

Point-of-Care Ultrasound for injured athletes in the Taekwondo Competition

Dae Hyoun Jeong, MD

IOC Dip Sp Phy, CAQSM, CAQGM, RMSK, RDMS, CEP, CET

Assistant Professor

Director, Sports Medicine and Geriatric MSK Medicine

Director, Point-of-Care Ultrasound Program

Department of Family and Community Medicine

Southern Illinois University School of Medicine

Springfield, Illinois, USA



SIU MEDICINE
FORWARD. FOR YOU.

DISCLOSURE



I, Dae Hyoun Jeong, MD, or family member(s), have no relevant financial relationships to be disclosed, directly or indirectly, referred to or illustrated with or without recognition within the presentation.





- WTF Commission Doctor, 2017 Muju WTF World Taekwondo Championship
- Venue Physician - 2017 IIHF Woman's Ice Hockey World Championship
- Venue Medical Officer - Bobsleigh, 2018 PyeongChang Winter Olympics
- Medical Director - Illinois Taekwondo State Organization (ITSO), USA
- Medical Director - Missouri State Taekwondo Organization (MSTO), USA
- Medical Director, Advisory Board, Illinois Senior Olympics, Illinois, USA
- Captain, 5th Medical Tent - 2017 Chicago International Marathon Game
- Ringside physician for MMA(mixed martial arts) games
- Team Physician for American football teams (high school and collegiate level)



OBJECTIVES



- Review the epidemiology of injuries in Taekwondo athletes during the competition
- Explain the pros and cons of point-of-care ultrasound (musculoskeletal and non-musculoskeletal) as a diagnostic modality
- Describe the ultrasound characteristics of fractures, dislocations and soft tissue injuries
- Explain the applications of point-of-care ultrasound in injured athletes during the competition with cases
- Discuss about the potentials, considerations and future direction of utilizing the point-of-care ultrasound in Taekwondo competition





COMPETITION INJURIES IN TAEKWONDO ATHLETES

- **Total injury rates (per athlete-exposures (A-E))**

For elite men 20.6~139.5 /1000 A-E

For elite female 25.3~105.5 /1000 A-E

➤ Competition injury rates for taekwondo: higher than American football, wrestling, and Shotokan style Karate

- **Injury rates for elite men**

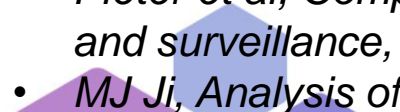
29.6% - head and neck

44.5% - lower extremities

- **Injury rates for elite women**

15.2% - head and neck

53.1% - lower extremities

- *Pieter et al, Competition injuries in takwondo: a literature review and suggestions for prevention and surveillance, Br J Sports Med 2012;46:485-491*
 - *MJ Ji, Analysis of injuries in taekwondo athletes, J. Phys. Ther. Sci. 28:231-234, 2016*
- 

COMPETITION INJURIES IN TAEKWONDO ATHLETES

- Majority of all injuries
: **Contusions** (M: 42.7% / F: 62.7%)
- Other common musculoskeletal injury types
Sprain/ Fracture/ Dislocation/ Tendon injury/ Strain
- Common non-musculoskeletal injury types
Concussion/ Epistaxis/ Laceration/ Abrasion
- Common site of injury
 - M : LE (***foot**) > head & neck > UE > trunk
 - F : LE (***foot**) > UE > Head & neck > Trunk
- *Pieter et al, Competition injuries in takwondo: a literature review and suggestions for prevention and surveillance, Br J Sports Med 2012;46:485-491*
- *MJ Ji, Analysis of injuries in taekwondo athletes, J. Phys. Ther. Sci. 28:231-234, 2016*



SPORTS AND MSK ULTRASOUND


- MSK US : High-resolution sonography for the visualization of joints, tendons, ligaments, muscles, and nerves
- **Delphi-based consensus paper of the European Society of Musculoskeletal Radiology in 2012 ***
- MSK US could be considered a first-line imaging modality for 72 clinical indications
 - (1) hand/wrist (2) elbow (3) shoulder (4) hip (5) knee (6) foot/ankle
- More widely accepted and utilized in sports medicine
: portability for immediate assessment of injuries in ski clinics, on the sidelines and in the training room **

* Klauser AS, et al. Clinical indications for musculoskeletal ultrasound: a Delphi-based consensus paper of the European Society of Musculoskeletal Radiology. Eur Radiol. 2012;22(5):1140–8.

** Yim ES, Corrado G. Ultrasound in sports medicine: relevance of emerging techniques to clinical care of athletes. Sports Med. 2012;42(8):665–80.

MSK ULTRASOUND GUIDELINES, CURRICULUMS AND CERTIFICATION



- **AIUM Practice Guideline** for the Performance of a musculoskeletal examination
 - **ESSR** : Musculoskeletal Ultrasound Technical Guidelines
 - **EULAR** : Guidelines for musculoskeletal ultrasound in rheumatology
 - **AMSSM** Recommended Sports Ultrasound Curriculum for Sports Medicine Fellowship
 - ❖ **Certifications**
 - **RMSK** : ARDMS / APCA
 - **RhMSUS** : American College of Rheumatology
 - **PGCert Musculoskeletal Ultrasonography** (UK)
- 

POINT-OF-CARE ULTRASOUND

“ Diagnostic or procedural guidance ultrasound performed by a clinician during patient encounter to help guide the evaluation and management of the patient “

“ Point-of-Care Revolution”

- Not a replacement to complete diagnostic ultrasound performed/or interpreted by radiologist
- Focused bedside ultrasound evaluation in suboptimal conditions with time limitations for specific clinical questions.



UC Irvine Medical Education



POINT-OF-CARE ULTRASOUND : PROS



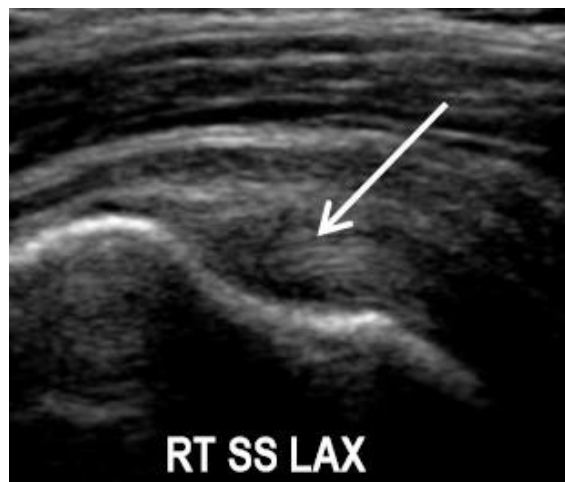
- **Portability** : laptop size / hand-held
- **Time-efficiency** : real-time, on-site prompt eval
- **Lower cost** compared to other modalities (X-ray/ CT/ MRI)
- High sensitivity and specificity of detecting MSK abnormalities
- **comparable to MRI in many indications**
- Ability to perform a **dynamic examinations**
- Point-of-Care **Ultrasound guided procedures**

- Parker L et al, Musculoskeletal imaging: medicare use, costs, and potential for cost substitution. [J Am Coll Radiol](#). 2008 Mar;5(3):182-8. doi: 10.1016/j.jacr.2007.07.016.
- Nazarian, The Top 10 Reasons Musculoskeletal Sonography Is an Important Complementary or Alternative Technique to MRI, *AJR* 2008;190: 1621-1626. 10.2214/AJR.07.3385

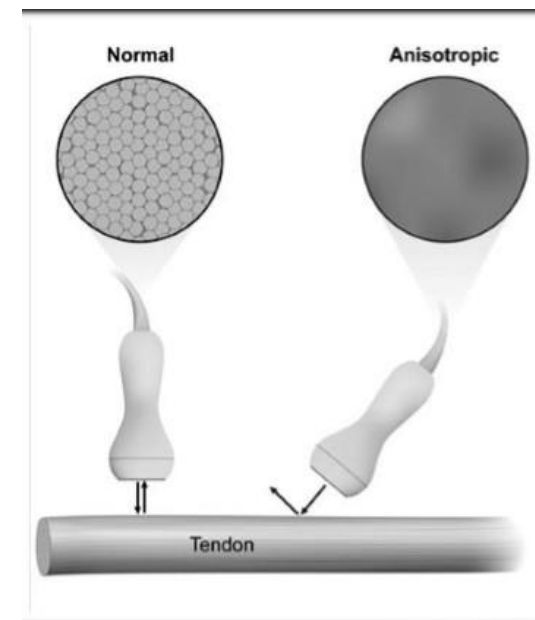


POINT-OF-CARE ULTRASOUND : CONS

- **Performer dependent** – false negative or positive, scanning time
 - Needs training and proficiency
- Not many sports medicine / musculoskeletal consultants are comfortable interpreting finding on the US
- Limited evaluation of gross structural anatomy
- Limited penetration of ultrasound signal into the joint or bone.
- Cannot detect bone bruising or edema



Anisotropy



EXPERIENCE FROM 2017 ITSO ILLINOIS STATE TAEKWONDO CHAMPIONSHIP





2017 ILLINOIS STATE TAEKWONDO CHAMPIONSHIP – STATISTICS OF TKD INJURIES

- Total 672 participants
- Total 42 injuries and illness
 - Non-MSK related injuries / illness
 - 16 Abrasions
 - 9 Lacerations (3 referee calls, 2 referee-stop)
 - 5 mild traumatic head injury (3 referee calls, 1 referee-stop)
 - 5 Epistaxis (4 referee calls)
 - 2 Dyspnea – 1 EIA



MSK RELATED INJURIES DURING THE COMPETITION



- **12 Contussion** (5 referee calls, 1 referee-stop decision)
: 2 foot / 3 knees /3 thigh /3 proximal arms 1 hand
- **3 fractures** (1 head & neck / 1 foot / 1 upper extremity)
: 1 Nasal fx/ 1 Navicular stress fx/ 1 Radial head fx of elbow
- **1 strain** (leg) : anterior tibialis muscle of the right leg
- **2 tendon injury** (1 ankle / 1 wrist)
 - 1 Flexor carpi ulnaris tendinopathy
 - 1 Peroneal tendinopathy of the ankle



MSK RELATED INJURIES DURING THE COMPETITION



- **2 Ankle sprains** (2 lateral ankle)
 - 1 ATFL + TFL (grade II) / 1 AFTL (grade I) + Acute Peroneal Tendinopathy

- **1 finger sprains** (1 Thumb)
 - 1 UCL of thumb (grade 2)

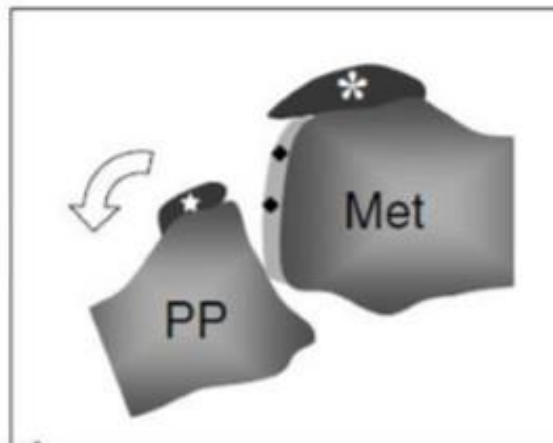
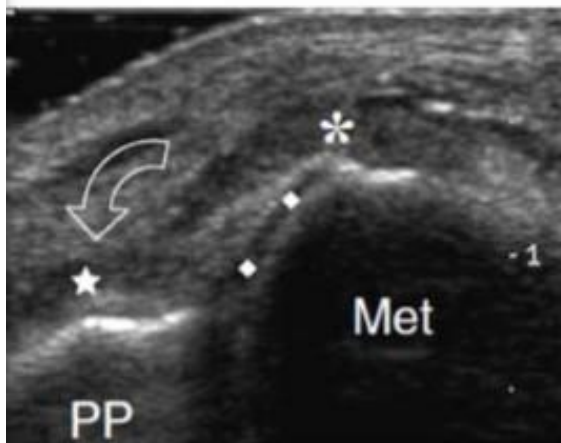
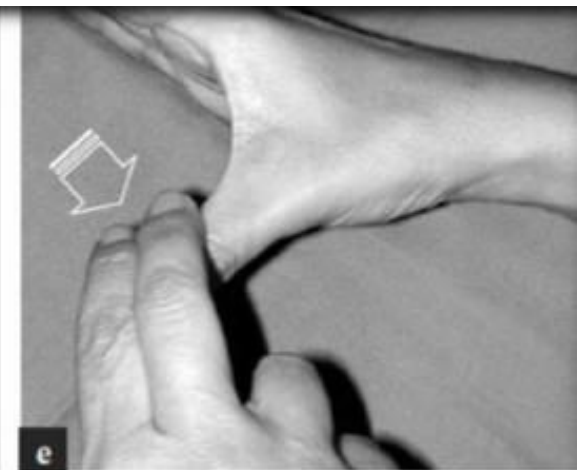
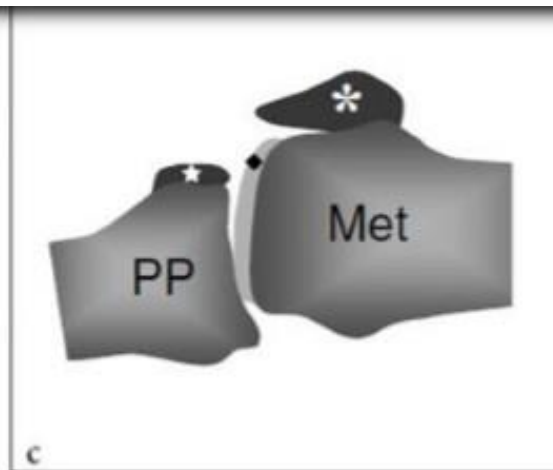
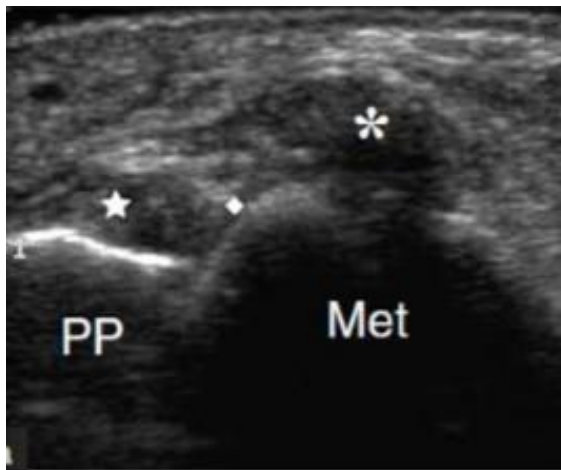
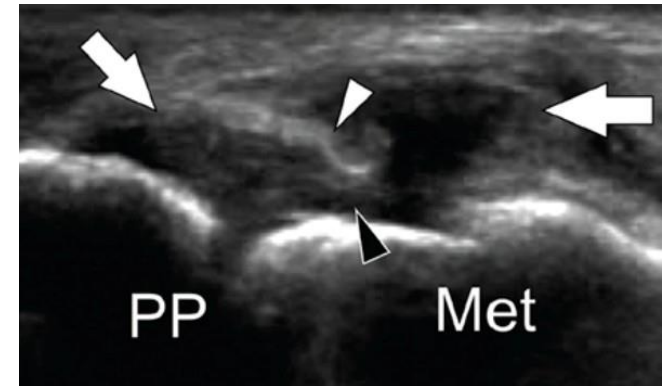
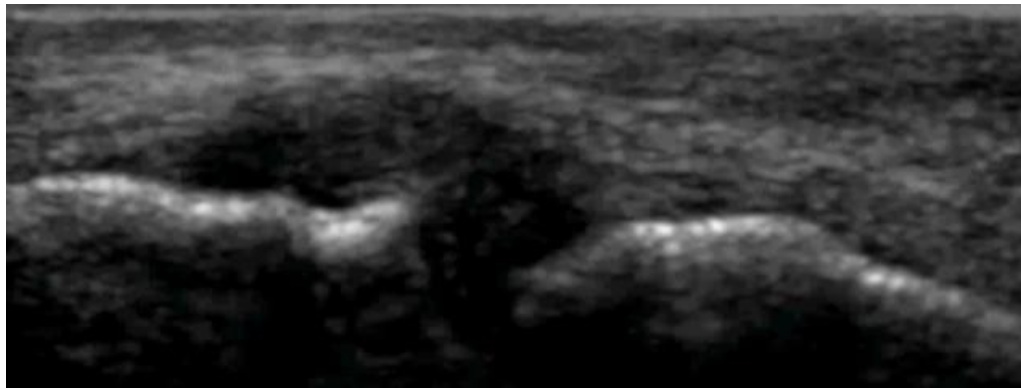
- **1 knee sprain**
 - MCL grade 2 Sprain of the knee w/o Meniscus / ACL inj.

- **1 wrist sprain** (FOOSH mechanism) - w/o tendon inj. or fx
 - Probable 1 grade 1 scapholunate sprain without instability

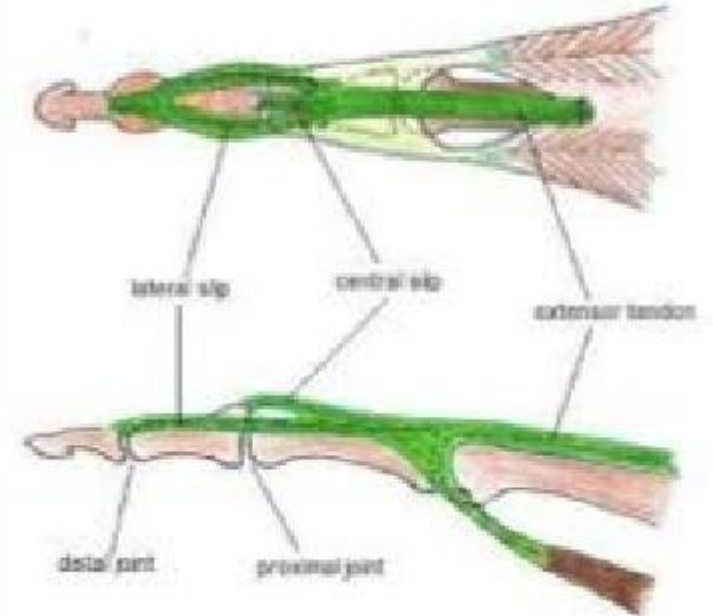
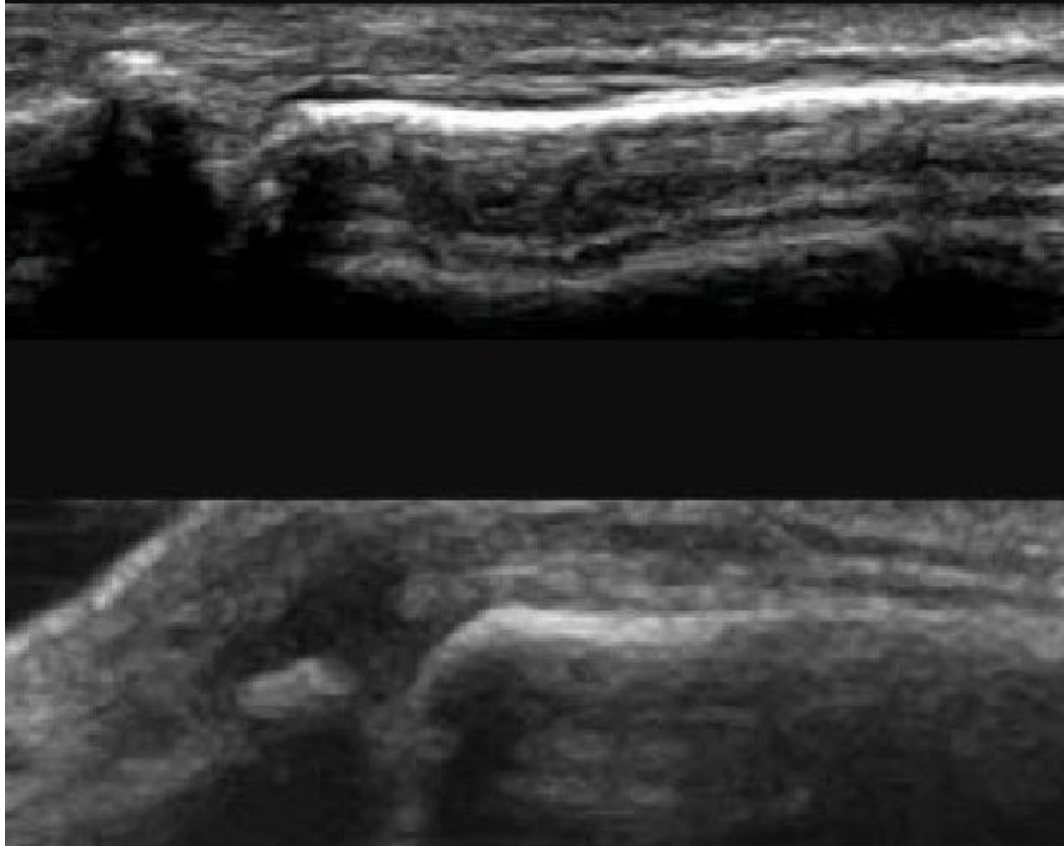
- **1 Shoulder sprain** : AC joint (grade 2) (w/o tendon injury)



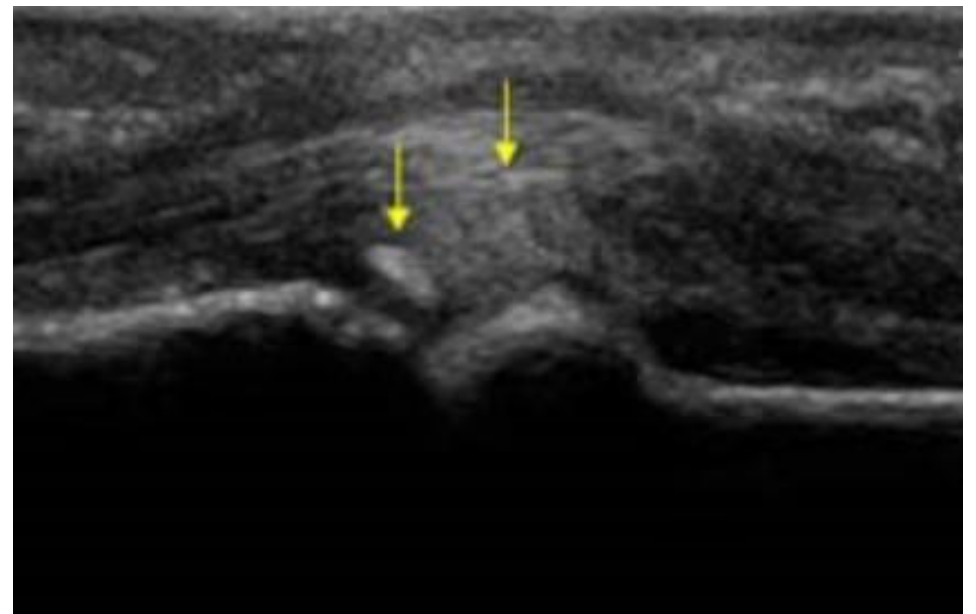
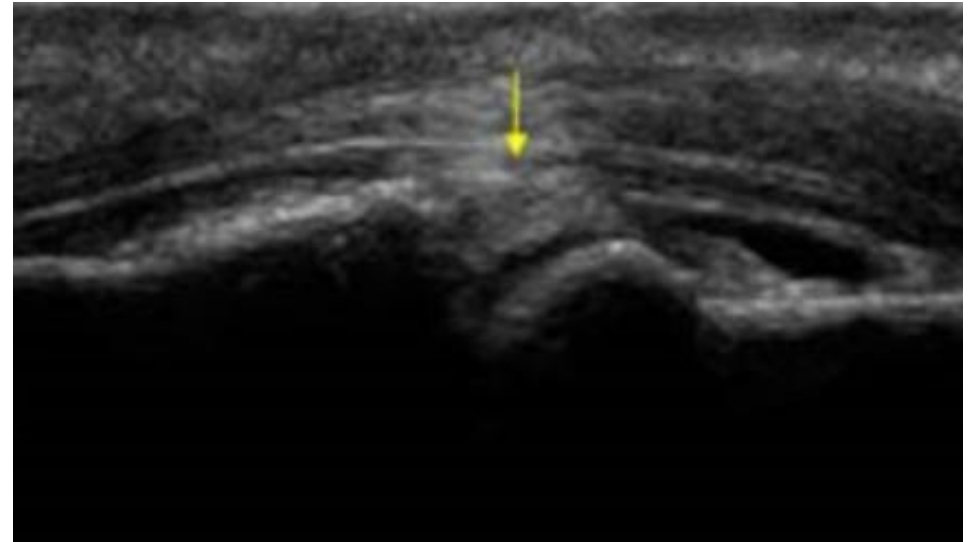
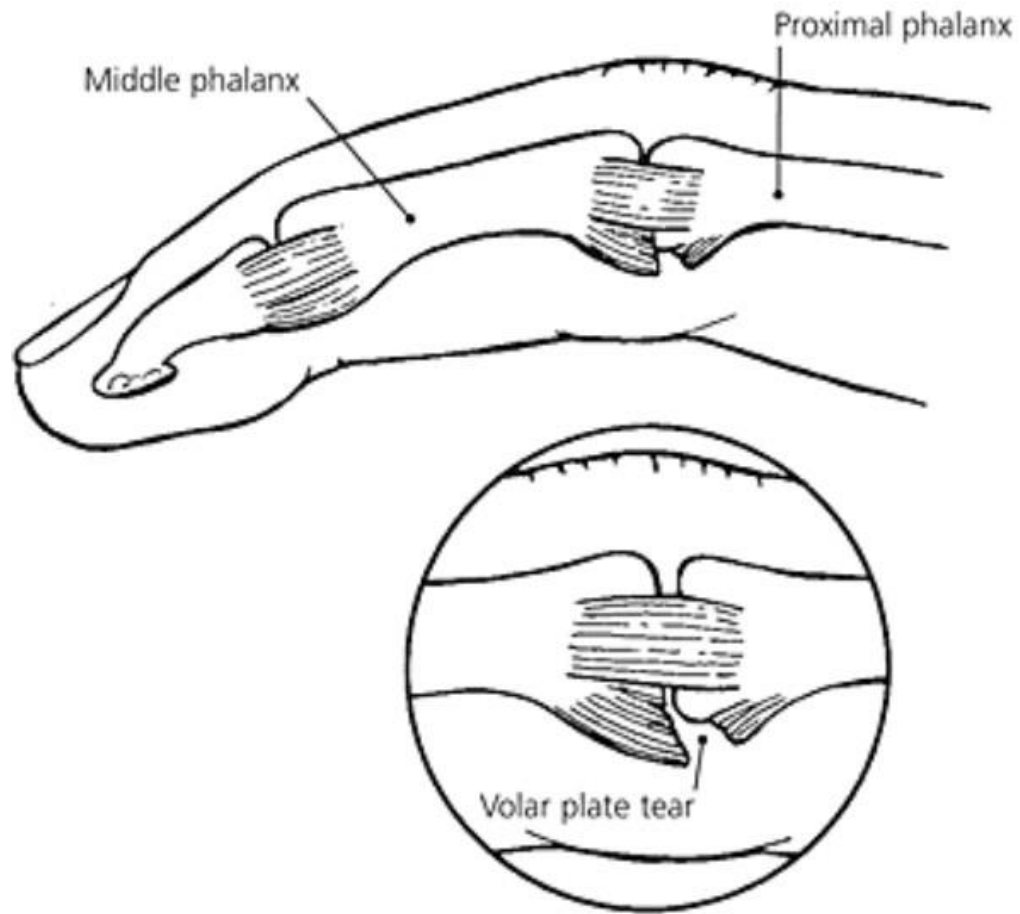
UCL TEAR OF THE THUMB



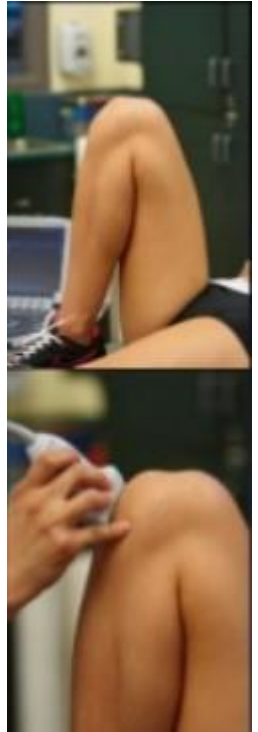
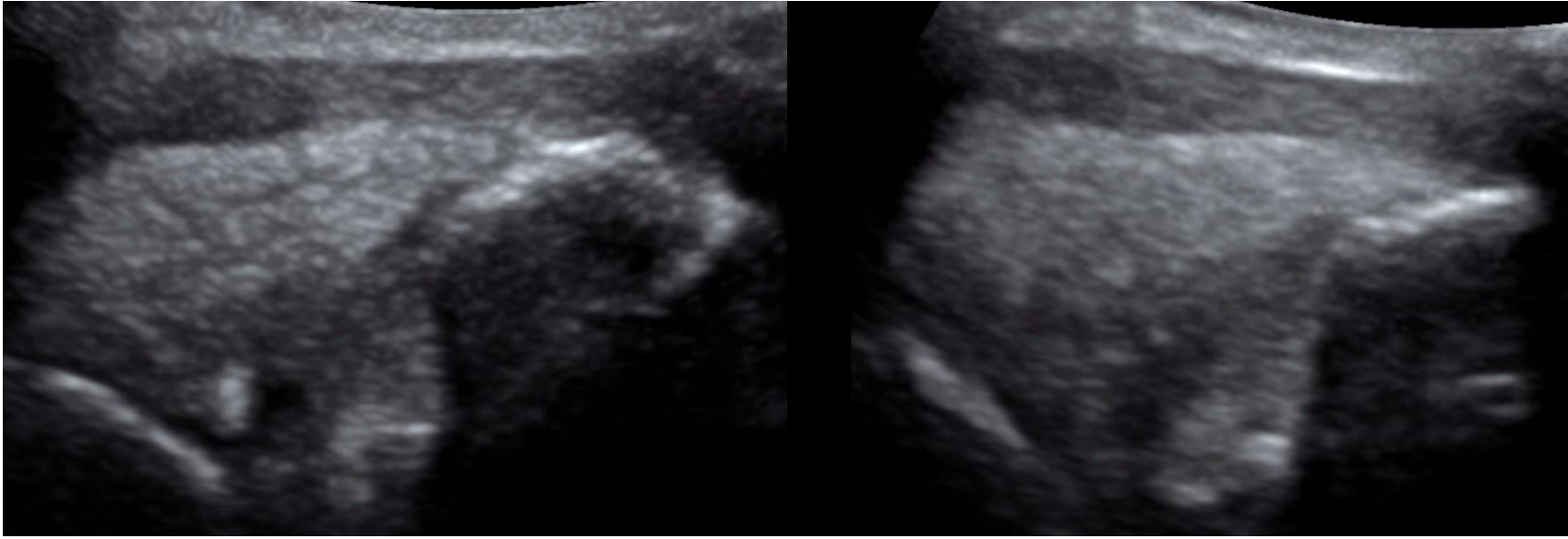
CENTRAL SLIP INJURY OF FINGER



VOLAR PLATE INJURY OF FINGER



ACL LAXITY

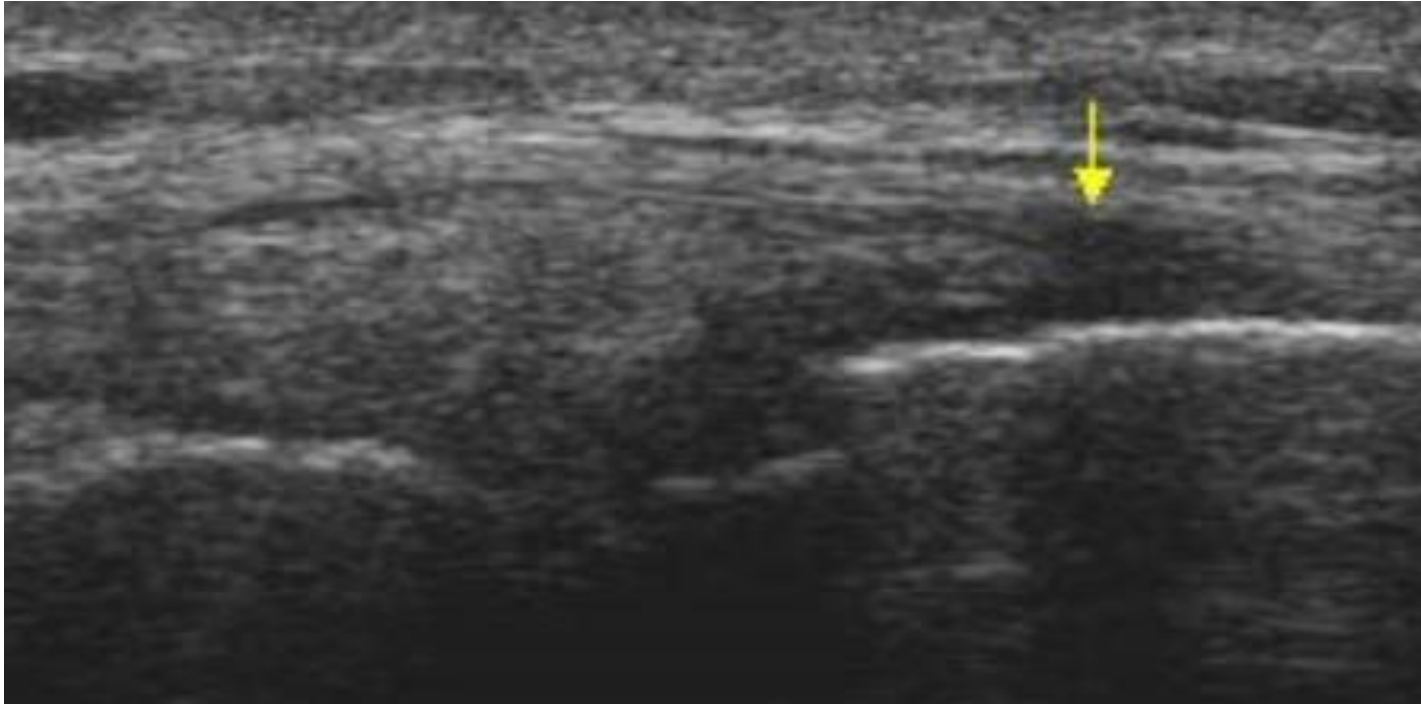


Dynamic ultrasound exam (anterior drawer test)

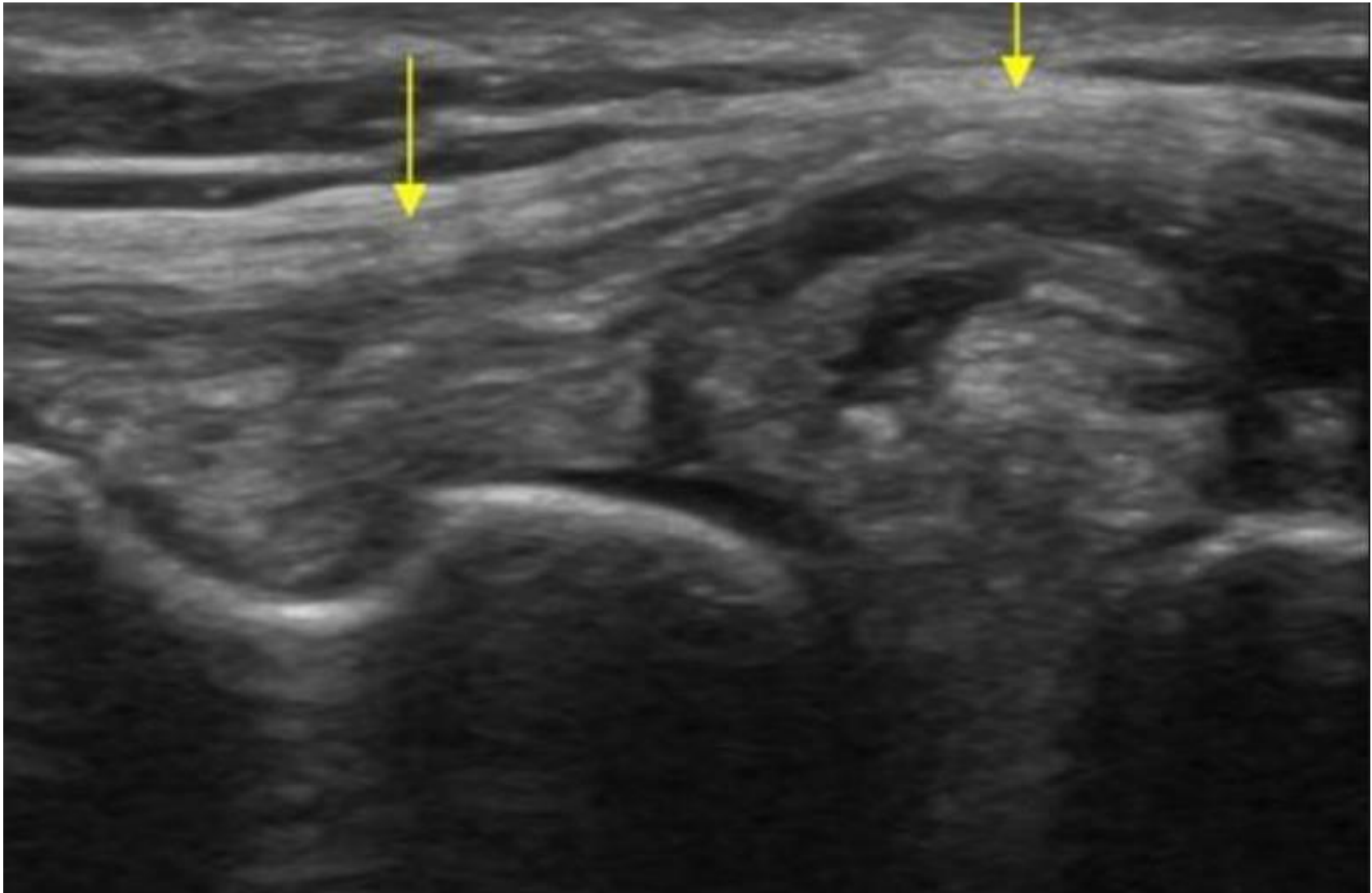
<https://youtu.be/lv5i7-pCFdY>



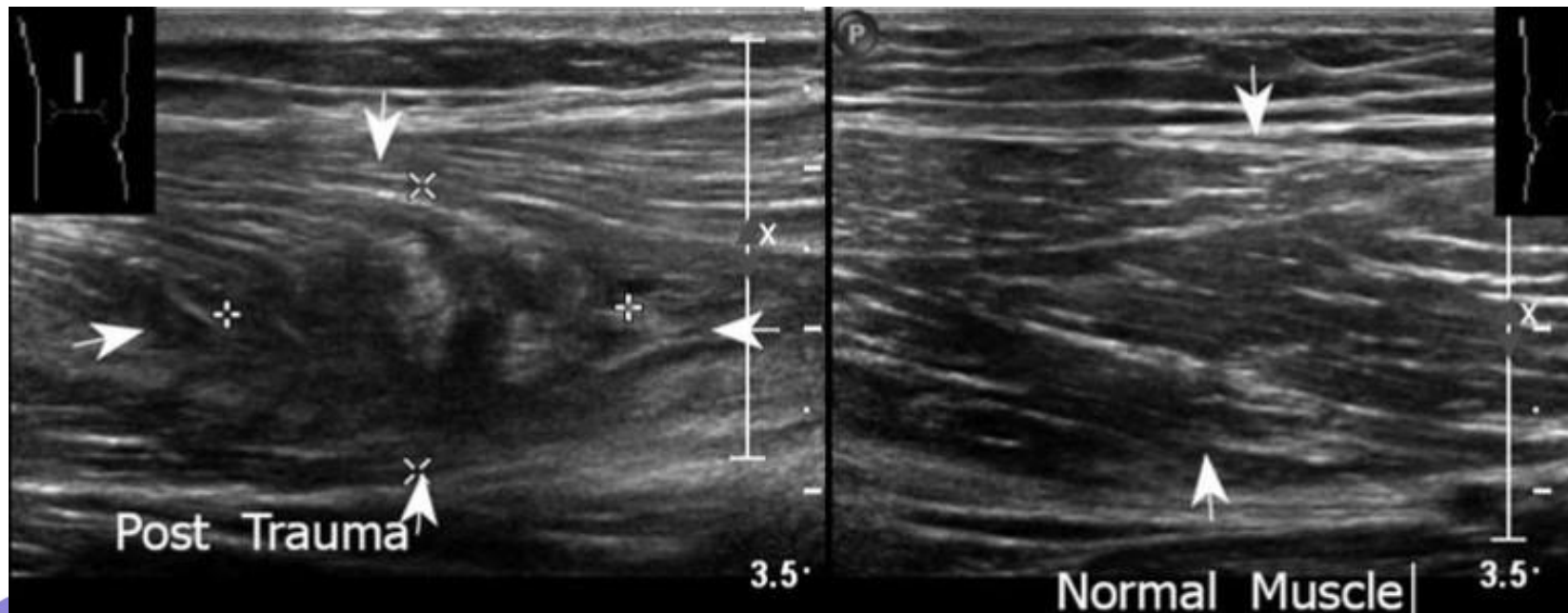
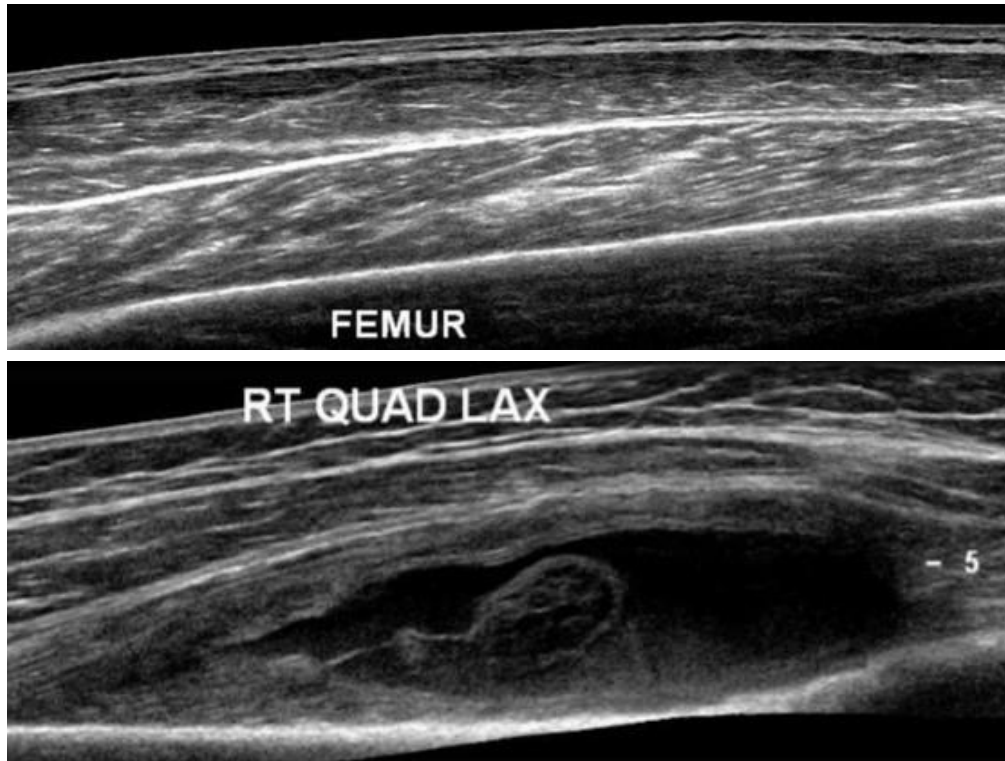
MCL TEAR



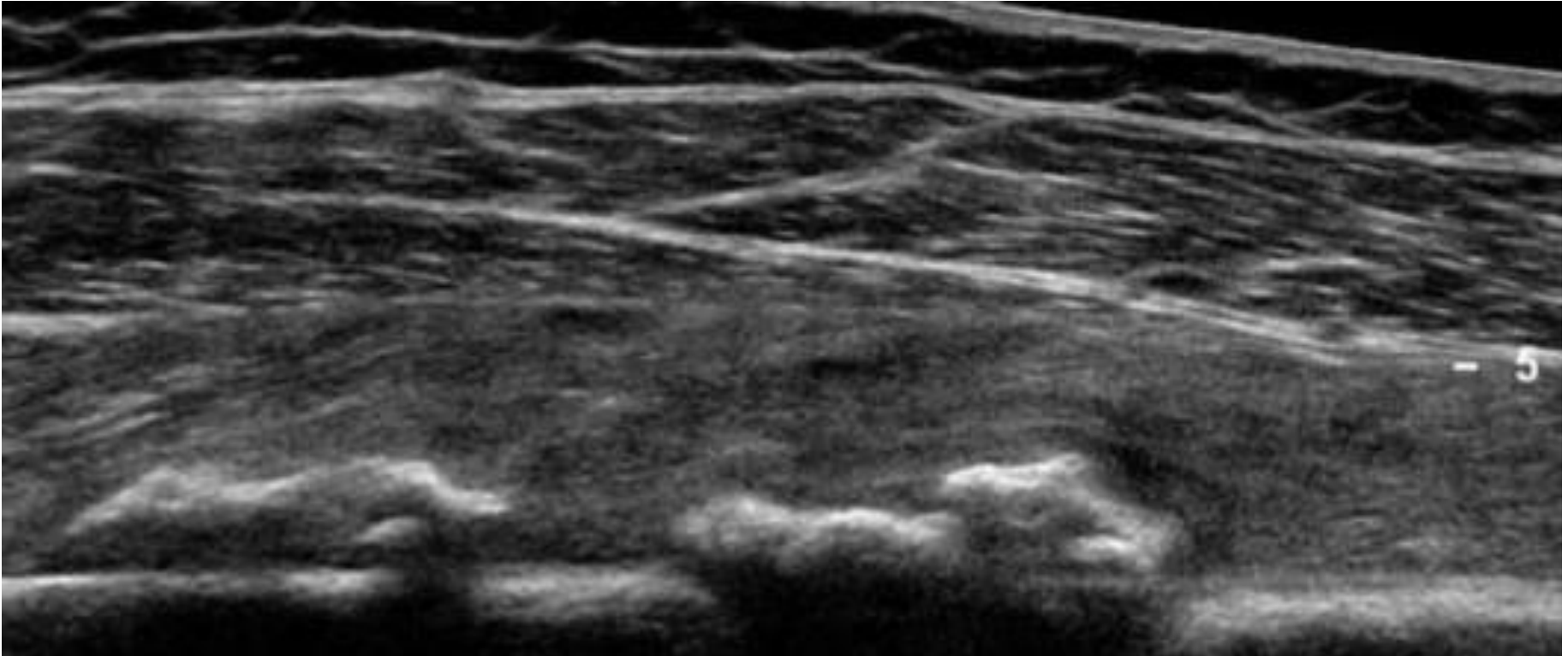
MENISCUS TEAR



CONTUSSION / HEMATOMA



MYOSITIS OSSIFICAN



CLASSIFICATION OF MUSCLE INJURY

| | | |
|---------|---|---|
| Grade 0 | Reversible damage of the muscle fiber No violation of the supporting connective tissue - DOMS | Hyperechoic hypertrophy (hyper or T2) of muscle |
| Grade 1 | Irreversible damage to the muscle fiber No violation of the supporting connective tissue | Hyperechoic cloud (or hyper T2) without disruption of muscle architecture |
| Grade 2 | Irreversible damage to a reduced number of muscle fibers Reaching the supporting tissue | Hyperechoic breach (or hyper T2) with blurred or irregular edges (sparks) with disorganization of muscle architecture |
| Grade 3 | Irreversible damage to a large number of muscle fibers Reaching the supporting tissue + hematoma | Musculo-aponeurotic or musculotendinous disinsertion with hematoma |
| Grade 4 | Partial or total rupture of a muscle | Avulsion or rupture of a muscle bundle with retraction |

GRADE I STRAIN



Grade I strain

GRADE 2 & 3 STRAIN



Grade 2 strain



Grade 3 strain

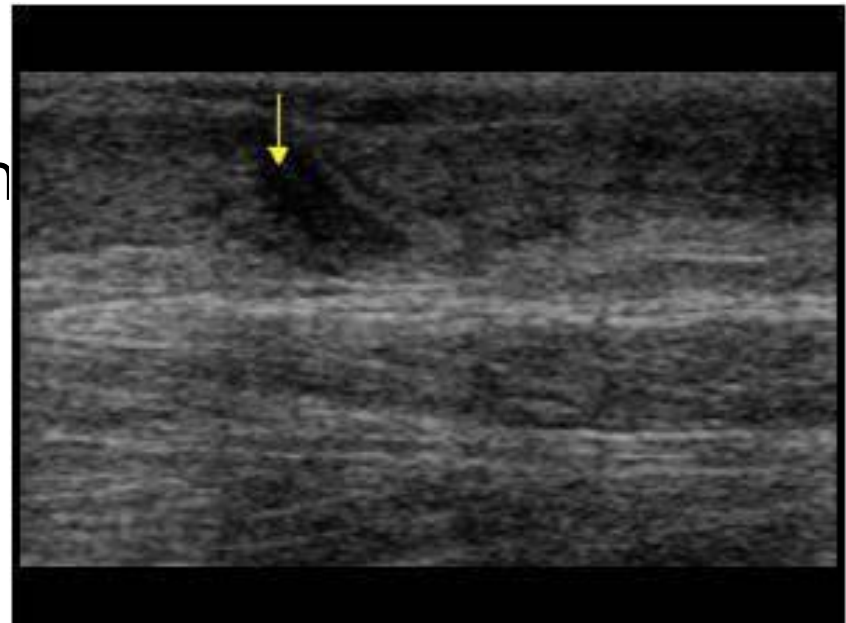
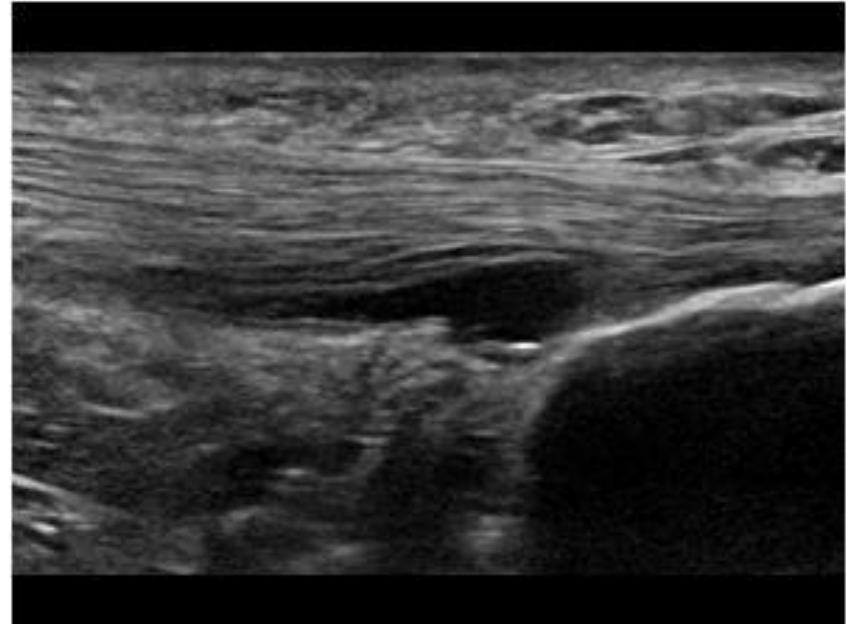
TENDON INJURY

- **Partial tear**

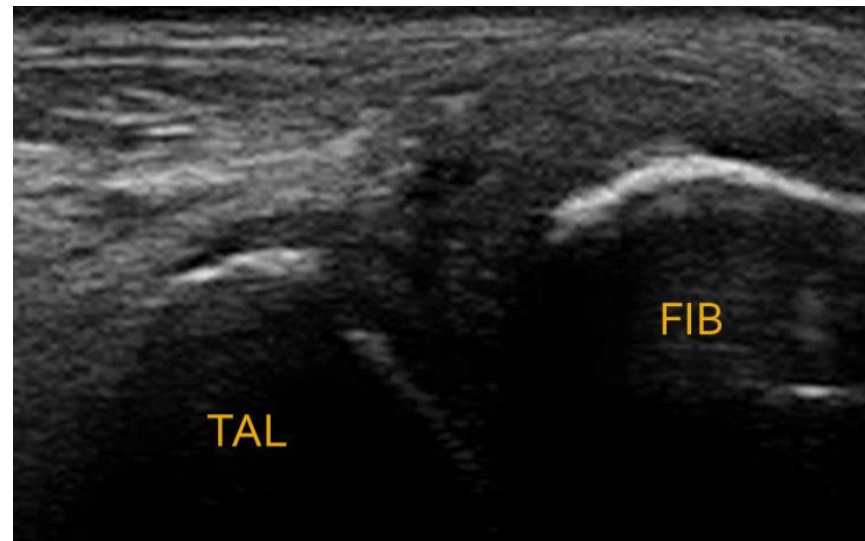
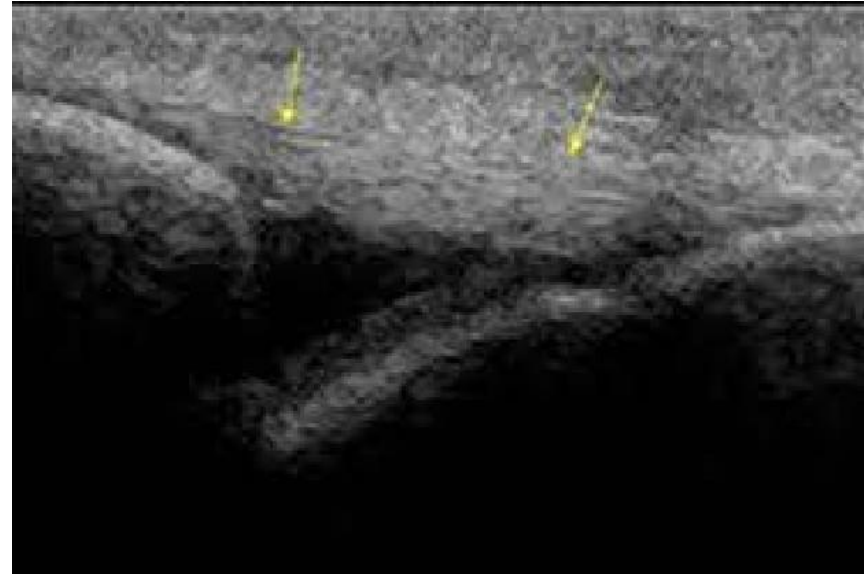
- Anechoic focal defect
- Background tendinosis

- **Complete tear**

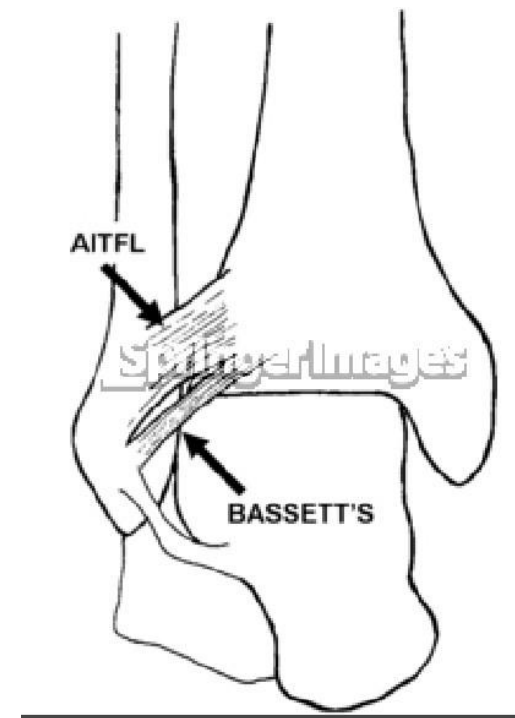
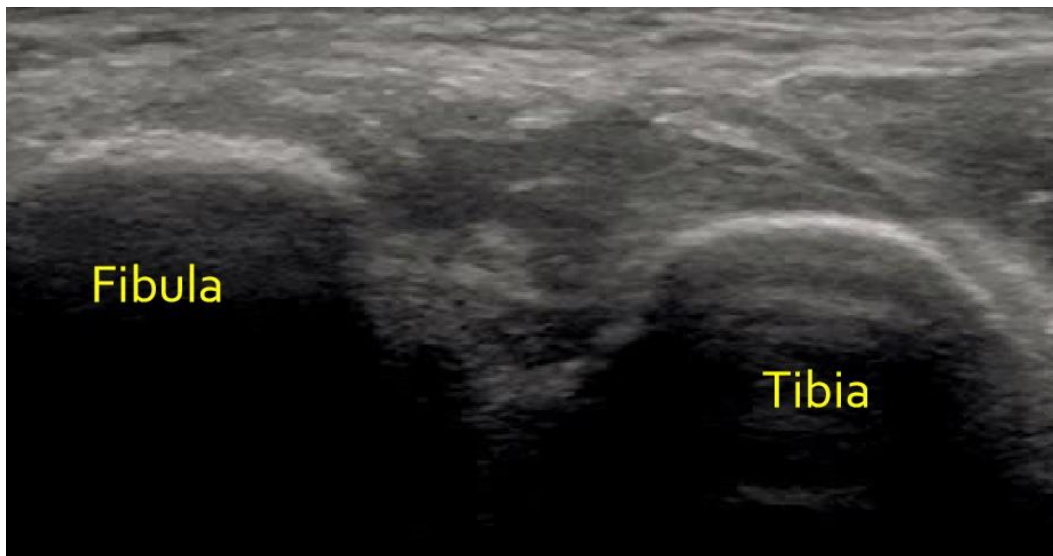
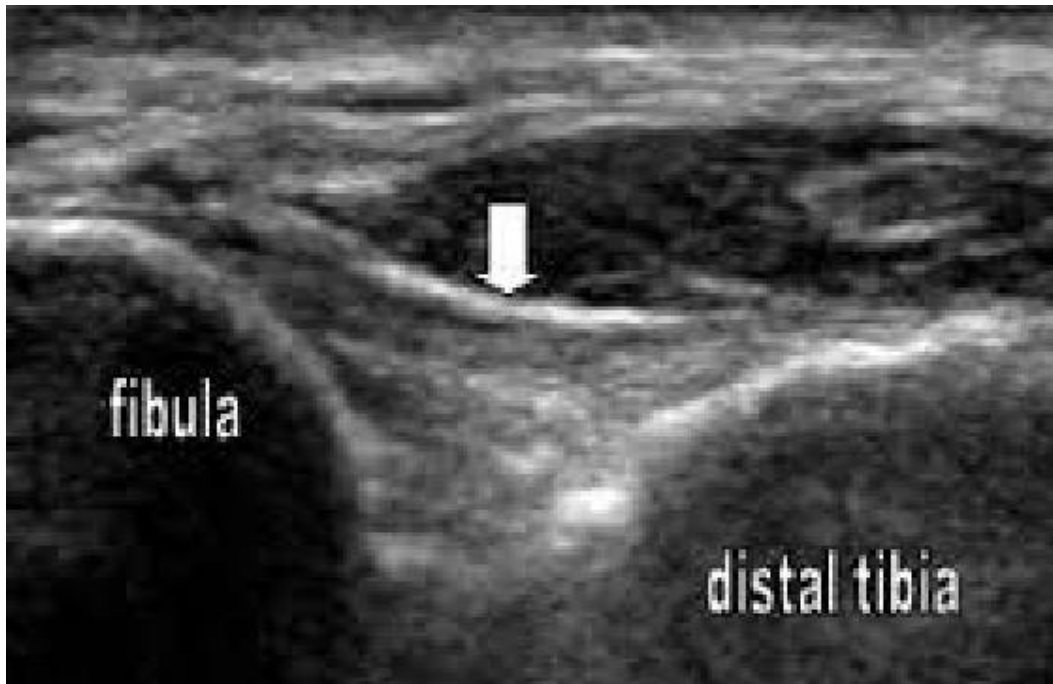
- Gap / absence
- Acute: fluid
- Chronic: scar tissue formation



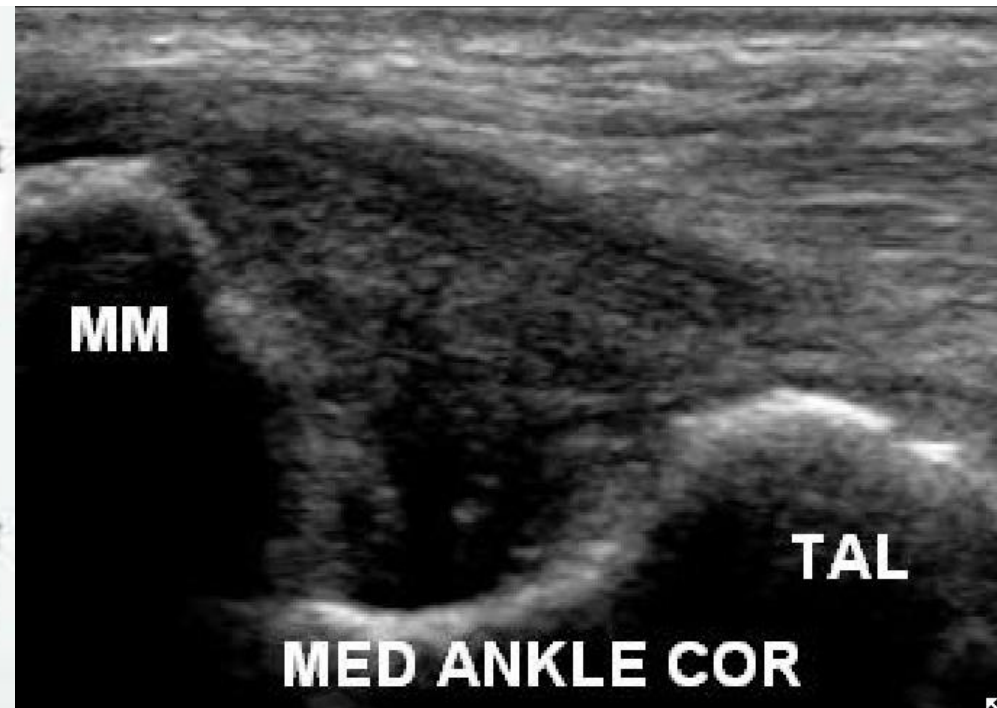
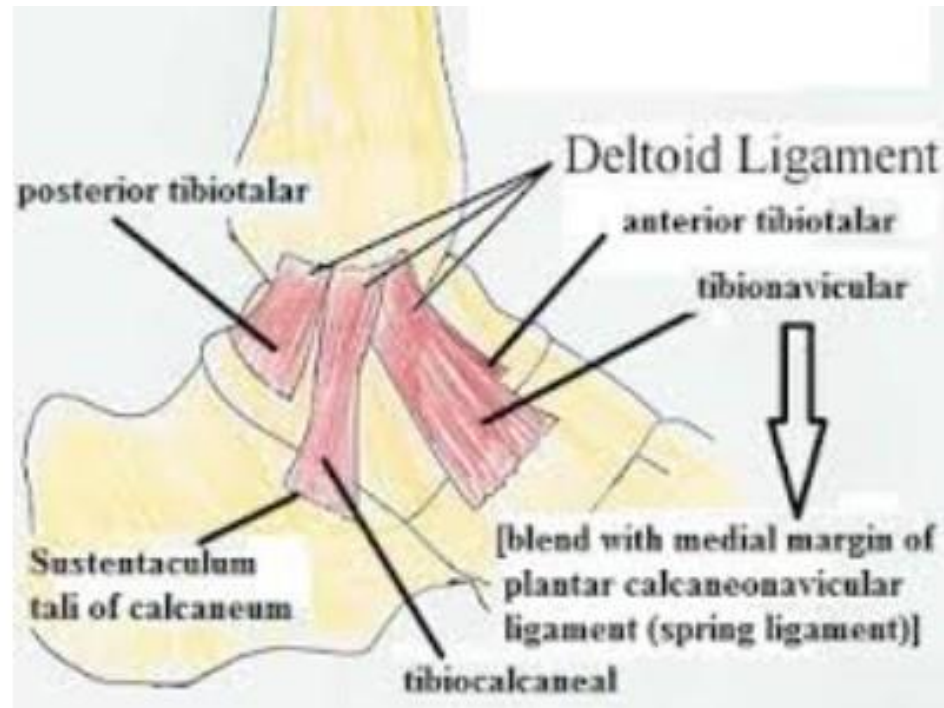
AFTL SPRAIN



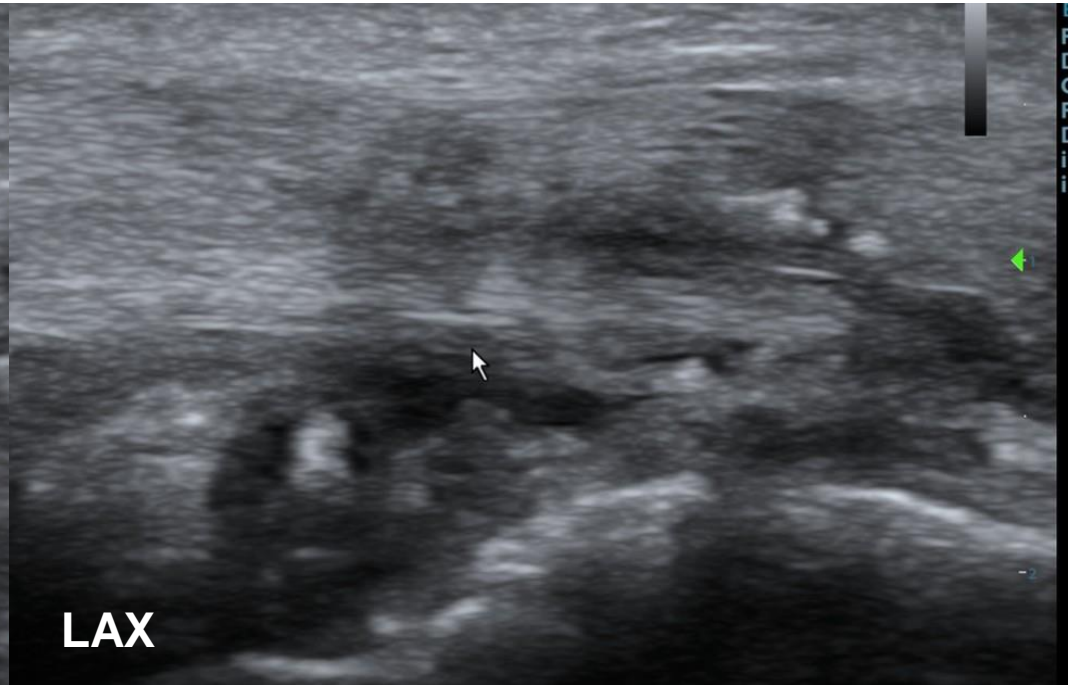
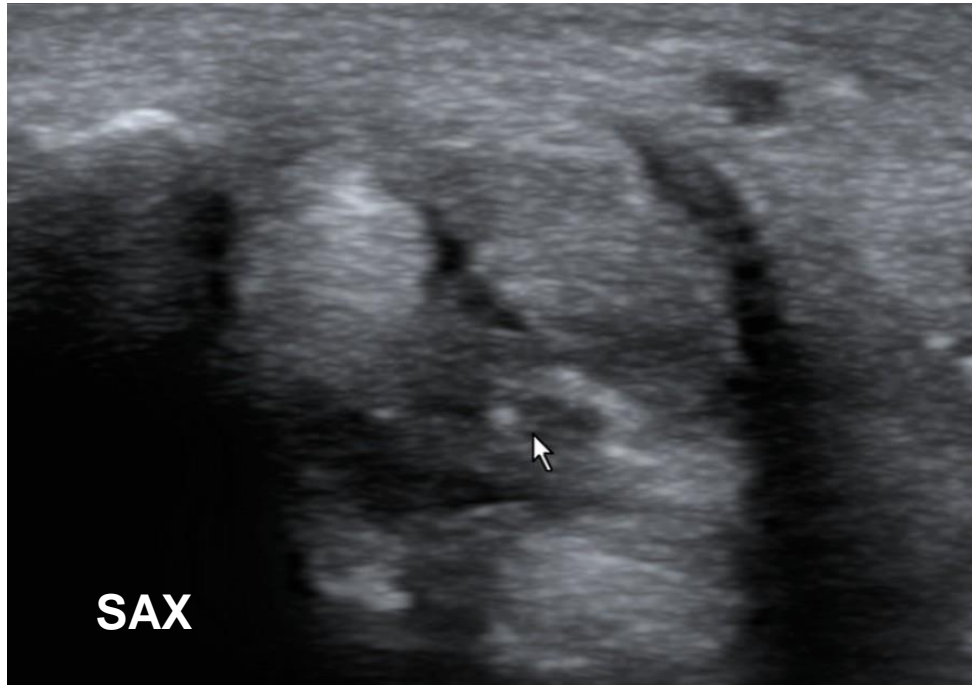
AITFL SPRAIN (HIGH ANKLE SPRAIN)



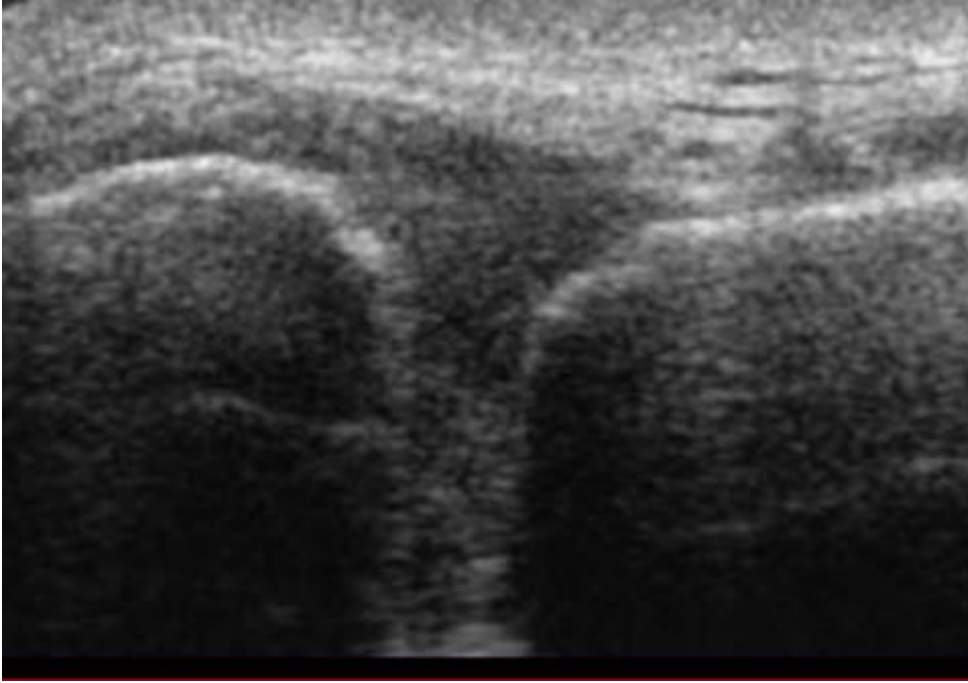
DELTOID LIGAMENT TEAR



PERONEAL TENDINOSIS WITH BONY AVULSION



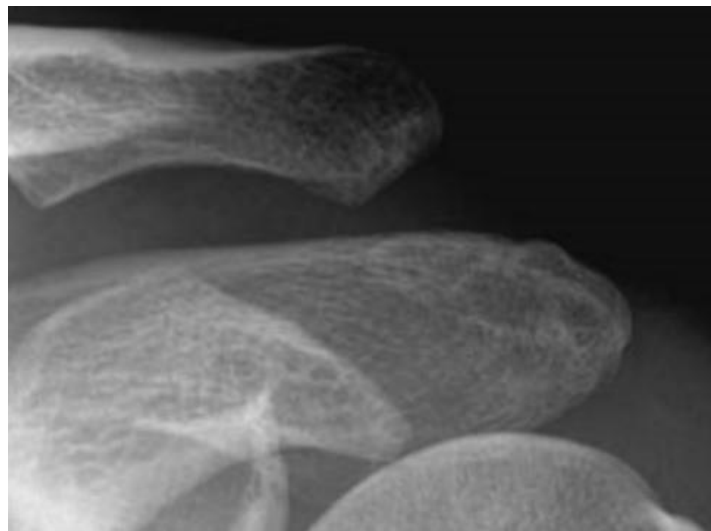
AC JOINT SEPARATION



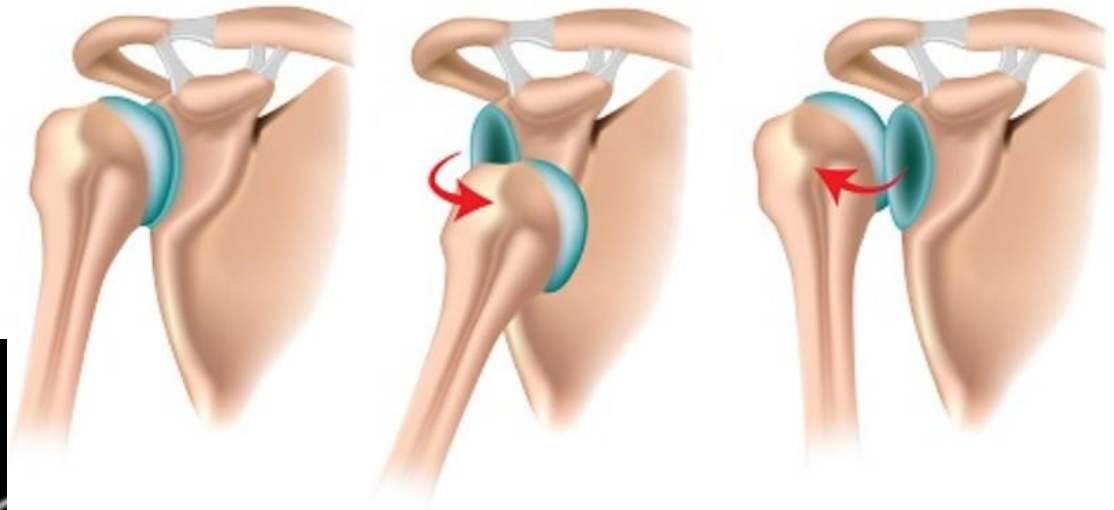
Normal AC joint space



Widening and height difference



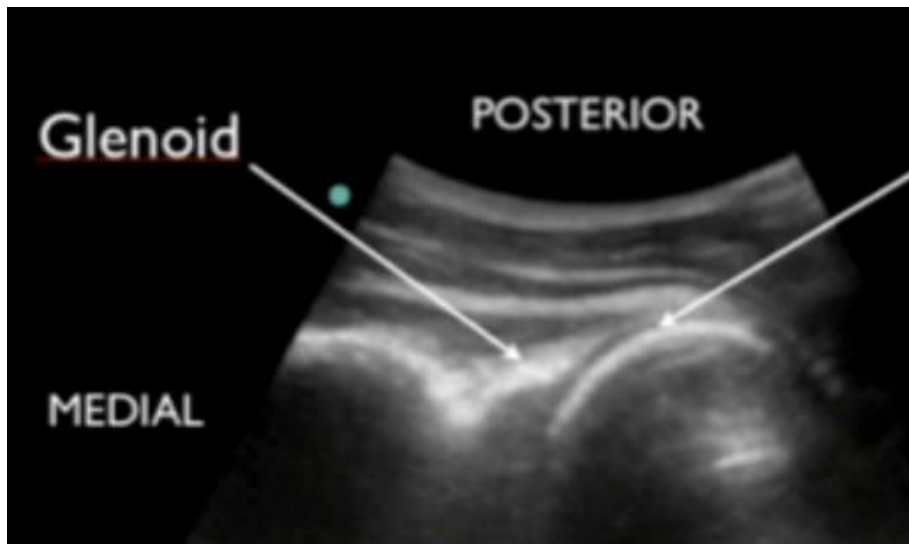
SHOULDER DISLOCATION



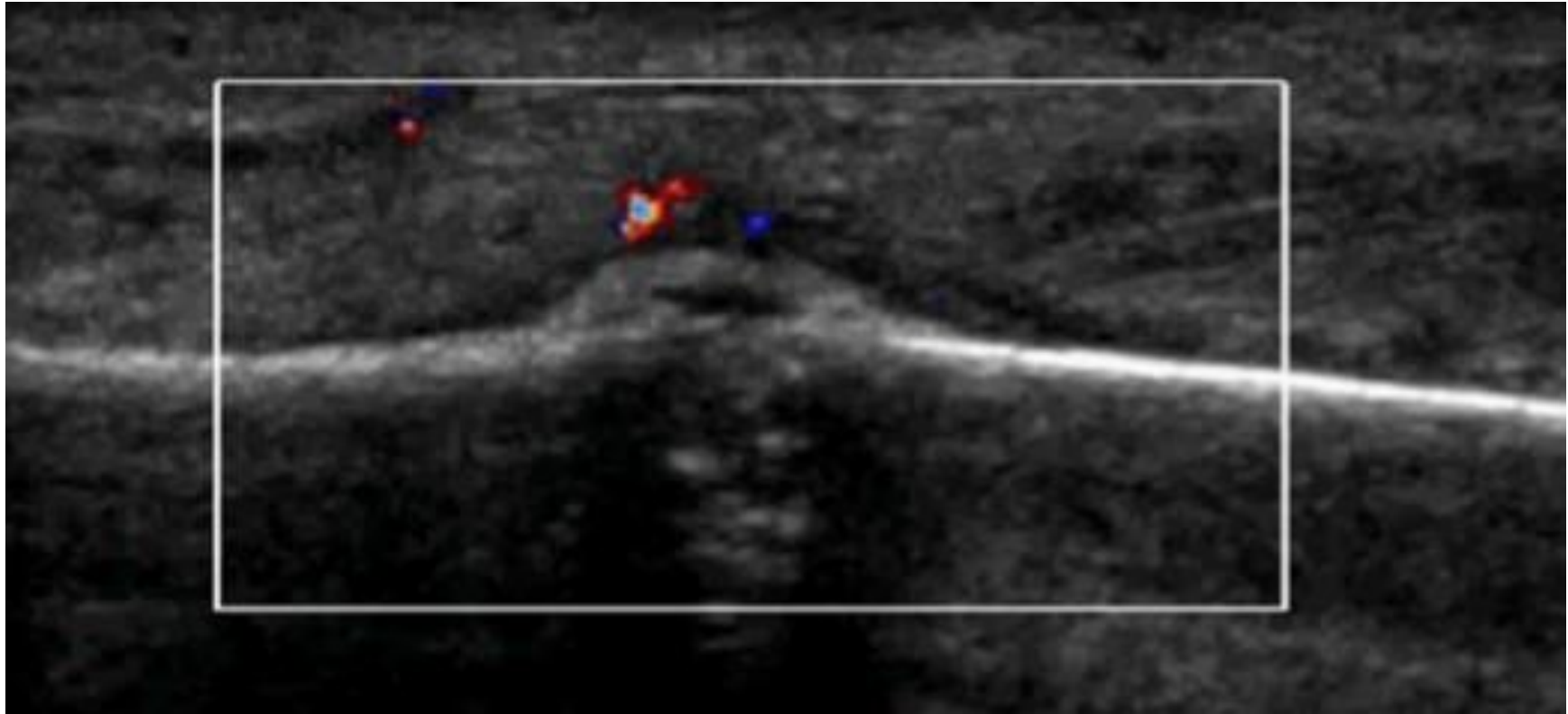
Normal
anatomy

Anterior
dislocation

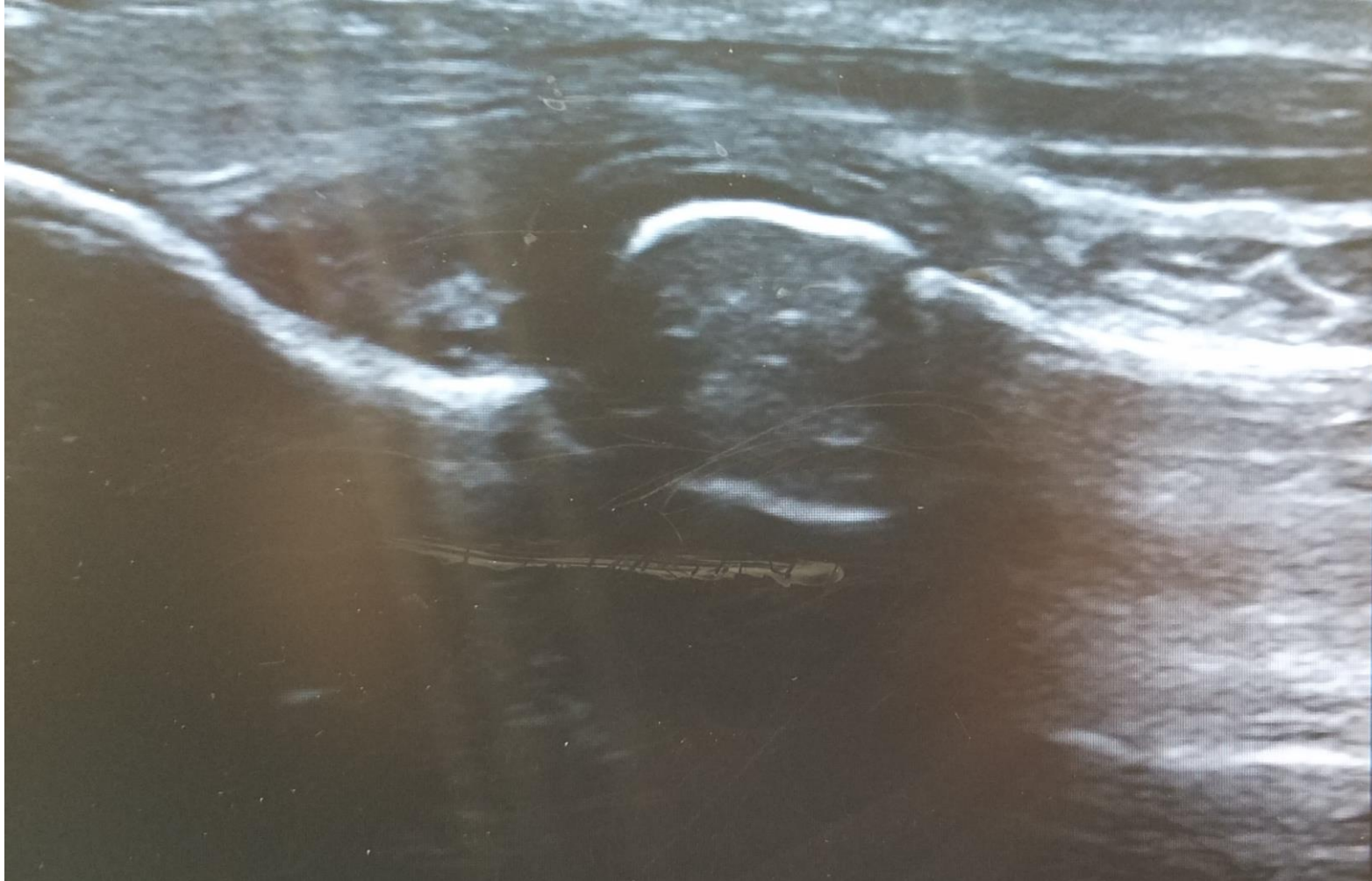
Posterior
dislocation



FRACTURE OF THE LONG BONE



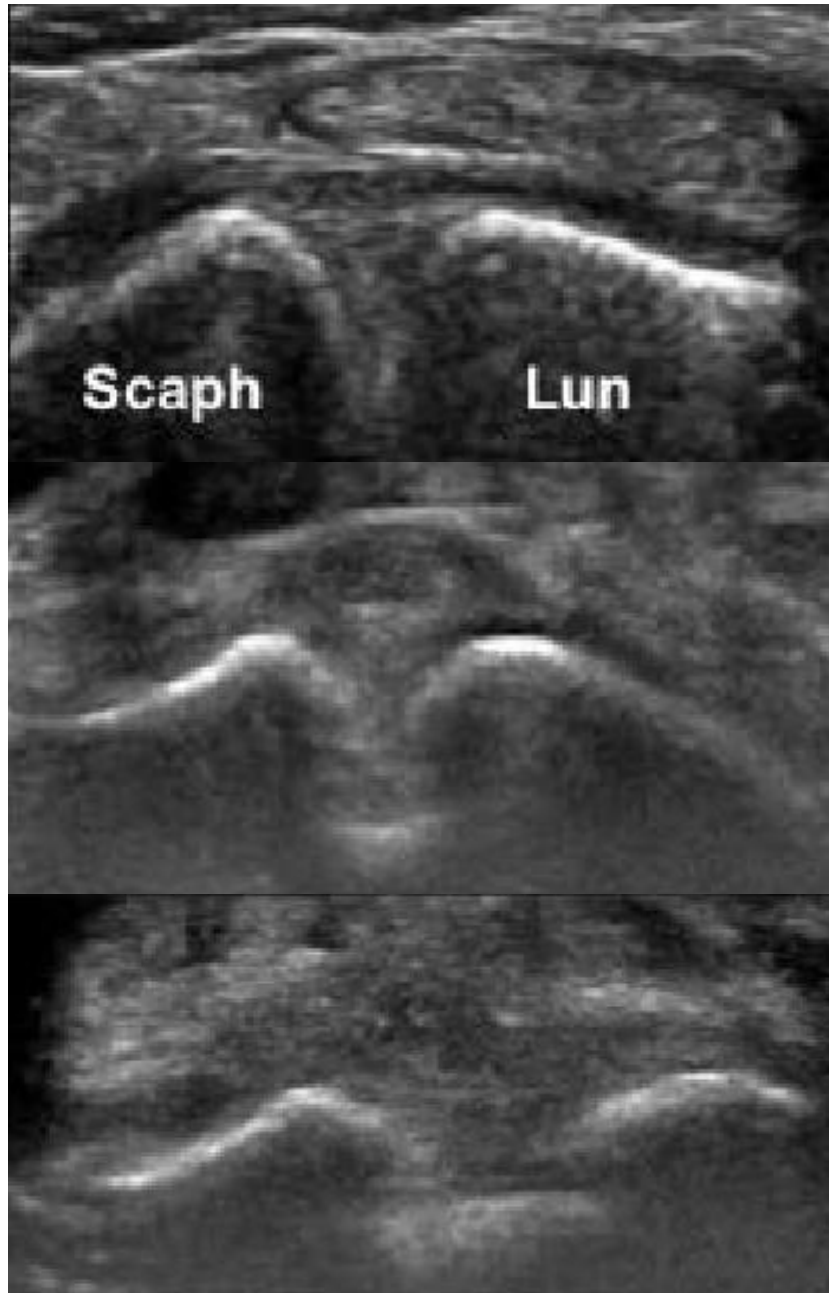
RADIAL HEAD FRACTURE



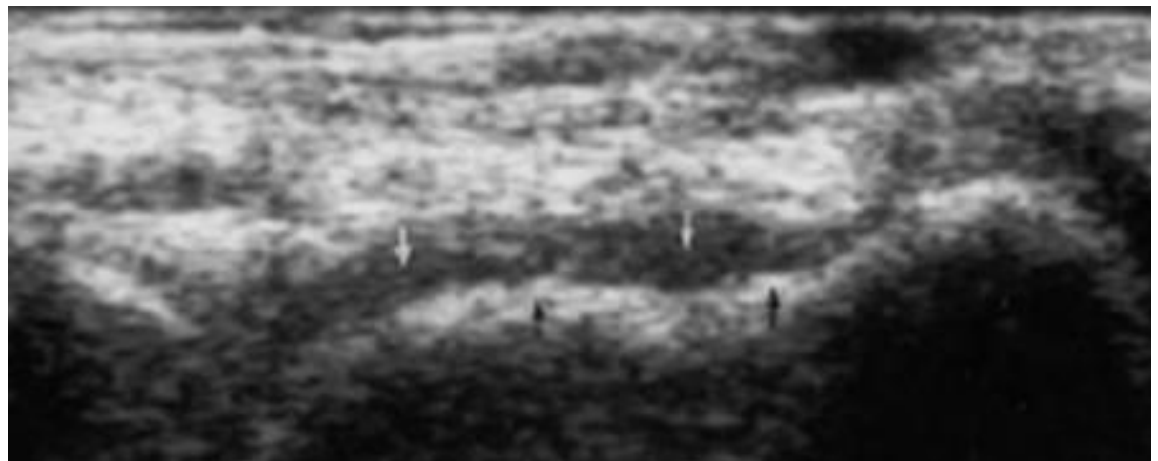
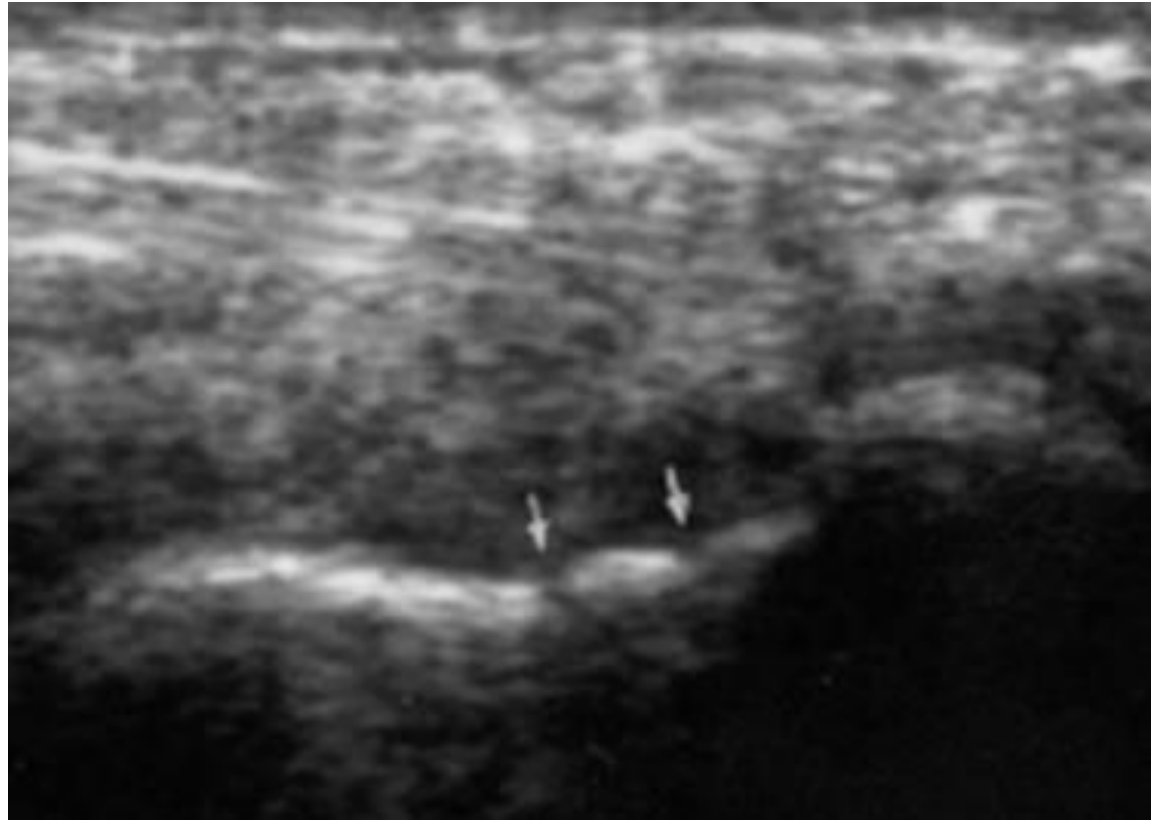
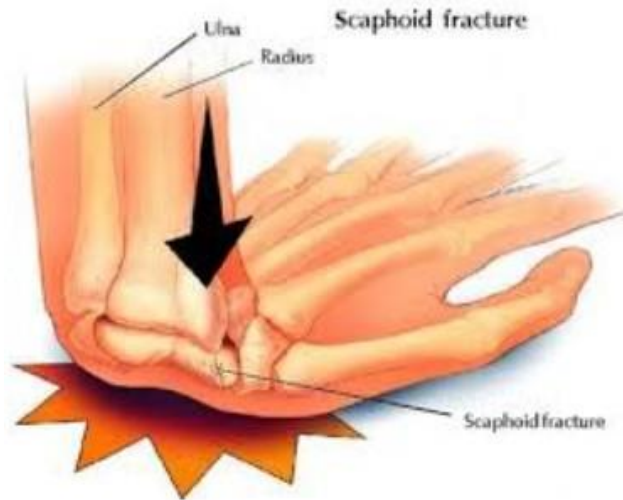
NASAL FRACTURE



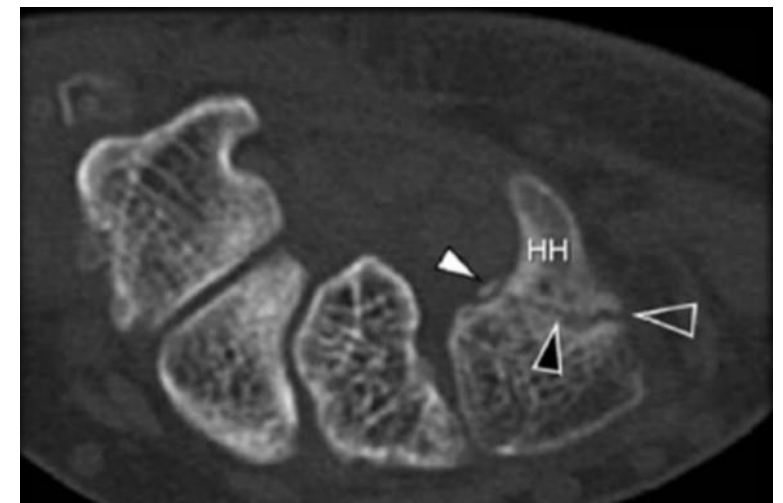
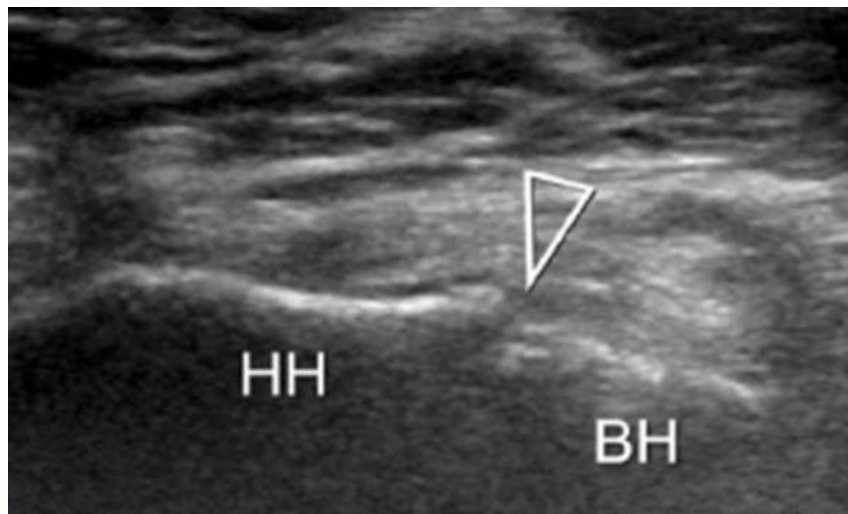
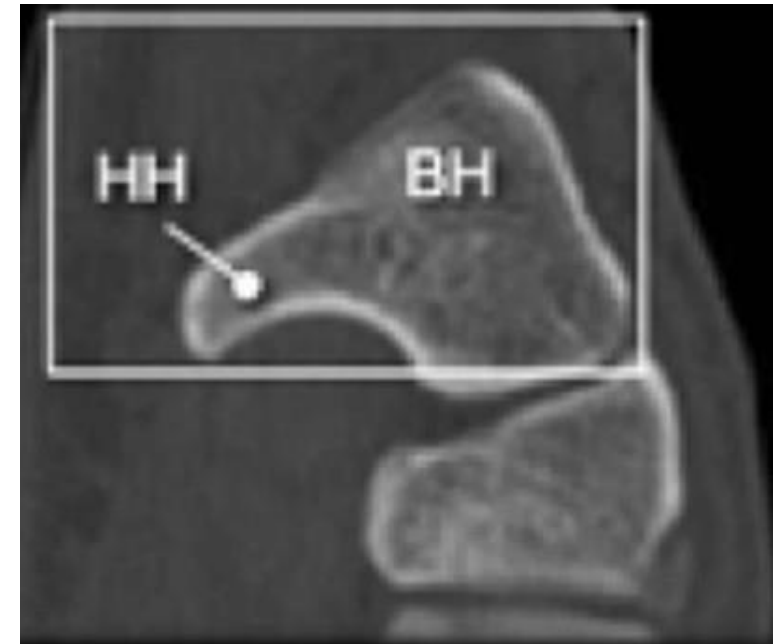
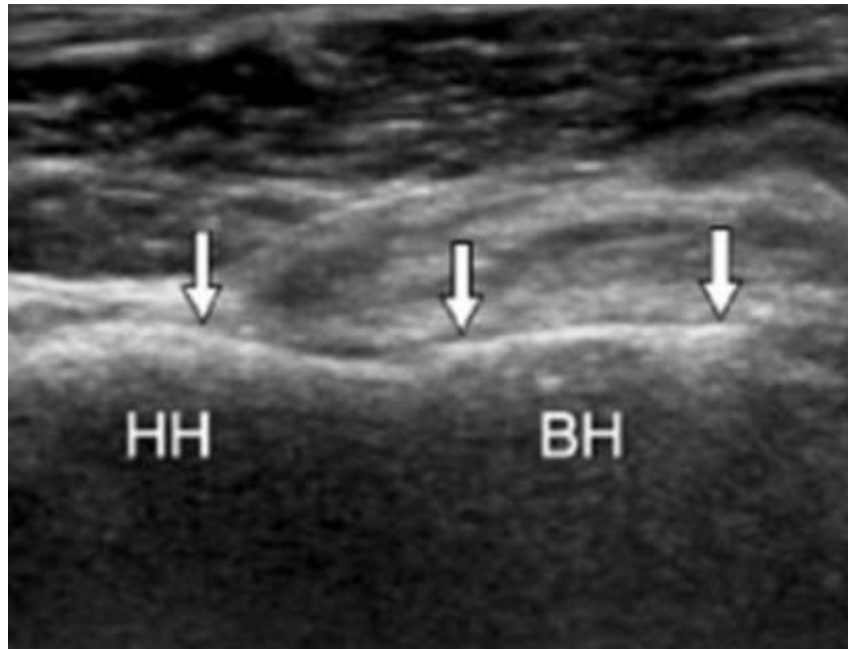
DORSAL SCAPHOLUNATE LIGAMENT



SCAPHOID FRACTURE

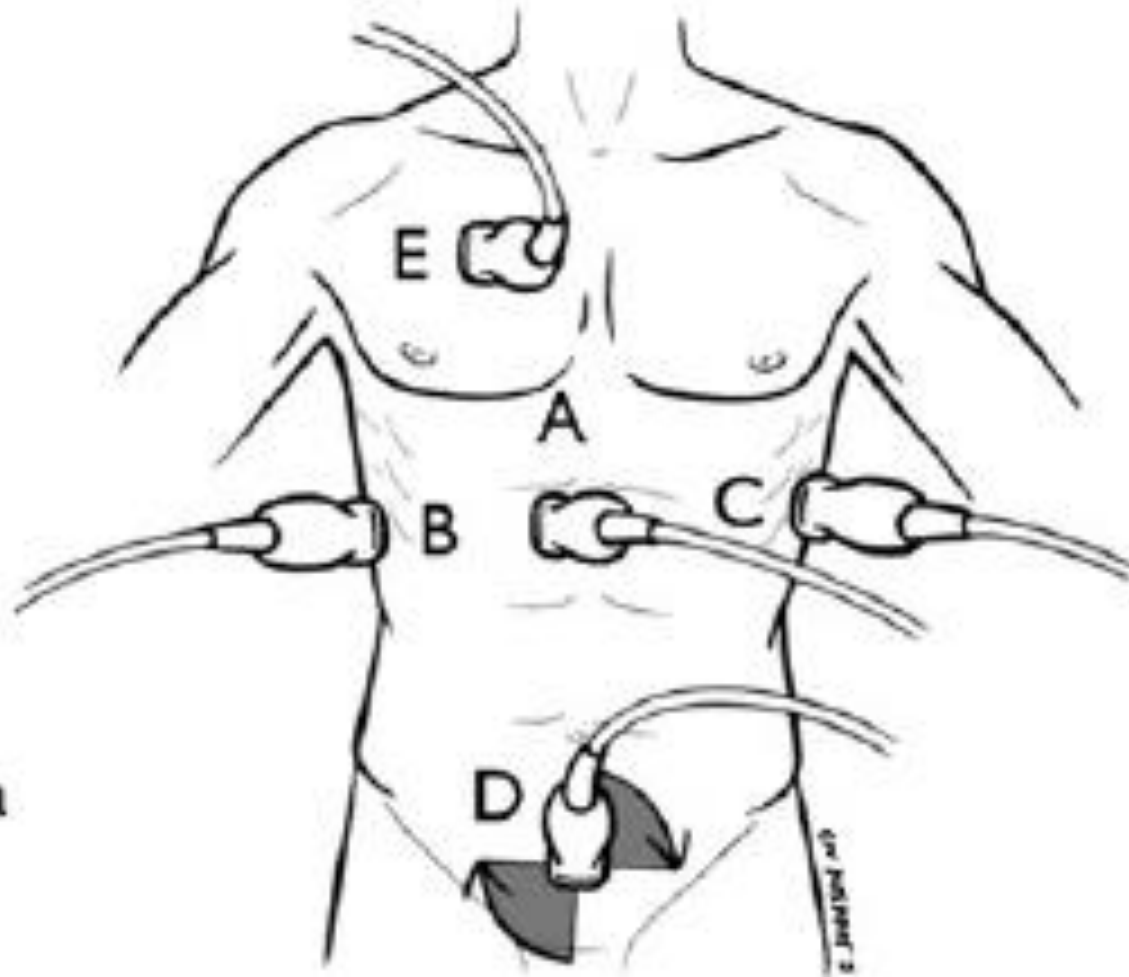


HOOK OF HAMATE FRACTURE

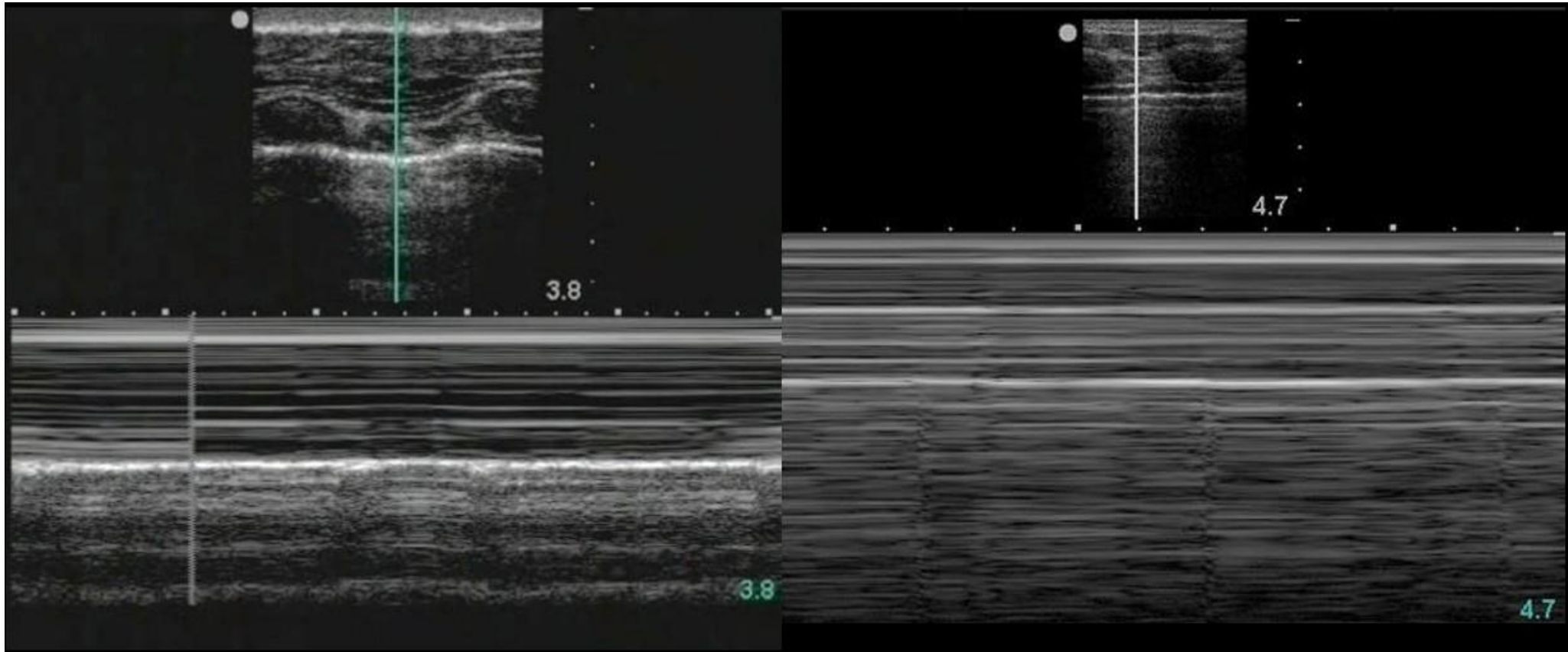


NON-MSK POCUS – E-FAST PROTOCOL

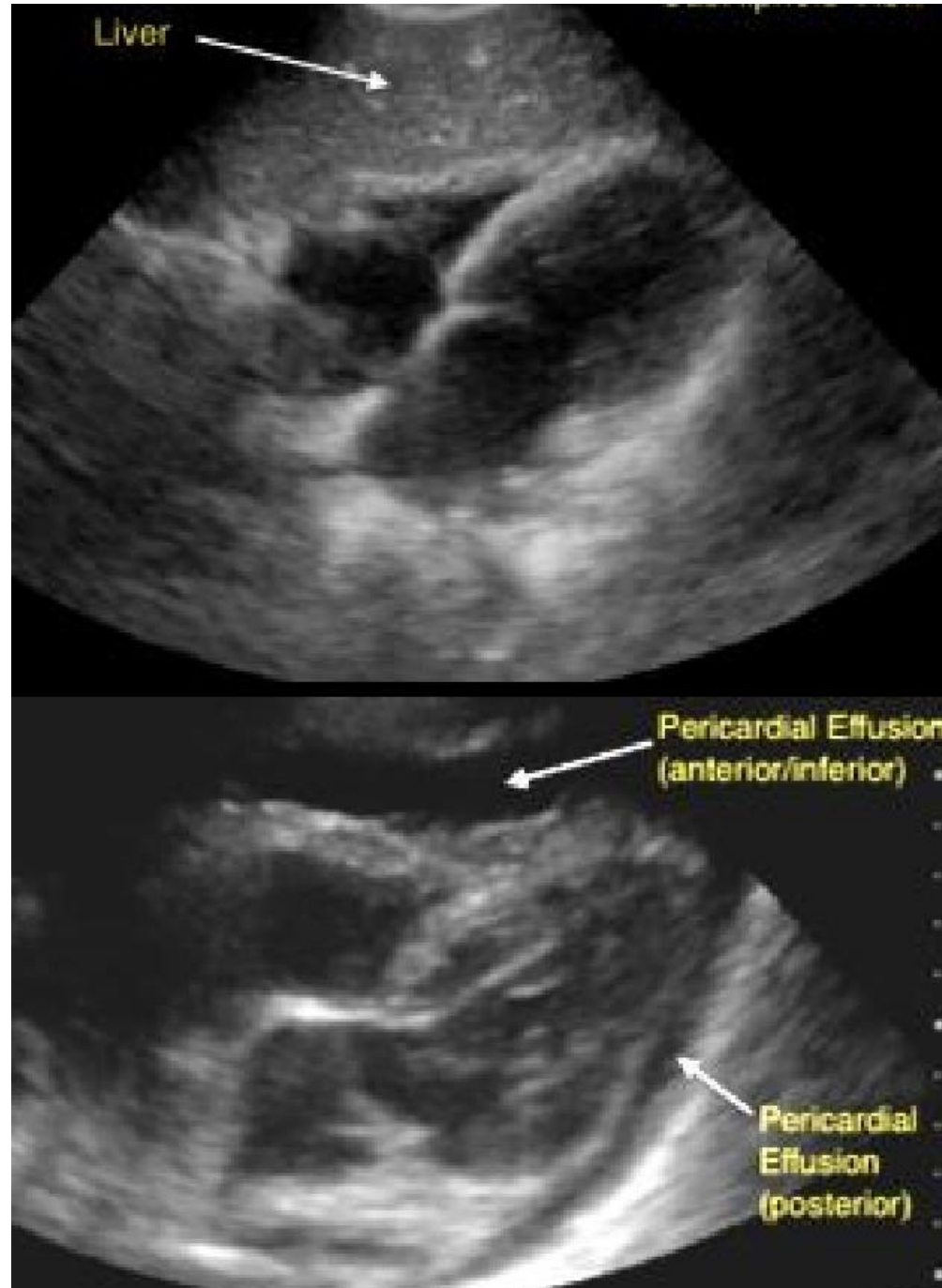
- A) IVC Long Axis
- B) FAST / RUQ
Add Pleural View
- C) FAST / LUQ
Add Pleural View
- D) FAST / Pelvis
- E) Pneumothorax
Pulmonary Edema



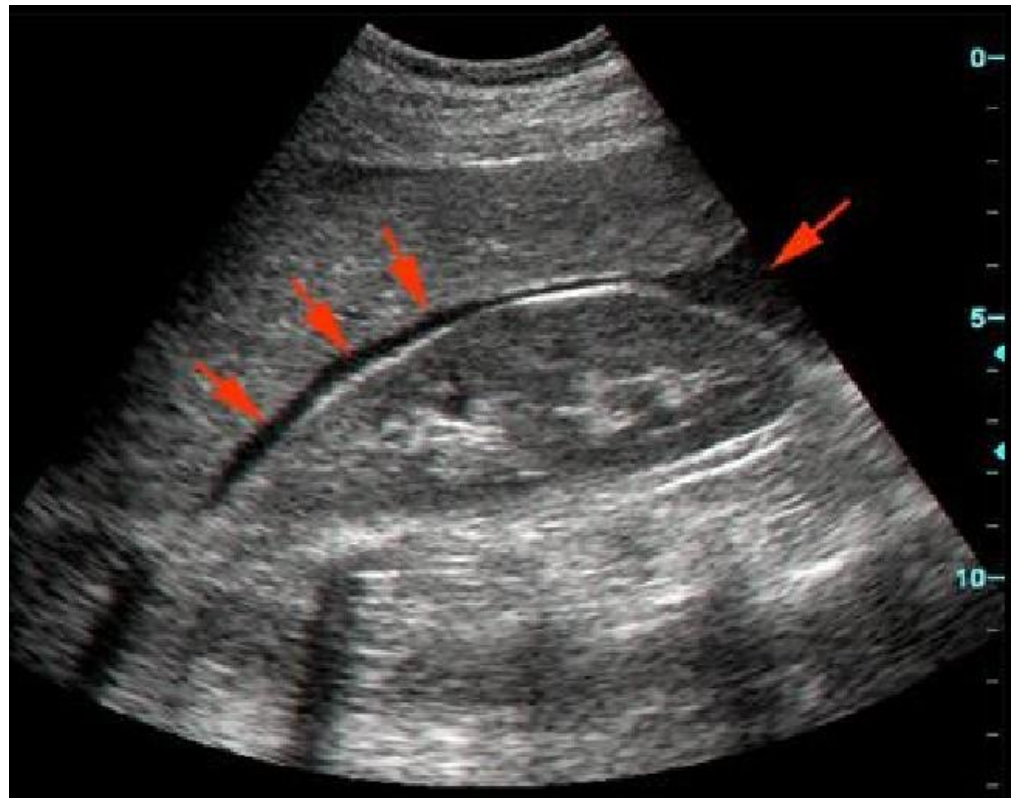
NON-MSK POCUS – E-FAST PROTOCOL - PNEUMOTHORAX



NON-MSK E-FAST PROTOCOL – PERICARDIAC EFFUSION



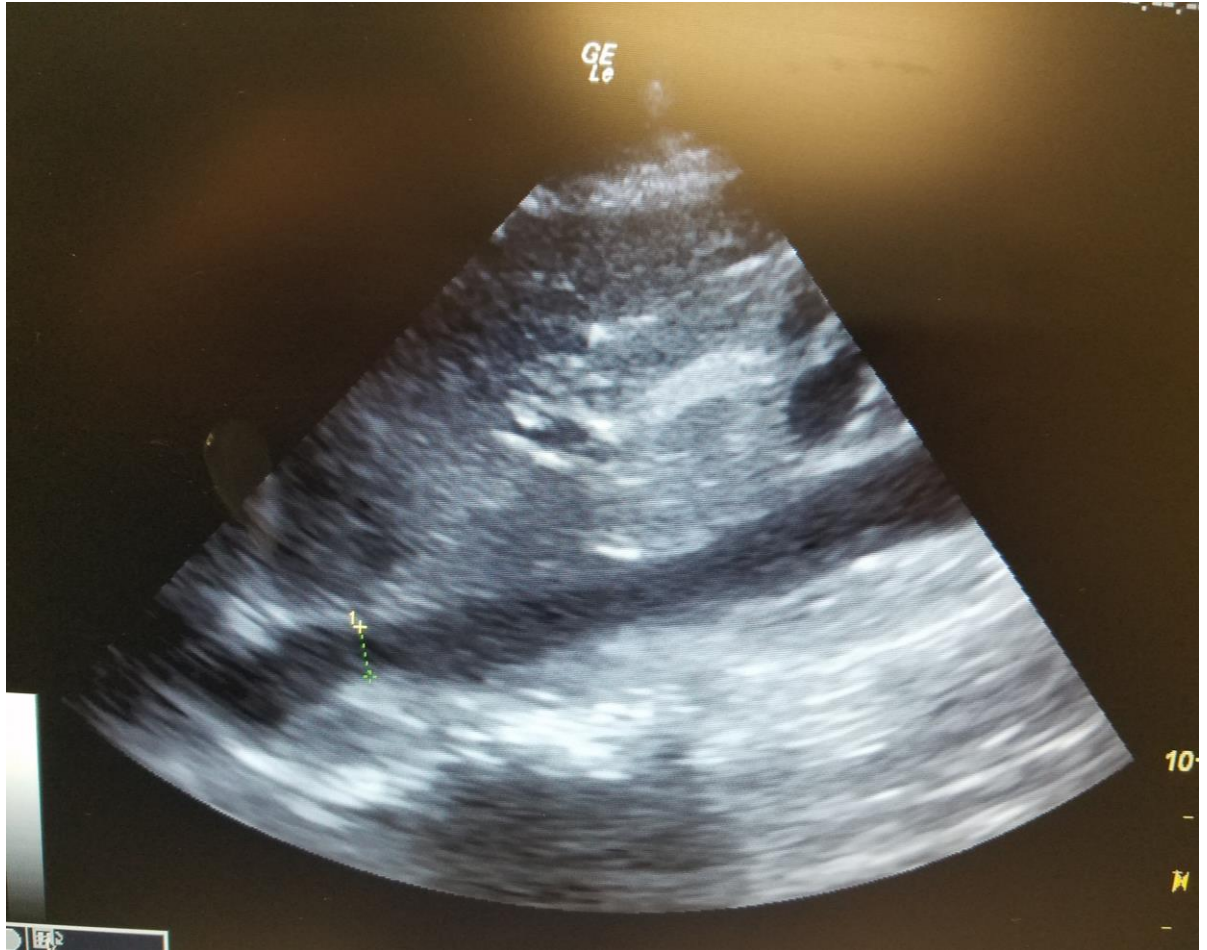
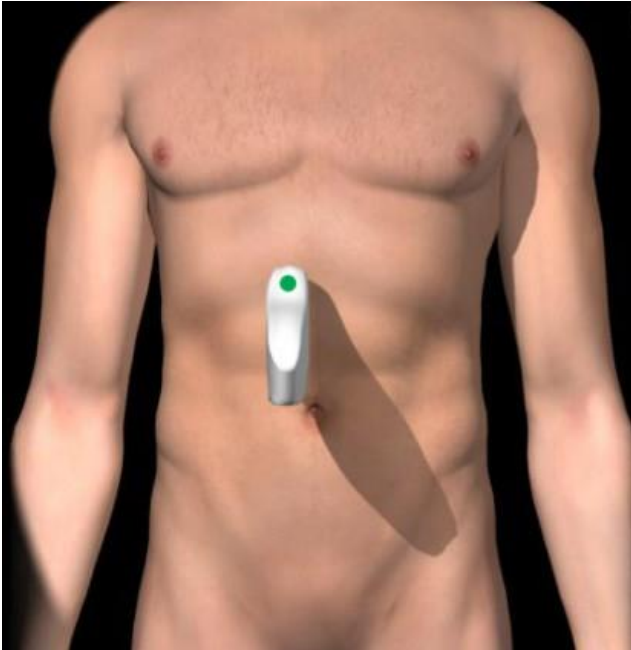
NON-MSK POCUS – E-FAST PROTOCOL : INTRA-ABDOMINAL HEMORRAGE



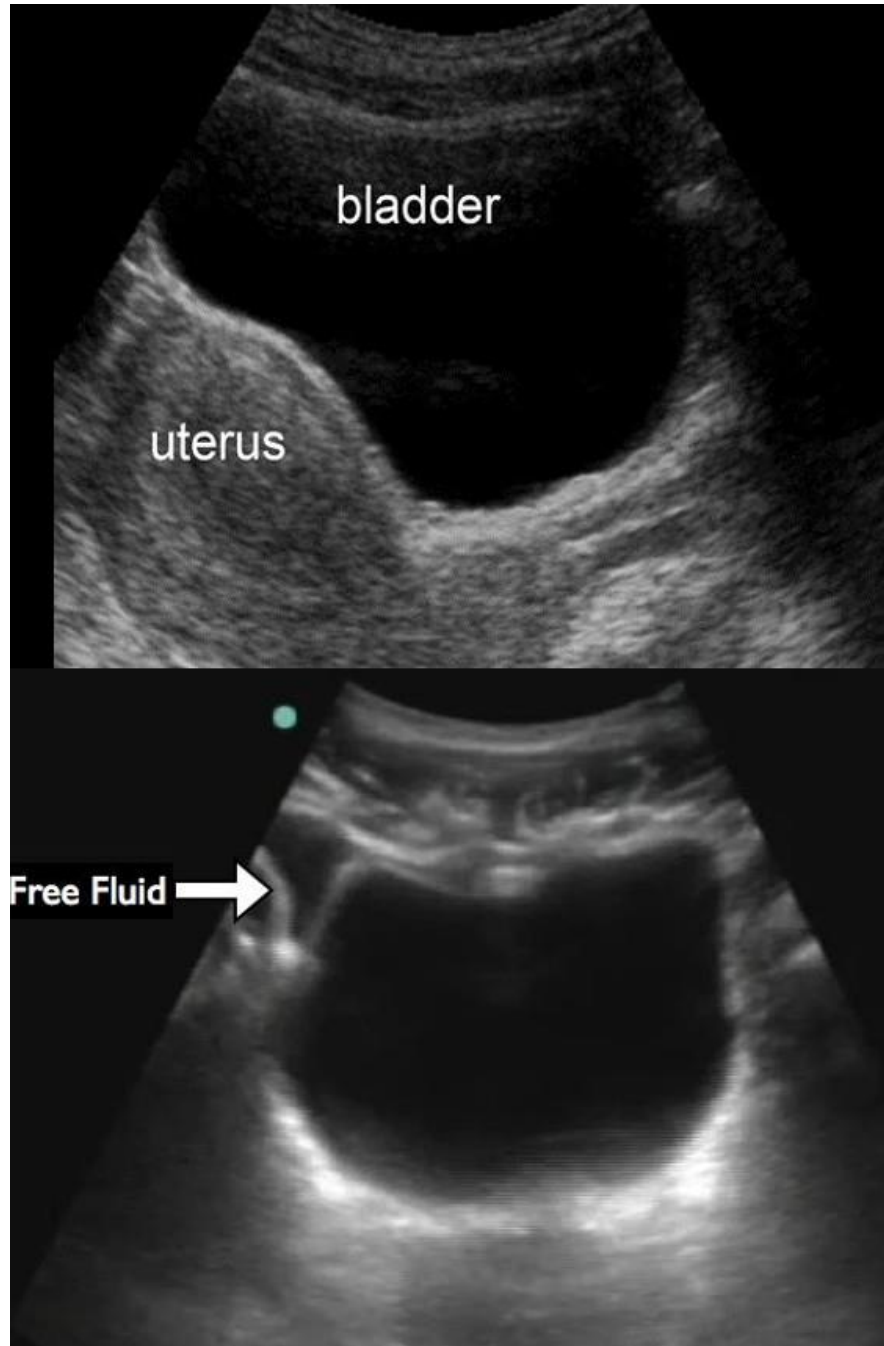
Morrison's pouch



NON-MSK POCUS – MEASURING IVC TO ESTIMATE CENTRAL VENOUS PRESSURE



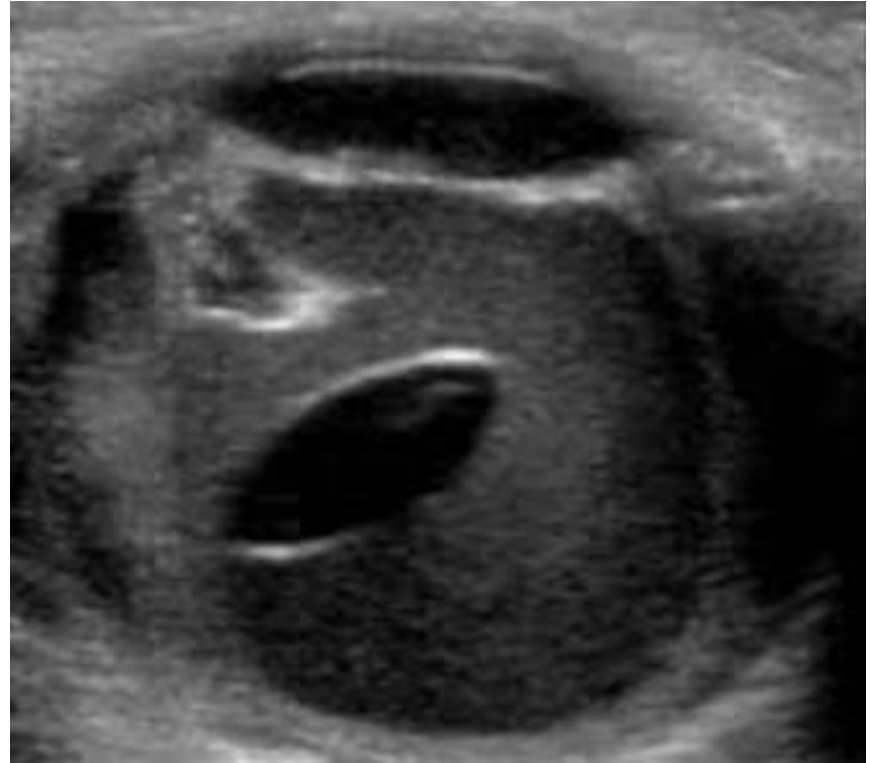
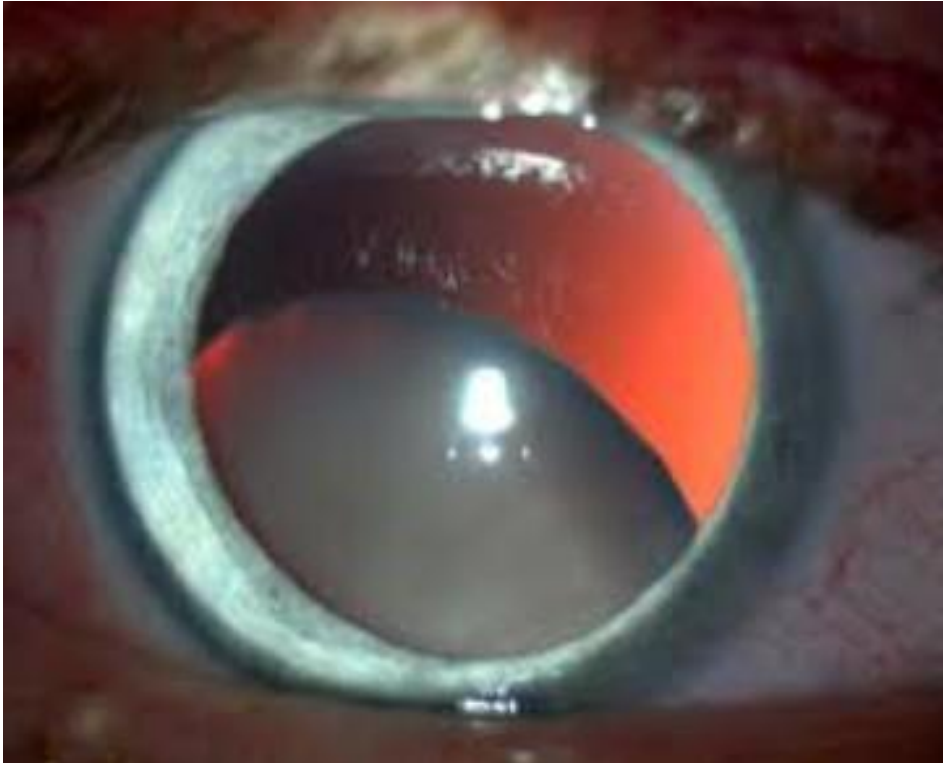
NON-MSK POCUS – E-FAST PROTOCOL : INTRA-ABDOMINAL HEMORRAGE



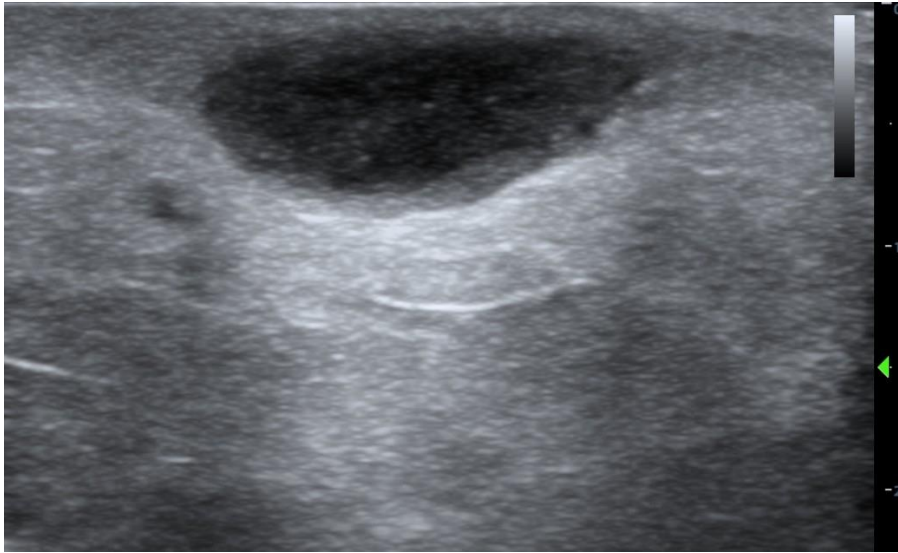
POCUS EYE EXAM – PUPILLARY REFLEX



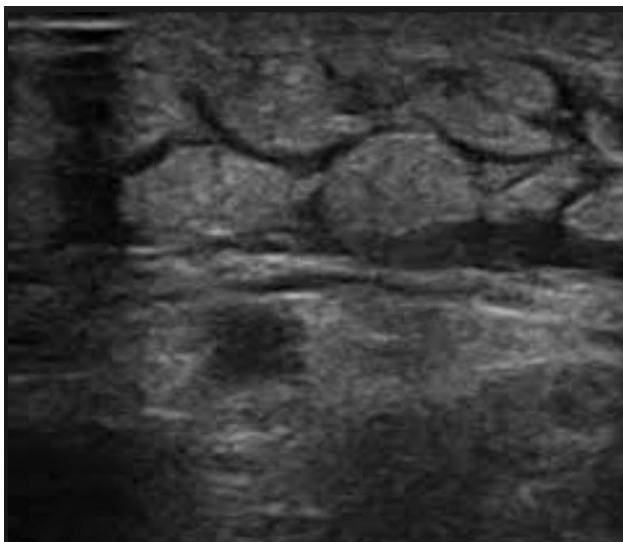
POCUS EXAM – SKIN AND SUBCUTANEOUS TISSUES



ULTRASOUND OF CUTANEOUS AND SUBCUTANEOUS TISSUE



Abscess



Cellulitis



CONSIDERATIONS OF POCUS IN TAEKWONDO



- **Adequate training / education is required**
 - One-on-one supervision is essential but not always available
-> recruit well-qualified and experience faculty
 - Needs to develop the educational material
: Handbook / Manual / Video / Workshop
- **Governance**
 - Maintain ultrasound skills up to date
 - Keep up to date with the latest literatures
 - Maintenance and quality assurance review of the ultrasound equipment



FUTURE DIRECTIONS



- Development of US curriculum and US workshops for MD/DO, ATC, PT for professional development
 - TKD competition specific ultrasound protocol
 - Web-based resources
 - Simulation-based hands-on training
- Promoting the use of POCUS in the competition by organizational support and policy enhancement
- More researches on ringside point-of-care ultrasound in the TKD competition



TAKE HOME MESSAGES

- Musculoskeletal Ultrasound (MSKUS) is very cost-effective diagnostic modality with high accuracy and reliability in Sports Medicine.
- Point-of-Care Ultrasound(POCUS) can be a promising adjunct to ringside physician's evaluation on injured TKD athletes for more accurate clinical assessment and solid management plan with confidence.
- POCUS reduces unnecessary ER transfer during the TKD competition
- POCUS can detect potentially harmful competition-related injuries which can be detrimental to TKD athletes' performance and athletic lifespan if not properly managed in a timely manner.
- It may shorten the time-loss of the injured athletes by reducing the waiting time for specialist referral and/or more costly diagnostic modality such as MRI
- More epidemiological and clinical researches using POCUS in Taekwondo are imperative
- Developing educational training program for point-of-care sports ultrasound focusing on TKD competition will be a key component to promote the use of ultrasound in TKD competition

REFERENCES

- Competition injuries in takwondo: a literature review and suggestions for prevention and surveillance
- MJ Ji, Analysis of injuries in taekwondo athletes, J. Phys. Ther. Sci. 28:231-234, 2016
- Klauser AS, et al. Clinical indications for musculoskeletal ultrasound: a Delphi-based consensus paper of the European Society of Musculoskeletal Radiology. Eur Radiol. 2012;22(5):1140–8.
- Yim ES, Corrado G. Ultrasound in sports medicine: relevance of emerging techniques to clinical care of athletes. Sports Med. 2012;42(8):665–80.
- International Federation for Emergency Medicine 2014, IFEM Point-of-Care Ultrasound Curriculum Guidance
- Parker L et al, Musculoskeletal imaging: medicare use, costs, and potential for cost substitution. [J Am Coll Radiol](#). 2008 Mar;5(3):182-8. doi: 10.1016/j.jacr.2007.07.016.
- Jamadar et al, Musculoskeletal Sonography: Important Imaging Pitfalls, AJR, 2010;194: 216-225. 10.2214/AJR.09.2712
- AIUM Practice Guideline for the Performance of a musculoskeletal ultrasound examination, 2012 AIUM
- ESSR musculoskeletal ultrasound technical guidelines
- J.T. Finnoff et al, AMSSM Recommended Sports Ultrasound Curriculum, PM R 7 (2015) e1-e11
- McNally, Ultrasound of the small joints of the hands and feet: current status, Skeletal Radiol (2008) 37:99–113 DOI 10.1007/s00256-007-0356-9
- Tagliafico et al, Elbow US: Anatomy, Variants, and Scanning Technique, Radiology: Volume 275: Number 3—June 2015
- Nestorova et al, Ultrasonography of the Hip, Medical Ultrasonography 2012, Vol. 14, no. 3, 217-224
- Van Holsbeeck, Musculoskeletal Ultrasound, Jp Medical Ltd; 3rd ed. Edition, March 1, 2016



Thank you!

