“Lumps and Bumps” of the Lower Extremity/MRI characterization

Mark I. Robbins, M.D.
American Radiologic Technologies
Musculoskeletal Radiology
Rye, New Hampshire

Utility of MR In Musculoskeletal Imaging
- Noninvasive
- Multiplanar capabilities
- No ionizing radiation
- High sensitivity with excellent spatial resolution = early detection

How Does MRI Form A Picture?
- Fat and Water in the Human body have an abundance of protons
- They resonate in a random frequency and orientation

Application of MRI Field
- When A High Strength Magnetic Field is applied, these protons align with it in proportion to Bo (the field Strength of the Magnet)

Energy Released to Create Picture
- RF Energy is release as the proton goes from high energy state to low (after our applied pulse stops)
- TR is when pulses applied
- TE is when you listen for the radio signal

A Paradox
- "Simplicity, simplicity, simplicity! I say, let your affairs be as two or three, and not a hundred or a thousand; instead of a million count half a dozen, and keep your accounts on your thumbnail." HD Thoreau, Walden, "Where I Lived and What I Lived For" (1854)
- "Simplify, but don’t oversimplify" A, Einstein
- For today, we’re going with the Concordian
Gradient Echo Images

- Shows susceptibility (blooming, foreign bodies, hemosiderin)
- Demonstrates hyaline cartilage
- Less imaging time (no refocusing)

6 year-old stepped on a nail

Vascular Magnetic Resonance Angiogram (MRA)
**Gradient Echo Flow Related Enhancement**

**Gradient Echo Vascular Flow Related Enhancement**

**T1 Weighted Images**
- Short TE/TR
- Fat is hyperintense (bright)
- Fatty marrow is bright
- Subcutaneous tissue
- Fibrocartilage and cortical bone is dark
- Fluid is dark

**Things That Are T1 Hyperintense**
- Fat
- Blood (methemoglobin)
- Proteinaceous fluid
- Melanin
- Paramagnetic compounds
- 30% calcium

**Quadriiceps Muscle Traumatic Hematoma**

**Lipoma**
- Follows fat on all sequences
- May have a capsule, central fat necrosis, or calcification
- Pelvis and retroperitoneal liposarcomas
72 year-old-male, intermetatarsal mass, gout, and negative aspirate

Liposarcoma Hallux

54 year-old male; first interspace swelling (companion case)

Lipotharrosis

Fat Globules within a Seroma”Degloving injury

Morel-Lavallee syndrome

- Tangential trauma to vascularized tissue
- Can be associated with fractures
- Skin and subcutis sheared from fascia: fusiform, ovoid or crescentic hematolymphatic collection, debris
- Closed internal injury resulting in degloving injury, usually presents acutely, but can be delayed
- Lymphatics are torn, slow to heal
- Development of capsule often requires percutaneous drainage or evacuation
- Can mimic tumor; MRI useful
**Lipoma Arborescens**
- Rare synovial proliferation of frondlike fatty tissue
- Swelling, effusion

**40 year old male with hindfoot pain while weight-bearing**

**Intraosseous Lipoma of Calcaneus**
- 15% of intraosseous lipomas
- Same location as unicameral bone cysts
- Asymptomatic or variably painful
- Dystrophic calcification
- Differentiation from normal trabecular rarefaction
- Low attenuation CT or fat signal on MRI

**Exuberant Callus Formation Motion about Fracture Site**

**Entities that can Have Low Signal**
- Fibromas
- Calcified lesions
- Synovitis
- Old blood products like hemosiderin (PVNS)
- High velocity blood flow (flow voids)

**57 year old male with enlarging anterior mass; rule out a ganglion**
Rheumatoid Nodules

- 20-30% of RA
- Long standing dz
- RF positive
- Increase incidence w/ Methotrexate
- Usually superficial, bursa, tendon, joints, or ligaments
- Often poorly defined mass low/iso muscle T1, low or bright T2, variable enhancement.

Rheumatoid Nodule

- Plantar forefoot
- Can be associated with RA

Rheumatoid nodule

- Low signal on T1 and T2
- Enhances
- Conforms to or is exophytic from any cord of the plantar aponeurosis
- Localized or diffuse infiltrative forms

Plantar fibromatosis

Large Plantar Fibromata

Aggressive Fibromatosis

30 year-old female; 5 year history
Calcifying Aponeurotic Fibroma

- Rare, locally aggressive fibroblastic lesion located in hands and soles of feet in young
- 50% recurrence post resection
- Juvenile aponeurotic fibroma, Keasby 1953
- Male 2:1 female
- Macroscopic: Rubbery gray white mass, adherent to tendons and fascia; gritty (calcium)

Calcifying Aponeurotic Fibroma

- Spindled fibroblasts bordering chondroid foci with calcification and cartilage more prominent in older children
- Differential diagnosis: rheumatoid nodule, chondroma, fibrous hamartoma of infancy, schwannoma, fibromatosis

Dermatofibroma Protuberans

- Low signal intermetatarsal mass
- Perineural fibrosis; not a malignant tumor
- Low T2, enhances
- DDx: Intermetatarsal bursitis, giant cell tumor of the tendon sheath, tophus, callous

Morton’s Neuroma

- Low signal intermetatarsal mass
- Perineural fibrosis; not a malignant tumor
- Low T2, enhances
- DDx: Intermetatarsal bursitis, giant cell tumor of the tendon sheath, tophus, callous
Morton’s Neuromas

- Mixed literature correlating size (>5mm transverse) with improved outcome post op.
- High prevalence in asymptomatic feet
  - Two studies up to 33% asymptomatic
  - Smaller more frequently asymptomatic

Rheumatoid Nodule Simulating a Morton’s Neuroma

62 year-old male from Georgia with bilateral swelling

Gout/Tophi

Gout with Erosion; Improved with Colchicine
**Large Tophus with Classic Erosions of Gout**

**Achilles Xanthoma**

**Post-operative Achilles Tendon**
75 y-old with trauma; intact repair

**Low Signal Achilles Masses/Lumpy Bumpy Disease**

- Chronic Achilles Tendinosis without cavitary changes or large areas of mucoid degeneration
- Repaired Achilles tendon
- Deposition diseases: gout, amyloid, xanthomas

**Postoperative Achilles**

**Giant Cell Tumor of the Tendon Sheath**

- Extra-articular form of PVNS
- Mimics Morton's neuromas, fibromas, callous from forefoot overload
- Lack of calcification may distinguish from a synovial sarcoma
Low signal synovial proliferation

- PVNS
- RA
- Hemophilia, hemorrhage
- Osteochondromatosis
- Synovial hemangioma
- Synovial sarcoma (extra-articular)

PVNS

PVNS (localized form)

PVNS Diffuse Form

Synovial osteochondromatosis

Hemophilia
**Synovial Hemangioma**
- Flow voids
- Phleboliths
- Soft tissue signs

**50 year-old female with a mass post bunionectomy/osteotomy**

**Anterior tibial pseudo aneurysm**
- High velocity flow void (black hole) producing low signal
- Pulsation “ghosting” (phase encode) artifact
- Surrounding blood products
- Proximity to an artery

**Chronic ATAF Ligament Tear Meniscoid Lesion**

**T2 Weighted Images**
- Fluid is hyperintense
- Marrow edema
- Most tumors
- Infiltrative process
- Marrow expansion
- Bursitis, synovial cysts, ganglia
- CSF
Intermetatarsal Bursitis

Anatomic Bursitis First MPJ

Anatomic Bursitis

Glomus tumor
- Painful subungual mass
- Temperature sensitive digit
- Exhibits signal that mimics a ganglion or cyst

Tenosynovitis

Ganglia
Large Neuroma - 53 year-old man; increasing mass r/o synovial cyst

Myxoma

Tarsal Tunnel Ganglion

Tarsal Tunnel Synovitis

Tarsal Tunnel/Anatomy of the Medial and Lateral Plantar Nerves

Medial Plantar Varix
Tarsal Tunnel Syndrome/Flexor Digitorum Accessorius Muscle

Schwannoma of Tarsal Tunnel

Solid Mass that Appears Cystic (Plexiform Neurofibroma)

Saphenous Neuroma

Sural Schwannoma
Plantar Neuroma

10 year-old with a palpable tibial mass

- Differential diagnosis: Primary bone neoplasm such as ABC, exostosis, unicameral bone cysts, non ossifying fibroma, Ewings, EG, osteosarcoma
- Soft tissue mass: Myositis ossificans, granuloma, neurofibroma, synovial cyst or ganglion

Osteochondroma

- Medullary continuity
- Points away from joint
- T2 bright cartilage cap
- Complications
  - Bursitis exostica, fracture, pain, malignant degeneration (cartilage cap of > 2cm)

20 year-old male with palpable plantar mass

Soft Tissue Mass/Synovial Sarcoma

Rare Intramuscular Metastasis

---

1/10/2014
**Gadolinium**

- Enhance solid tumors
- Shortens the T1 of enhancing tissue
- Rim enhancement of abscesses, ganglia, synovial cysts, myxomas, and other fluid structures

**SUMMARY**

- MRI can characterize soft tissue masses based on properties of the tissue.
- Useful to assess involvement of bone, tendons, and neurovascular structures
- The exact histology of many lesion cannot be predicted by imaging features.
- Management of any palpable mass should be based on the clinical presentation.

**THANKS!**