The use of Ultrasound for the Diagnosis and Treatment of the Musculoskeletal System

St. Joseph’s Refresher Course
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THIS WORKSHOP WILL FOCUS ON 2 MAIN TOPICS:

Carpal Tunnel Syndrome
Shoulder Pain
WHY ULTRASOUND?

• Portability
• Cost-Effective
• Patient Comfort
• High Resolution Imaging
• Real Time Dynamic Imaging
• Every Patient can undergo Ultrasound
• No problem with hardware
• No problems with claustrophobia or need for medication
• 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 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
A wide, thick ligament called the **flexor retinaculum** connects the pisiform and hamate hook to the scaphoid and trapezium.

*Anatomy of Movement* p. 151
Carpal Tunnel

- median nerve
- flexor carpi radialis
- flexor pollicis longus tendon
- flexor digitorum superficialis tendons
- hook of hamate
- flexor digitorum profundus tendons
- trapezium
- trapezoid
- capitate
- hamate

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
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
The cutaneous innervation of the dorsal (A) and palmar (B) surfaces of the hand.
Carpal Tunnel Physical Exam

Sensory Examination – pin wheel
Pinch grip

Provocative Testing
• Tinel Sign
• Phalen’s Test
• Carpal Compression Test
THE ROLE OF ULTRASOUND IN THE DIAGNOSIS AND MANAGEMENT OF CARPAL TUNNEL SYNDROME: A NEW PARADIGM


NERVE CONDUCTION - SENSITIVITY > 85%

ULTRASOUND - SENSITIVITY UP TO 97.9%

SPECIFICITY WAS SIMILAR WITH BOTH PROCEDURES
TEST **SENSITIVITY** IS THE ABILITY OF A TEST TO CORRECTLY IDENTIFY THOSE WITH THE DISEASE (TRUE POSITIVE RATE).

TEST **SPECIFICITY** IS THE ABILITY OF THE TEST TO CORRECTLY IDENTIFY THOSE WITHOUT THE DISEASE (TRUE NEGATIVE RATE).
ULTRASOUND EVALUATION OF CTS
MSMPC DIAGNOSTIC PROTOCOL

- See Handout
DIAGNOSTIC ULTRASOUND OF THE CARPAL TUNNEL

Patient Demonstration
MSMPC CRITERIA
FOR ULTRASOUND DIAGNOSIS OF CARPAL TUNNEL SYNDROME

- CSAc (Cross Sectional Area Crease) > 10 mm²
- 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
Proximal Carpal Tunnel - Normal
Proximal Carpal Tunnel - Abnormal
CARPAL TUNNEL INJECTION
CANDIDATES FOR ULTRASOUND GUIDED CARPAL TUNNEL HYDRODISSECTION

- Carpal Tunnel Surgical Failures
- Pregnant Women
- Poor Surgical Risks: e.g., Elderly patient with multiple medical problems
- Alternative for Patients Refusing Surgery
- A Reasonable Alternative for Conservative Treatment Failures
BENEFITS OF ULTRASOUND GUIDED CARPAL TUNNEL HYDRODISSECTION

- 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
Consider prone 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 3rd and 4th fingers
Almost horizontal injection - the needle travels parallel to the tendons and nerve
OTHER TECHNIQUES

Recommendations for the best technique still being developed.

- uses an ulnar approach

- includes fenestration of the flexor retinaculum
N.B. - Inject in line with the radial aspect of the 4th finger.
CARPAL TUNNEL HYDRODISSECTION CASE STUDY

66 y.o. female – c/o recurrence of discomfort, numbness, tinging 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.

QUESTIONS ?
DIAGNOSTIC ULTRASONIC OF THE SHOULDER
Rotator Cuff - 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.

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.

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).
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

The Essentials of Musculoskeletal Care p. 99

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

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

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

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".

Figure 3
Chevy of Washington (2011) 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
PALPATION OF THE SUPRASPINATUS TENDON
PALPATION OF THE INFRASPINATUS TENDON
Infraspinatus Tendon

Left Shoulder - Posterior View

Cyriax p. 42
PALPATION OF THE SUBSCAPULARIS TENDON
Right Shoulder
Anterior View

SUBSCAPULARIS TENDON

Cyriax p. 43
ROTOR CUFF PALPATION

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

Right Shoulder

Acromion

Clavicle

Neumann p.101
ULTRASOUND EVALUATION OF THE SHOULDER

MSMPC DIAGNOSTIC PROTOCOL

- See Handout
DIAGNOSTIC ULTRASOUND OF THE SHOULDER

Patient Demonstration
Normal

RIGHT LONG SUPRA POSTERIOR
Partial Tear

RIGHT LONG SUPRA ANTERIOR
Supraspinatus
Longitudinal View
Partial Tear
Supraspinatus Transverse View

Partial Tear
Supraspinatus Longitudinal View

Partial Tear
Supraspinatus Transverse View

Partial Tear
LEFT TRANS A-C JOINT MID PORTION
MRI VS. ULTRASOUND

  - 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.

**PDGs** – 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
Efficacy of treating rotator cuff pathology with PRP

- Multiple studies have shown effectiveness – more research needed.

- **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
PRP SHOULDER 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
8/17/18: 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.
QUESTIONS ?
The End

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