



# Pediatric Musculoskeletal Ultrasound

Raymond Sze, MD

Children's National Health System

George Washington University

# Outline of Presentation

- **5 Ways US is *better* than MR for MSK**
- Techniques
- Infection
- Masses
- Trauma

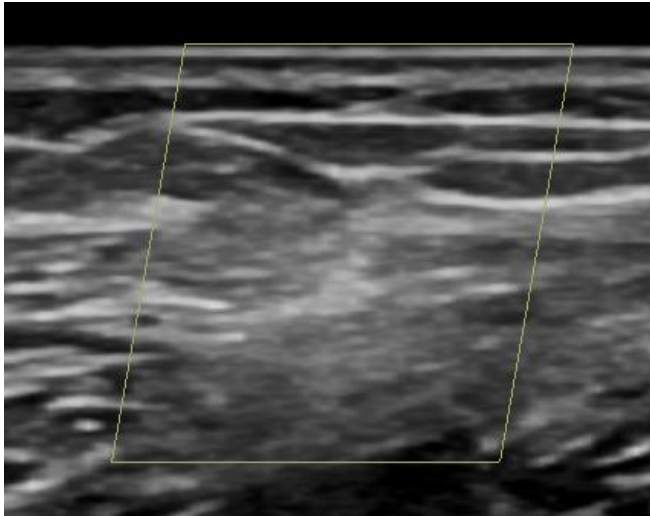
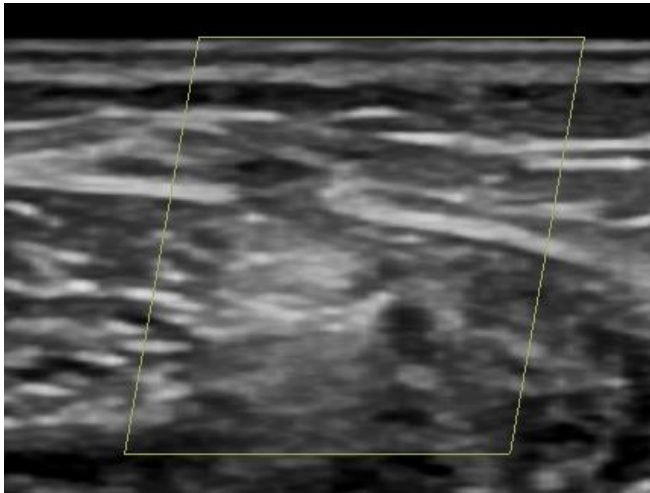
# 1. Every patient can have US

- No sedation
- No claustrophobia
- No problems with pacemakers or metal implants
- More comfortable positioning



M. Callahan

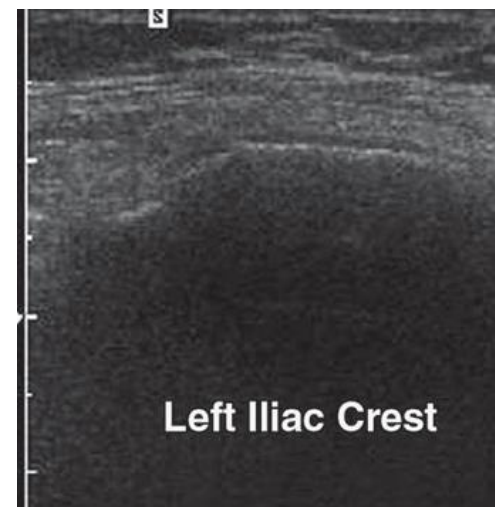
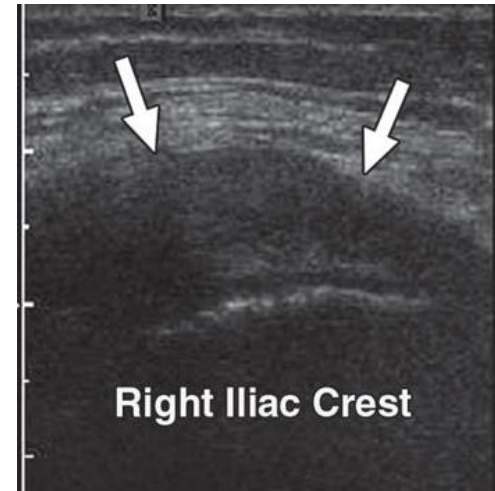
## 2. Real time dynamic examination



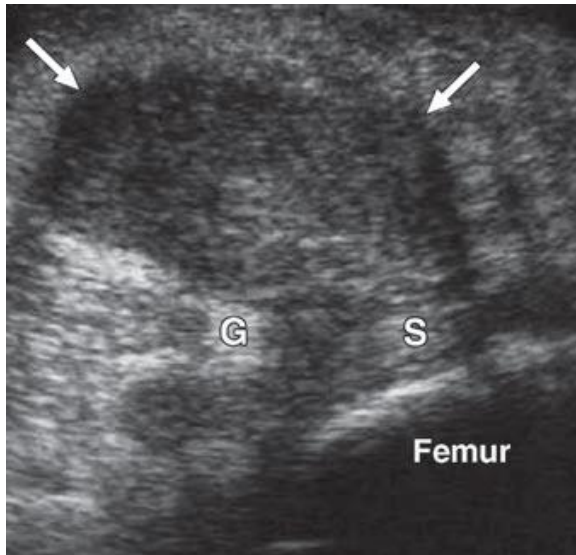
- Leg pain with exertion
- US for DVT
- US reveals muscle hernia: focal defect in fascia over tibialis anterior with muscle protruding

### 3. Probe can be placed where it hurts

- Increasing right hip pain. **2 normal hip and 1 normal spine MR**
- US over area of most tenderness: right iliac crest
- Thickened and calcified external oblique tendon



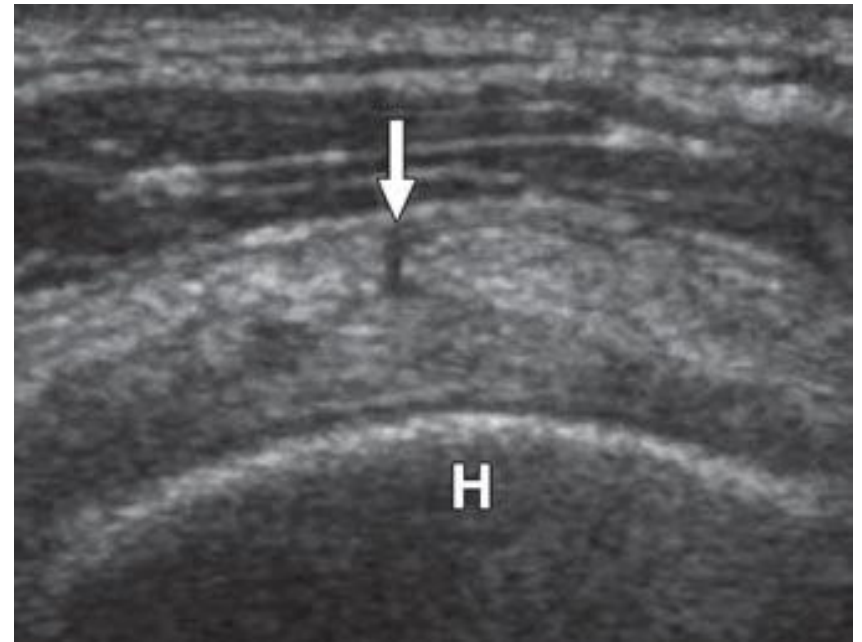
## 4. US is better for fluid vs solid



- Posterior knee pain
- **MR showed Baker cyst; referred for US guided aspiration**
- US shows solid material and internal vascularity: rheumatoid pannus

# 5. US can resolve finer details

- Shoulder pain for 1 year
- **Shoulder MR negative**
- US shows supraspinatus tear



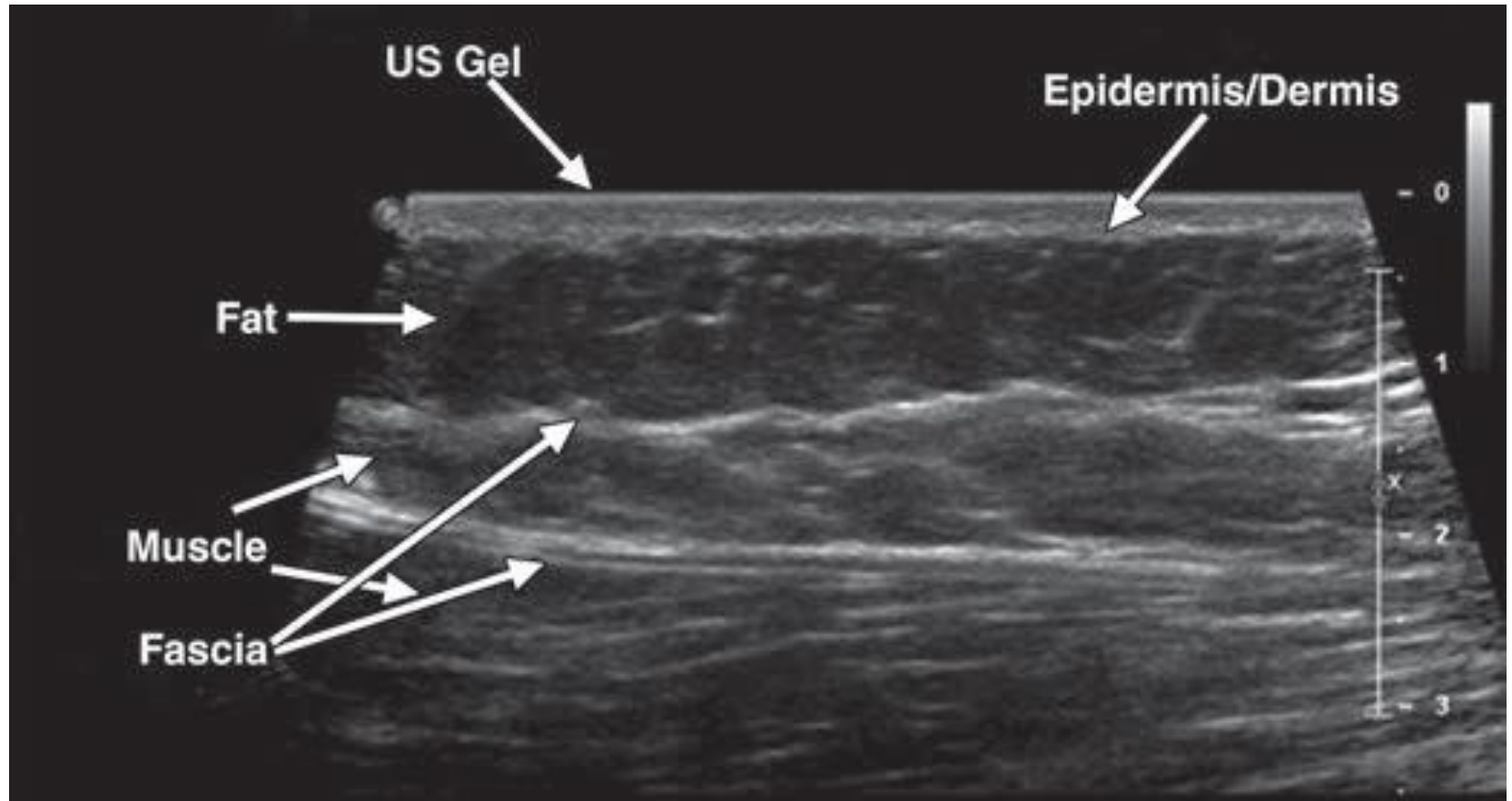
Nazarian LN. AJR 2008

# Outline of Presentation

- 5 Ways US is better than MR for MSK
- **Techniques**
- Infection
- Masses
- Trauma



# Anatomy



# Equipment

- High frequency linear transducers
- May require lower frequency for deeper structures and larger field of view

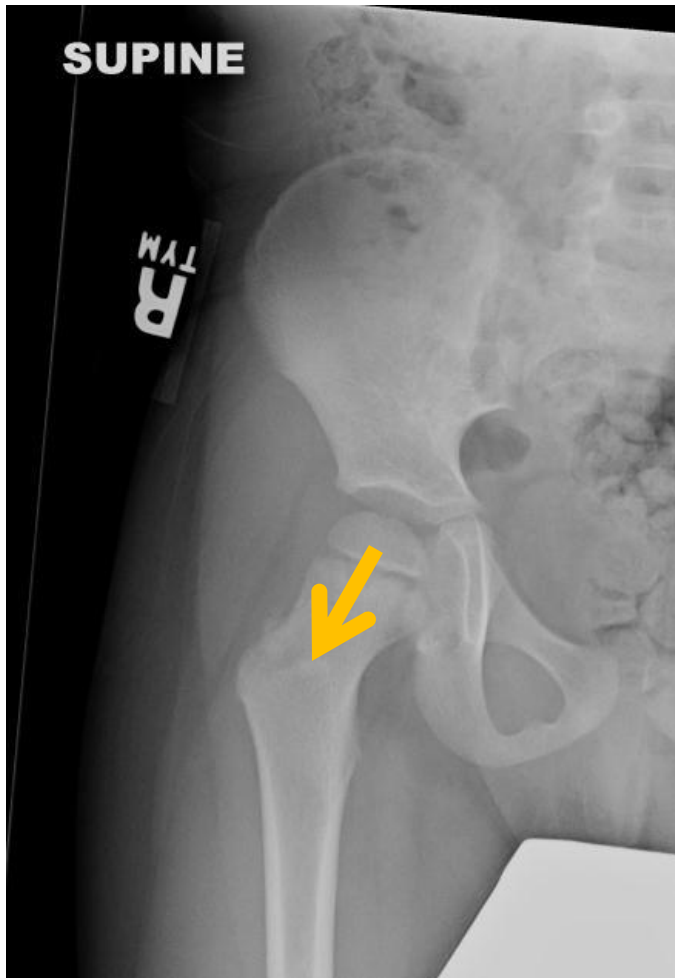


# Positioning and Comfort

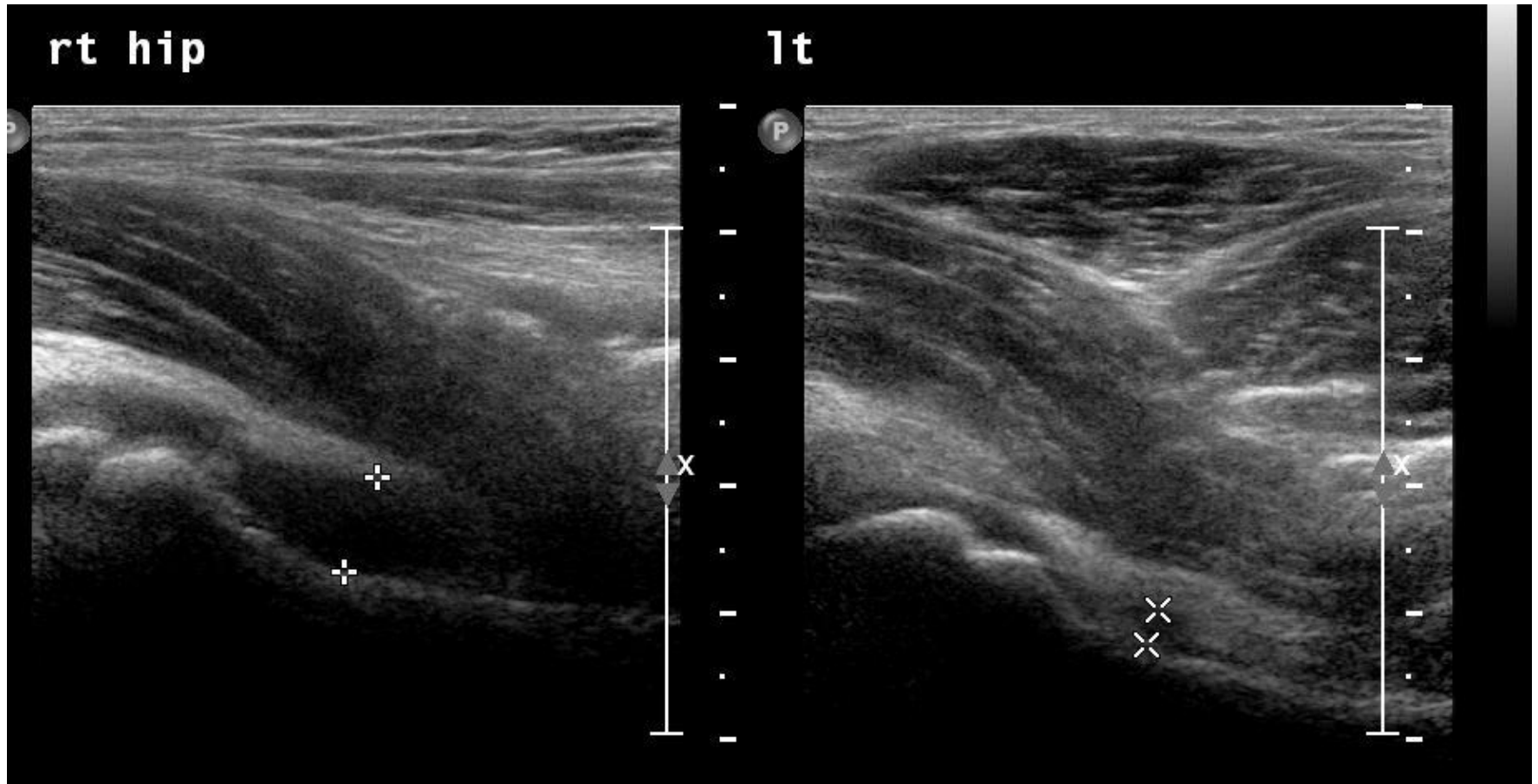


Callahan M. Pediatr Radiol 2013

# Hip Ultrasound for Effusion



# Hip effusion



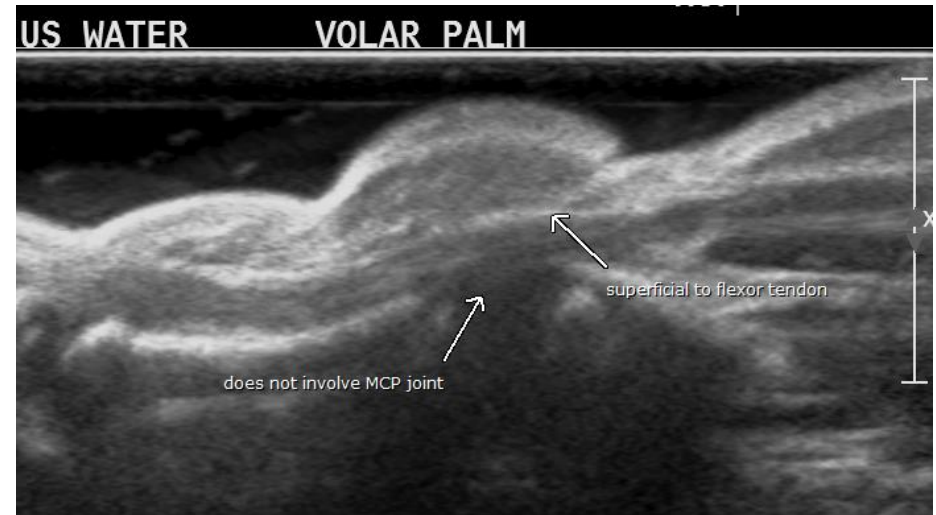
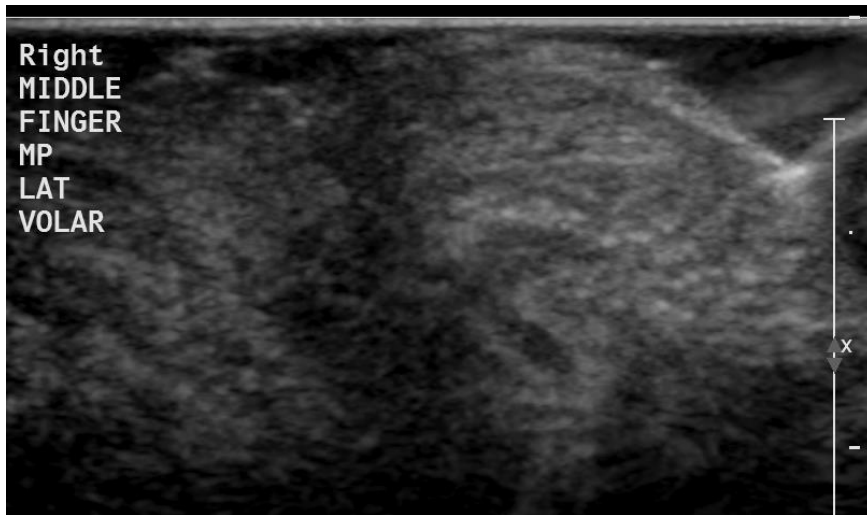
# Water Bath Technique



Krishnamurthy R. Pediatr Radiol 2013

- Better for curved contours of hands and feet
- Larger field of view than stand off pads
- No compression by transducer
- No discomfort

# Water bath technique



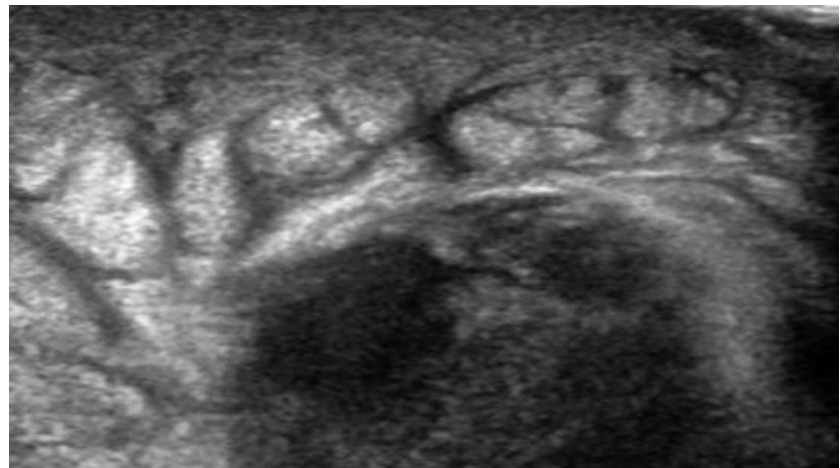
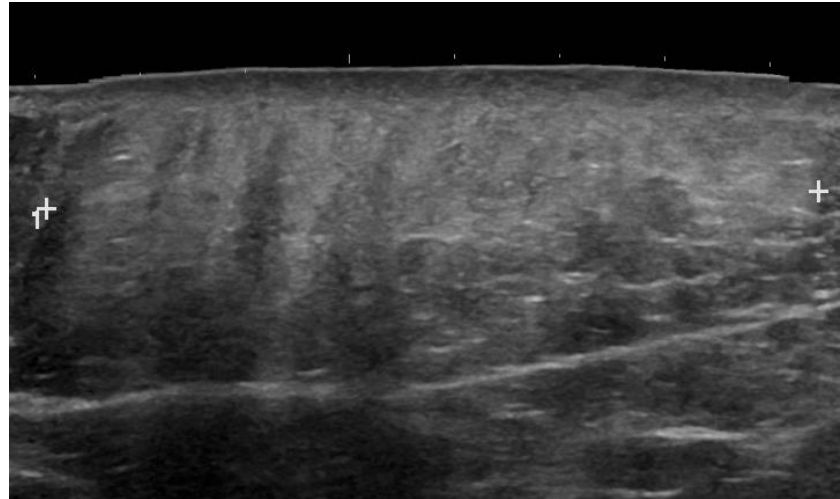
# Outline of Presentation

- 5 Ways US is better than MR for MSK
- Techniques
- **Infection**
- Masses
- Trauma

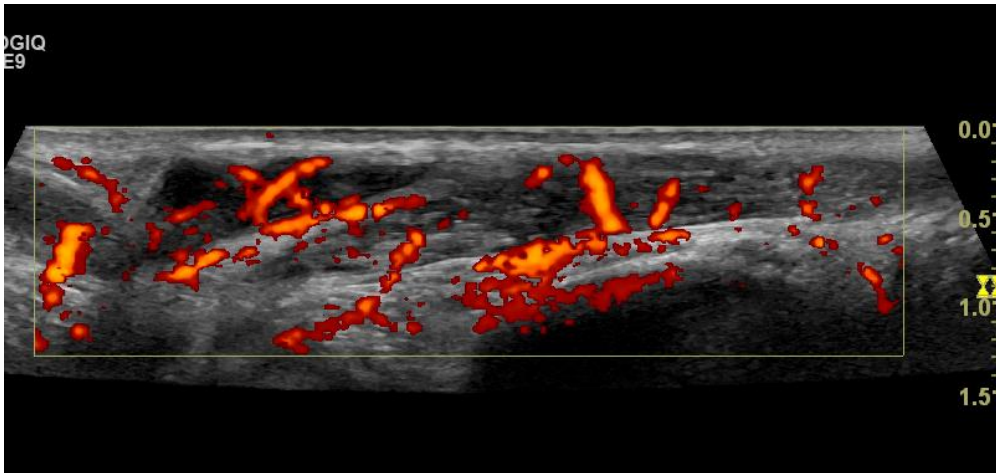
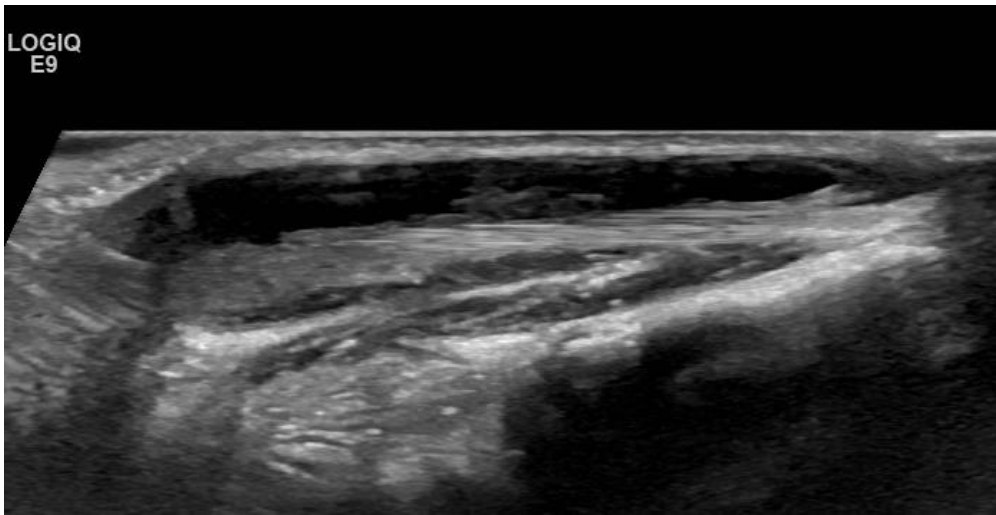


# Cellulitis

- Acute infection of subcutaneous tissues
- *S. aureus* and *S. pyogenes*
- Diffuse thickening and  $\uparrow$  echogenicity
- Cobblestone appearance due to inflammatory exudate



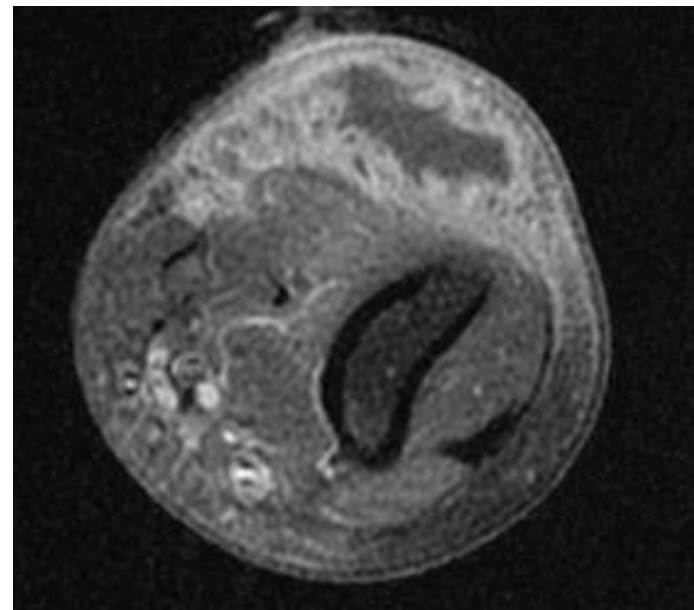
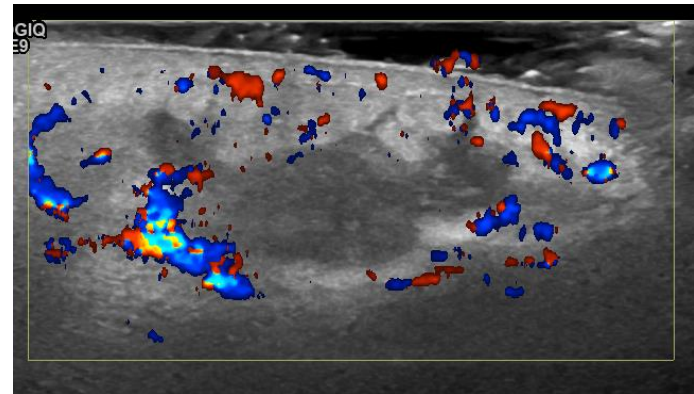
# Infectious Tenosynovitis



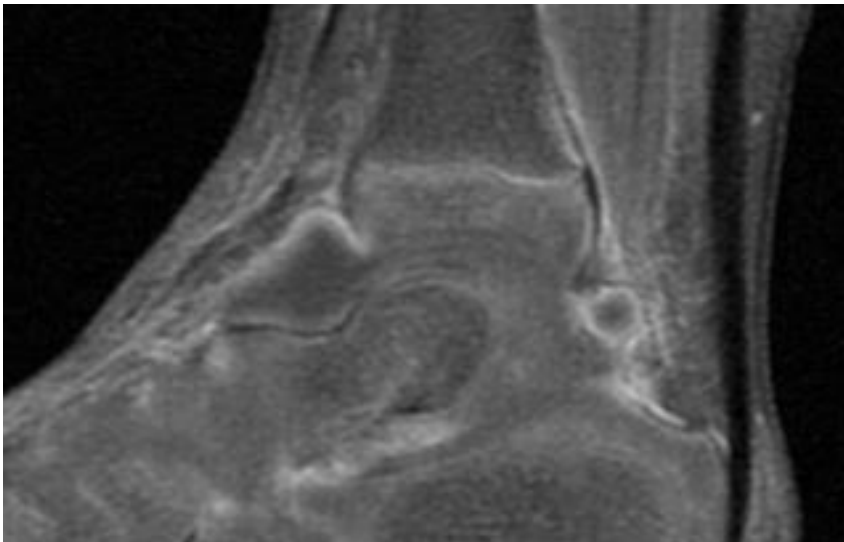
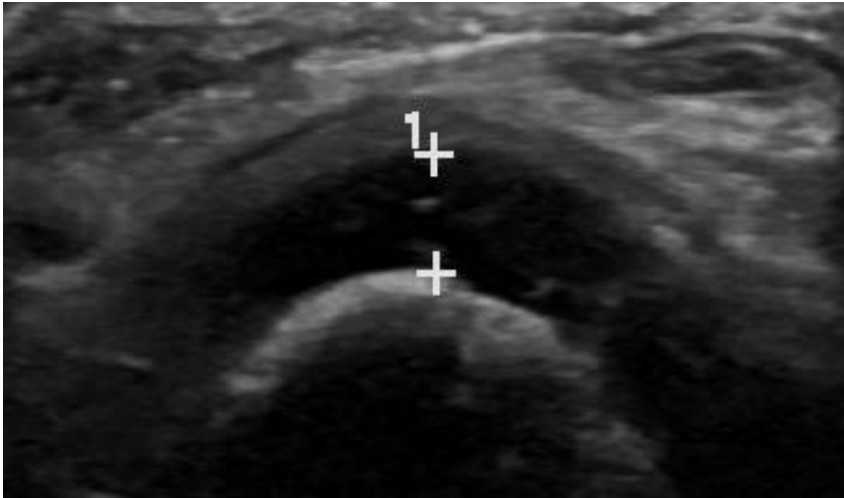
- Most frequent tendon sheaths of digital flexor muscles
- Usually penetrating injury (bite, puncture)
- Enlarged tendons and hyperemia

# Abscess

- Peripheral hyperemia; absent central flow
- Internal echoes represent debris or gas
- Dynamic evaluation for motion of pus



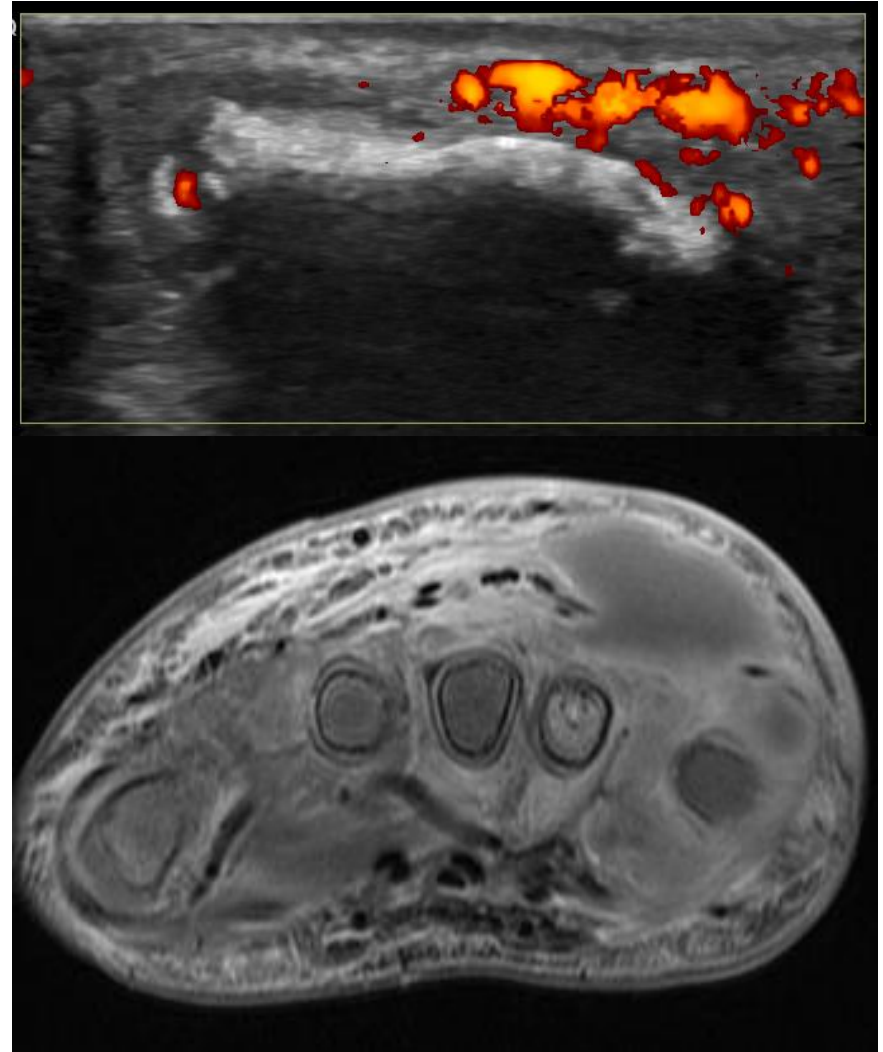
# Septic arthritis



- Rapidly destructive joint disease
- 25-50% irreversible loss of function
- Hematogenous seeding of joint during bacteremia
- **Pitfall:** US can not differentiate infected fluid from non-infected fluid

# Osteomyelitis

- Subperiosteal fluid collection
- Main role guide aspiration
- Useful for osteomyelitis complicating metallic fixation

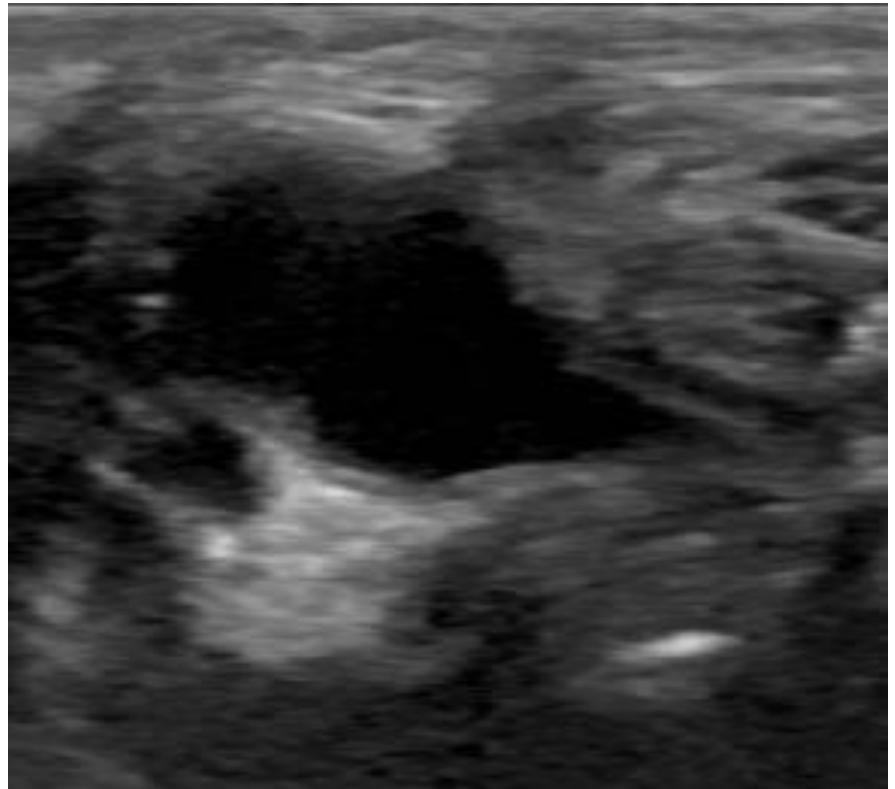


# Outline of Presentation

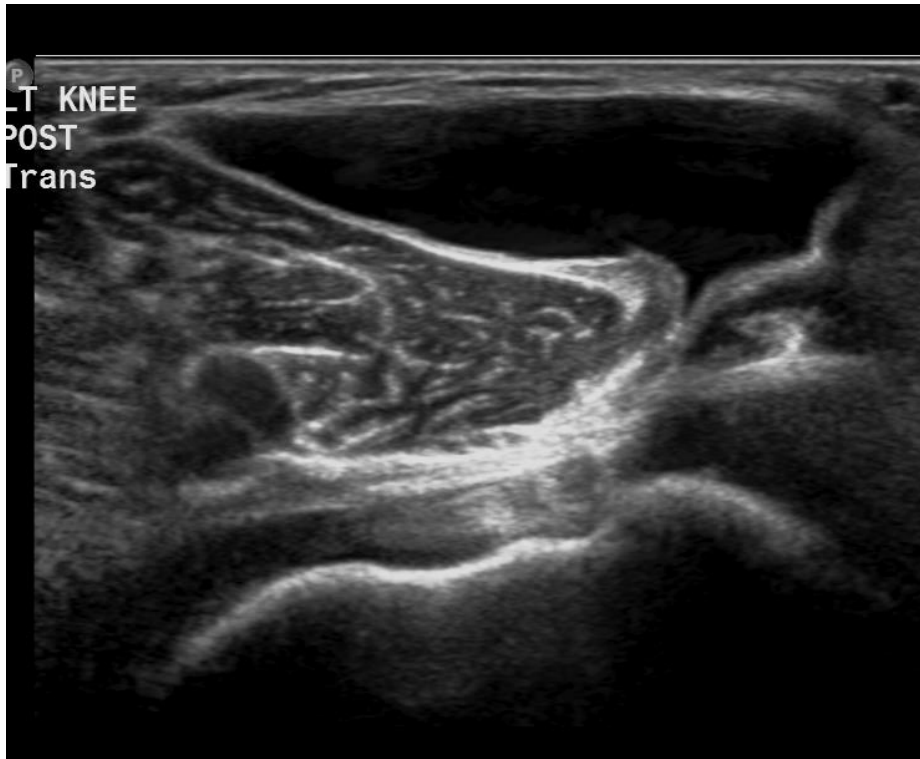
- 5 Ways US is better than MR for MSK
- Techniques
- Infection
- **Masses**
- Trauma

# Cystic: Ganglion cyst

- Mucin filled,  
fibrous capsule
- Communication  
with joint or  
tendon sheath  
(seen in 25-35%  
of cases)



# Cystic: Baker cyst

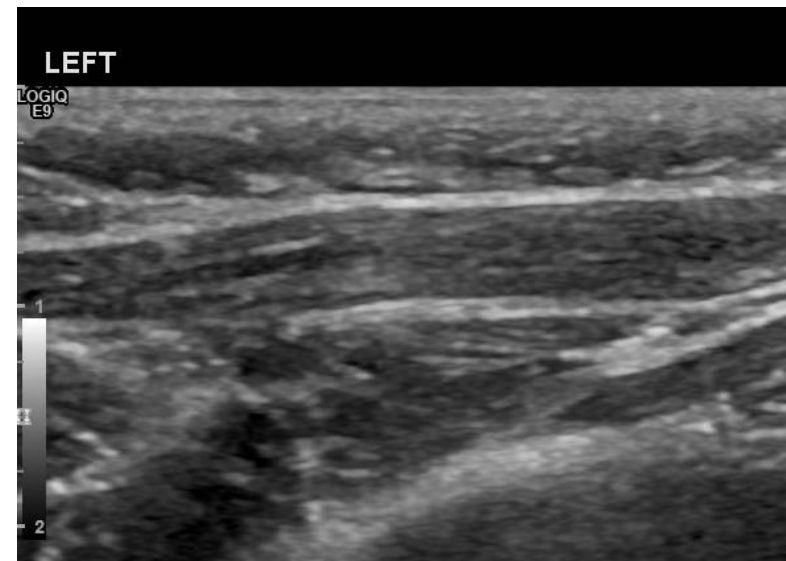
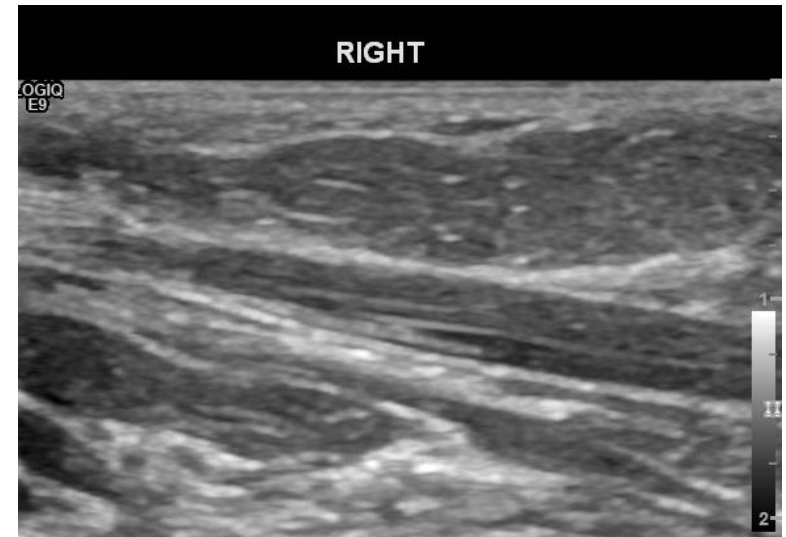


- Herniated synovium between tendons of semimembranosus and medial gastrocnemius
- Complications: synovial osteochondromatosis, hemorrhage, synovitis, infection

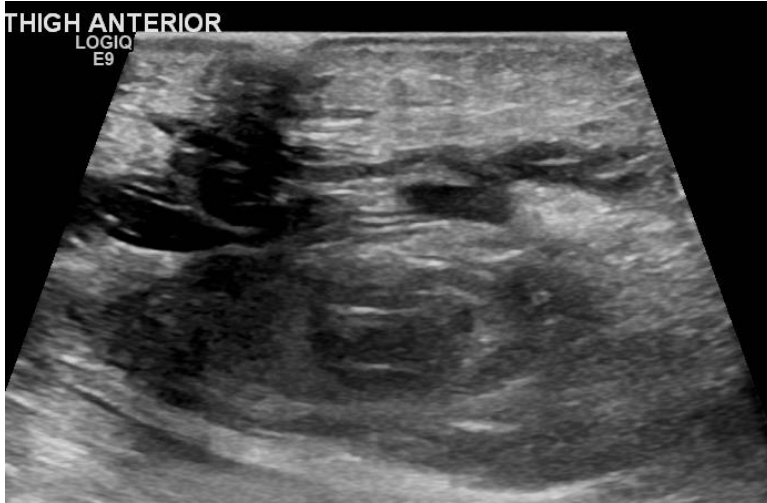


# Solid: Lipoma

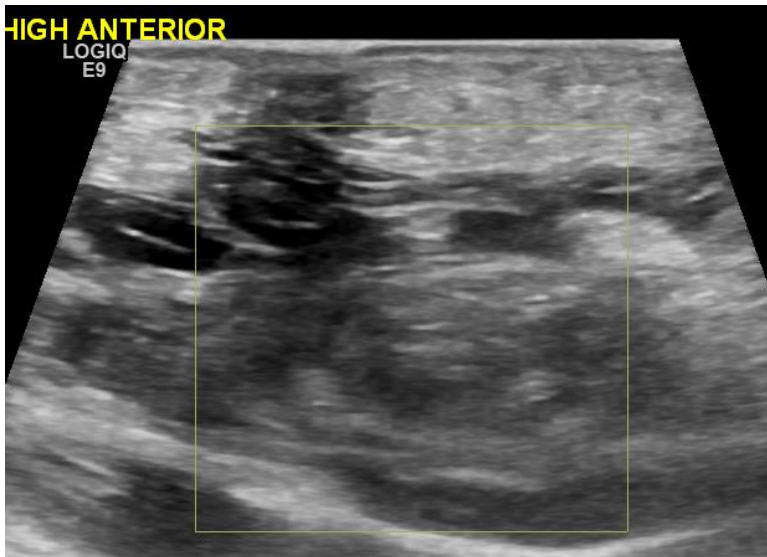
- Benign proliferation of fat cells with variable amounts of fibrous tissue
- Classic US appearance well-defined echogenic mass
- **Pitfall:** Lipoma can not be accurately diagnosed (49-64%)



# Solid: Hematoma



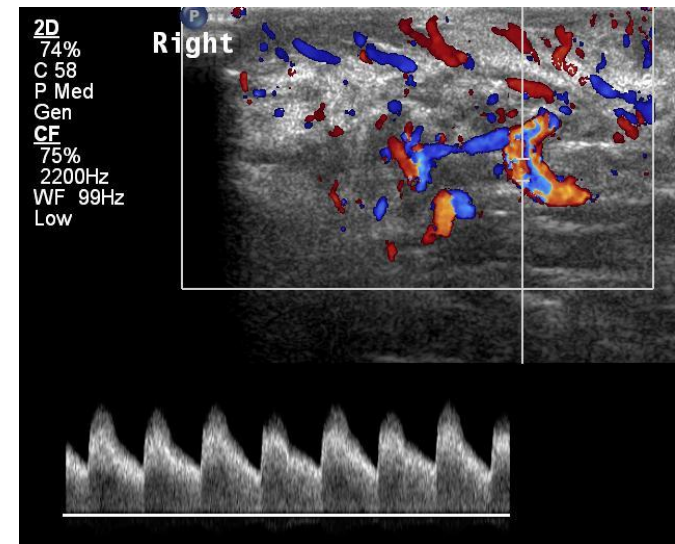
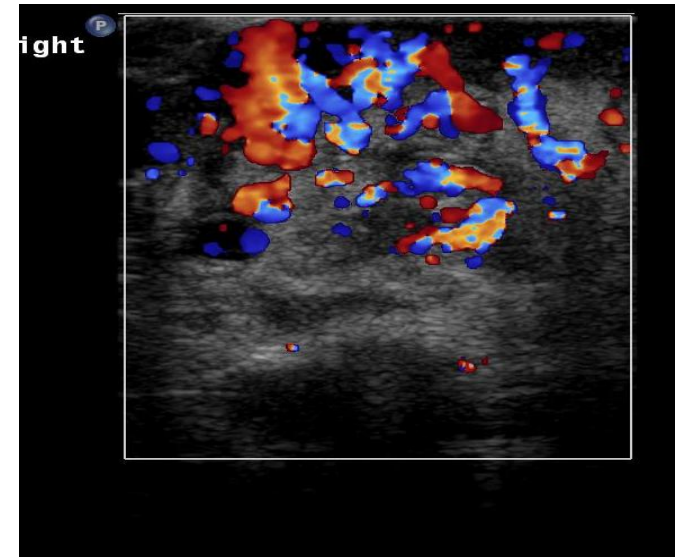
- Acute: well-defined and hypoechoic
- Sub-acute: heterogeneous and echogenic



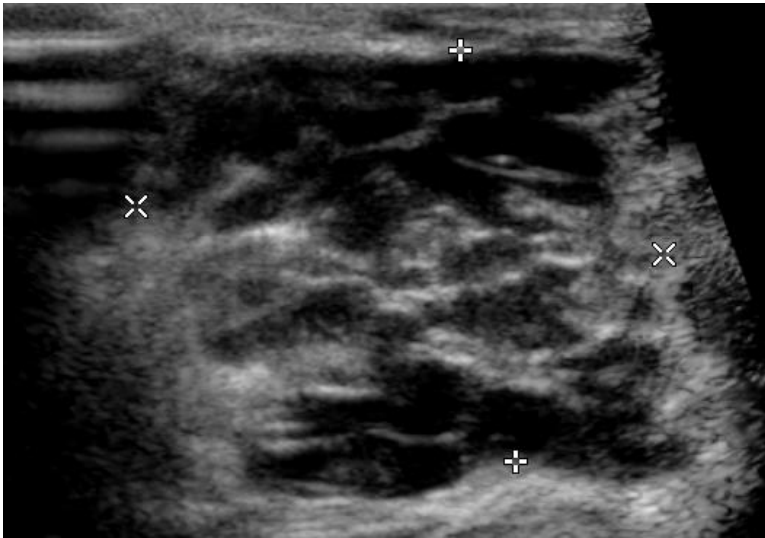
- Chronic: liquefy, anechoic
- **Pitfall:** Hematomas can't be reliably differentiated from hemorrhagic soft-tissue neoplasm

# Vascular: AVM

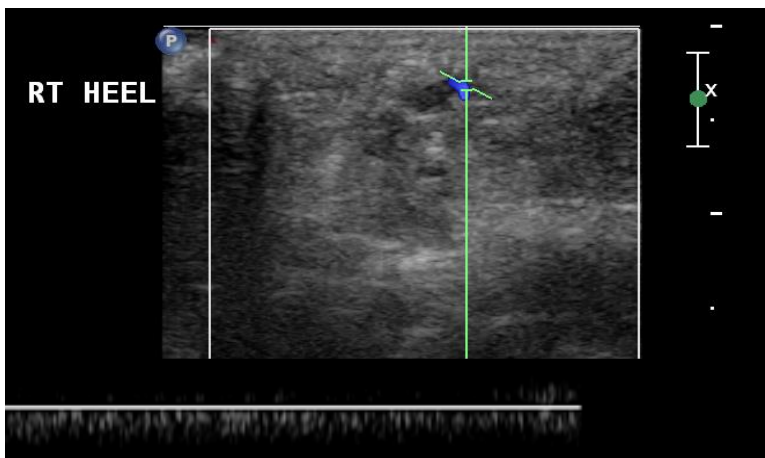
- Abnormal connection artery to adjacent vein
- Dilated, tortuous vascular channels with arterial and venous flow



# Vascular: Venous malformation

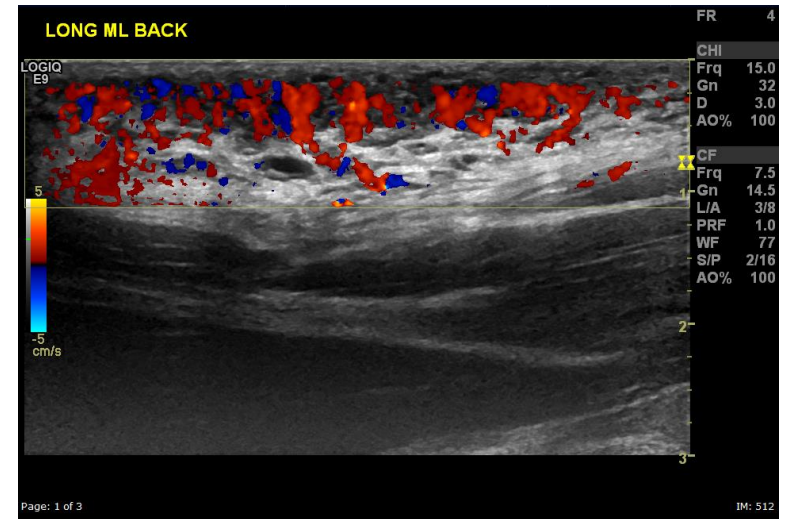
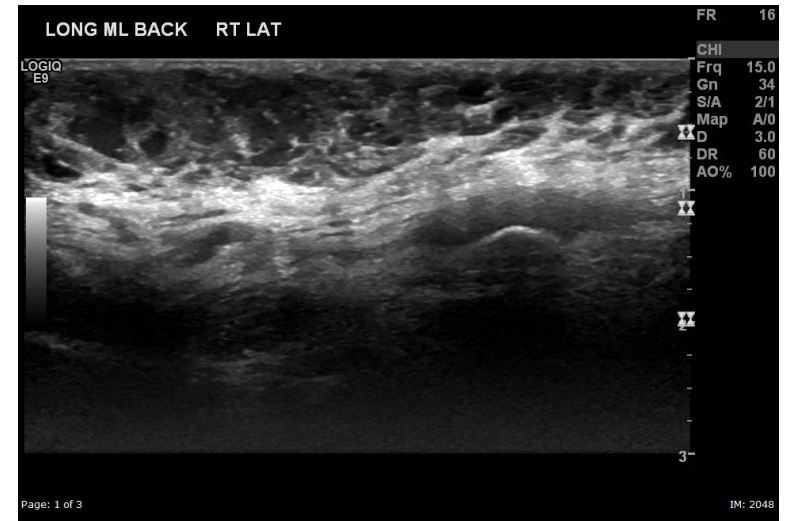


- Compressible, hypoechoic, heterogenous masses
- Phleboliths
- Monophasic, low-velocity venous flow

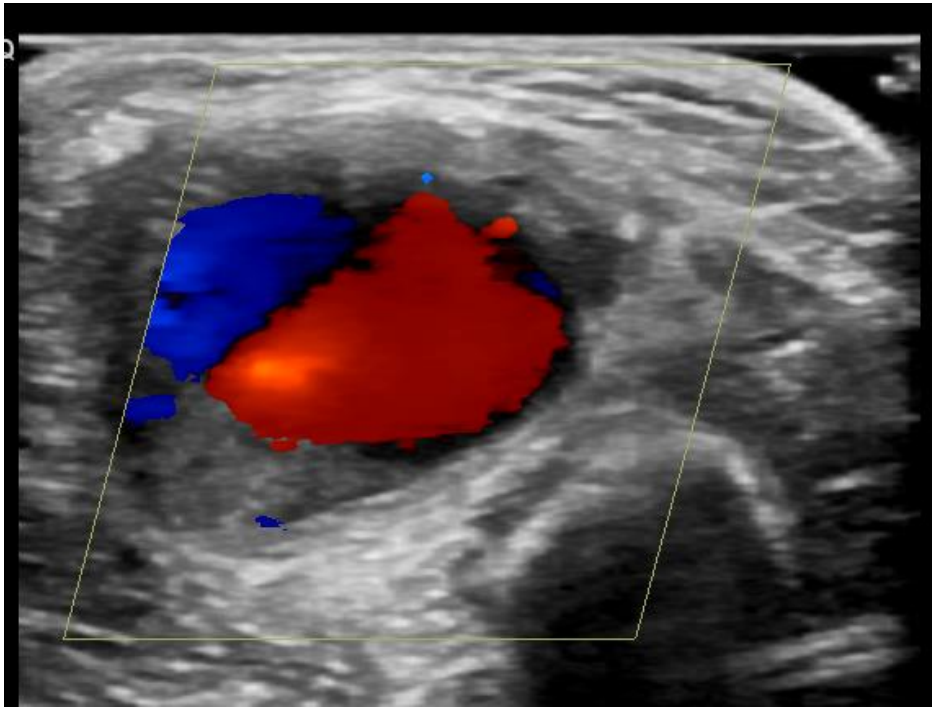


# Vascular: Hemangioma

- Benign endothelial neoplasms
- Grow first year; usually involute before 9 yo
- Well circumscribed solid mass
- Robust arterial and venous flow



# Vascular: Pseudoaneurysm



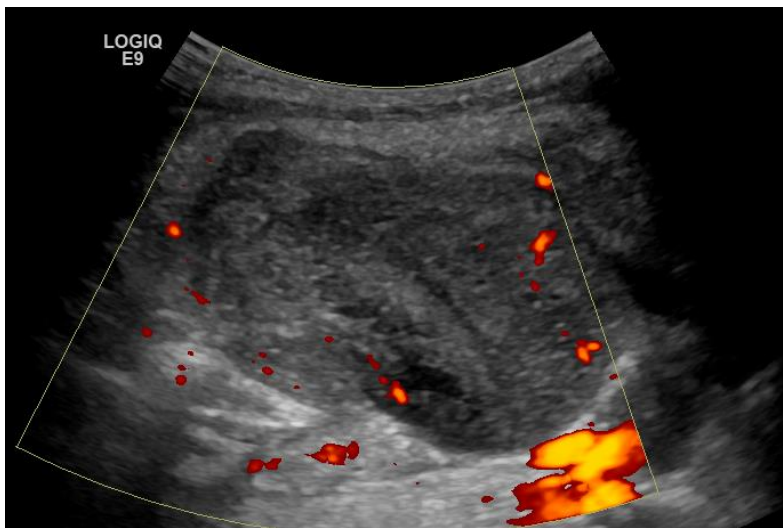
- Contained arterial rupture
- Maintains connection to feeding artery
- Yin-Yang sign: swirling internal flow
- To-and-fro waveform at neck from bidirectional flow

# Solid: Malignancy

- > 5 cm
- Involvement of deep fascial layers
- Heterogeneity
- Poorly defined margins
- Increased vascularity
- Rapid growth



# Solid: Peripheral Nerve Sheath Tumor



- Tumors of Schwann cell origin
- Target sign (increased central/ decreased peripheral) non-specific
- Continuity with peripheral nerve entering and exiting mass (eccentric specific for Schwannoma)
- MPNST: large size, ill-defined margins; rapid growth; central necrosis

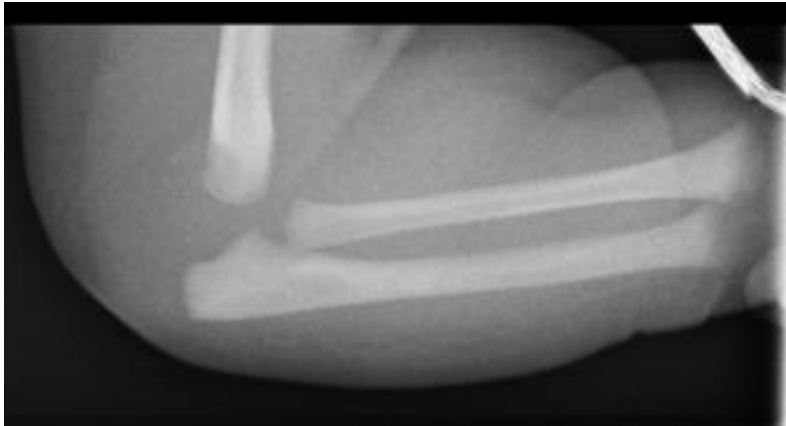


# Outline of Presentation

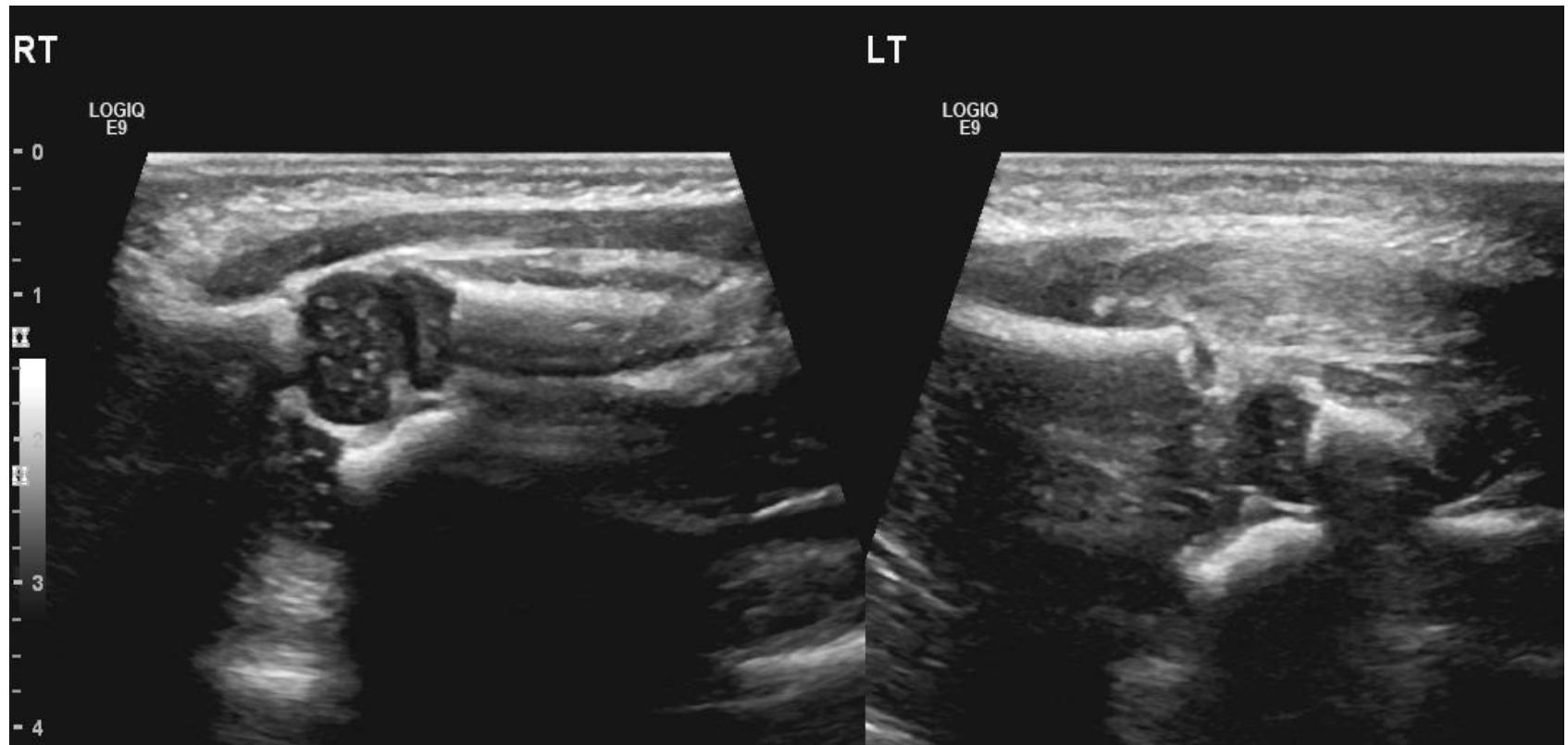
- 5 Ways US is better than MR for MSK
- Techniques
- Infection
- Masses
- **Trauma**

# Newborn with decreased motion

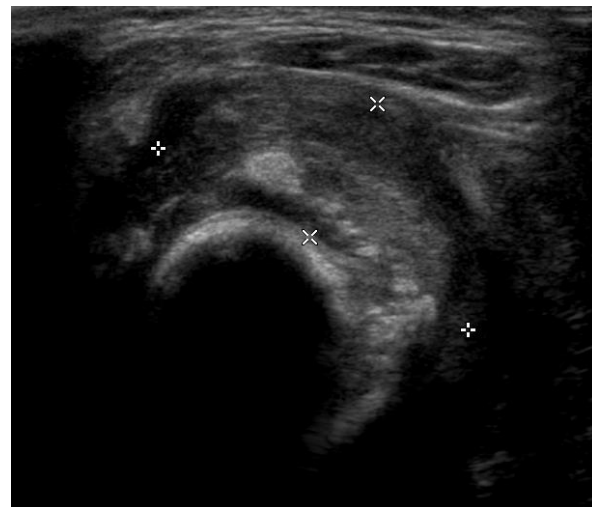
- US particularly useful for infants: lack of ossification limits radiography



# Salter I Fracture



# Child Abuse: Subperiosteal hematoma



# Conclusions

- US is rapid, non-ionizing, portable, sensitive, and repeatable for MSK diagnosis
- The **water bath** is effective for small, superficial lesions; water must be lukewarm
- US can **speed time to diagnosis** and treatment of MSK infections
- Most US findings in soft tissue masses are **non-specific**; be aware of **pitfalls**
- US can be useful to diagnose **neonatal trauma**