



# The Use of Ultrasound for the Diagnosis and Treatment of the Musculoskeletal System

**St. Joseph's Refresher Course**

**March 2023**

**Kenneth Iles, DC**

**John Finkenstadt, MD**

# ULTRASONOGRAPHY IN FAMILY MEDICINE

- **Musculoskeletal – Diagnosis and Injection**  
eg: Carpal Tunnel; Shoulder Rotator Cuff; Knee Aspiration;  
Ganglion Cysts; Dequervain's Tenosynovitis
- **Thyroid Nodules**
- **Enlarged Lymph Nodes**
- **Pericardial Effusion**
- **Abdominal Aortic Aneurysm**
- **Obstetrics**

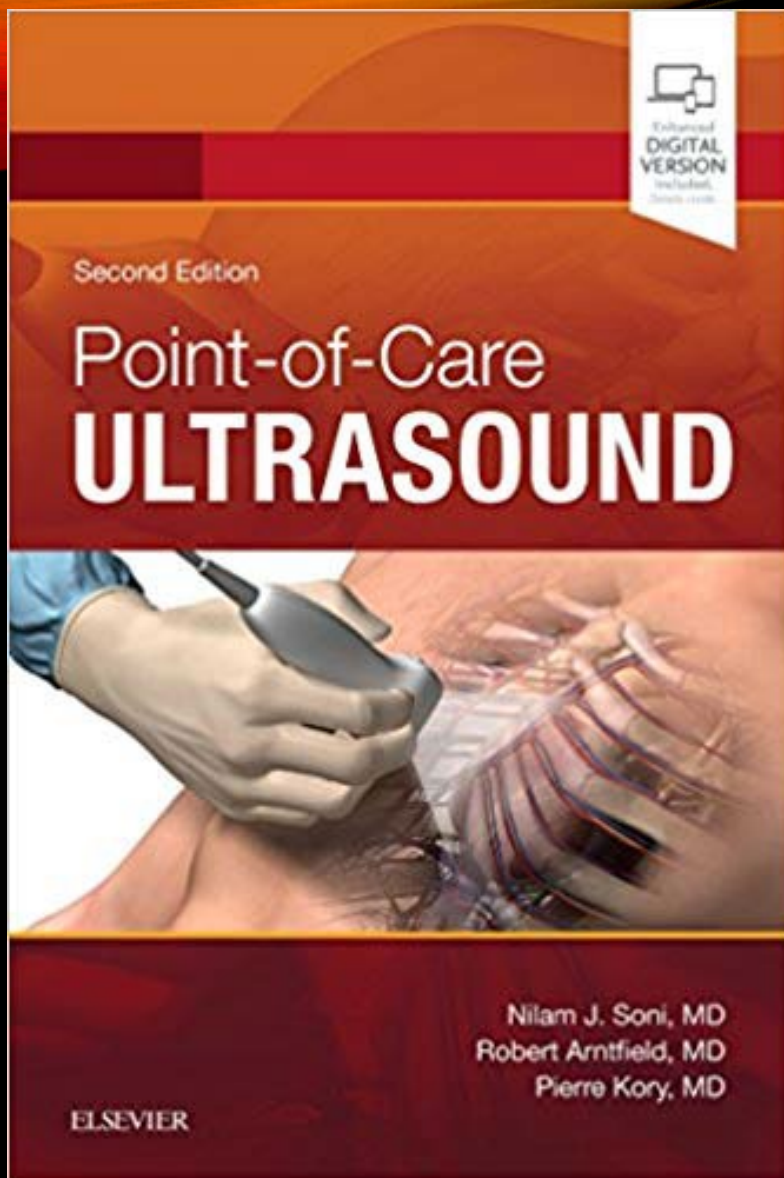
# REFERENCES: ULTRASOUND IN FAMILY MEDICINE

1. **Point of Care Ultrasound in General Practice: A Systematic Review**

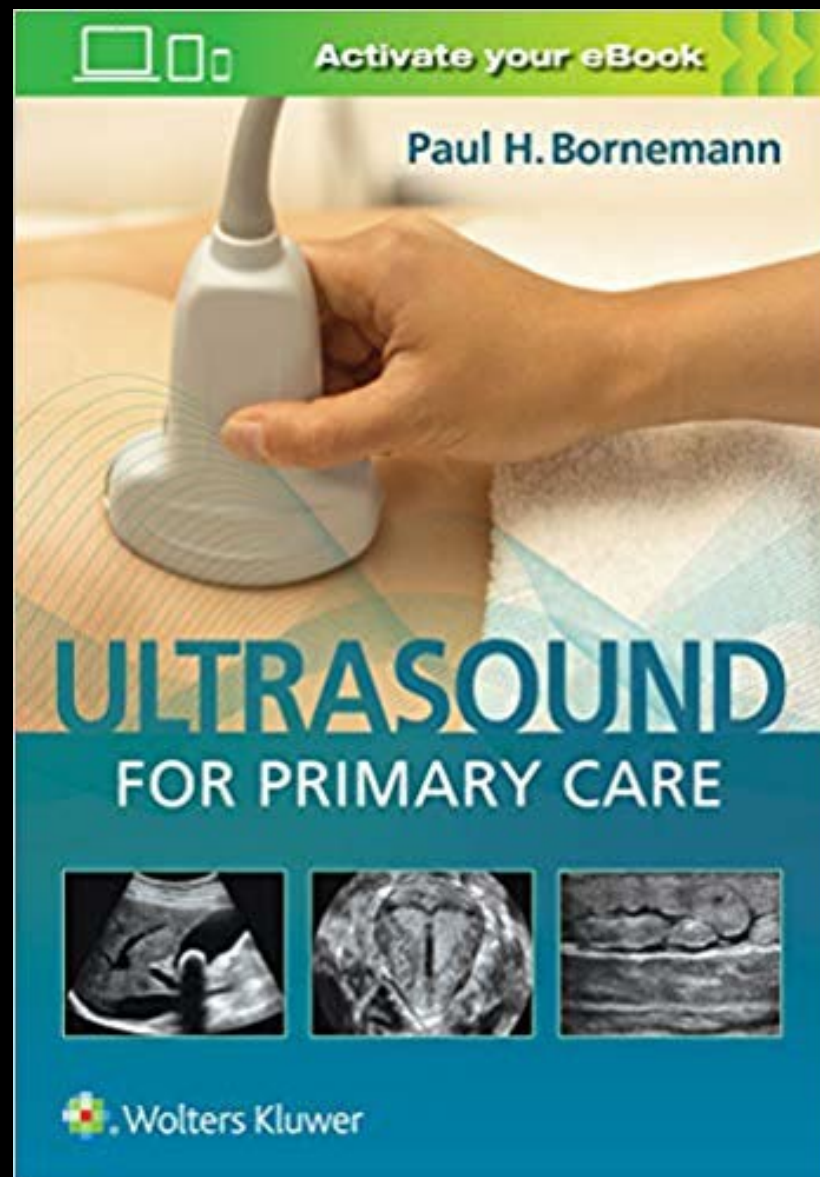
Ann Fam Med Jan/Feb 2019 vol. 17 no. 1 61-69.

2. **Point of Care Ultrasonography in Family Medicine**

Am Fam Physician. 2018 Aug 15;98(4):200-202.



June 2019



September 2020

THIS WORKSHOP WILL FOCUS ON  
2 MAIN TOPICS:

DIAGNOSIS AND TREATMENT OF:

**Carpal Tunnel Syndrome**

**Shoulder Rotator Cuff Tears**

# WHY ULTRASOUND?

- **Portability**
- **Cost-Effective**
- **Patient Comfort**
- **High Resolution Imaging**
- **Real Time Dynamic Imaging**

# OTHER REASONS TO CONSIDER ULTRASOUND

- **Every patient can undergo Ultrasound**
- **No problem with hardware**
- **No problems with claustrophobia or need for sedation**
- **Probe can be placed over symptomatic area**
- **Color Doppler shows inflammation**
- **Better for differentiating fluid from solid areas**
- **Facilitates bilateral comparison**
- **Can be used to follow the long course of a structure such as a nerve**
- **Useful in guiding interventions**

# LIMITATIONS OF ULTRASOUND IN MUSCULOSKELETAL DIAGNOSIS

**Intra-articular Pathology**

**Degenerative Change**

**Labral Tears**

**Fractures**

**Bone Tumors**

**Operator Dependent**



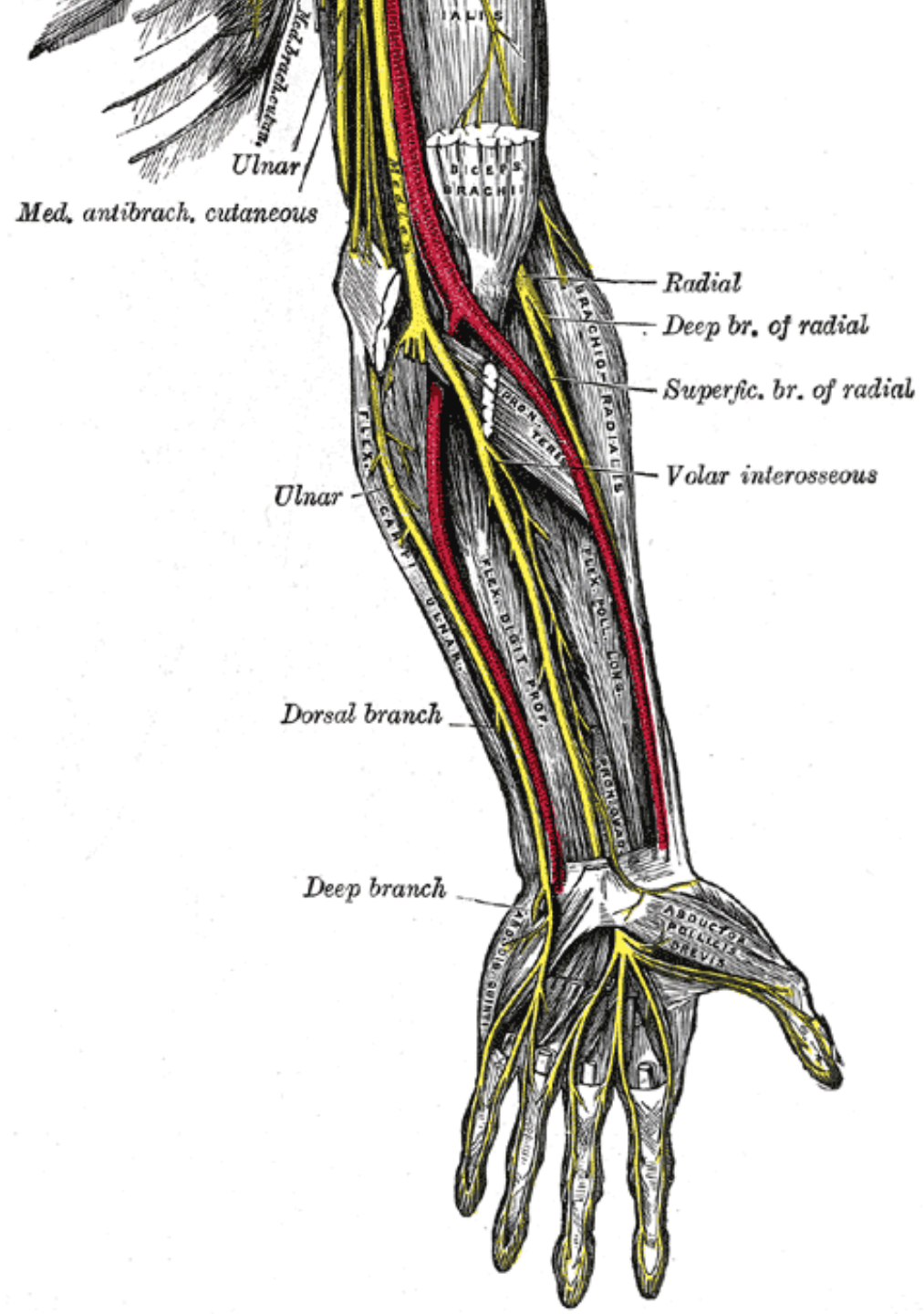
# REQUEST FOR VOLUNTEERS FOR DEMOS

**Carpal Tunnel Evaluation**

**Shoulder Pain Evaluation**

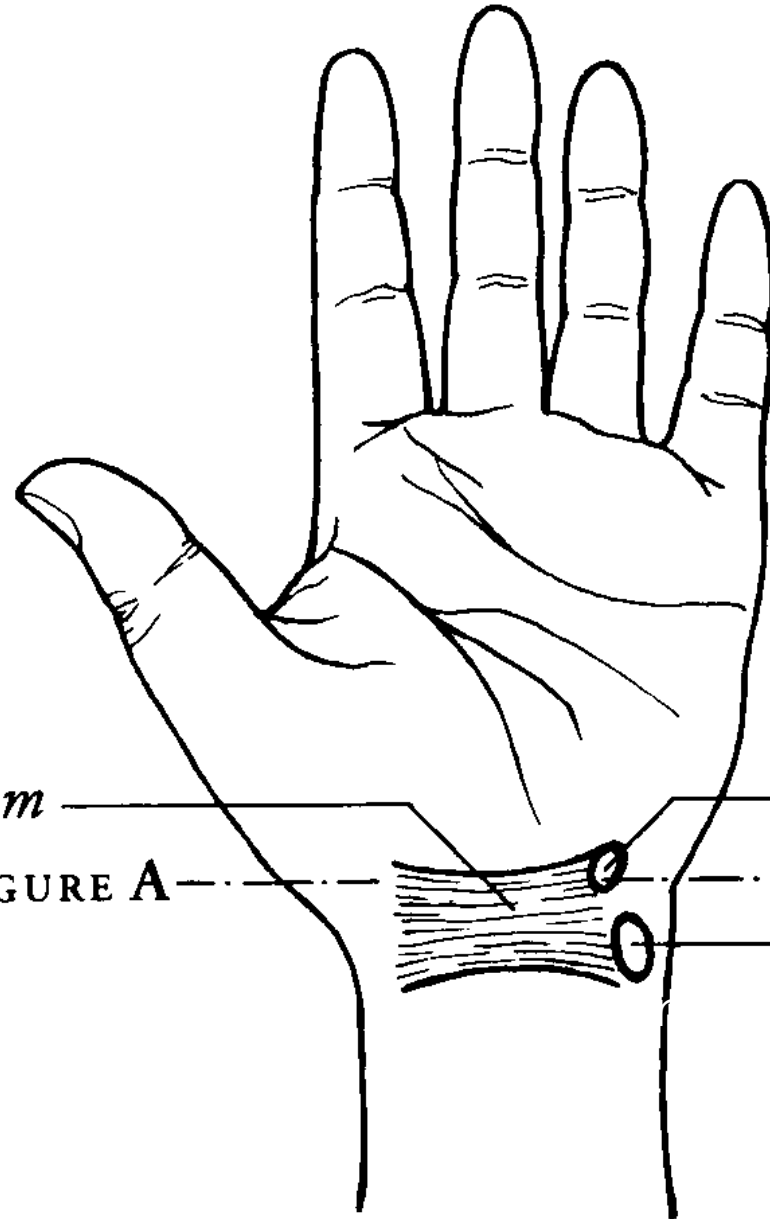
# **CARPAL TUNNEL SYNDROME**

- **Compression of the Median Nerve  
beneath the  
Flexor Retinaculum**



# Flexor Retinaculum

A wide, thick ligament called the **flexor retinaculum** connects the pisiform and hamate hook to the scaphoid and trapezium.

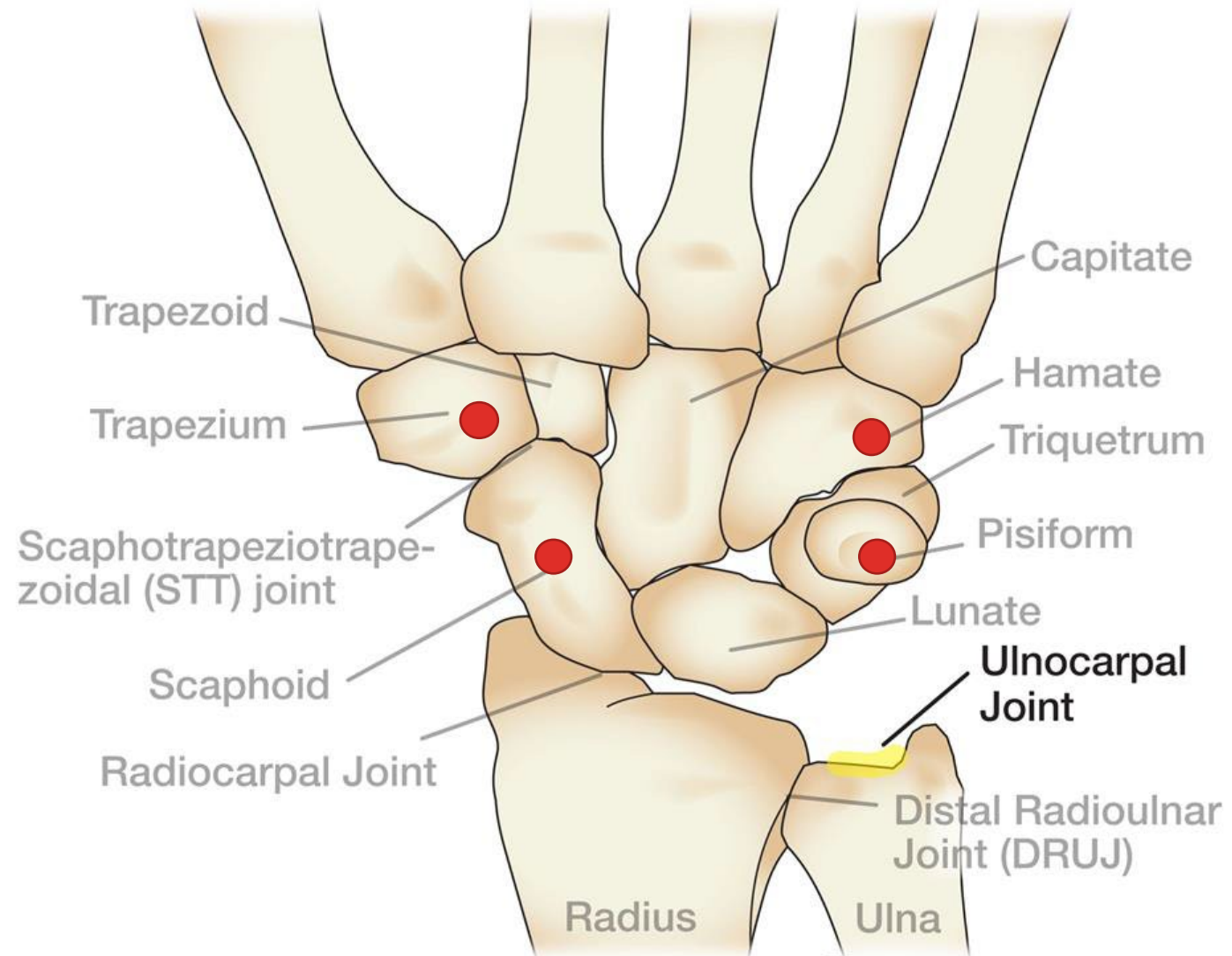


*flexor retinaculum*

*hook of hamate*

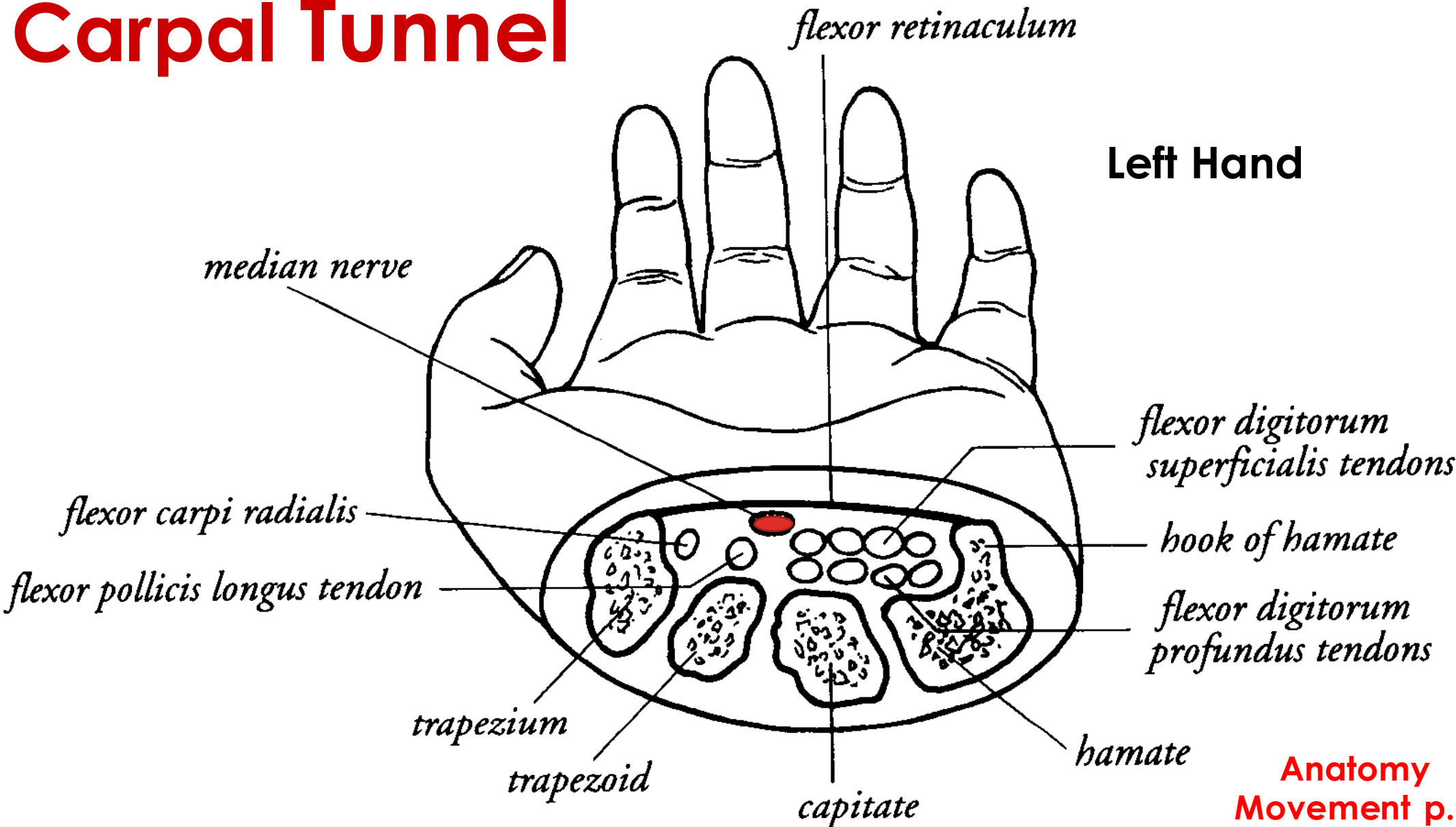
SECTION FOR FIGURE A

*pisiform bone*



**Left Hand – palmar view**

# Carpal Tunnel



Left Hand

# PREVALENCE OF CARPAL TUNNEL SYNDROME

- **3.8% of the general population and up to 9.0% of Women**
- **The most common upper extremity entrapment neuropathy**
- **90% of all compressive neuropathies**
- **Estimated \$2 billion per year financial burden to society**

# **RISK FACTORS FOR CARPAL TUNNEL SYNDROME**

**Obesity**

**Diabetes**

**Pregnancy**

**Hypothyroidism**

**Rheumatoid Arthritis**

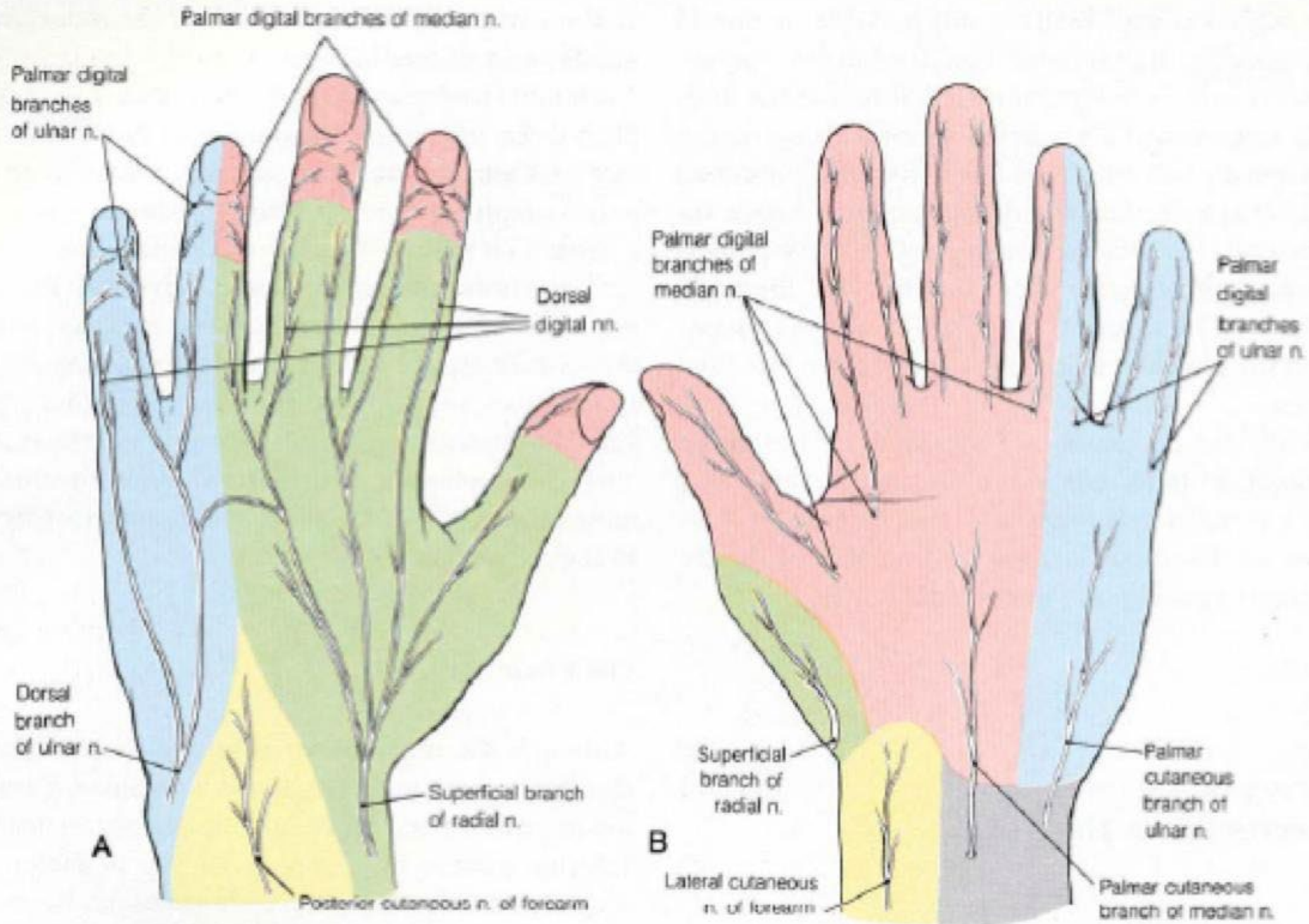


# SYMPTOMS OF CARPAL TUNNEL SYNDROME

- Motor, Sensory and Autonomic Impairments
- Pain (especially at night) and Tingling
- Intrinsic Hand Weakness
- Reduced Grip Strength
- Alteration of Temperature Control

# **CARPAL TUNNEL SYNDROME PHYSICAL EXAM**

- **Tinel's Sign**
- **Phalen's Test**
- **Carpal Compression Test**
- **Pinch Grip (thumb and 5<sup>th</sup> finger)**
- **Sensory Examination – pin wheel**



Ulnar n.

Radial n.

Median n.

3-110 The cutaneous innervation of the dorsal (A) and palmar (B) surfaces of the hand.

# Phalen's Test



# Reverse Phalen's Test



# ULTRASOUND DIAGNOSIS OF CARPAL TUNNEL SYNDROME

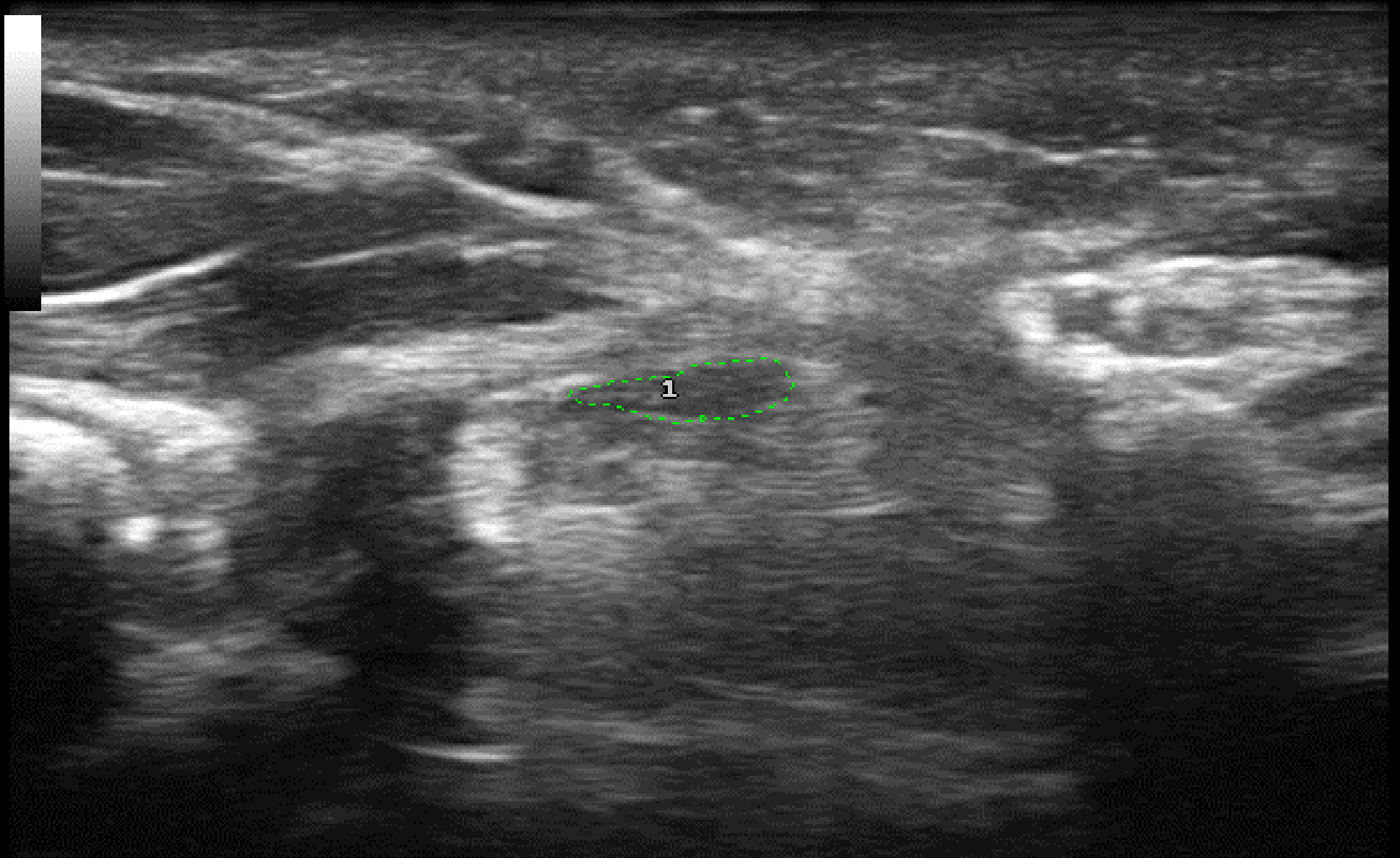
- CSAc(Cross Sectional Area crease)  $>10 \text{ mm}^2$
- **WFR(Wrist-Forearm Ratio)  $>1.2$**
- Enlarged Median N. proximal to the Carpal Tunnel inlet in longitudinal view(Notch Sign, or Dumbell Sign)
- **Bowing of the Flexor Retinaculum at the Scaphoid-Pisiform level**
- Distal flattening of the Median N. in the Carpal Tunnel
- **Decreased mobility of Median N. on dynamic imaging**

B F 18 MHz G 70%  
D 3 CM XV C  
PRC 9-5-H PRS 5  
PST 4 MV 2

WRIST LA435

A1 7 mm<sup>2</sup>  
P 1.39 CM

Proximal  
Carpal Tunnel  
- Normal

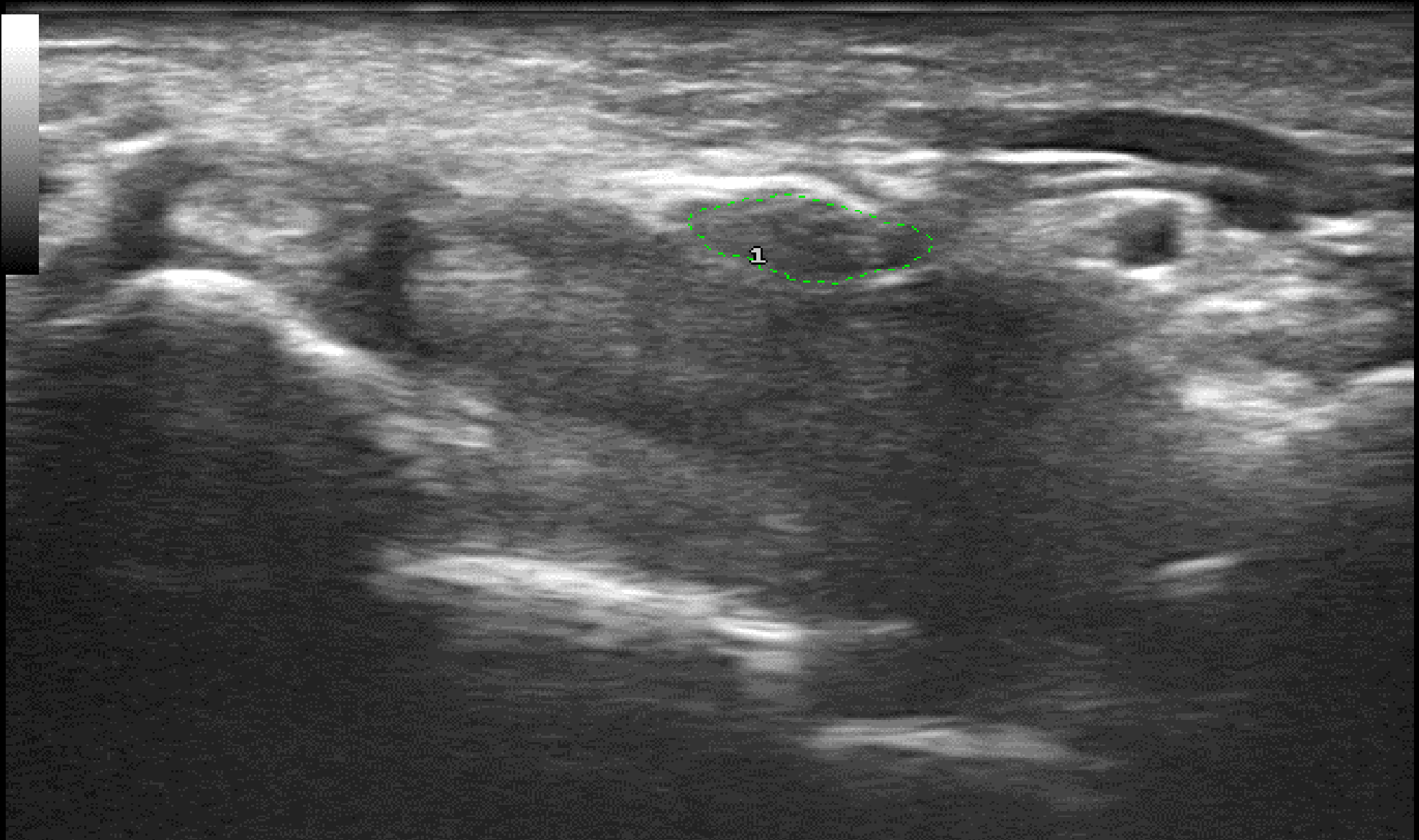


U 18 MHz G 70%  
PRC 3 CM XV C  
PST 4 9-5-H PRS 5  
MV 2

WRIST LA435

A1 12 mm<sup>2</sup>  
P 1.55 cm

**Proximal  
Carpal Tunnel  
- Abnormal**



LEFT



# THE ROLE OF ULTRASOUND IN THE DIAGNOSIS AND MANAGEMENT OF CARPAL TUNNEL SYNDROME : A NEW PARADIGM

AUTHORS: MCDONAGH C, ALEXANDER M, KANE D.  
RHEUMATOLOGY (OXFORD), 2015 JAN;54(1):9-19.

**NERVE CONDUCTION – SENSITIVITY > 85%**

**ULTRASOUND – SENSITIVITY UP TO 97.9%**

**SPECIFICITY WAS SIMILAR WITH BOTH PROCEDURES**

TEST **SENSITIVITY** - THE ABILITY OF A TEST TO CORRECTLY IDENTIFY THOSE WITH THE DISEASE (TRUE POSITIVE RATE).

TEST **SPECIFICITY** - THE ABILITY OF THE TEST TO CORRECTLY IDENTIFY THOSE WITHOUT THE DISEASE (TRUE NEGATIVE RATE).



**DIAGNOSTIC ULTRASOUND  
FOR  
CARPAL TUNNEL SYNDROME**

**Patient Demonstration**

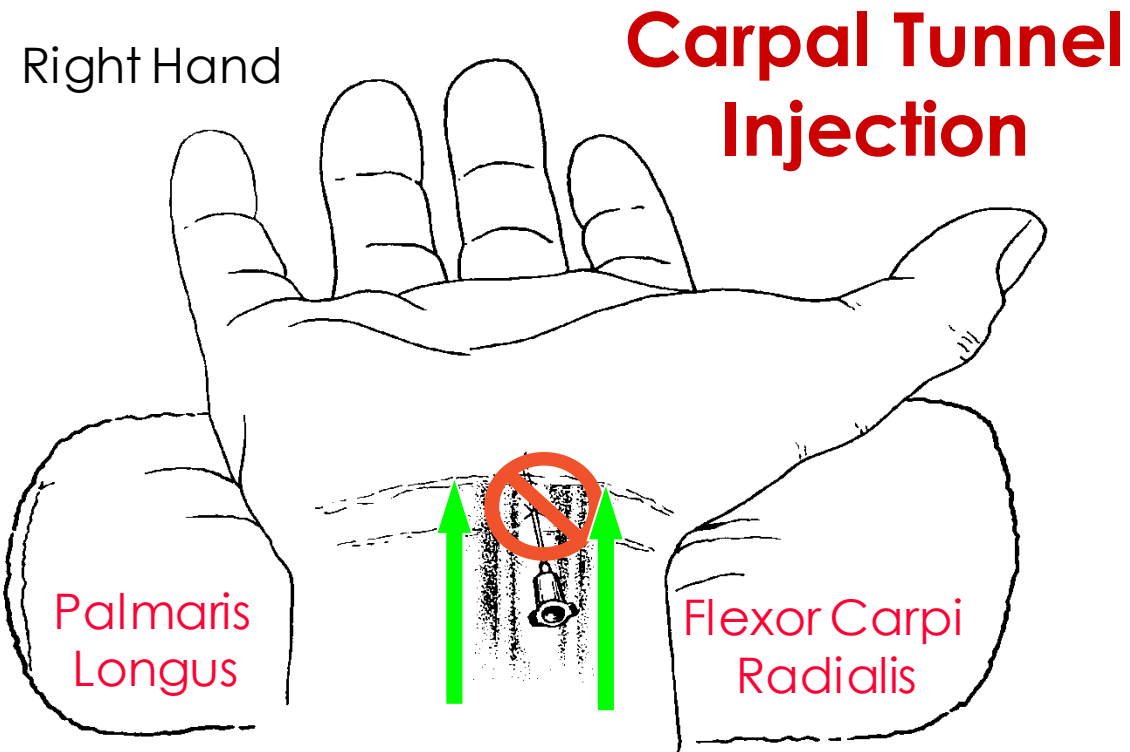


Fig. 6-5. Injection of the median carpal tunnel, the wrist dorsiflexed over a rolled towel.

N.B. - Inject in line with the radial aspect of the 3<sup>rd</sup> and 4<sup>th</sup> fingers.

# CANDIDATES FOR ULTRASOUND GUIDED CARPAL TUNNEL HYDRODISSECTION

- Carpal Tunnel Surgical Failures
- **Pregnant Women**
- Poor Surgical Risks: eg. Elderly patient with multiple medical problems
- **Reasonable Alternative for Conservative Treatment Failures**
- Alternative for Patients Refusing Surgery
- **Aid in Diagnosis in Select Patients**

# BENEFITS OF ULTRASOUND GUIDED CARPAL TUNNEL HYDRODISSECTION

- Overall Safety
- **Better than Non-Imaged Guided**
- Accuracy of Medication Placement
- **Ease of Performance**
- Lower Level of Invasiveness than Surgery
- **Lower Cost vs. Surgical Release**
- Shorter Recovery Period
- **Effectiveness**

# CARPAL TUNNEL HYDRODISSECTION

**Goal – Decrease pressure on the median nerve from the flexor retinaculum and decrease inflammation of the median nerve and underlying flexor tendons**

**27G - 1 ½ inch needle - 8 ml of fluid with Kenalog - 40 (0.5 to 1.0 ml)**

**Ultrasound Guided – Transverse position of the probe**

**Local skin anesthesia optional**

**Maintain slight extension of the wrist**

**Supine position**

**Inject in distal direction**

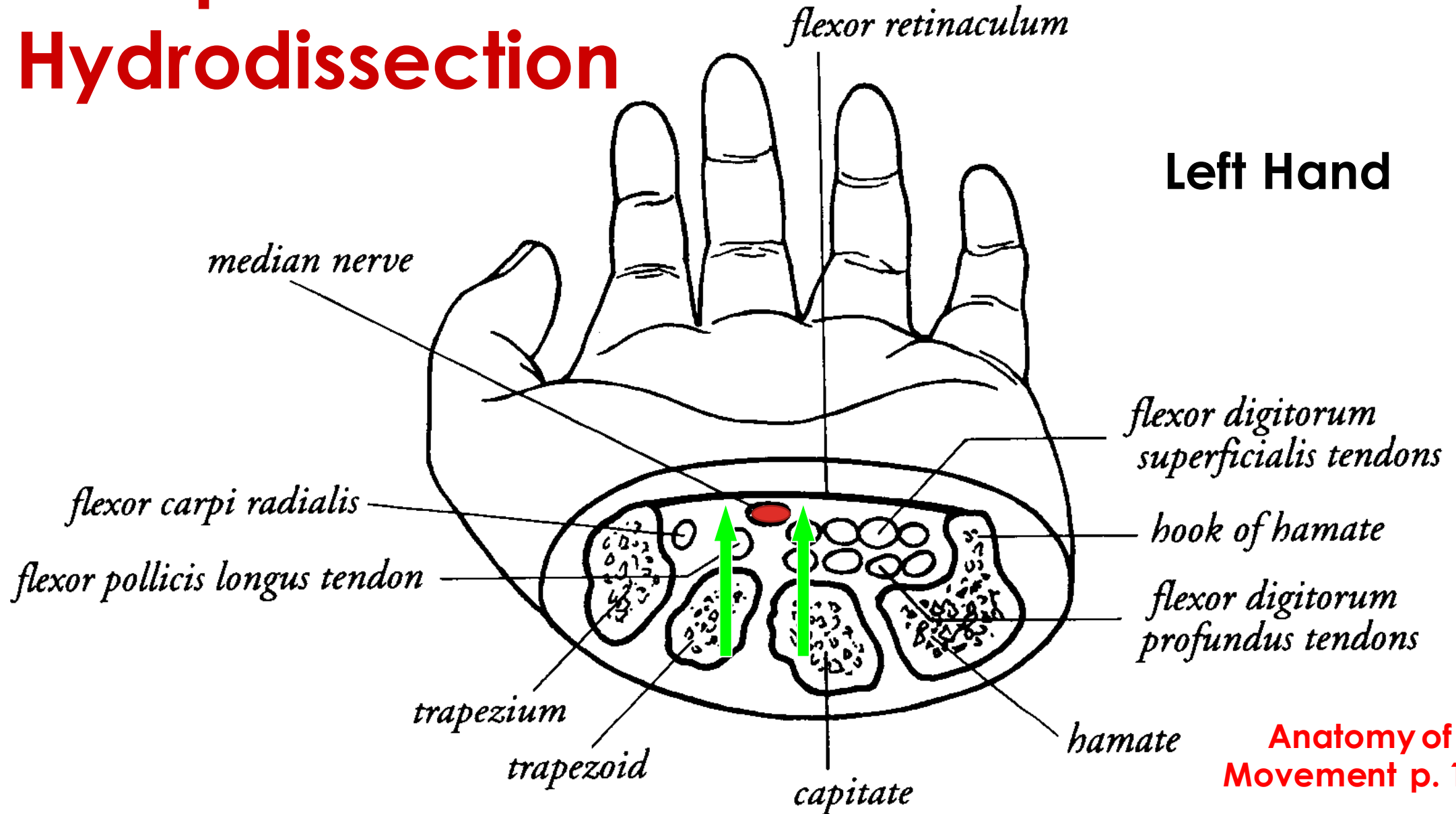
**Inject along the Radial and Ulnar aspects of the nerve**

**Start approx. 1.0 cm proximal to the wrist crease and aim for radial aspect of the 3<sup>rd</sup> and 4<sup>th</sup> fingers**

**Almost horizontal injection – the needle travels parallel to the tendons and nerve**

# Carpal Tunnel Hydrodissection

Left Hand



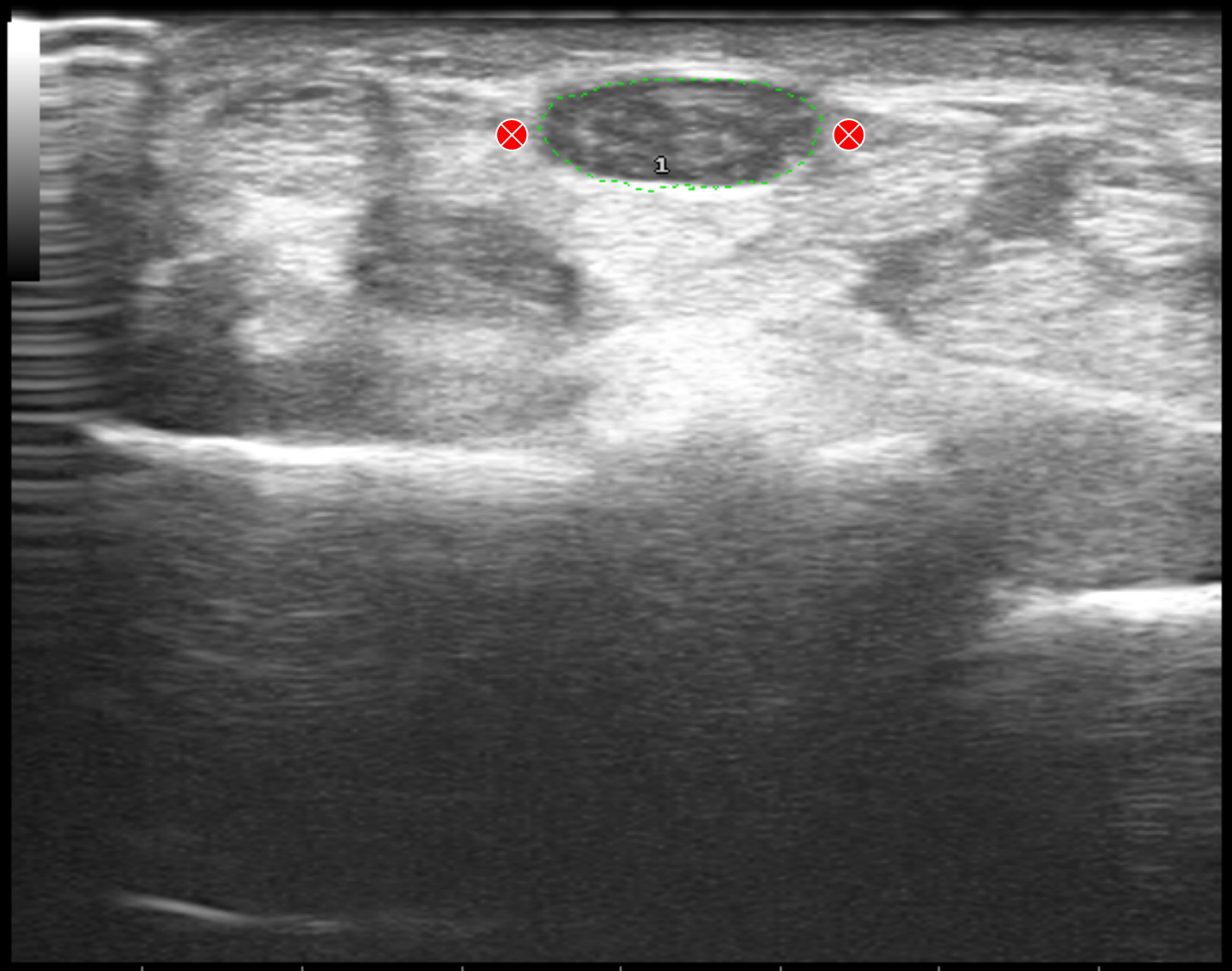
**Anatomy of  
Movement p. 151**



B F 18 MHZ G 70%  
D 3 CM XV C  
PRC 9-5-H PRS 5  
PST 4 MV 2

WRIST LA435

A1 24 mm<sup>2</sup>  
P 2.15 CM



# OTHER INJECTION TECHNIQUES

**Recommendations for the best technique still being developed.**

Smith J, Wisniewski SJ, Finnoff JT, Payne JM. Sonographically Guided Carpal Tunnel Injections: The Ulnar Approach. *Journal of Ultrasound Medicine*. 2008, Oct, 27(10);1485-90.

**- uses an ulnar approach**

Malone D, Clark T, Wei N. Ultrasound Guided Percutaneous Injection, Hydrodissection, and Fenestration for Carpal Tunnel Syndrome: Description of a New Technique. *The Journal of Applied Research*. 2010, 10(3);116-123.

**- includes fenestration of the flexor retinaculum**

# CARPAL TUNNEL HYDRODISSECTION CASE STUDY

66 y.o. female – c/o recurrence of discomfort, numbness, tingling in the right hand.

S/P Carpal Tunnel Surgery on Right in 1999, Left 1996.

**4/27/18:** Dx Ultrasound on the Right consistent with CTS

Exam: mild tenderness, Phalen test equivocal, Pinch grip negative

**5/17/18:** Carpal Tunnel Hydrodissection – 40 mg Kenalog with D5W – 6 ml total.

**6/21/18:** F/U – Significantly improved. Tingling and numbness much better. c/o Mild recurrence of symptoms with activity.

**2/11/19:** F/U – Remains improved. Essentially pain free. Occasional tingling only.



**QUESTIONS**

**ABOUT**

**CARPAL TUNNEL SYNDROME ?**

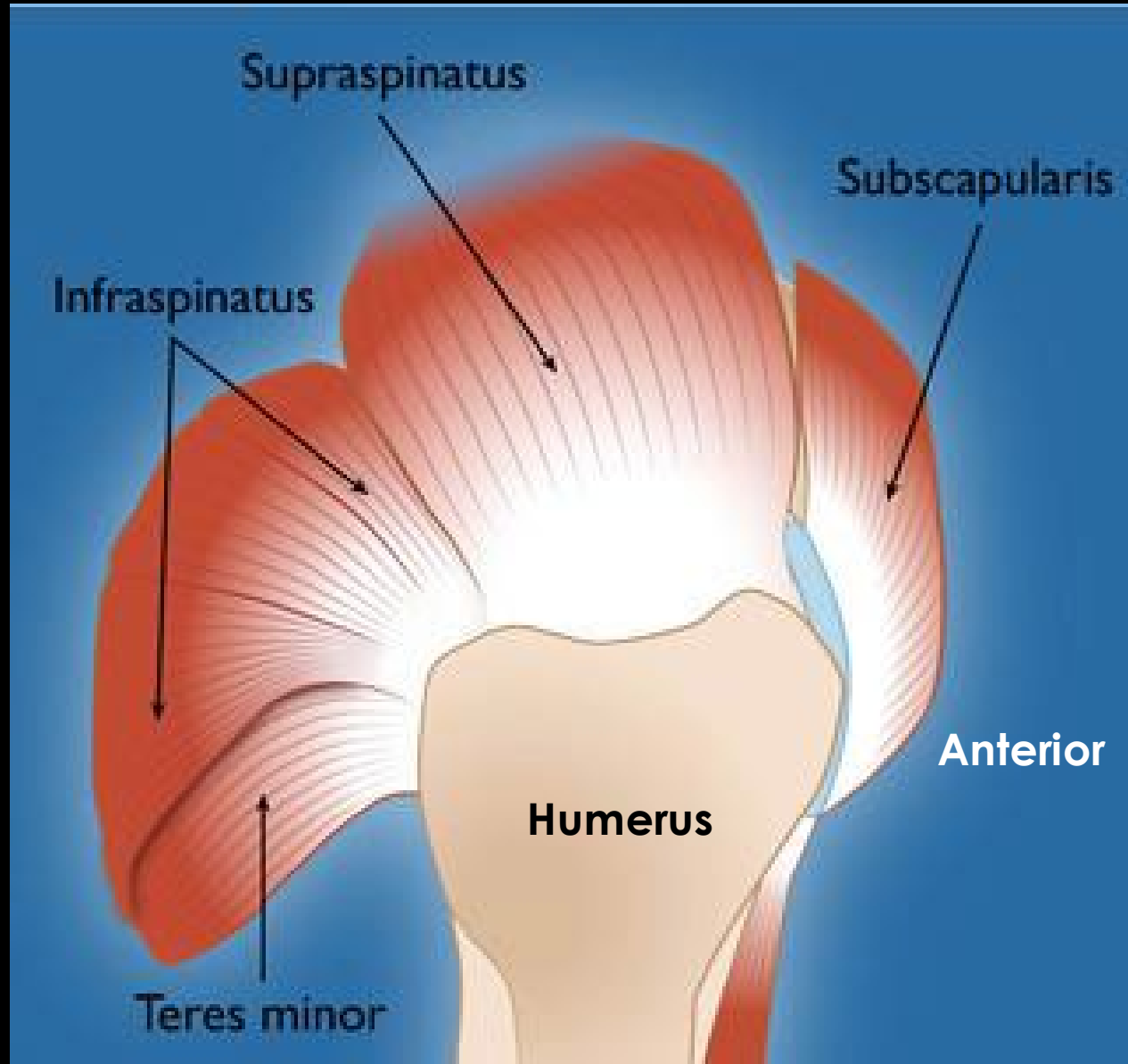


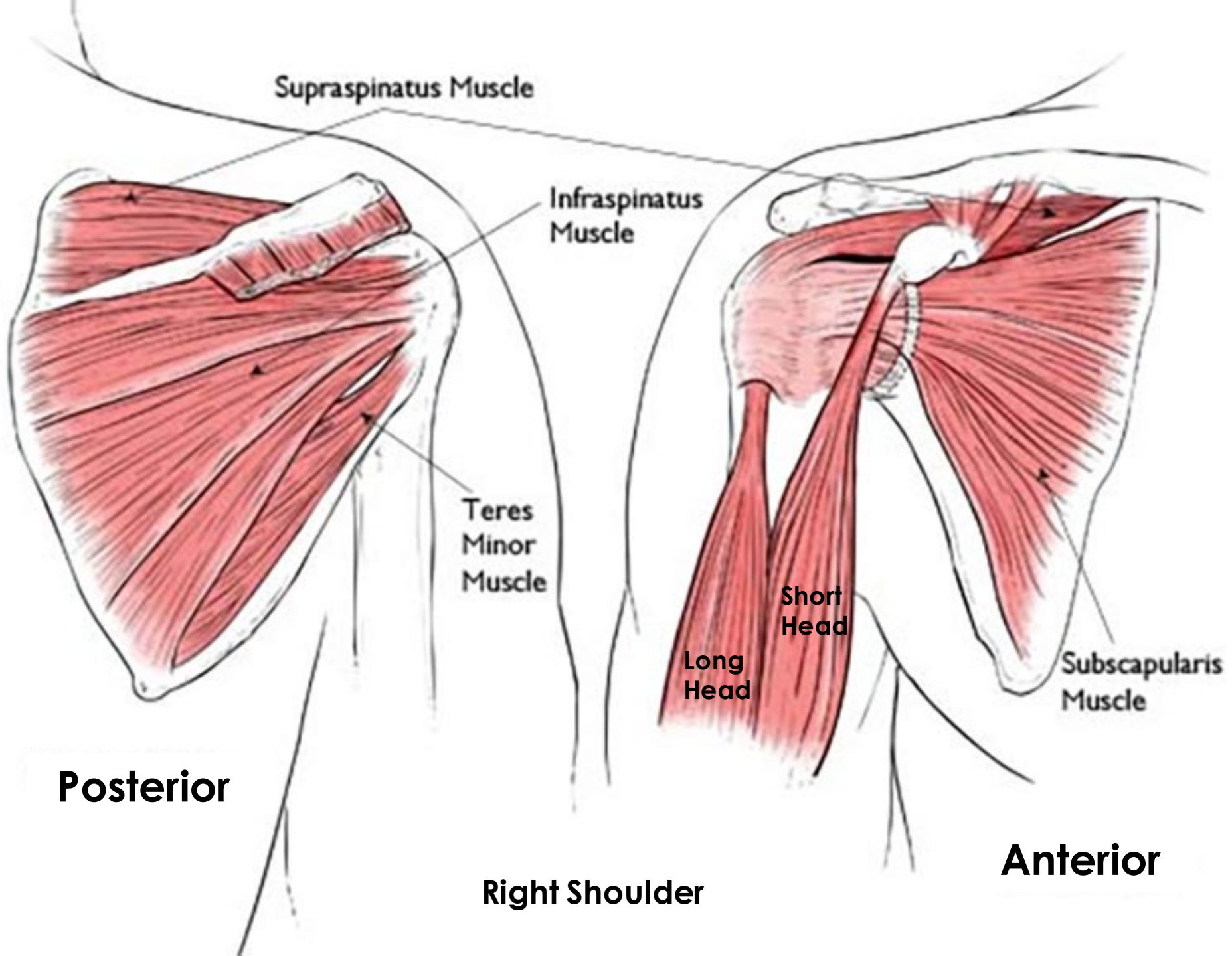
**DIAGNOSTIC ULTRASOUND**

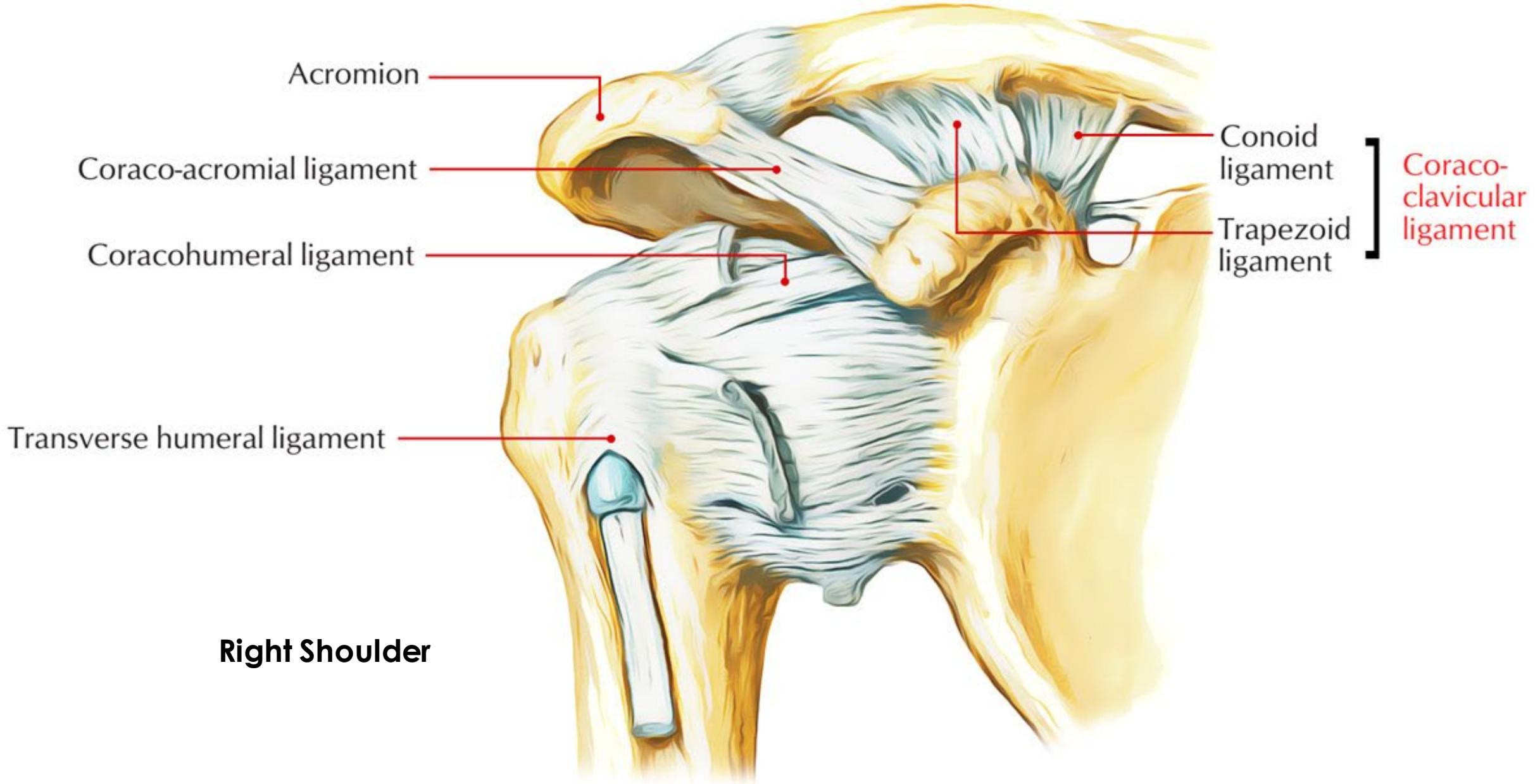
OF THE

**SHOULDER**

# Rotator Cuff – Right Shoulder







Acromion

Coraco-acromial ligament

Coracohumeral ligament

Transverse humeral ligament

Conoid ligament

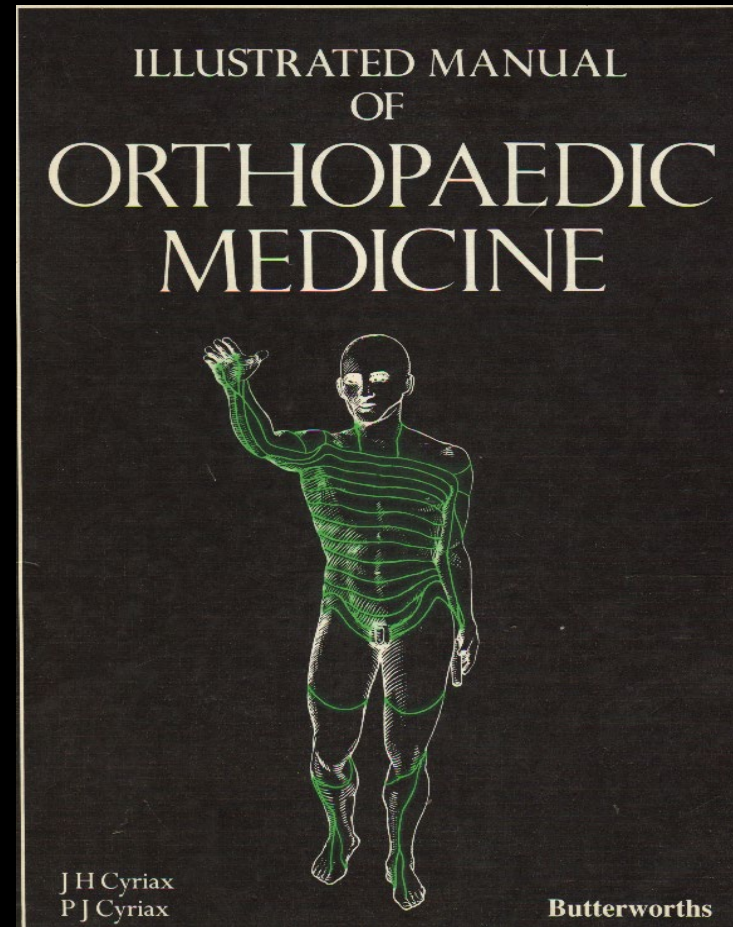
Trapezoid ligament

Coraco-clavicular ligament

**Right Shoulder**



# Dr. James H. Cyriax, M.D., M.R.C.P.



# The shoulder

## Summary

A straightforward joint producing clear findings. History of little importance diagnostically. Exclude neck as source of pain before proceeding to examination of shoulder. Nearly all shoulder structures are of C5 derivation.

For convenience, the acromio- and sternoclavicular joints are included in the following table.

## Examination

*Active elevation I:* willingness.

*Passive elevation:* joint capsule, psychogenic limitation.

*Active elevation II:* painful arc (lesion lies in a pinchable position).

*Passive abduction:* glenohumeral range (cf active elevation I).

*Passive lateral rotation:* joint capsule.

*Passive medial rotation:* joint capsule.

*Resisted abduction:* supraspinatus.

*Resisted adduction:* pectoralis major, latissimus dorsi (both rare).

*Resisted lateral rotation:* infraspinatus.

*Resisted medial rotation:* subscapularis.

*Resisted elbow flexion:* biceps.

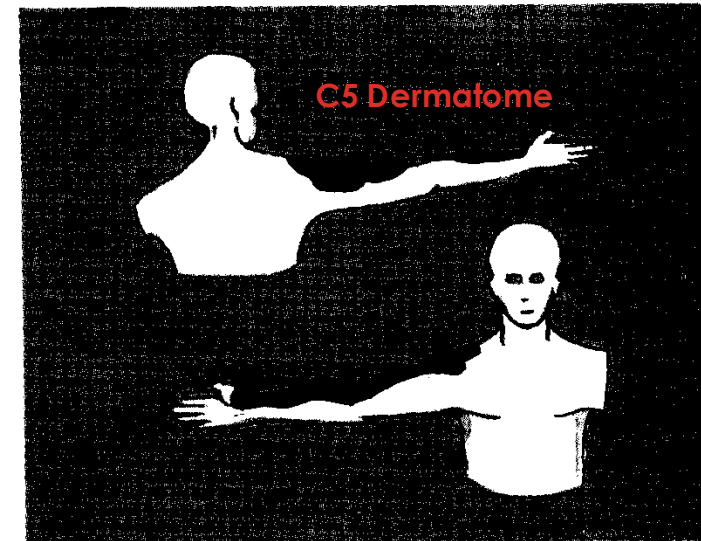
*Resisted elbow extension:* triceps (rare).

## Capsular pattern

Some limitation of medial rotation (except in a very mild case), greater limitation of passive abduction, greatest limitation of passive lateral rotation.

## End-feel

Hard on elevation suggests arthritis.



IV.1



# SHOULDER PHYSICAL EXAM

## DEMONSTRATION

# SHOULDER PHYSICAL EXAM

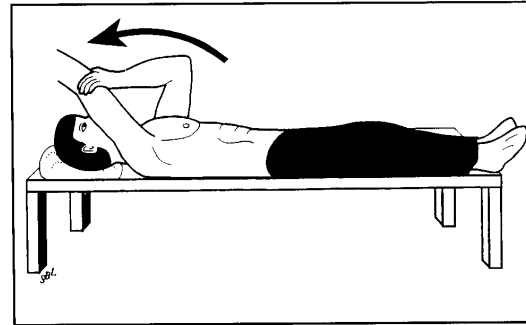
- Observation
- **Neck Motion**
- **Active** - Elevation
- **Passive** – **Abduction, Lateral Rotation, Medial Rotation**
- **Resisted** – Abduction / Adduction; Internal / External Rotation; Flexion / Extension
- **Empty Can test**
- Palpation – Rotator Cuff Tendons, A-C Joint, other
- **DTR's**
- Pulses

# RESULTS OF PASSIVE TESTING

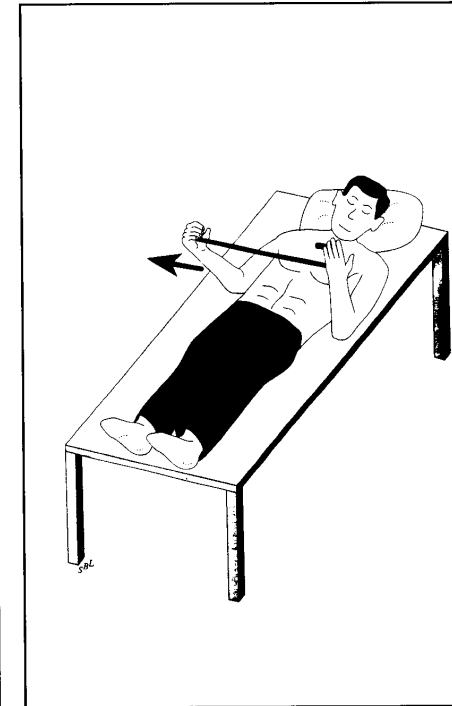
**Capsulitis** – Impaired  
Elevation and Lateral Rotation

**Rotator Cuff Pathology** – Impaired  
Elevation and normal Lateral Rotation

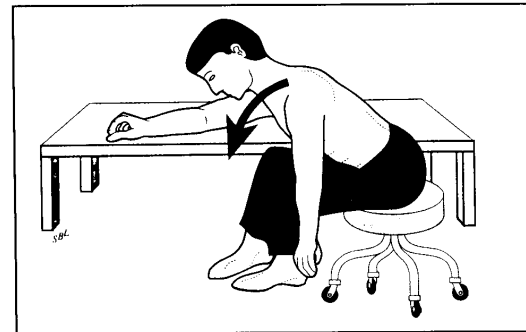
# STRETCHING EXERCISES



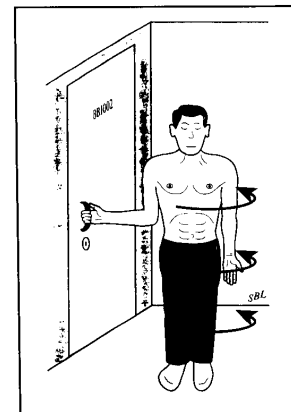
A Stretching in overhead reach using the opposite arm as the "therapist"



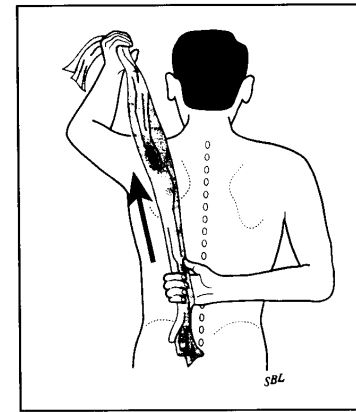
C Stretching in external rotation using the opposite hand as the "therapist"



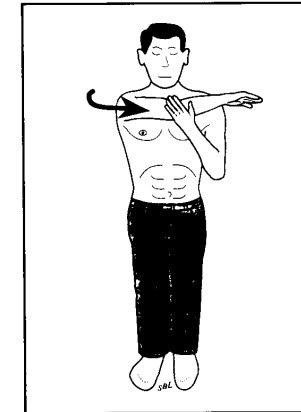
B Stretching in overhead reach using the progressive forward lean to apply a gentle elevation force to the arm



D Stretching in external rotation by turning the body away from a fixed object to apply a gentle stretching force



E Stretching in internal rotation using a towel to apply a gentle stretching force



F Stretching in cross-body reach using the opposite arm as the "therapist"

The Essentials of  
Musculoskeletal Care p. 99

Figure 3

University of Washington (Jackins) exercises for stiff shoulders

# RESULTS OF RESISTED TESTING

Resisted **ABDUCTION** - **SUPRASPINATUS**

Resisted **ADDUCTION** - **PECTORALIS MAJOR, LATISSIMUS DORSI**

Resisted **LATERAL ROTATION** – **INFRASPINATUS**

Resisted **MEDIAL ROTATION** – **SUBSCAPULARIS**

Resisted **ELBOW FLEXION** – **BICEPS**

Resisted **ELBOW EXTENSION** - **TRICEPS**

# ROTATOR CUFF PALPATION

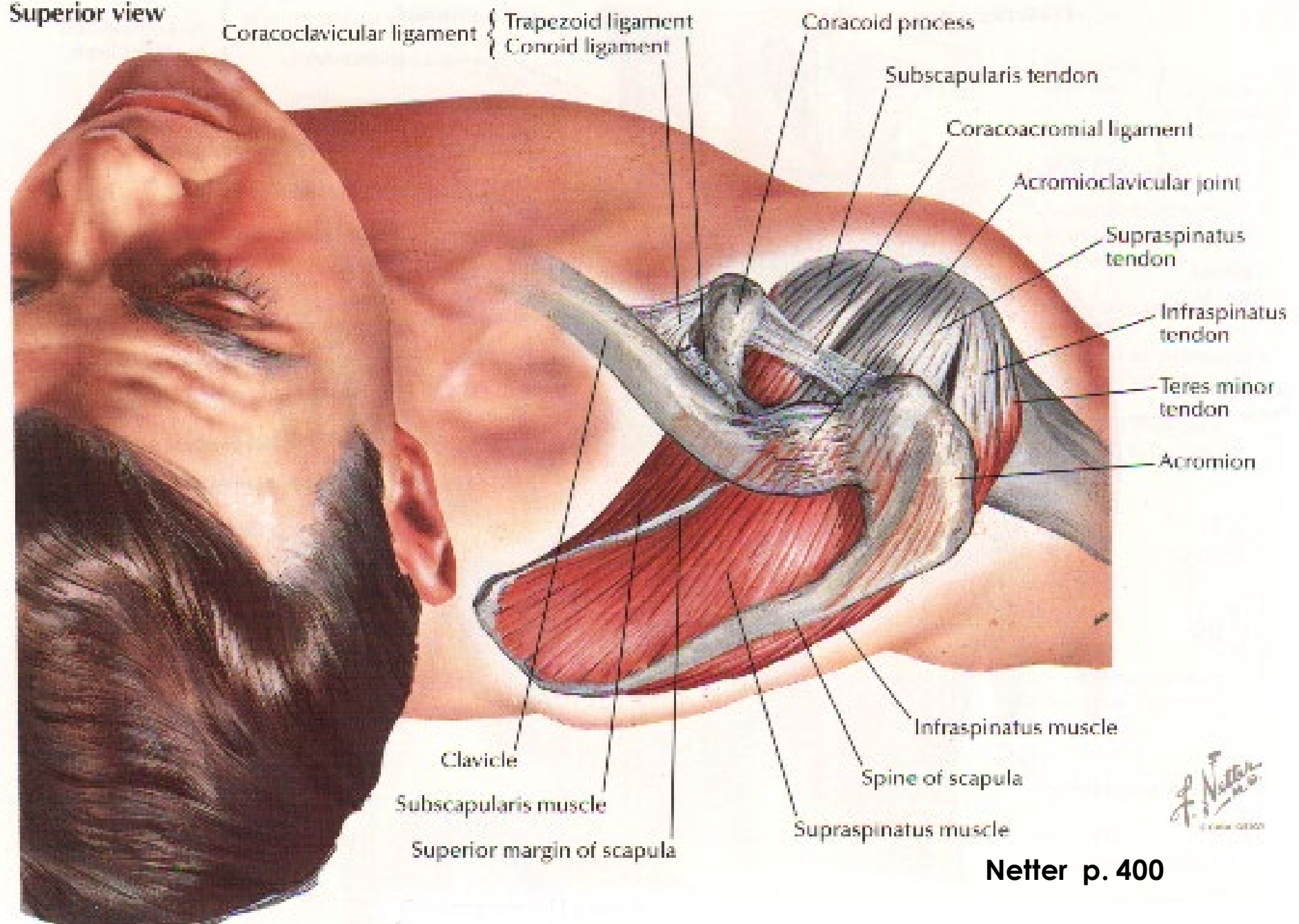
- **Supraspinatus** – Hand in back pocket
- **Subscapularis** – Elbow flexed and arm externally rotated
- **Infraspinatus** – Hand on opposite shoulder
- Other areas: A-C Joint, Biceps Tendon, Capsule, Coracoid, Etc.



# PALPATION OF THE SUPRASPINATUS TENDON



Superior view



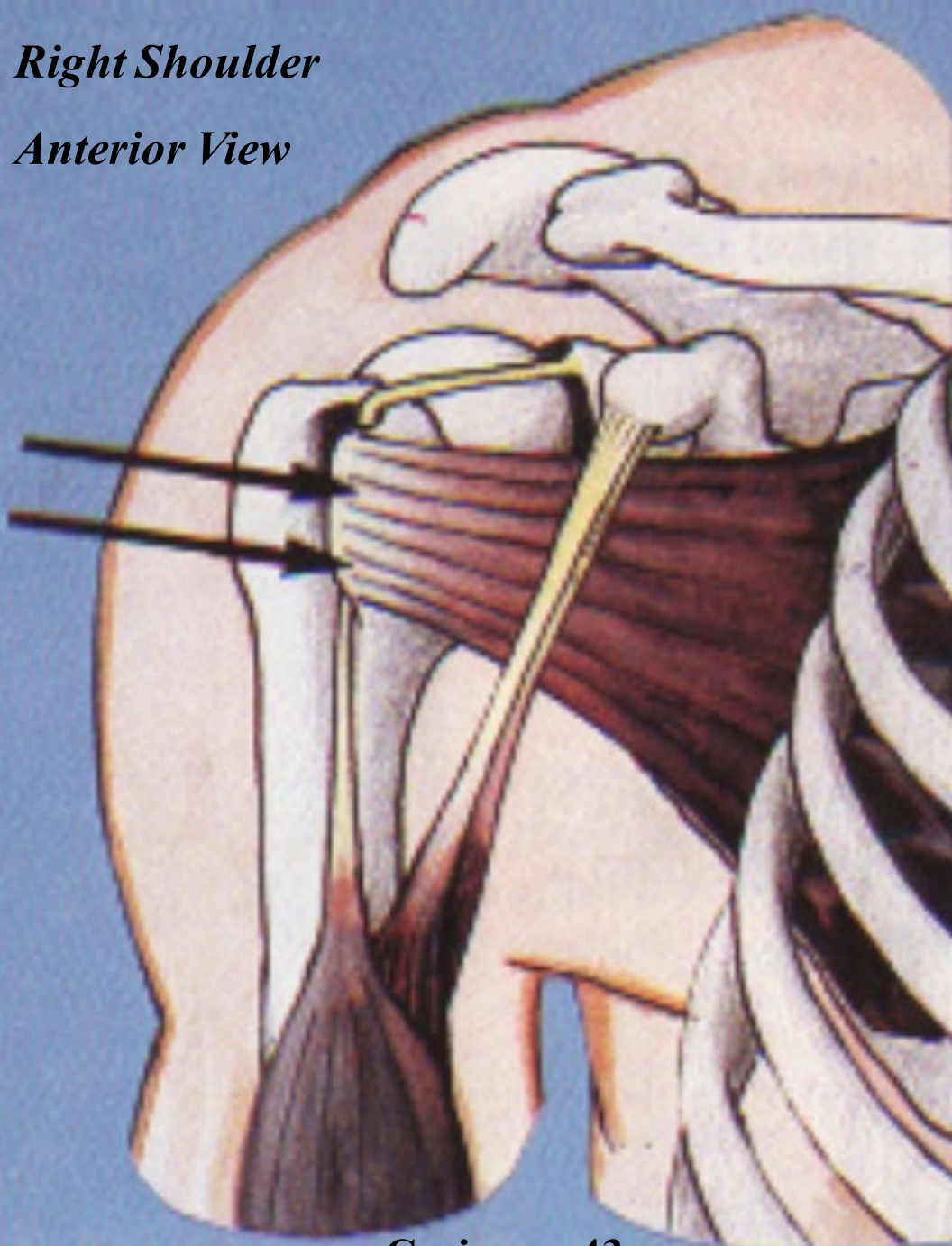
*F. Netter M.D.*  
© 2000

# PALPATION OF THE SUBSCAPULARIS TENDON



*Right Shoulder*

*Anterior View*



**SUBSCAPULARIS  
TENDON**

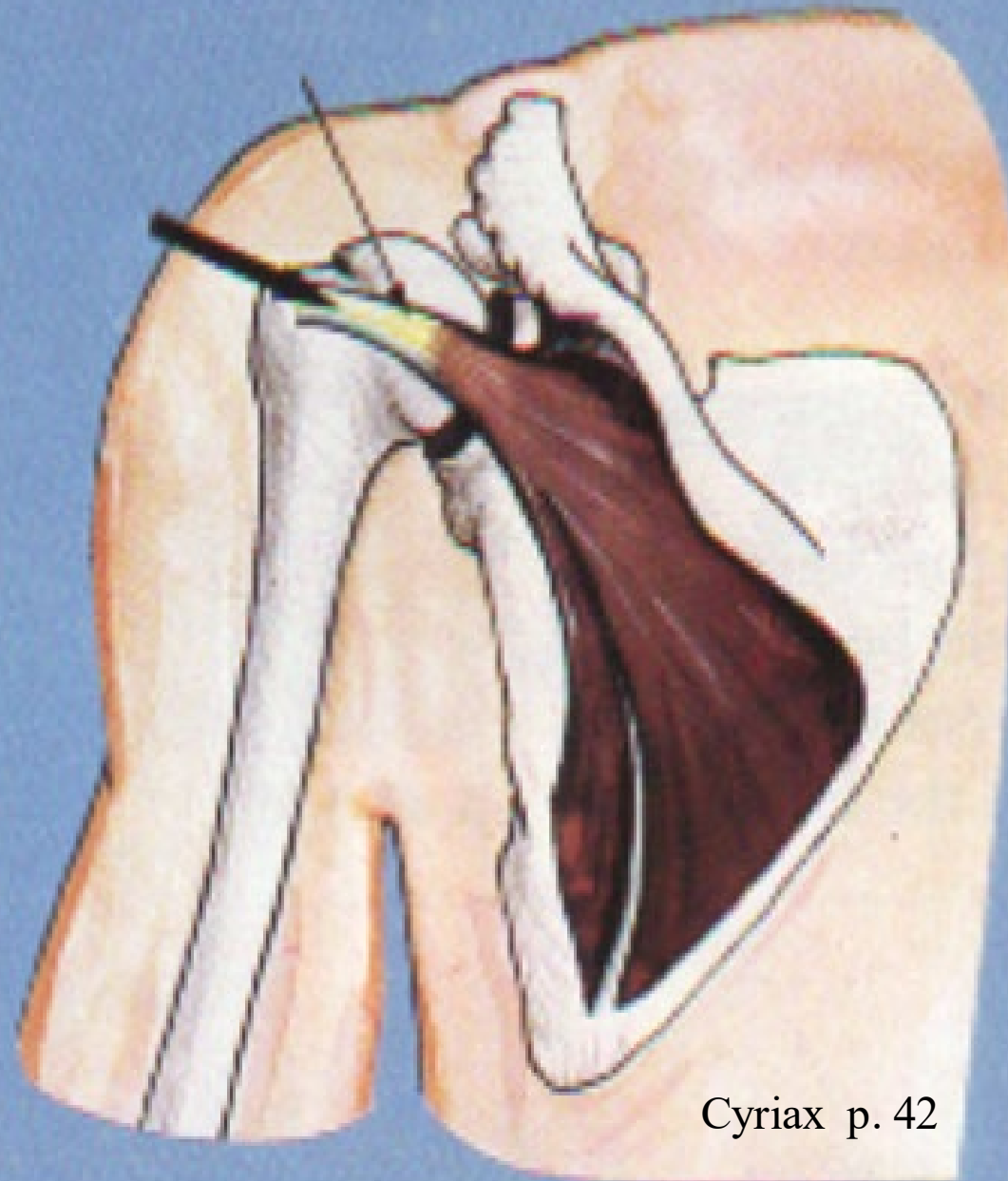
Cyriax p. 43

# PALPATION OF THE INFRASPINATUS TENDON



*Left Shoulder - Posterior View*

# Infraspinatus Tendon



Cyriax p. 42

# ROTATOR CUFF PALPATION

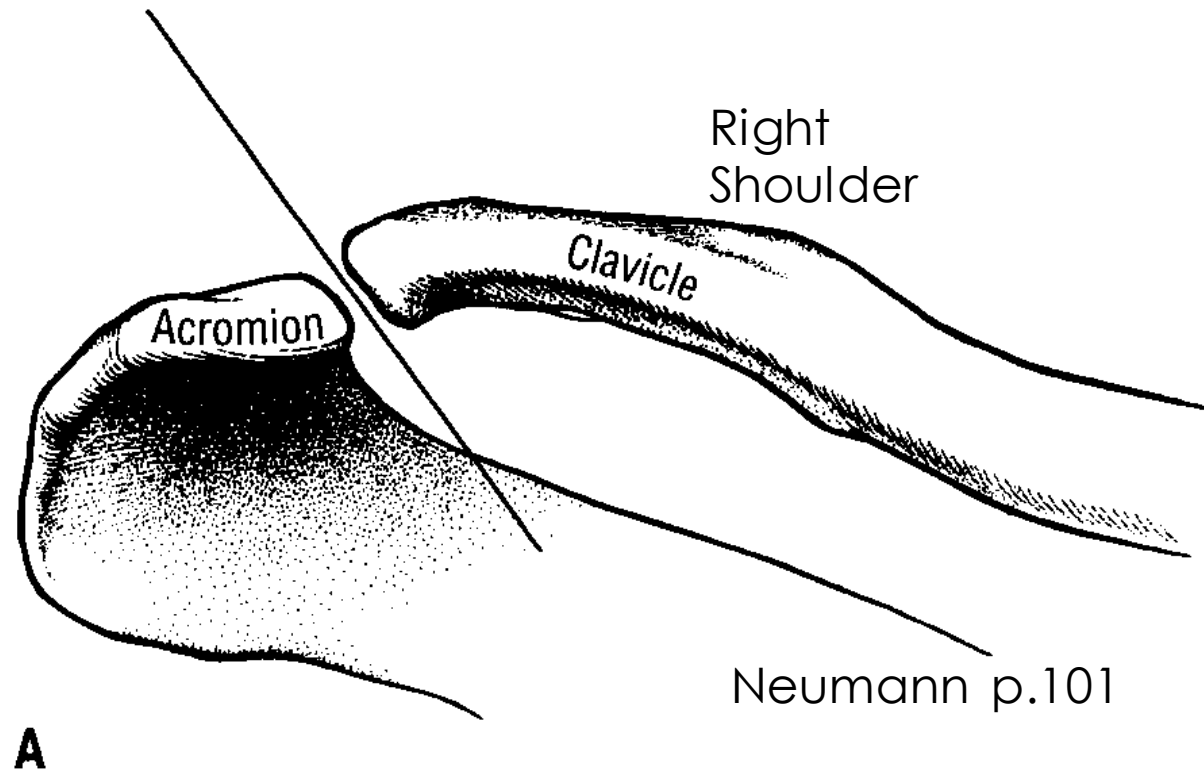
- **Supraspinatus** – Hand in back pocket
- **Subscapularis** – Elbow flexed and arm externally rotated
- **Infraspinatus** – Hand on opposite shoulder
- Other areas: A-C Joint, Biceps Tendon, Capsule, Coracoid, Etc.

# PALPATION OF THE A-C JOINT





# ORIENTATION OF THE A-C JOINT





## **A - C Joint Injection**

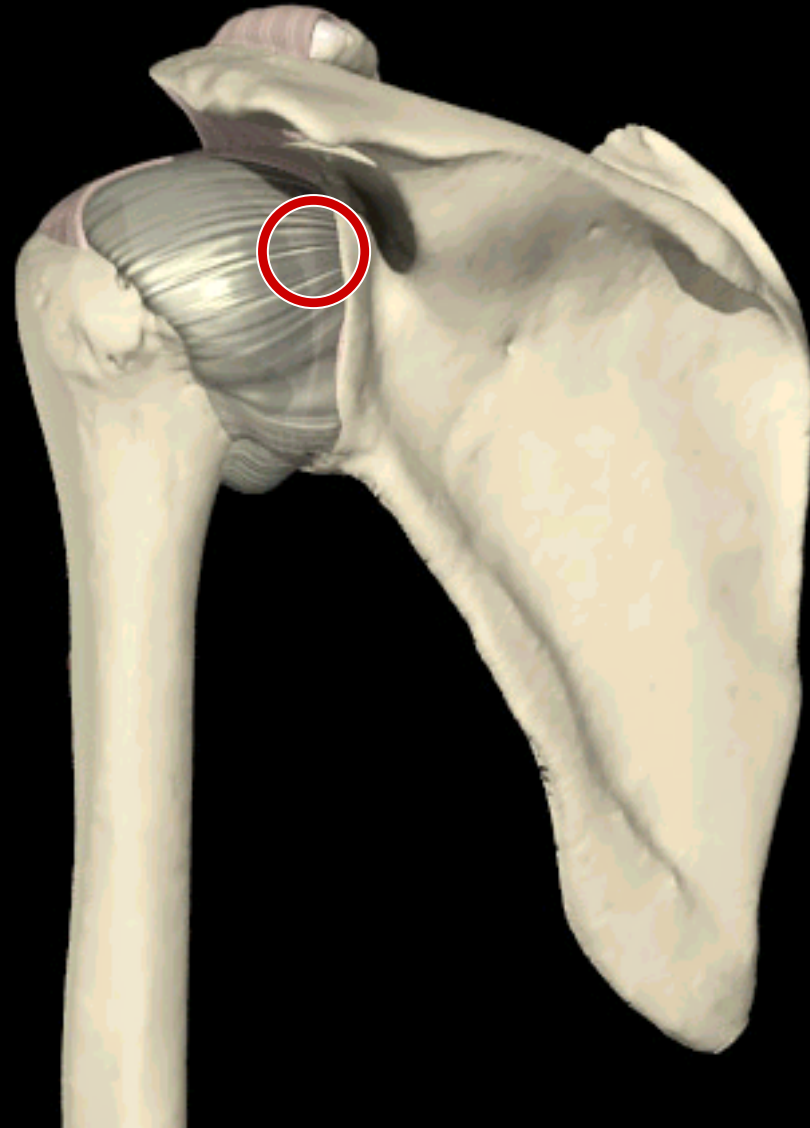
- Patient seated or lying on an incline
- Superior–Anterior approach

**27 gauge - 1.25 inch  
needle**

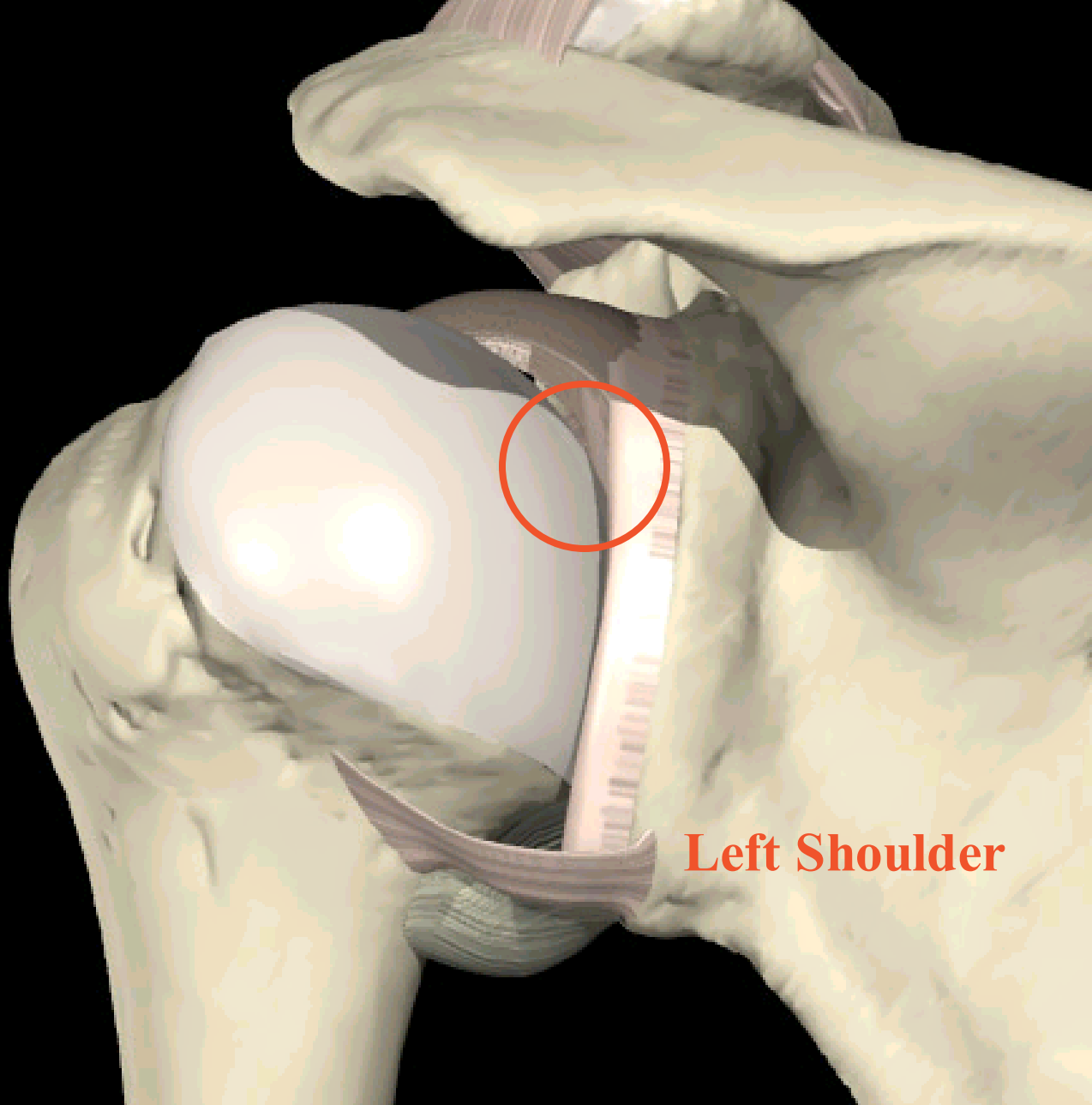
**2 cc's**

# GLENOHUMERAL JOINT INJECTION

Left Shoulder  
Posterior View

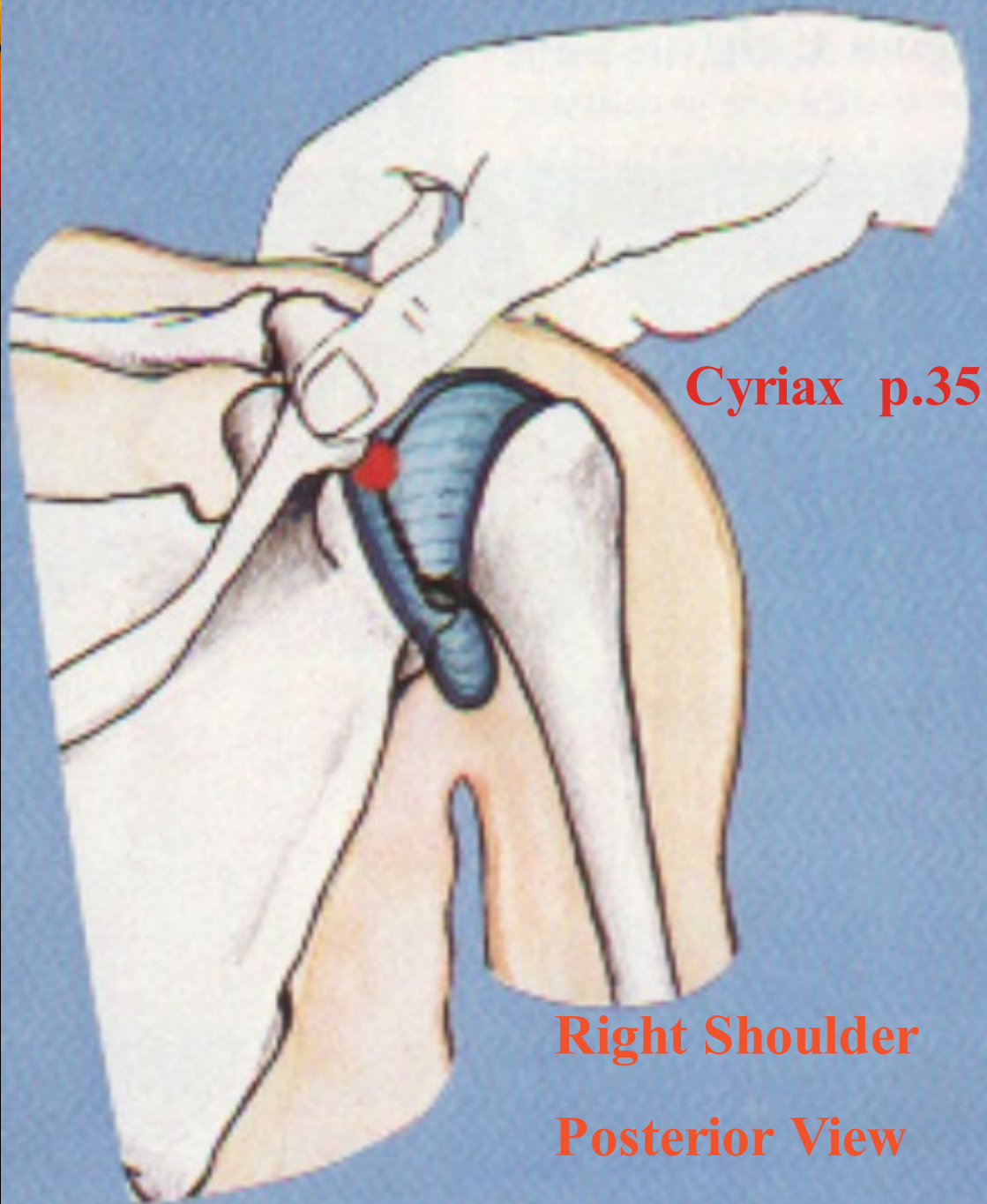


Interactive Shoulder © 2000 Primal Pictures  
Ltd.



**Left Shoulder**

Interactive Shoulder © 2000 Primal Pictures Ltd.



## **Glenohumeral Joint Injection**

**Patient seated with hand in lap**

**Posterior Approach**

**25 gauge 2 inch needle**

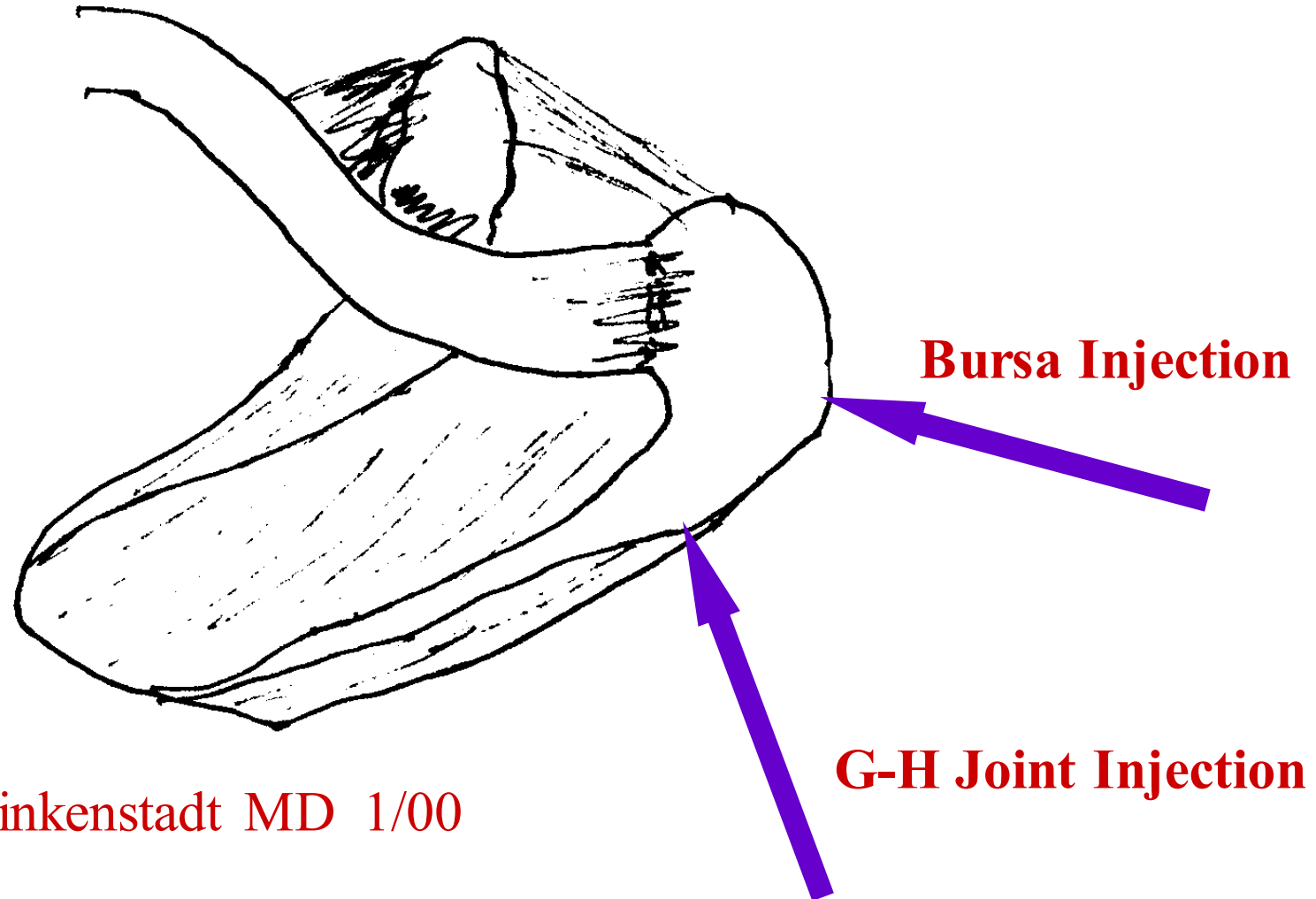
**5 to 10 cc's**

Index finger on the coracoid process

Thumb on the angle of the acromion

Insert needle on horizontal plane 1 to 2 cm inferior to angle of acromion

# Superior View Right Shoulder



John Finkenstadt MD 1/00



# ULTRASOUND EVALUATION OF THE SHOULDER

## MSMPC DIAGNOSTIC PROTOCOL

– See Handout



**DIAGNOSTIC ULTRASOUND  
OF  
THE SHOULDER**

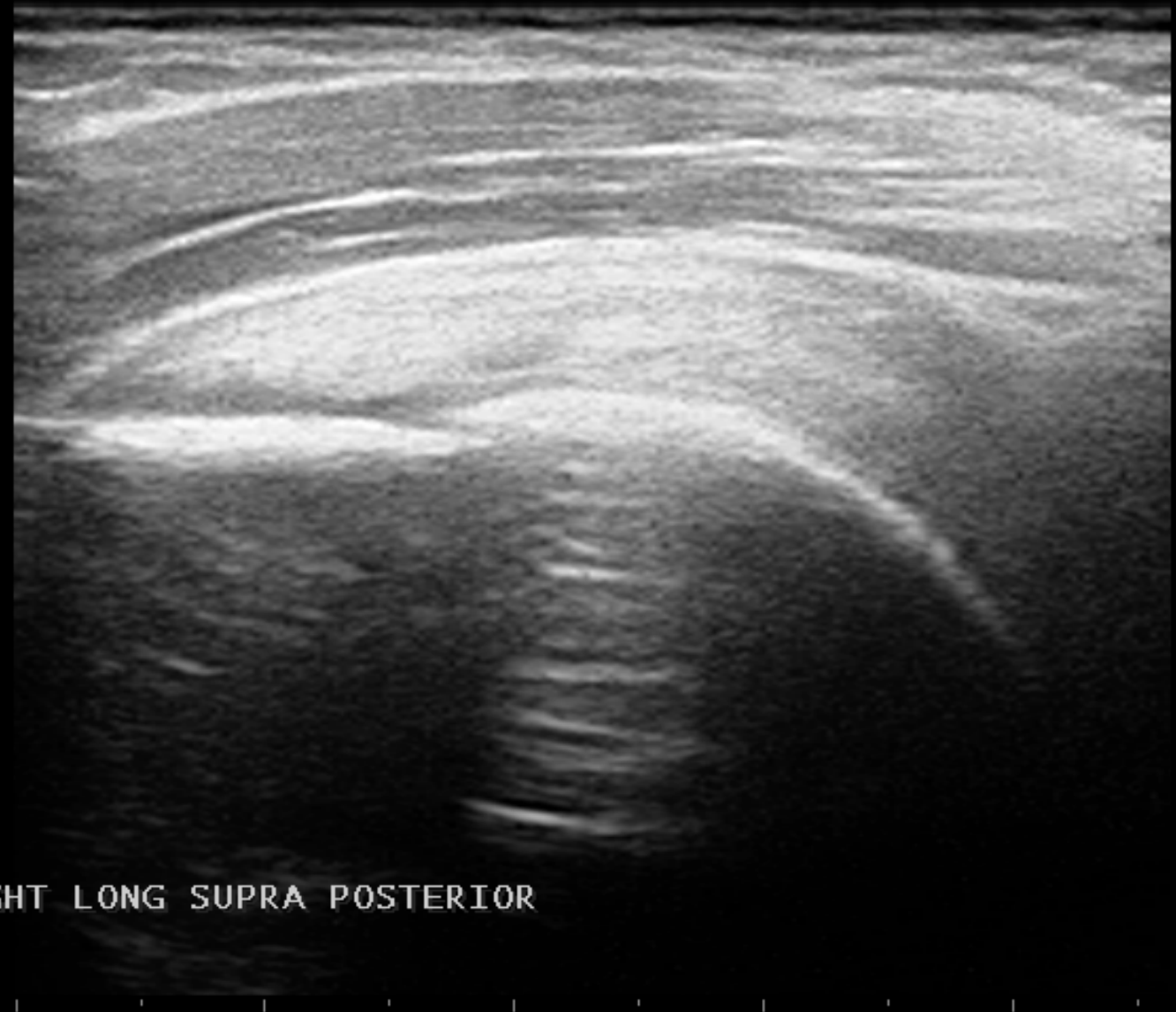
**Patient Demonstration**



B F 10 MHz G 70%  
D 4 cm XV C  
PRC 10-5-L PRS 5  
PST 4 MV 2

SHOULDER LA523

**Normal**



RIGHT LONG SUPRA POSTERIOR

B F 10 MHz G 70%  
D 4 cm XV C  
PRC 10-5-L PRS 5  
PST 4 MV 2

SHOULDER LA523

**Partial  
Tear**



RIGHT LONG SUPRA ANTERIOR

B F 10 MHz G 70%  
D 5 cm XV C  
PRC 10-5-L PRS 5  
PST 4 MV 2

SHOULDER LA523



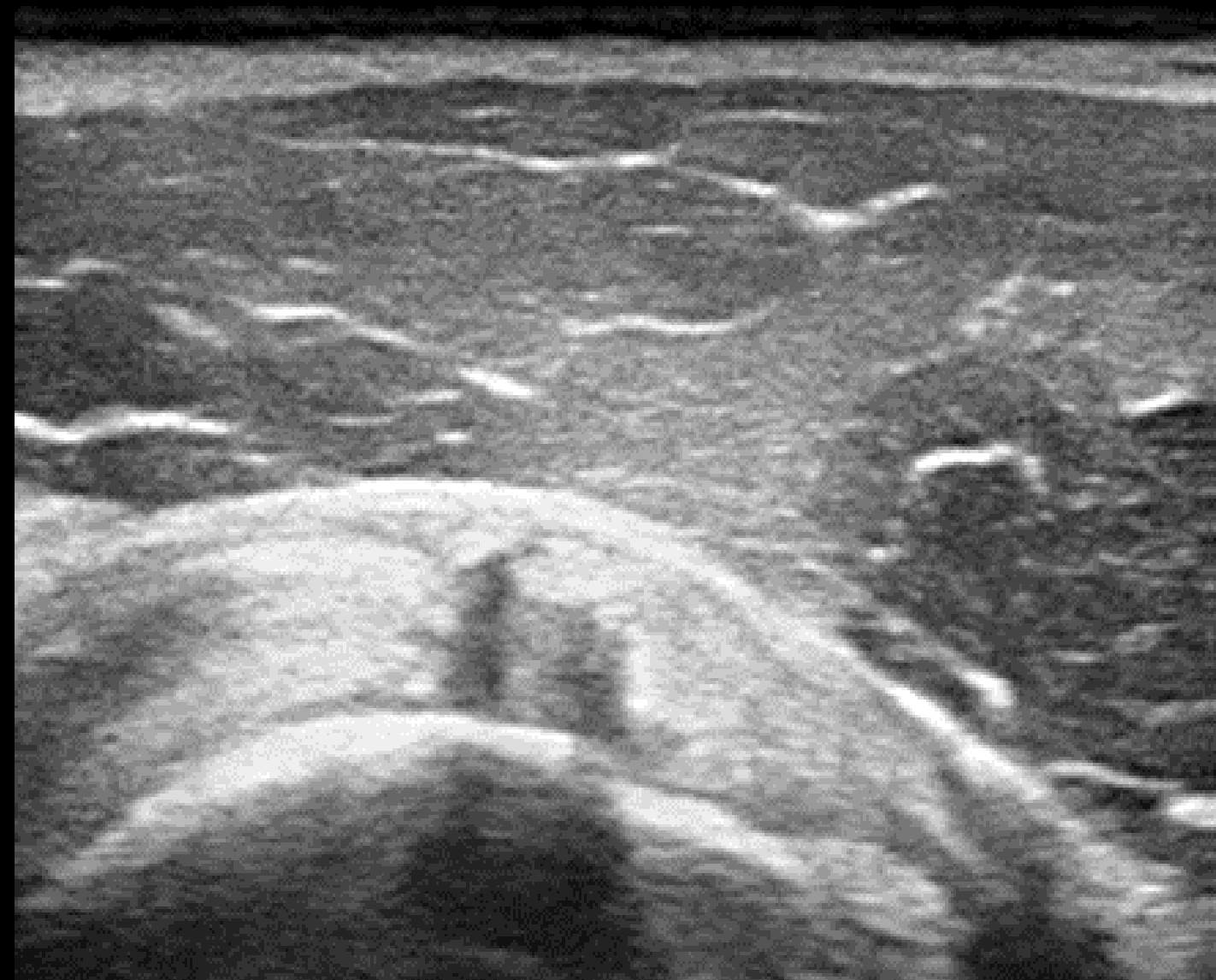
**Supraspinatus  
Longitudinal View**

**Partial Tear**



B F 10 MHz G 70%  
D 5 cm XY C  
PRC 10-5-L PRS 5  
PST 4 MV 2

SHOULDER LA523



**Supraspinatus  
Transverse View**

**Partial Tear**

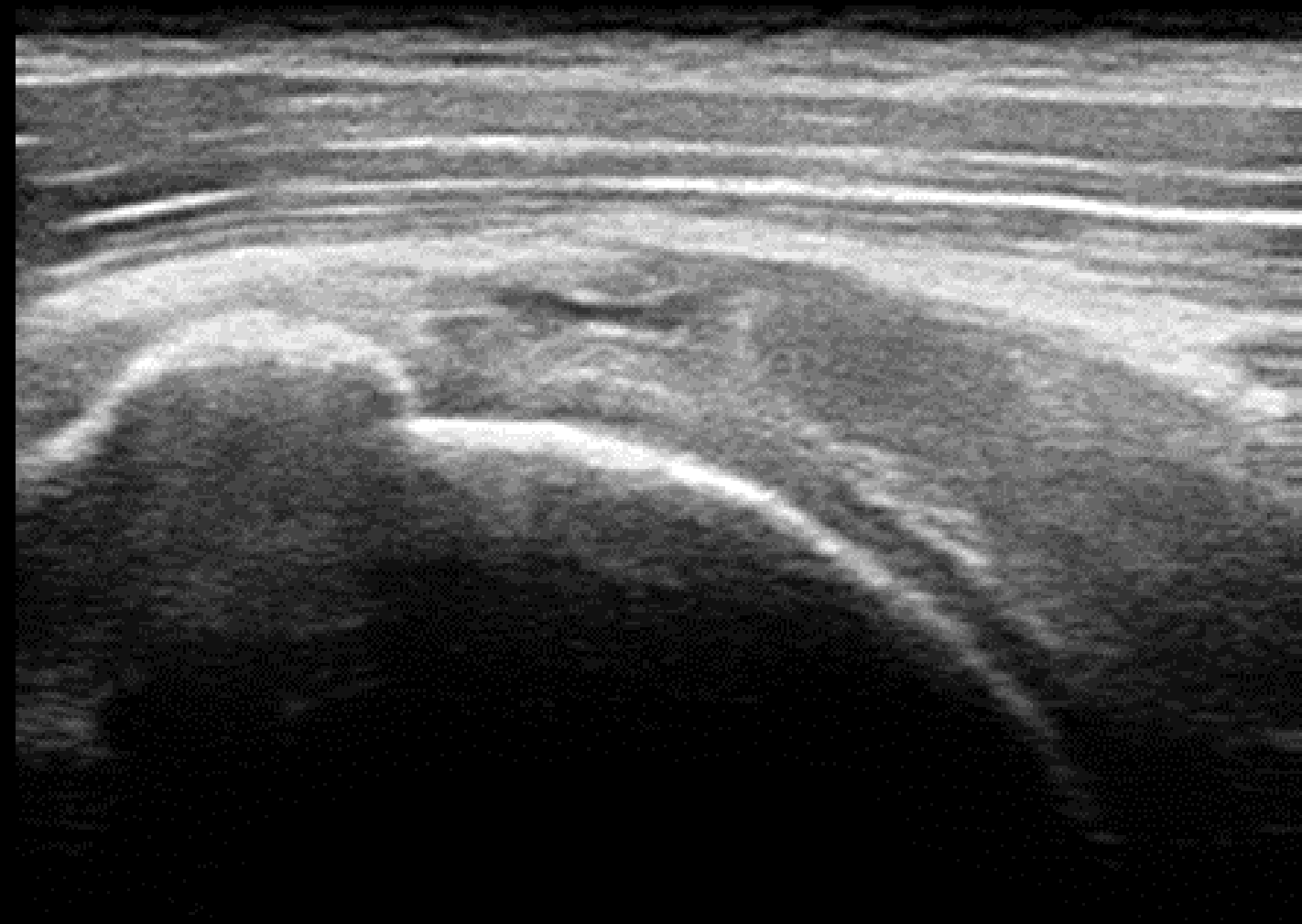
B F 10 MHz G 70%  
D 5 cm XV C  
PRC 10-5-L PRS 5  
PST 4 MV 2

SHOULDER LA523



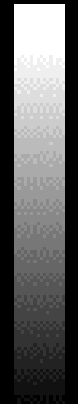
**Supraspinatus  
Longitudinal View**

**Partial Tear**



B F 10 MHz G 70%  
D 5 cm XV C  
PRC 10-5-L PRS 5  
PST 4 MV 2

SHOULDER LA523



**Supraspinatus  
Transverse View**

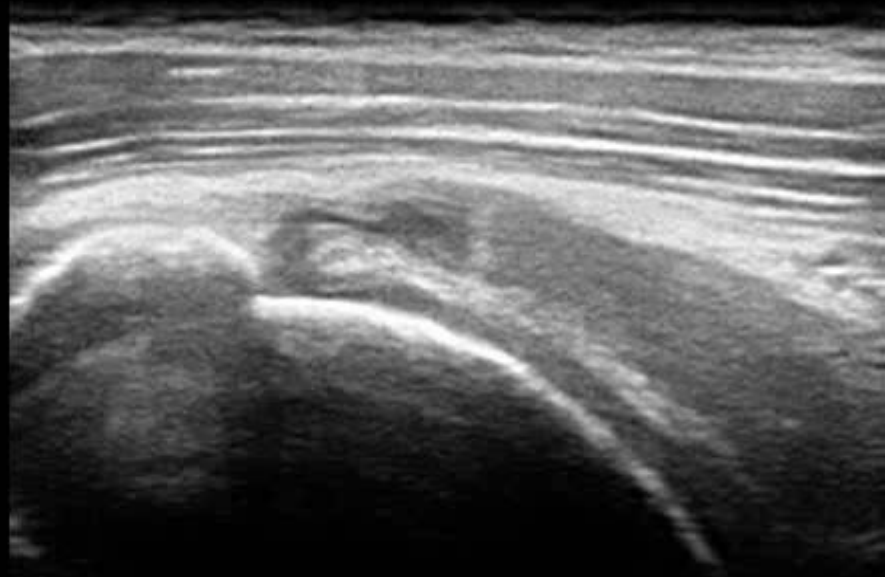
**Partial Tear**



B F 10 MHz G 70%  
D 5 cm XV C  
PRC 10-5-L PRS 5  
PST 4 MV 2

0:00:00.48

SHOULDER LA523

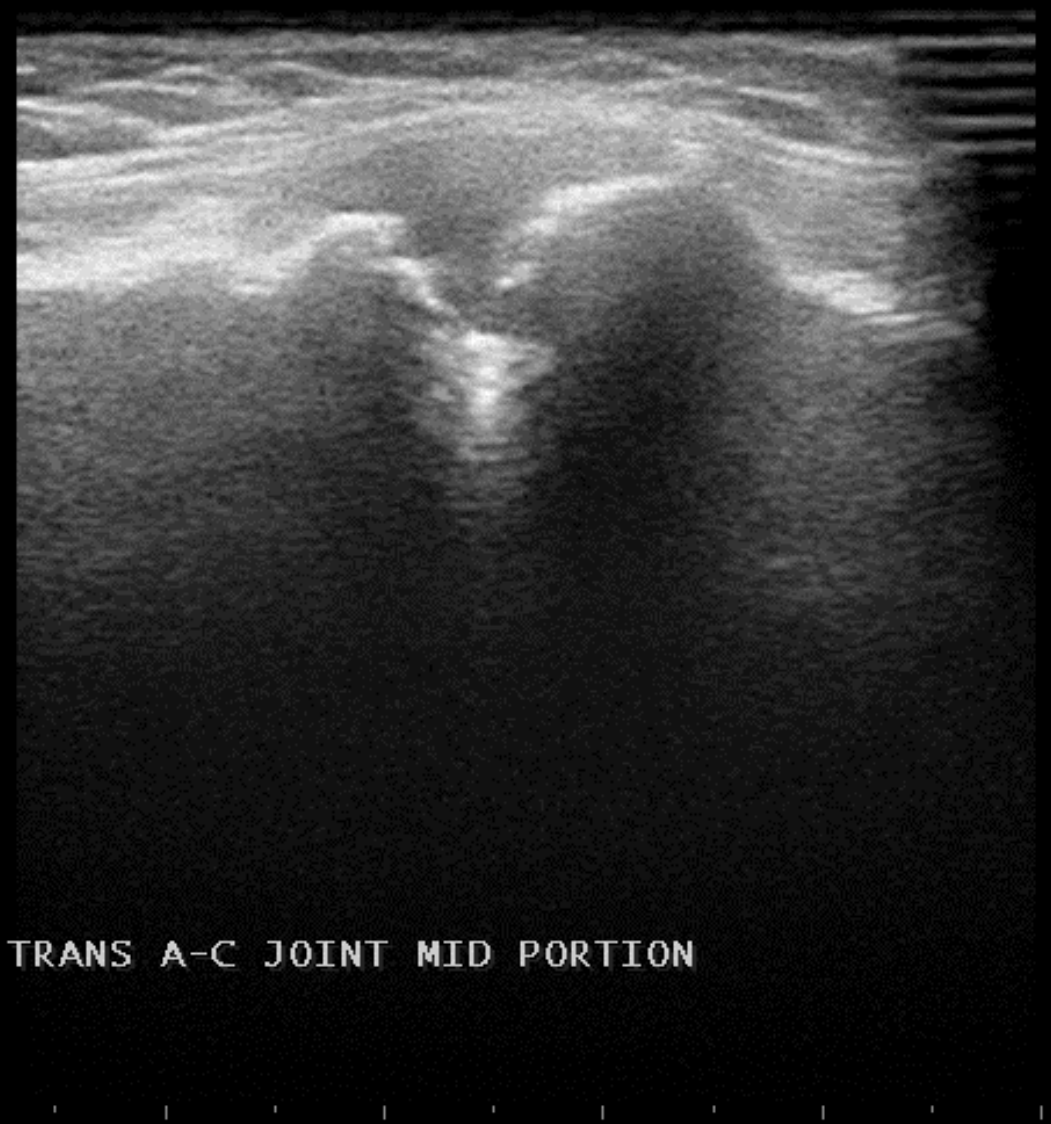


LEFT LONG SUPRA ANTERIOR

**Video Clip**

B F 10 MHz G 70%  
D 5 cm XV C  
PRC 10-5-L PRS 5  
PST 4 MV 2

SHOULDER LA523



LEFT TRANS A-C JOINT MID PORTION



# MRI VS. ULTRASOUND

- Accuracy of MRI, MR Arthrography, and Ultrasound in the Diagnosis of Rotator Cuff Tears: A Meta-Analysis. AJR:192, June 2009; 1701-1707.
  - Dept. of Radiology, Thomas Jefferson University Hospital
- A meta-analysis of 65 articles showed:
- **No significant difference between MRI and Ultrasound for the diagnosis of partial or full thickness tears of the rotator cuff.**
- MR Arthrography was slightly superior to both of the above.

# PLATELET RICH PLASMA (PRP)

PRP promotes natural healing mechanisms by release of growth factors and other bioactive substances.

## **PDGFs** – Platelet Derived Growth Factors alpha and beta

- Plays a role in cell differentiation and neovascularization

## **TGF** – Transforming Growth Factors beta 1 and beta 2

- Stimulates Tendon Differentiation and Formation of Collagen

## **EGF** – Epithelial Growth Factor

- Induces Fibroblast Proliferation

## **VEGF** – Vascular Endothelial Growth Factor

- Stimulates Neovascularization

# PLATELET RICH PLASMA (PRP)

- AUTOLOGOUS CONCENTRATION OF PLATELETS OBTAINED BY WHOLE BLOOD CENTRIFUGATION



Mention Secondary Processing to remove rbc's

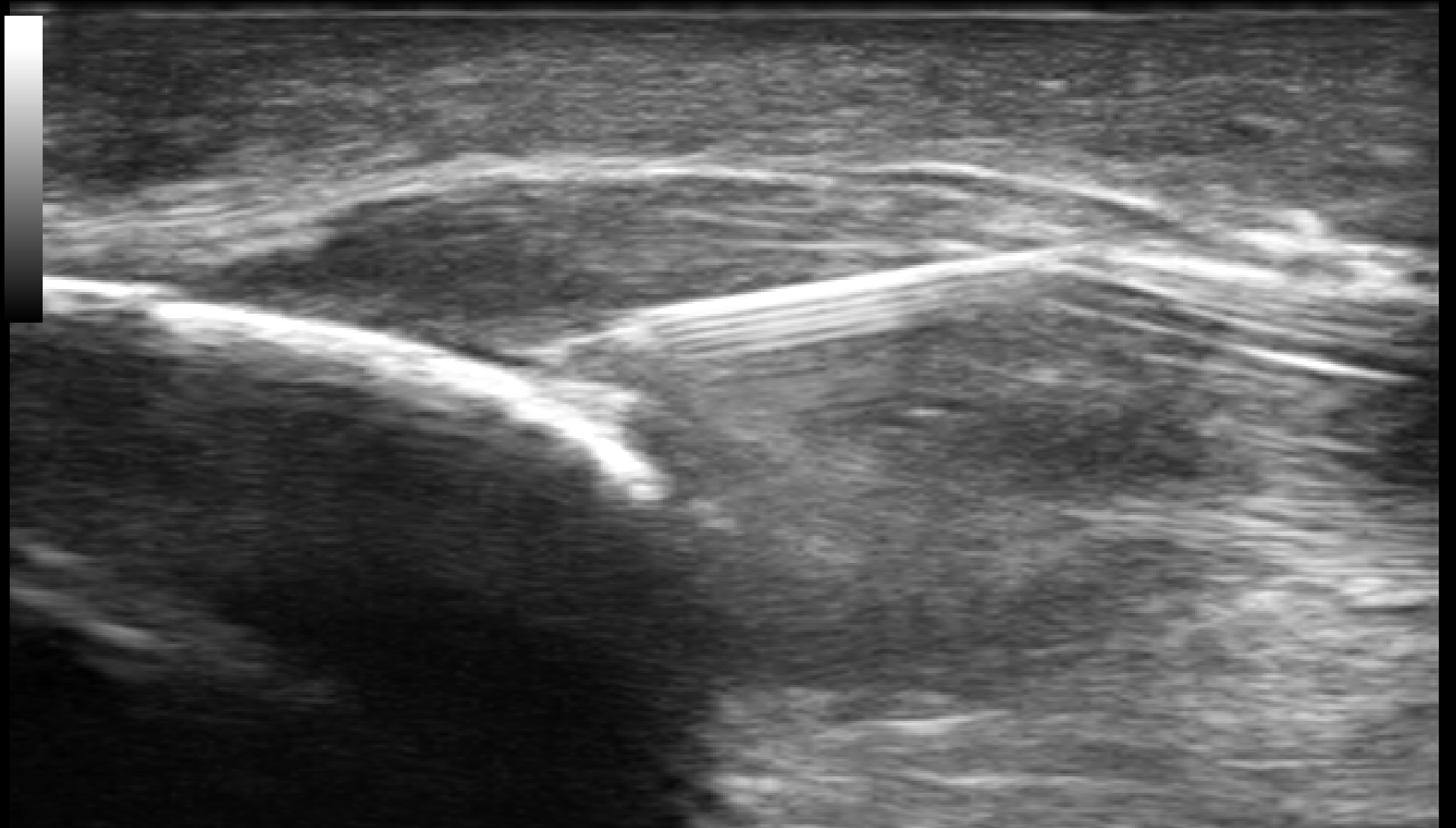
18 MHz G 70%  
D 4 cm XV C  
PRC 10-5-H PRS 5  
PST 4 MV 2

SHOULDER LA435



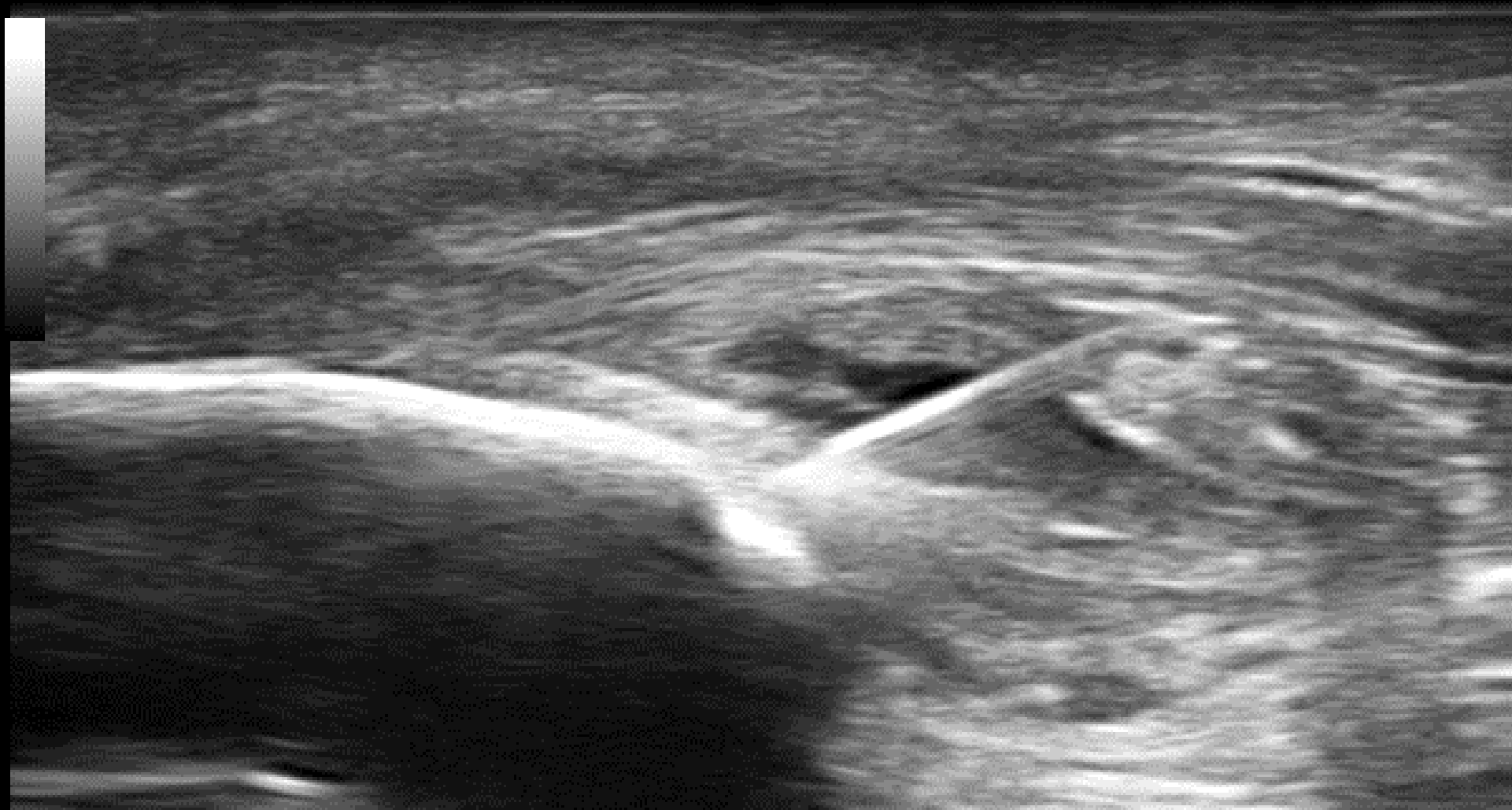
LEFT

B	F	15	MHZ	G	70%
	D	3	CM	XV	C
	PRC	10-5-H		PRS	5
	PST	4		MV	2



43 y, F,  
B F 15 MHz G 70%  
D 3 cm XV C  
PRC 10-5-H PRS 5  
PST 4 MV 2

FEB 14 2018 10:52am



## PRP SHOULDER INDIVIDUAL CASE STUDY

61 yo accountant and avid weight lifter c/o R shoulder pain.

Hx of Right shoulder surgery. Several years of pain with activity.

Pain is primarily anterior.

Exam: Restriction to elevation – 170 degrees (180 left), lateral rotation 60 degrees.

Positive empty can test, Tender over the supraspinatus

Prolotherapy with aqueous testosterone: 12/28/16 and 5/9/17

– with a marginal response.

**6/09/17:** Dx Ultrasound– partial thickness tear supraspinatus, A-C joint degenerative changes, subscapularis tendinosis

PRP Right shoulder

**7/07/17:** F/U - Sore for 2 days, no improvement as yet

**8/17/17:** F/U –About 30% improved, restarted working out

**9/08/17:** F/U and Repeat Ultrasound –partial thickness tear supraspinatus. Continues to improve clinically.

**4/18/18:** Phone – Significantly improved, about 80% better.

**2/04/19:** Phone –Essentially pain free. Full workouts. Still limited tightness.

# EFFICACY OF TREATING ROTATOR CUFF PATHOLOGY WITH PRP

- **American Academy of Orthopaedic Surgeons:** 2013 Poster Presentation  
Study on rotator cuff tendinopathy without a full thickness tear
- **204 patients** – 102 injected directly into tendon with PRP
  - 102 controls injected into the subacromial space with steroid
- **1- year follow-up:** PRP group had significantly better ROM  
48 steroid treated patients and only 3 PRP treated patients required surgery



# EFFICACY OF TREATING ROTATOR CUFF PATHOLOGY WITH PRP

- **Multiple studies have shown mixed results.**
- **Our impression is that over 80 to 90% of our patients have had positive results treating tendinopathy or partial tears.**
- **We hope to have our case study results completed within the next year.**
- **More research needed.**

# QUESTIONS ?

You are all invited to our office on a select Tuesday to witness our clinical use of ultrasound imaging.

# **The End**

**John Finkenstadt, M.D.**

**Kenneth Iles, D.C.**

**Madison-Irving Medical Center**

**475 Irving Avenue - Suite 402**

**Syracuse, N.Y. 13210**

**(315) 478-9710**