Joseph J. Stuart, MD^b, Ian K.Y. Lo, MD^c, Grant E. Garrigues, MD^b, Col. (ret) Dean C. Taylor, MD^{b,*}

^aSchool of Medicine, Duke University, Durham, NC, USA

^bDepartment of Orthopaedic Surgery, Duke Sports Sciences Institute, Durham, NC, USA

^cDepartment of Surgery, University of Calgary, Calgary, AB, Canada

Young adults <40 often related to either trauma and full thickness defect or elite throwing populations with partial thickness tears from chronic overuse.

Delayed management of acute, full thickness tears can lead to tendon retraction, atrophy of muscles and poor surgical outcomes (Lazarides et al, 2015)



Lets lead the way and be careful in our approach...

“Atraumatic rotator cuff defects are commonly referred to as tears, but if rotator cuff thinning is part of the normal aging process, the word ‘tear’ which implies damage in need of repair may be inappropriate.”

“Given that pain the cognitive and emotional responses to nociception makes humans feel protective and prepare for the worst, accurate descriptions of the pathophysiologic processes that do not exacerbate maladaptive responses are important.”

(Teunis et al, 2014)



Anything else to consider?



THEULTRASOUNDSITE
PASSION • DEDICATION • INNOVATION

Fatty infiltration of rotator cuff musculature – can we see it and clinical impact...?

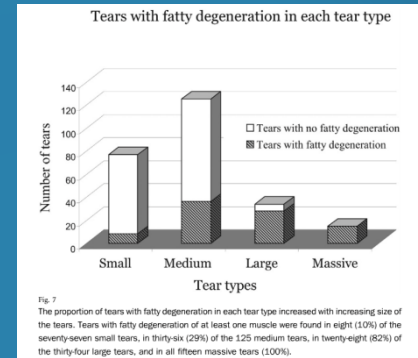
829

COPYRIGHT © 2010 BY THE JOURNAL OF BONE AND JOINT SURGERY, INCORPORATED

Relationship of Tear Size and Location to Fatty Degeneration of the Rotator Cuff

By H. Mike Kim, MD, Nirvikar Dahiya, MD, Sharlene A. Teefey, MD, Jay D. Keener, MD, Leesa M. Galatz, MD, and Ken Yamaguchi, MD

Investigation performed at the Washington University School of Medicine, St. Louis, Missouri



- Disruption of the anterior part of the supraspinatus tendon has been shown to be the strongest predictor of the development of supraspinatus fatty infiltration.
- The distance between the biceps tendon and the anterior margin of a full-thickness tear was significantly smaller in shoulders with fatty degeneration than in those without fatty degeneration.

Atrophy and Fatty Infiltration of the Supraspinatus Muscle: Sonography Versus MRI

Viviane Khoury¹
Étienne Cardinal²
Paul Brassard³

OBJECTIVE. The objective of our study was to compare sonography with MRI for the evaluation of supraspinatus muscle atrophy and fatty infiltration.

SUBJECTS AND METHODS. Forty-five shoulders in 39 patients who had undergone shoulder MRI for the assessment of rotator cuff disease were evaluated blindly with sonography.

Study suggests that there is a good correlation between sonography and MRI or the assessment of supraspinatus muscle atrophy and fatty infiltration.



THE ULTRASOUNDSITE
PASSION • DEDICATION • INNOVATION

Exploring shoulder ultrasound use in practice..

Ottenheim et al. *BMC Family Practice* 2014, **15**:115
<http://www.biomedcentral.com/1471-2296/15/115>



RESEARCH ARTICLE

Open Access

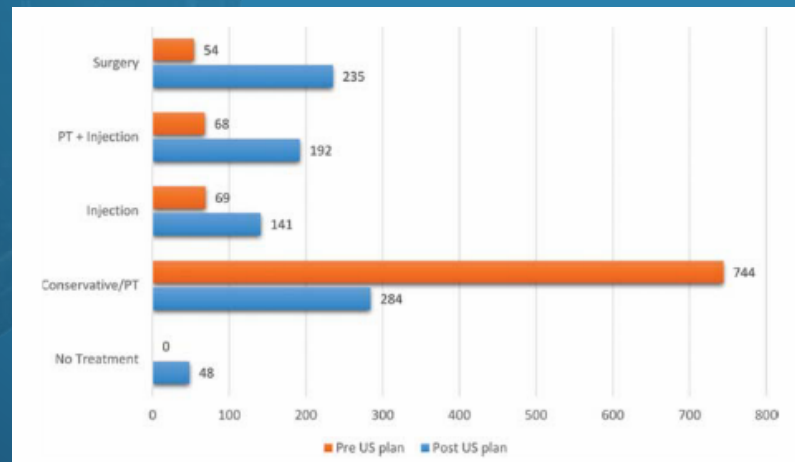
Ultrasound-diagnosed disorders in shoulder patients in daily general practice: a retrospective observational study

Ramon PG Ottenheim^{1*}, Inge GM van't Klooster¹, Laurens MM Starmans¹, Kurt Vanderdood², Rob A de Bie³, Geert-Jan Dinant¹ and Jochen WL Cals¹

A predefined selection of 240 ultrasound reports of patients with shoulder pain referred by GP to Radiology.

Average age 55

40% demonstrated no structural abnormalities – appropriateness of referral?



ORIGINAL RESEARCH

Impact of Shoulder Sonography on Clinical Decision Making

Michael V. Friedman, MD, Travis J. Hillen, MD, David V. Holland, MD, James M. Essenberg, MD, Jennifer L. Demertzis, MD

591 (63.2%) had a post-US treatment plan that differed from pre-US treatment, showing a statistically significant impact on patient treatment.

After US 56% were referred for invasive treatment – rationale? Further details?

MORE STUDIES NEEDED TO EXPLORE THE CLINICAL IMPACT OF DIAGNOSTIC ULTRASOUND USE



THEULTRASOUNDSITE
PASSION • DEDICATION • INNOVATION

Lets not forget the patient... and what they think – it is their shoulder!

Received: 3 August 2017 | Revised: 7 August 2017 | Accepted: 11 August 2017

DOI: 10.1002/msc.1213

WILEY

SERVICE EVALUATION

Physiotherapists utilizing diagnostic ultrasound in shoulder clinics. How useful do patients find immediate feedback from the scan as part of the management of their problem?

Gordon Lumsden  | Kerry Lucas-Garner | Sarah Sutherland | Ron Dodenhoff

Regarding the ability to understand their shoulder problem better and in feeling reassured about their problem,..
97% of patients either strongly agreed or agreed that this was the case.

Concerning the capability of managing their problem..
89% of patients strongly agreed or agreed that they felt more able to do this.

In total, 96% of patients evaluated the ultrasound scan to be of very high/high value to them



THEULTRASOUNDSITE
PASSION • DEDICATION • INNOVATION

Suggestions for the indications for diagnostic shoulder ultrasound

- Mechanical shoulder pain that is..
 - Not improving with conservative management
 - History of trauma (Suspicion of traumatic RC injury, bony injury)
 - Suspicious for acute calcific tendinopathy
- Need for education and reassurance: Altered beliefs regarding previous diagnoses – focussed on ‘tear’ or other structural pathology and clinically little evidence to support. Educate and reassure.
- Diffuse symptoms, further structural information may be helpful to clarify as part of reasoning process.
- Assist to guide injections – perform once and accurately.



Precautions of shoulder ultrasound

- Older age groups , perhaps >50 years old – likely to have asymptomatic structural findings that are not always relevant to the clinical picture. (Trauma can still be relevant!)
- Careful discussion of findings if not relevant –avoid terminology such as ‘tear’ if normal ageing related change. Perhaps ‘defect’, ‘normal structural change’.
- Uncertainty of diagnosis, non MSK presentation – have established pathway to formal imaging in Radiology based service.



General advice

- Ensure competent to use
- Establish peer support network to assist skill development and learning – can be digital, see our secure, verified Medshr group.
- Develop links with imaging department – be prepared for the unexpected.
- Be proactive – follow your referrals, log cases for discussion, broaden your horizons – Rheumatology, bony injuries. Challenge you previous assumptions.



A summary...of sorts

- Ultrasound able to visualise extra articular structures well around the shoulder in comparison to other imaging techniques
- Can provide greater structural information and supplement clinical examination tests.
- Needs to be used in the clinical context – appropriate awareness of asymptomatic findings, lack of evidence to support some assumptions.
- Patient satisfaction is high with ultrasound use, likely to improve outcome.
- **BIG QUESTIONS** – Is shoulder ultrasound arguably best placed in the clinical domain going forward to reduce ‘over medicalisation’. Where should it be performed?



Bursal references

Awerbuch, Mark S. "The clinical utility of ultrasonography for rotator cuff disease, shoulder impingement syndrome and subacromial bursitis." *Medical Journal of Australia* 188.1 (2008): 50.

Couanis, G., W. Breidahl, and S. Burnham. "The relationship between subacromial bursa thickness on ultrasound and shoulder pain in open water endurance swimmers over time." *Journal of Science and Medicine in Sport* 18.4 (2015): 373-377.

Daghir, Ahmed A., et al. "Dynamic ultrasound of the subacromial–subdeltoid bursa in patients with shoulder impingement: a comparison with normal volunteers." *Skeletal radiology* 41.9 (2012): 1047-1053.

Grainger, Andrew J., et al. "MR anatomy of the subcoracoid bursa and the association of subcoracoid effusion with tears of the anterior rotator cuff and the rotator interval." *American Journal of Roentgenology* 174.5 (2000): 1377-1380.

Ishii H, Brunet JA, Welsh RP, Uhtoff HK. "Bursal reactions" in rotator cuff tearing, the impingement syndrome, and calcifying tendonitis. *J ShoulderElbow Surg* 1997; 6: 131-136.

Kennedy, Marion S., Helen D. Nicholson, and Stephanie J. Woodley. "Clinical anatomy of the subacromial and related shoulder bursae: A review of the literature." *Clinical Anatomy* (2016).



Bursal references

Le Goff, Benoit, et al. "Assessment of calcific tendonitis of rotator cuff by ultrasonography: comparison between symptomatic and asymptomatic shoulders." *Joint Bone Spine* 77.3 (2010): 258-263.

O'Connor PJ, Rankine J, Gibbon WW. Interobserver variation in sonography of the painful shoulder. *J Clin Ultrasound* 2005; 33: 53-56

Ruangchaijatuporn, Thumanoon, et al. "Ultrasound evaluation of bursae: anatomy and pathological appearances." *Skeletal radiology* 46.4 (2017): 445-462.

Schmidt WA, Schmidt H, Schicke B, Gromnica-Ihle E. Standard reference values for musculoskeletal ultrasonography. *Ann Rheum Dis.* 2004;63:988–94.

Tsai, Y., et al. "Detection of subacromial bursa thickening by sonography in shoulder impingement syndrome." *Chang Gung medical journal* 30.2 (2007): 135.

White, Eric A., Mark E. Schweitzer, and Andrew H. Haims. "Range of normal and abnormal subacromial/subdeltoid bursa fluid." *Journal of computer assisted tomography* 30.2 (2006): 316-320.



Calcific rotator cuff tendinopathy references

- Adler, RS et al.(2008) Rotator cuff in asymptomatic volunteers: Contrast-enhanced US Depiction of intratendinosus and peritendinous vascularity. Radiology.
- Aina, R. et al (2001) Calcific Shoulder Tendinitis: Treatment with modified US-guided Fine-Needle Technique, Radiology, 455-461.
- Bosworth BM: Calcium deposits in the shoulder and subacromial bursitis: a survey of 12,122 shoulders. J Am Med Assoc 1941, 116:2477-2482
- Chan R, Kim DH, Millett PJ, Weissman BN: Calcifying tendinitis of the rotator cuff with cortical bone erosion. Skeletal Radiol 2004, 33:596-599.
- Chiou HJ, Hung SC, in SY, Wei YS, Li MJ: Correlations among mineral components, progressive calcification process and clinical symptoms of calcific tendonitis. Rheumatology 2010, 49:548-555.
- Cho, NS et al (2010) Calcific tendinitis: Natural history and association with endocrine disorders. Journal of elbow and shoulder surgery.
- De witt, PB et al (2016) Calcific tendinitis: Natural history and association with endocrine disorders. European Radiology.
- Lewis, J et al (2010) The prevalence of neovascularity in patients clinically diagnosed with rotator cuff tendinopathy.
- Le Goff B, Berthelot JM, Guillot P, Gle ´marec J, Maugars Y (2010) Assessment of calcific tendonitis of rotator cuff by ultrasonography: comparison between symptomatic and asymptomatic shoulders. Joint Bone Spine 77:258–263. doi:10.1016/j.jbspin.2010.01.012
- Lin, C (2012) ‘Calcified plaque resorptive status as determined by high-resolution ultrasound is predictive of successful conservative of calcific tendinosis. European Journal of Radiology.



Calcific rotator cuff tendinopathy references

- Louwerens, MDa,* , Inger N. Sierevelt, MSc, Ruud P. van Hove, MD, Michel P.J. van den Bekerom, MD, Arthur van Noort, MD PhD: Prevalence of calcific deposits within the rotator cuff tendons in adults with and without subacromial pain syndrome: clinical and radiologic analysis of 1219 patients. *Journal of Elbow and Shoulder Surgery* 2015, 1-6.
- Merolla, G et al (2016) Calcific tendinitis of the rotator cuff: state of the art in diagnosis and treatment, *Journal of Orthopaedics and Traumatology*, 7-14.
- Oliva, F., Alessio Gai Via and Nicola Maffulli (2012) Physiopathology of intratendinous calcific deposition. *BMC Medicine*.
- Linsell L, Dawson J, Zondervan K, et al. Prevalence and incidence of adults consulting for shoulder conditions in UK primary care; patterns of diagnosis and referral. *Rheumatology (Oxford)* 2006;45:215–21
- Sansone, V. (2016). Calcific tendinopathy of the rotator cuff: the correlation between pain and imaging features in symptomatic and asymptomatic female shoulders, *skeletal Radiology*.
- van der Windt DA, Koes BW, de Jong BA, et al. Shoulder disorders in general practice: incidence, patient characteristics, and management. *Ann Rheum Dis* 1995;54:959–64.
- Uhthoff HK, Sarkar K, Maynard JA: Calcifying tendonitis: A new concept of its pathogenesis. *Clin Orthop Relat Res* 1976, 118:164-168



Rotator cuff references

Bureau, Nathalie J., et al. "Sonographic Visualization of the Rotator Cable in Patients With Symptomatic Full-Thickness Rotator Cuff Tears." *Journal of Ultrasound in Medicine* 35.9 (2016): 1899-1905.

Ciccione, James, et al. "ACCURACY OF OFFICE-BASED ULTRASONOGRAPHY OF THE SHOULDER FOR THE DIAGNOSIS OF ROTATOR CUFF TEARS." *Journal of Bone & Joint Surgery, American Volume* 6 (2005).

Connor, P. M., D. M. Banks, and A. B. Tyson. "Magnetic resonance imaging of the asymptomatic shoulder of overhead athletes." *British Journal of Sports Medicine* 38.2 (2004): 244-246.

Jiang, Yebin, et al. "Trabecular microstructure and surface changes in the greater tuberosity in rotator cuff tears." *Skeletal radiology* 31.9 (2002): 522-528.

Khoury, Viviane, Étienne Cardinal, and Paul Brassard. "Atrophy and fatty infiltration of the supraspinatus muscle: sonography versus MRI." *American Journal of Roentgenology* 190.4 (2008): 1105-1111.

Mall, N. A., et al. "Symptomatic Progression Of Asymptomatic Rotator Cuff Tears: A Prospective Study Of Clinical And Sonographic Variables." *Journal of Orthopaedic & Sports Physical* 41.5 (2011): 368-369.

Mall, Nathan A., et al. "An evidenced-based examination of the epidemiology and outcomes of traumatic rotator cuff tears." *Arthroscopy: The Journal of Arthroscopic & Related Surgery* 29.2 (2013): 366-376.

Mall, Nathan A., et al. "Symptomatic progression of asymptomatic rotator cuff tears." *J Bone Joint Surg Am* 92.16 (2010): 2623-2633.



Rotator cuff references

Matthewson, Graeme, et al. "Partial thickness rotator cuff tears: current concepts." *Advances in orthopedics 2015* (2015).

Middleton, William D., Sharlene A. Teefey, and Ken Yamaguchi. "Sonography of the rotator cuff: analysis of interobserver variability." *American Journal of Roentgenology* 183.5 (2004): 1465-1468.

Minagawa, Hiroshi, et al. "Prevalence of symptomatic and asymptomatic rotator cuff tears in the general population: from mass-screening in one village." *Journal of orthopaedics* 10.1 (2013): 8-12.

Moosmayer, Stefan, and Hans-jørgen Smith. "Diagnostic ultrasound of the shoulder—a method for experts only? Results from an orthopedic surgeon with relative inexperience compared to operative findings." *Acta orthopaedica* 76.4 (2005): 503-508.

Ok, Hyun Soo, et al. "Clinical Relevance of Classifying Massive Rotator Cuff Tears: Results Based on Functional and Radiological Findings After Arthroscopic Repair." *The American Journal of Sports Medicine* (2016): 0363546516667498.

Safran, Ori, et al. "Natural history of nonoperatively treated symptomatic rotator cuff tears in patients 60 years old or younger." *The American journal of sports medicine* 39.4 (2011): 710-714.

Smith, T. O., et al. "Diagnostic accuracy of ultrasound for rotator cuff tears in adults: a systematic review and meta-analysis." *Clinical radiology* 66.11 (2011): 1036-1048.

Sofka, Carolyn M., Ziyad K. Haddad, and Ronald S. Adler. "Detection of muscle atrophy on routine sonography of the shoulder." *Journal of ultrasound in medicine* 23.8 (2004): 1031-1034.




Tips and pitfalls in diagnostic ultrasound imaging of the rotator cuff tendons – when is it pathological

April 14th

Odense



THEULTRASOUNDSITE
PASSION • DEDICATION • INNOVATION



The Shoulder

Practical scanning, Pathology



Short axis view of the anterior shoulder



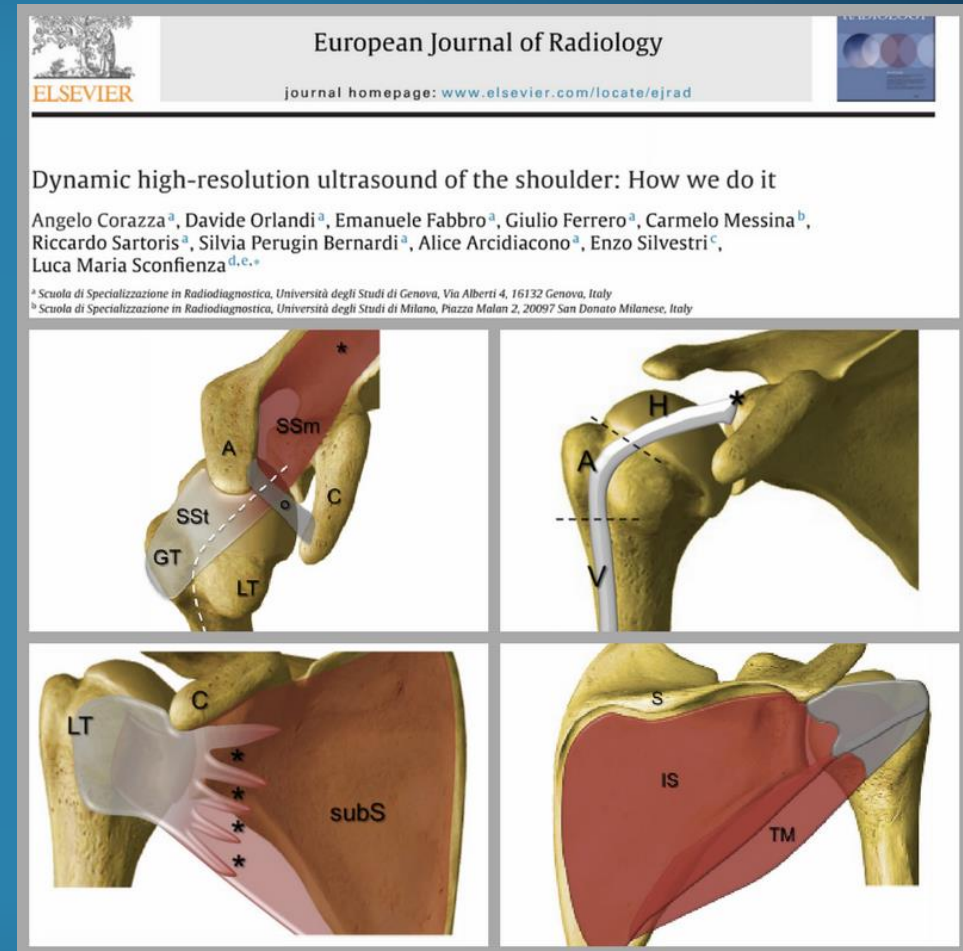
THEULTRASOUNDSITE
PASSION • DEDICATION • INNOVATION



THEULTRASOUNDSITE
PASSION • DEDICATION • INNOVATION

Ultrasound of the shoulder

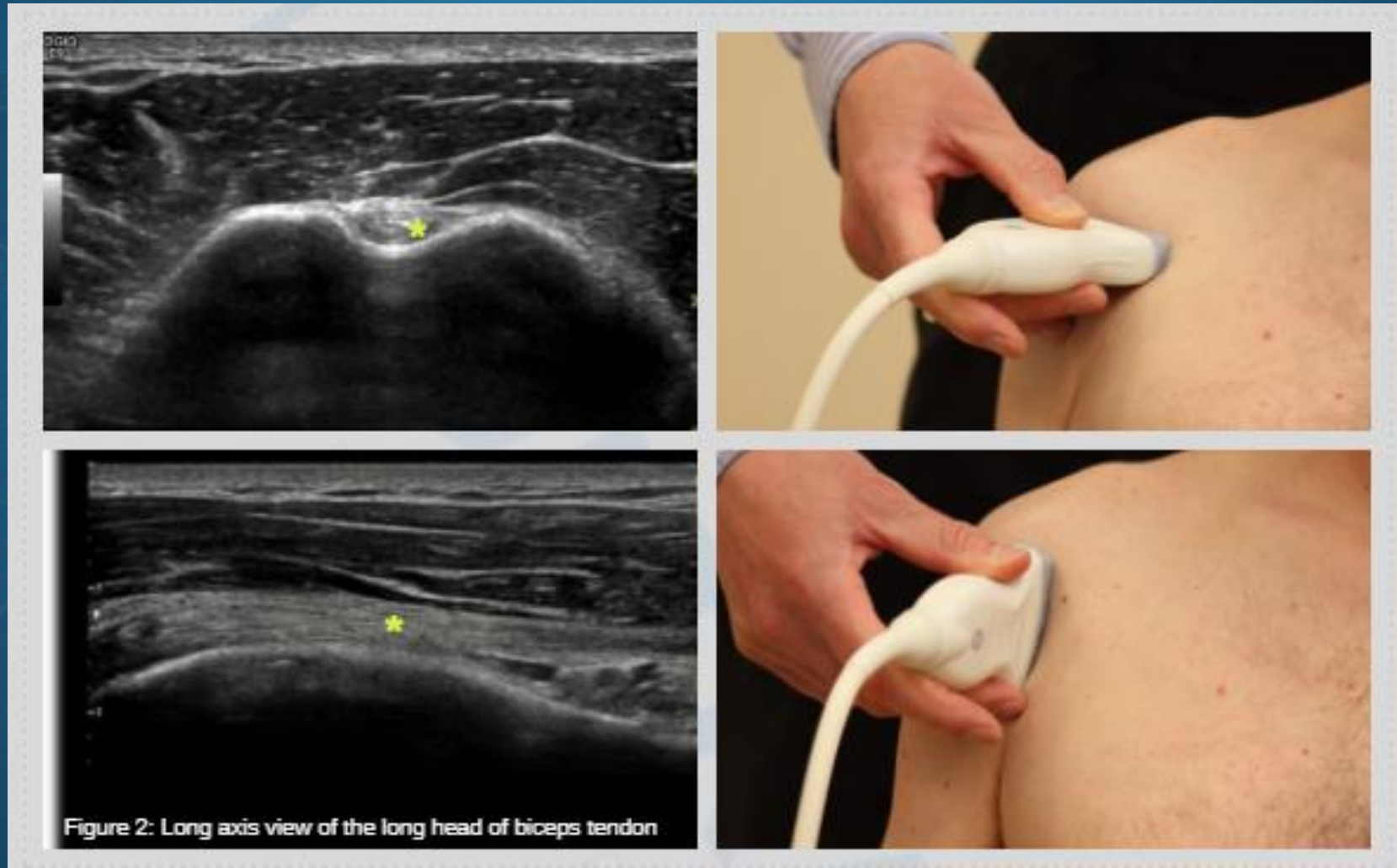
- Patient sitting on stool
- Stand behind patient to scan, so both therapist and patient can see screen
- Standard views
 - Biceps
 - Subscapularis
 - Supraspinatus inc anterior free edge
 - Infraspinatus



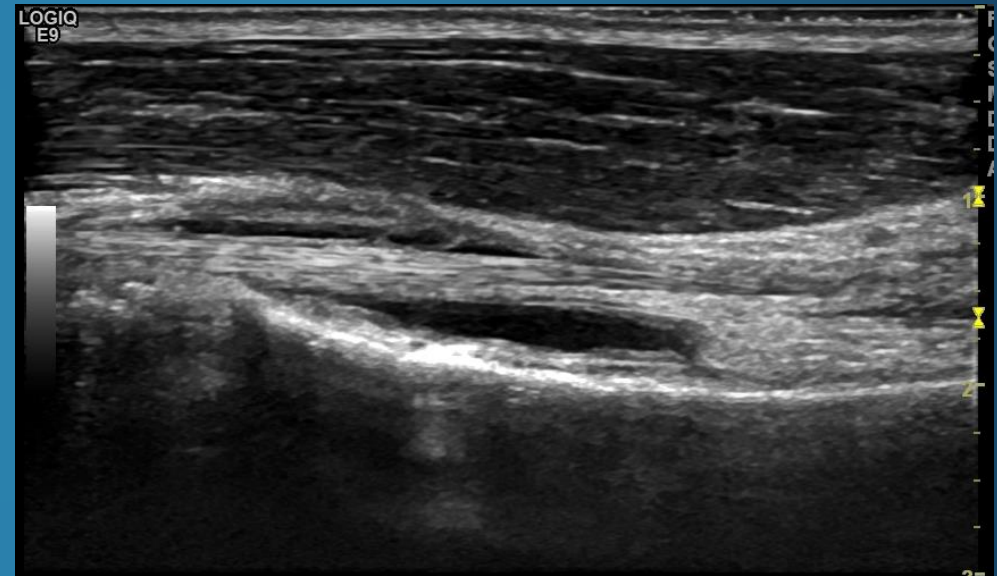
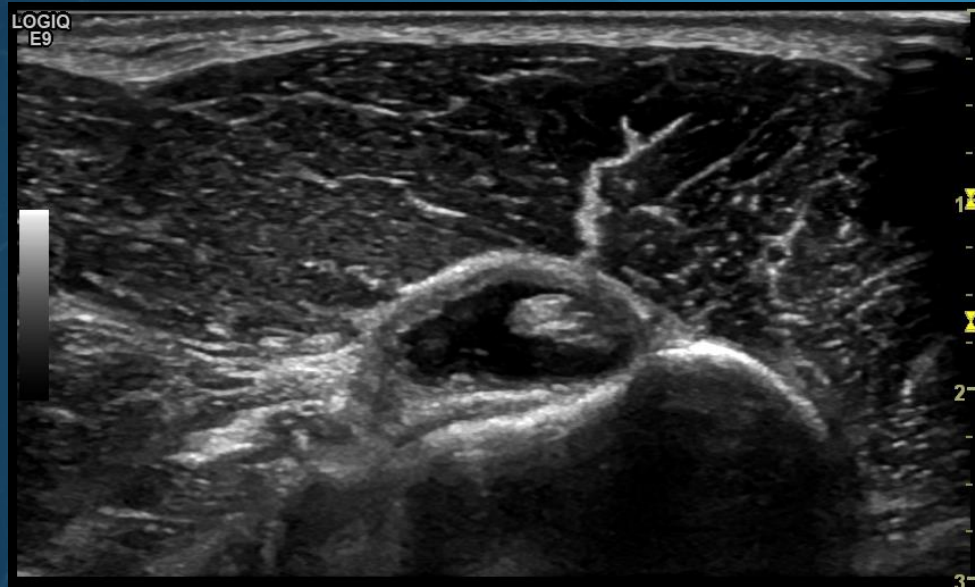
Long head of biceps



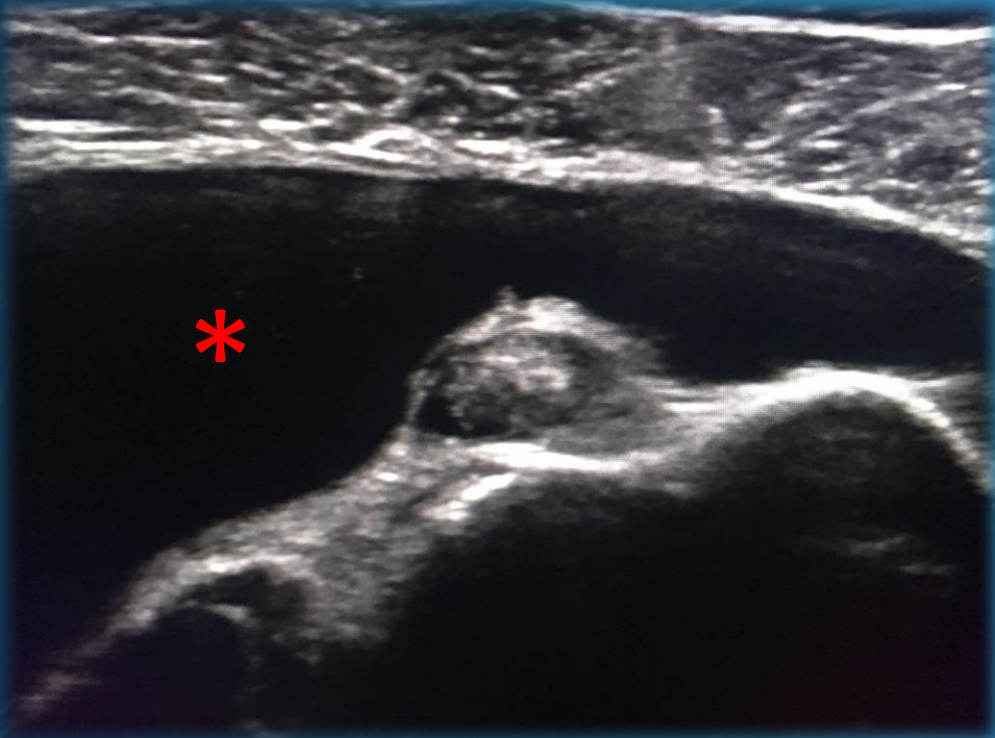
Long head of biceps – the starting point!



Long head of biceps tendon sheath effusion - what does it mean?



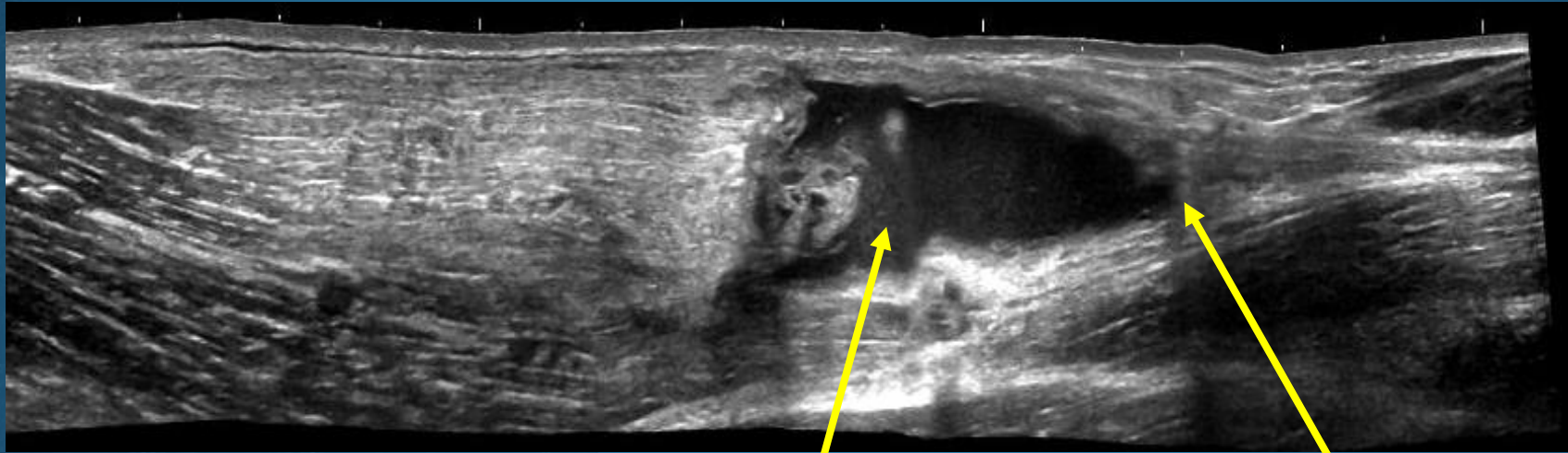
Watch out for a pitfall when reporting LHB...



What is *?

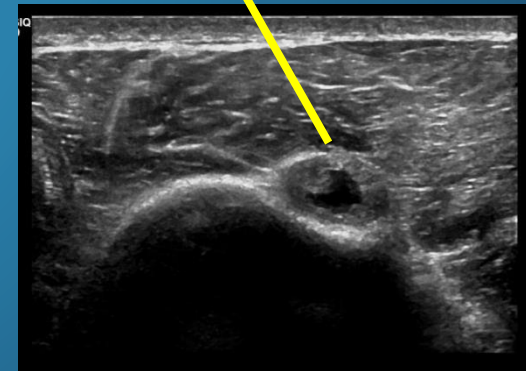
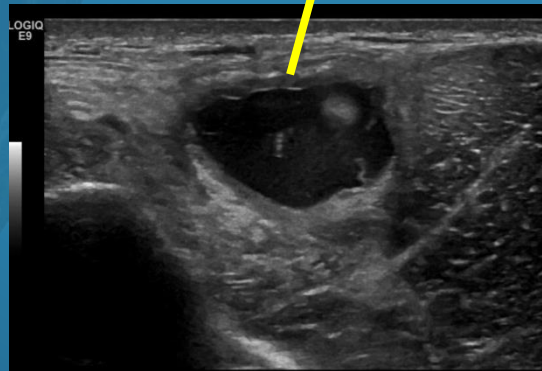


Long head of biceps tendon rupture



Cross-sectional images correlating with panoramic view.

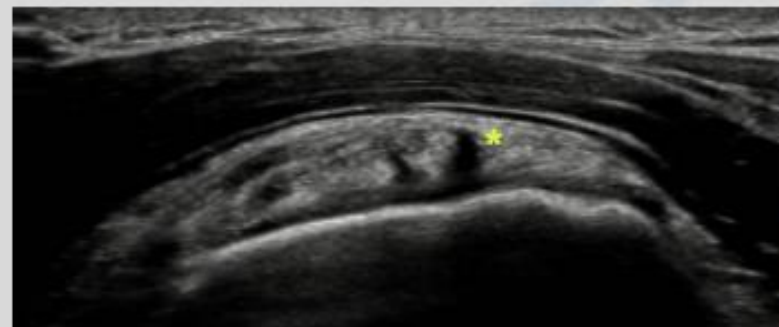
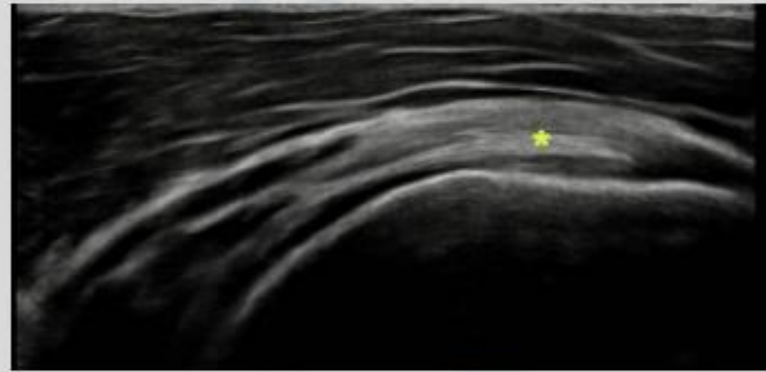
Note the “empty sheath and partially empty sheath correlating with the degree of tendon retraction



Subscapularis tendon



Subscapularis tendon



Subscapularis calcific tendinopathy



Subscapularis full thickness defect

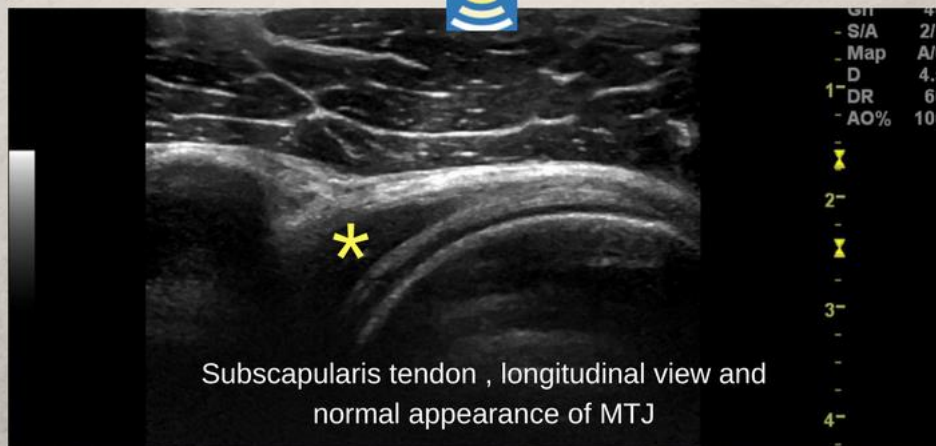


Subscapularis pitfalls

Subscapularis
#shoulderultrasoundpitfalls



Subscapularis tendon, normal appearance not defects



Subscapularis tendon , longitudinal view and normal appearance of MTJ

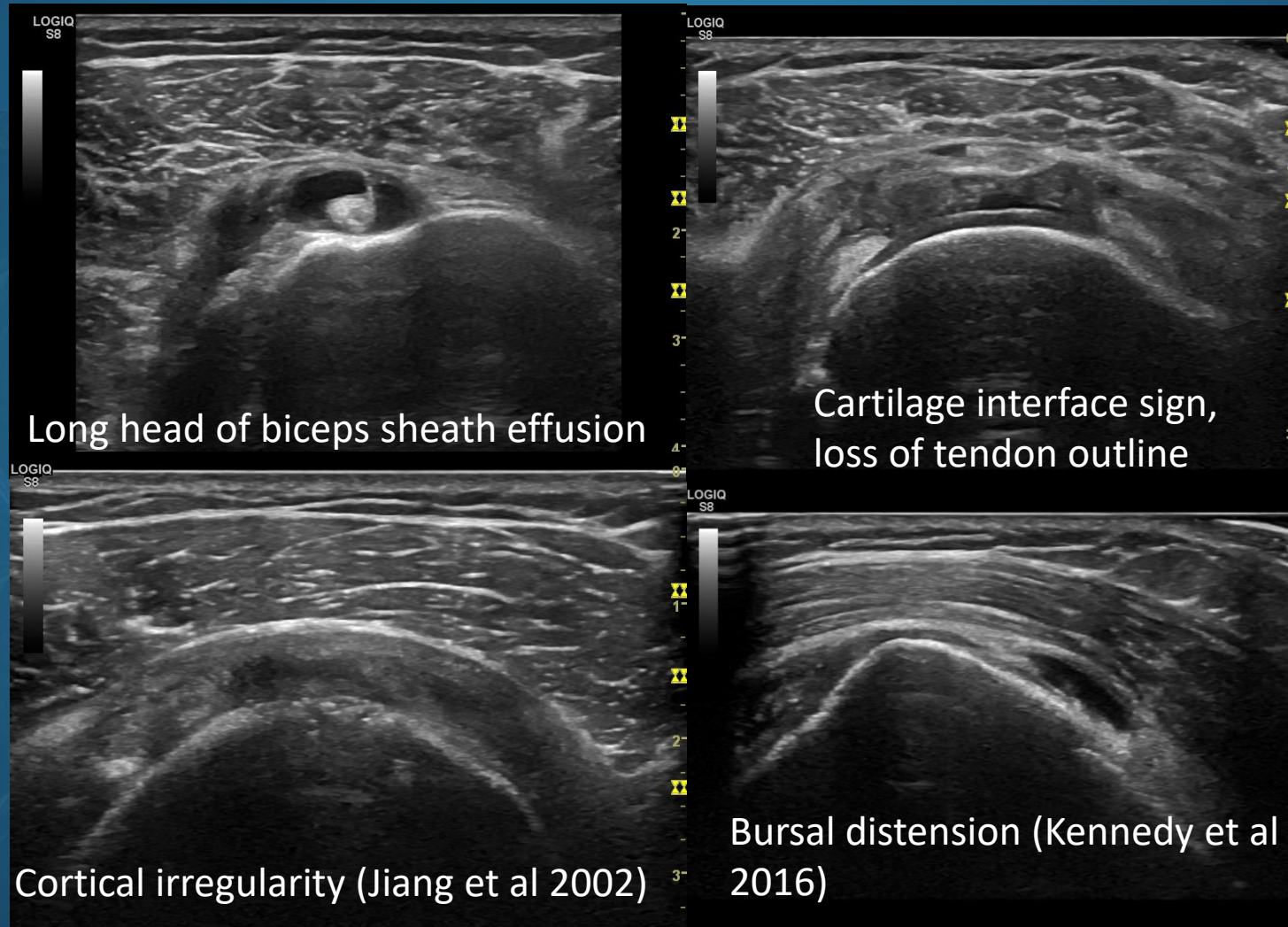


Practical in groups – Long head of biceps and Subscapularis

- Visualise the LHB in a transverse plane and follow from the GHJ to the distal musculotendinous junction
- Visualise the LHB in a longitudinal view and ensure you can see the tendon clearly on the right and left side of the screen.
- Visualise the Subscapularis in a longitudinal plane and dynamically assess for impingement.
- Visualise the Subscapularis in a transverse plane and highlight the 'Tiger Stripes'



Indirect signs of rotator cuff defects?



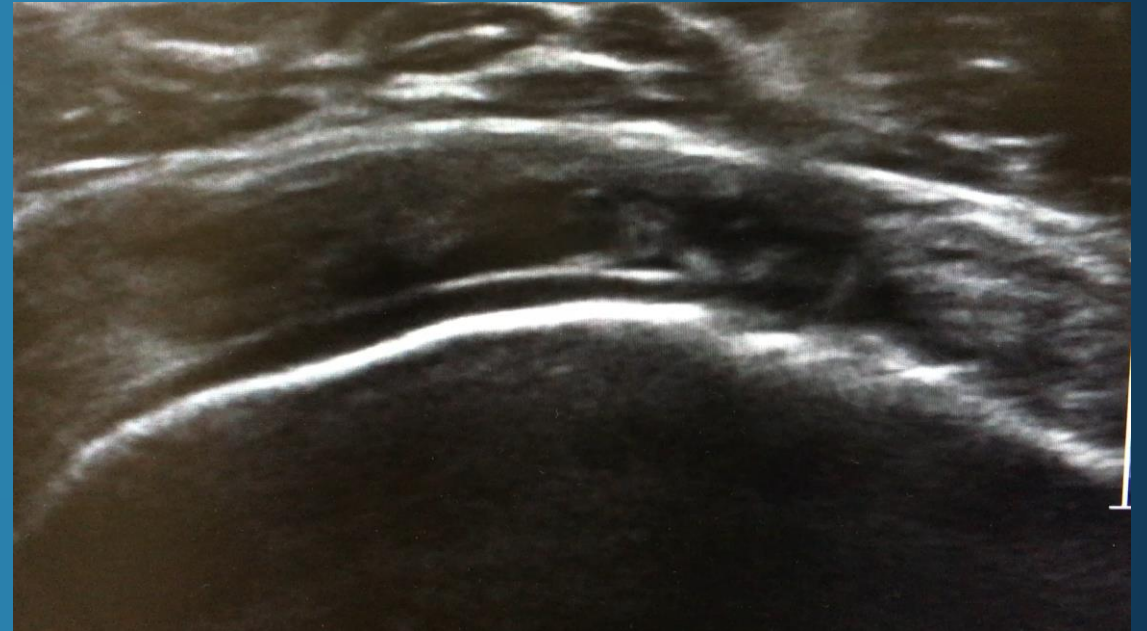
Can we differentiate acute from degenerative rotator cuff tendon defects on ultrasound?

ACUTE DEFECT..

- Fluid filled defect and focally tender
- Less likely to have deltoid indentation
- Can retain tendon outline
- Often associated bursal, LHB/Joint effusion

CHRONIC DEFECT...

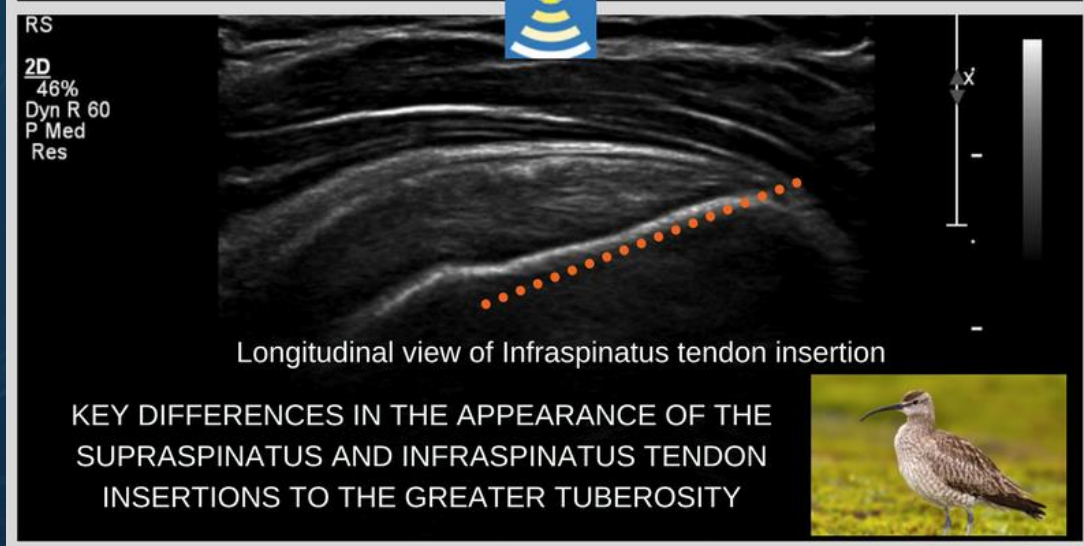
- Minimal free fluid
- Indentation of deltoid
- Loss of tendon outline



THE WHOLE EXAM IS KEY!



Trying to highlight the difference
between Infraspinatus and
Supraspinatus
...think bony landmark..
..and birds beaks!



Supraspinatus tendon



Supraspinatus tendon



Figure 5: Short axis view of the supraspinatus tendon

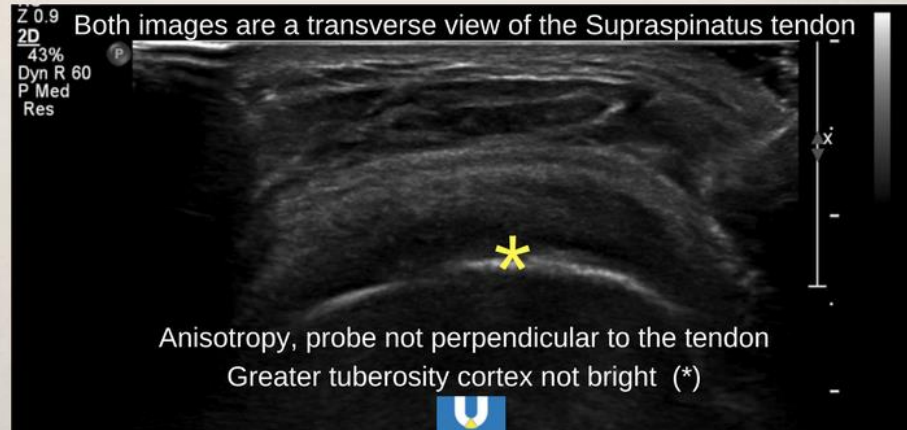


Figure 6: Short axis view of the supraspinatus tendon



Pitfalls of Supraspinatus...Anisotropy!

Anisotropy of the Supraspinatus tendon #shoulderultrasoundpitfalls

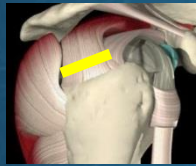


Top tips!

Short axis view of Supraspinatus tendon



Pure cross-section at proximal part of SS



Pure cross-section at mid part of SS



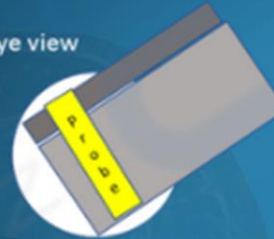
Pure cross-section at Distal part of SS

Supraspinatus in transverse view

Probe position in relation to the tendon

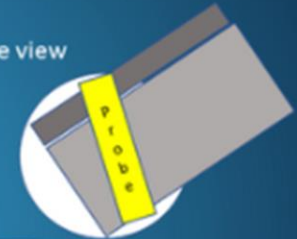
Birds eye view

Correctly scanned
Pure transverse view of
supraspinatus tendon



Birds eye view

Incorrectly scanned
Oblique view of
supraspinatus tendon



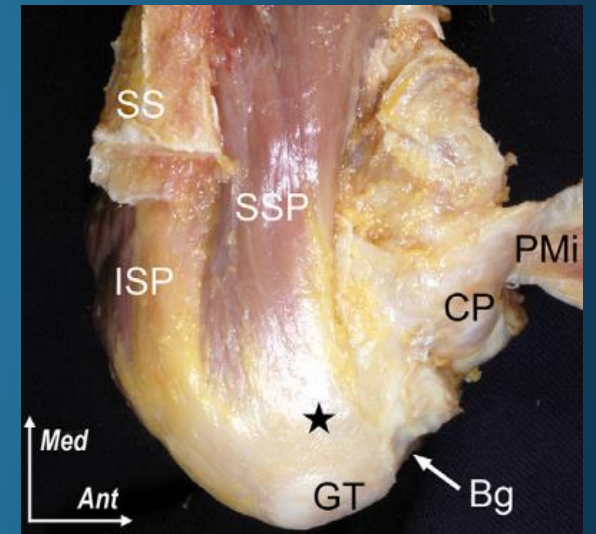
Supraspinatus tendon



Figure 5: Short axis view of the Supraspinatus tendon

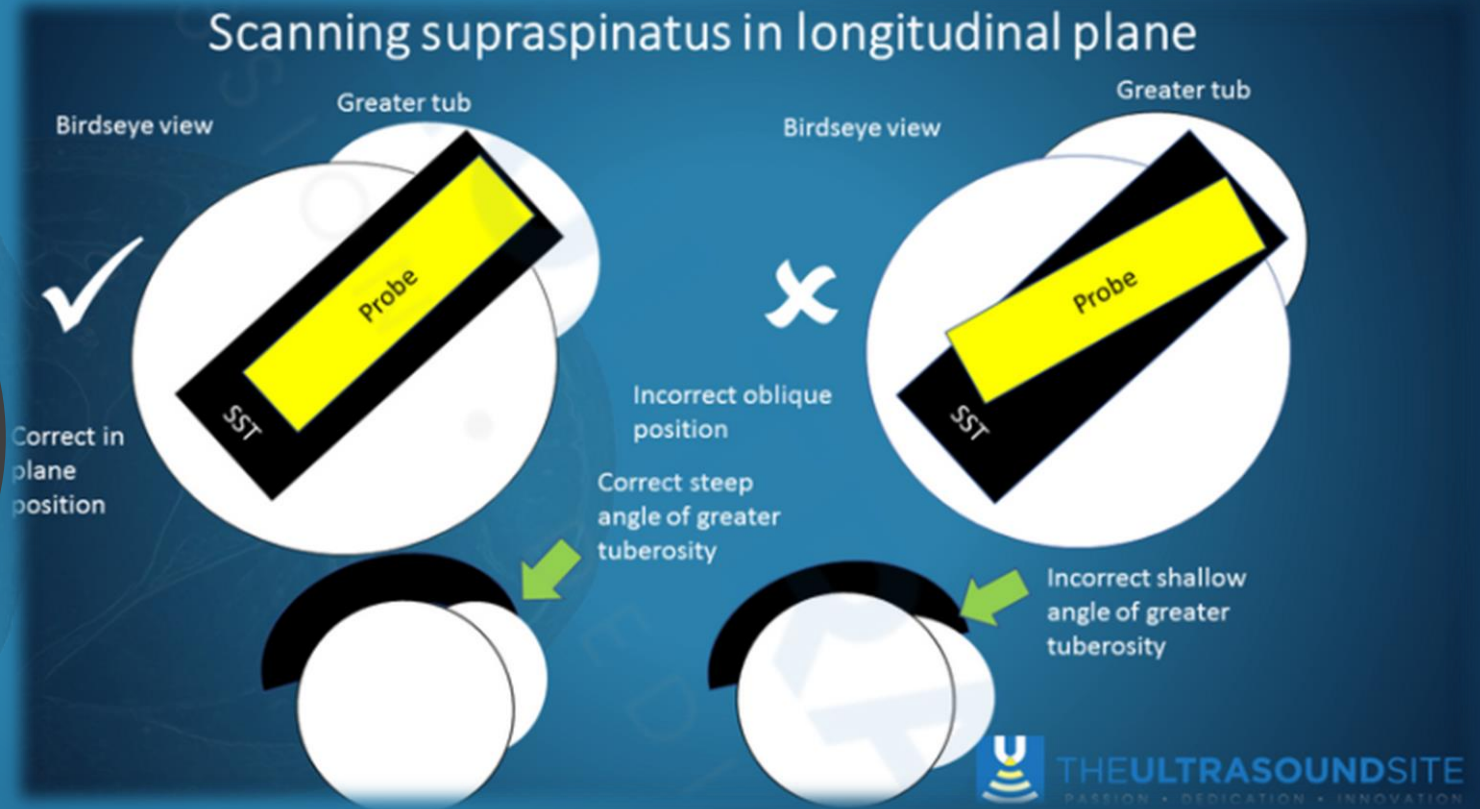
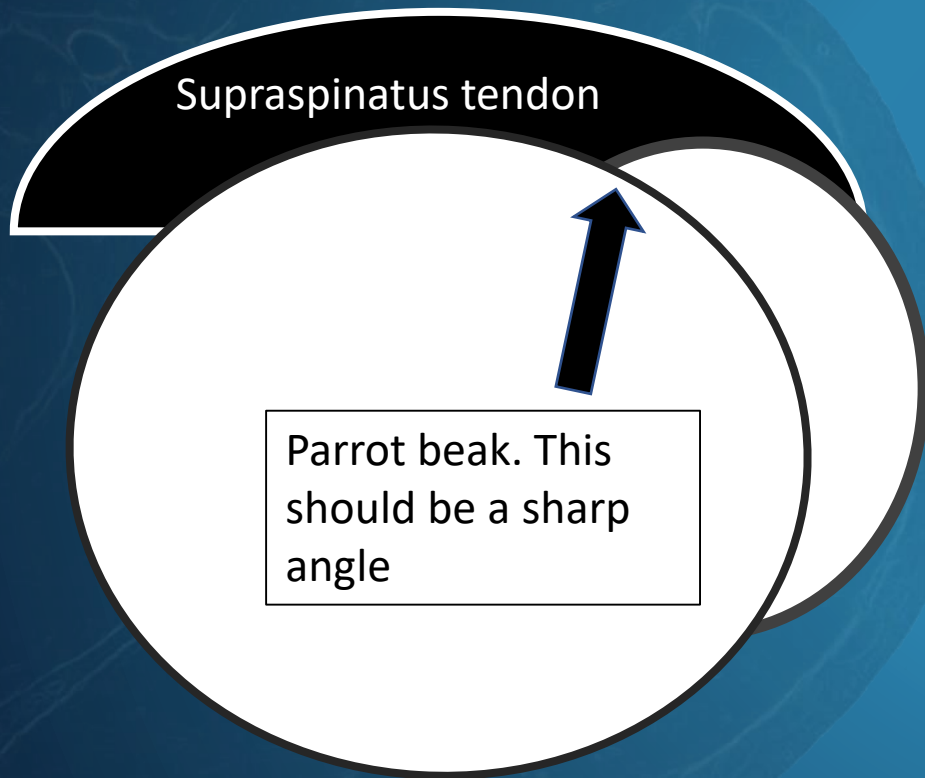


Figure 6: Short axis view of the Supraspinatus tendon

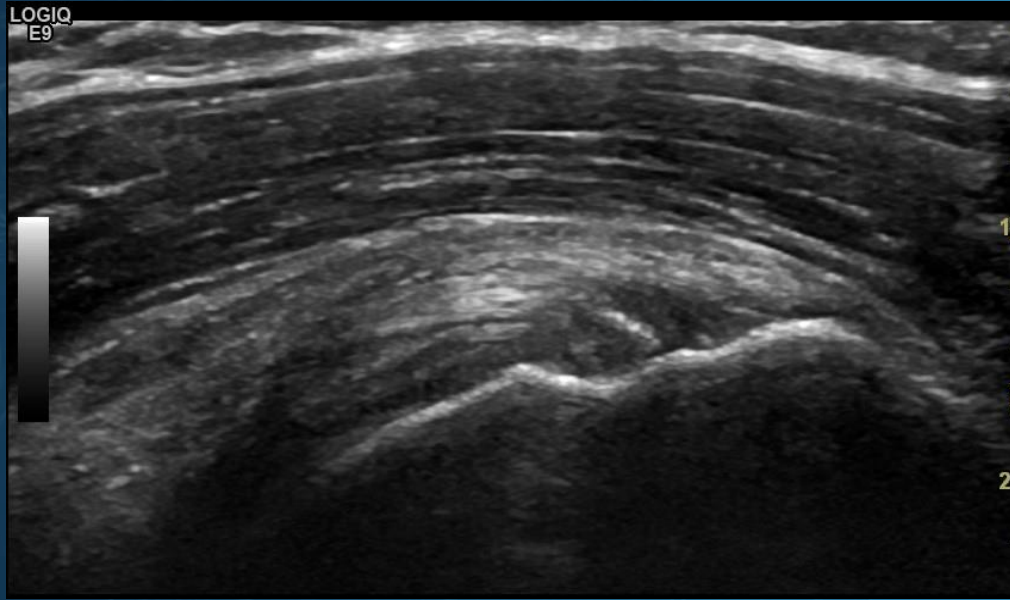


Top tips!

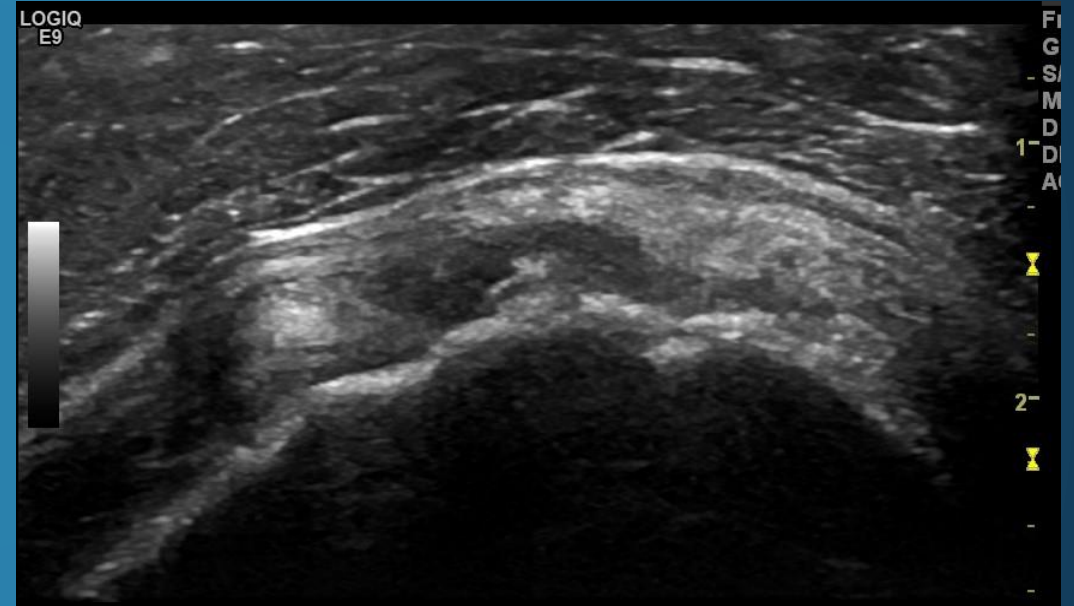
Long axis view of the Supraspinatus tendon



Partial articular sided Supraspinatus tears



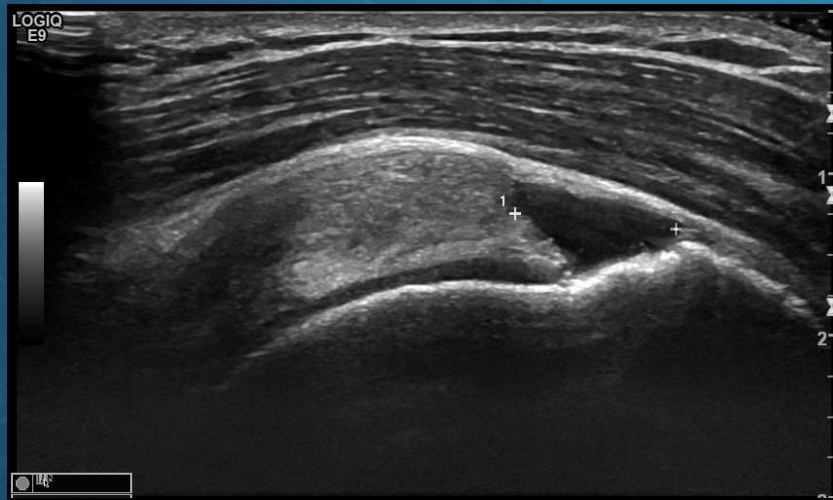
Partial Articular sided
Supraspinatus Avulsion tear or
“PASTA” lesion (long view)



Partial Articular sided Supraspinatus
Avulsion tear or “PASTA” lesion (trans
view)



Full thickness Supraspinatus tears

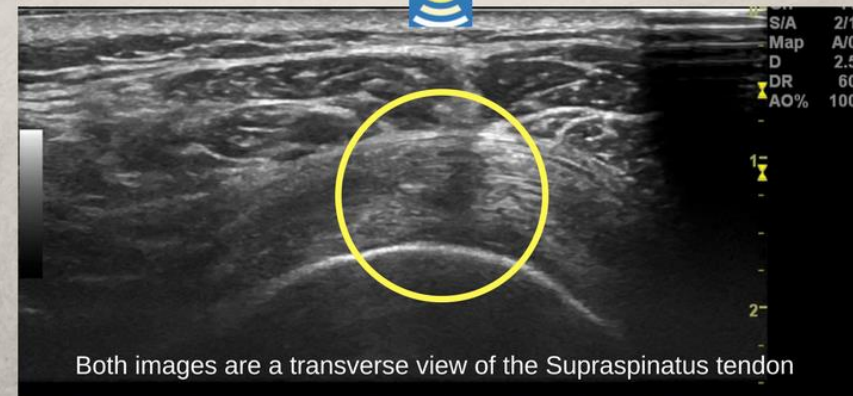


Pitfalls of Supraspinatus...watch out!

MTJ of the Supraspinatus tendon
#shoulderultrasoundpitfalls



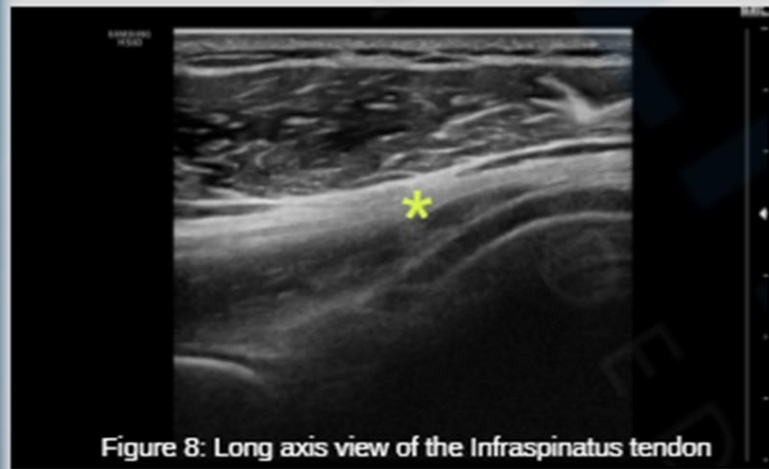
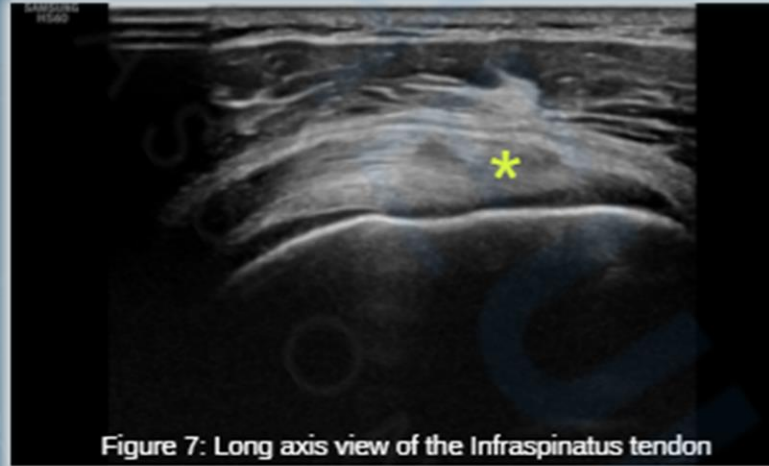
The impact fascial planes can have on images
#shoulderultrasoundpitfalls



Infraspinatus tendon

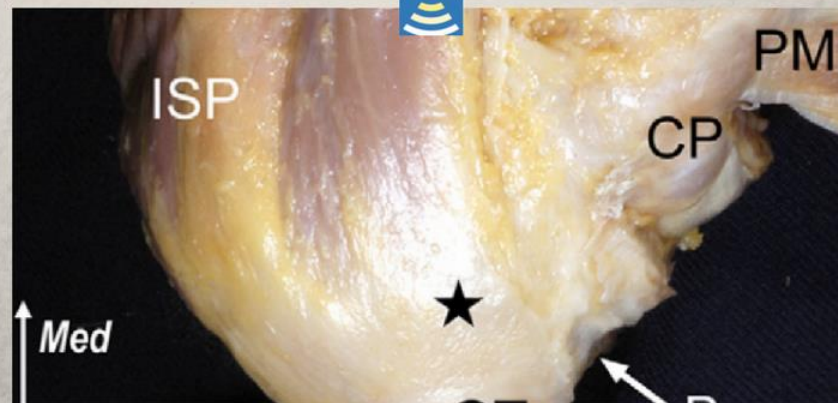


Infraspinatus tendon



Pitfalls of Infraspinatus/ Supraspinatus junction

Junction of Supraspinatus and Infraspinatus tendons
#shoulderultrasoundpitfalls



962

COPYRIGHT © 2008 BY THE JOURNAL OF BONE AND JOINT SURGERY, INCORPORATED

Humeral Insertion of the Supraspinatus and Infraspinatus

New Anatomical Findings Regarding the Footprint of the Rotator Cuff

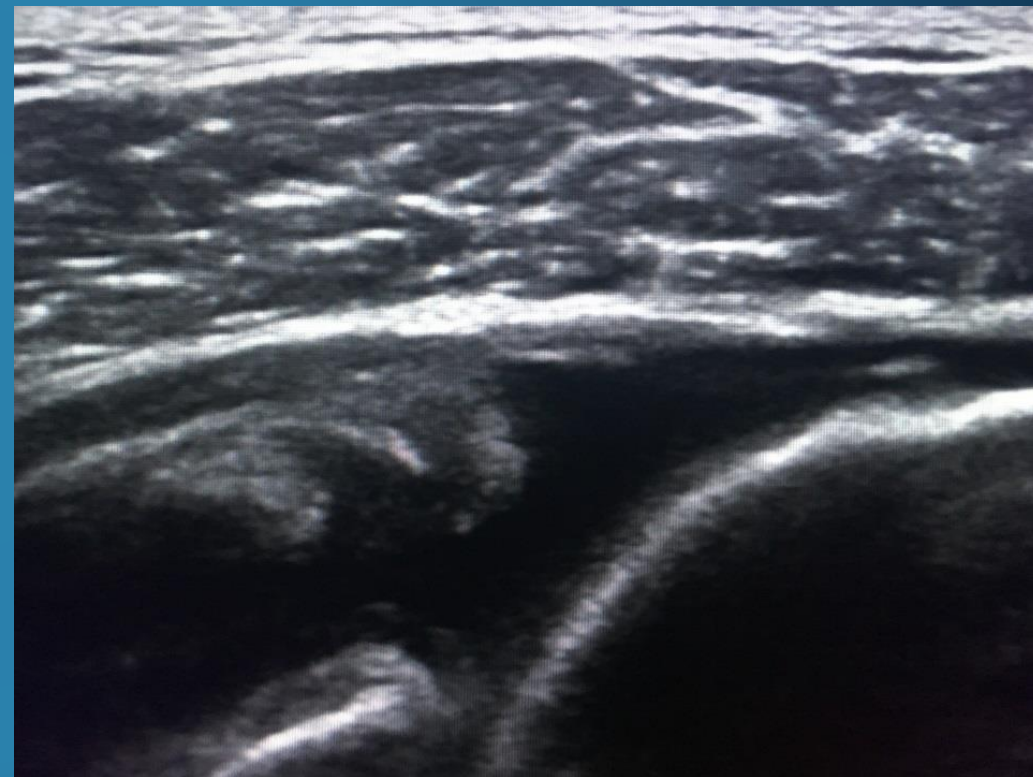
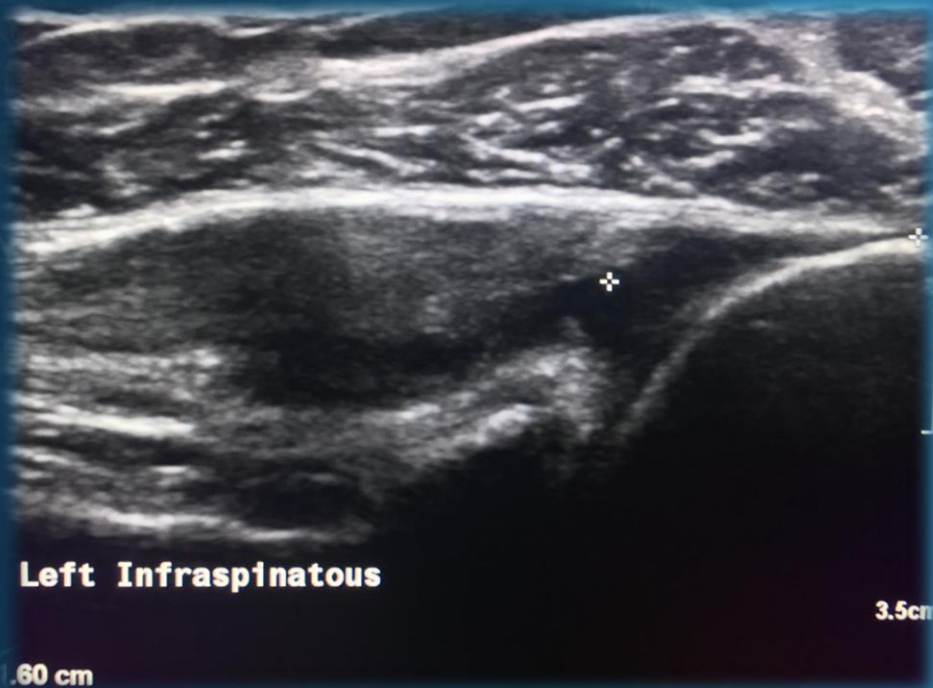
By Tomoyuki Mochizuki, MD, Hiroyuki Sugaya, MD, Mari Uomizu, MD, Kazuhiko Maeda, MD, Keisuke Matsuki, MD, Ichiro Sekiya, MD, Takeshi Muneta, MD, and Keiichi Akita, MD

Investigation performed at the Unit of Clinical Anatomy, Graduate School, Tokyo Medical and Dental University, Tokyo, Japan

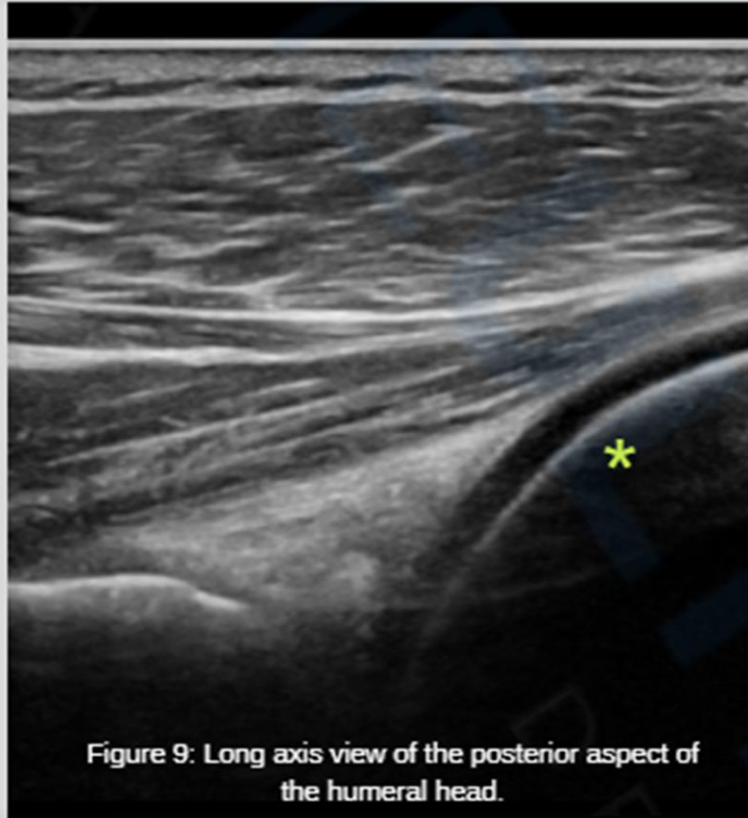


THEULTRASOUNDSITE
PASSION • DEDICATION • INNOVATION

Ruptured Infraspinatus



Posterior recess of glenohumeral joint



Practical in groups

- Visualise the Supraspinatus in a longitudinal and transverse plane. Ensure a “pure” cross section with no tapering of the tendon thickness.
- Ensure a “pure” Longitudinal view with a steep angle at the transition of the humeral head to greater tuberosity “the parrot beak”
- Visualise the Infraspinatus
- Visualise the posterior recess of the joint

