

MUSCULOSKELETAL INFECTION

Special Imaging



Special Imaging

- “Additional Imaging”
- May assist in diagnosis and, possibly, treatment
- Help create the “picture”
- May help differentiate from neoplasia

Special Imaging

18yr old male pt
What is it?

- Lymphoma
- Ewings Sarcoma
- Metastasis
- Osteomyelitis



Special Imaging



Special Imaging



Special Imaging



Special Imaging

- Computed Tomography Scanning (CT)
- Magnetic Resonance Imaging Scan (MRI)
- Isotope Scans
- Ultrasonography
- Positron Emission Tomography (P.E.T. Scanning)

Special Imaging

- X-rays still most informative: most utilised
- Expensive - ? Value for money?
- Certainly not routine usage in acute or chronic osteomyelitis of long bones
- More commonly in spinal pathology

Special Imaging – CT Scanning

- Excellent bony definition
 - = “high-definition X-rays”
 - Sternoclavicular joint
 - SIJ
 - Spine

Special Imaging – CT Scanning

- Acute Osteomyelitis
 - Intraosseous gas
 - Osteopaenia / decreased density of infected bone
 - Soft tissue mass / abscess
 - Extent of medullary involvement
 - Pus = increased density as compared to marrow fat

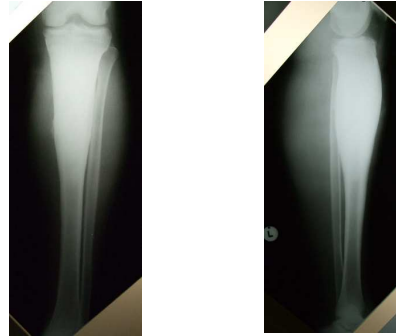
Special Imaging – CT Scanning

- Subacute Osteomyelitis
 - Narrowing of medullary cavity by granulation tissue
 - Better definition of periosteal reaction

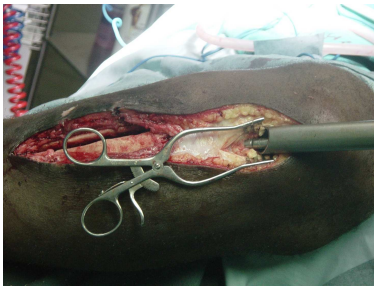
Special Imaging – CT Scanning

- Chronic Osteomyelitis
 - Obliteration of medullary cavity
 - Cloacae
 - Definition of sequestra – NB linear
 - Sclerosing Osteomyelitis of Garre
 - Brodie's abscess obscured by sclerosis

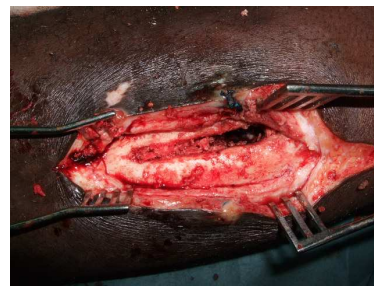
Special Imaging – CT Scanning



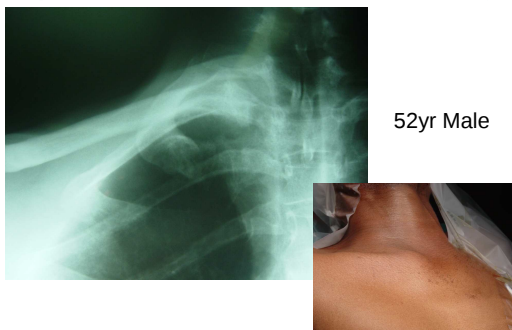
Special Imaging – CT Scanning



Special Imaging – CT Scanning



Special Imaging – CT Scanning



Special Imaging – CT Scanning



Special Imaging – CT Scanning

- 24yr old male
- GSW traversing R hip & involving the pelvis 3 months previously
- Laparotomy & prolonged ICU stay
- Chronic L hip sepsis and acetabular chronic osteomyelitis

Special Imaging – CT Scanning



Special Imaging – CT Scanning



Special Imaging – CT Scanning



Special Imaging – CT Scanning



Special Imaging – CT Scanning



Special Imaging - MRI

- “The Jargon”
 - T1
 - T2
 - STIR
 - T1 with Fat Suppression
 - GADO (Gadolinium)
 - DOT (Dotarem)

Special Imaging - MRI

- Water proton spin produces a magnetic field
- External magnetic field imposes alignment of the spin of these protons
- Specific radio frequency / electromagnetic pulses are targeted to disturb this alignment
- Protons realign themselves when radio frequency discontinued
- Antenna placed on relevant anatomy for visualisation & this realignment is

Special Imaging - MRI

- T1 – Fat enhancement
- T2 – Water enhancement (“T2 = H2O”)
- STIR (**S**hort **T**ime to **I**nvert **R**ecovery)
 - T2-like
 - “Negative of a T1” but also some fat enhancement
- T1 with Spectral Fat Suppression
 - Water greatly enhanced
 - Accentuates enhancement with Gadolinium (Dotarem®)
- Gadolinium – “contrast”- increased

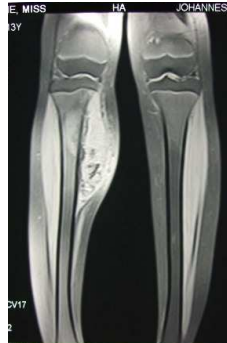
Special Imaging - MRI

- T1



Special Imaging - MRI

- T2



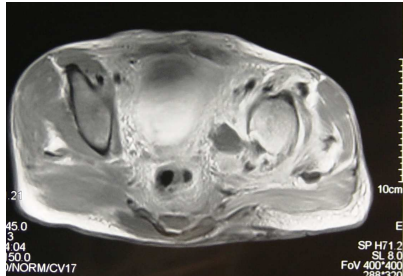
Special Imaging - MRI

- STIR



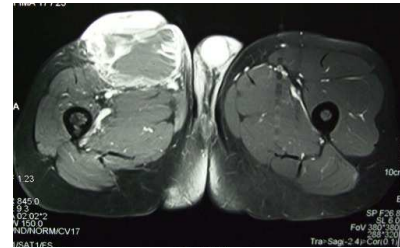
Special Imaging - MRI

- STIR



Special Imaging - MRI

- T1 with Fat Suppression (& Gadolinium)



Special Imaging - MRI

- T1 with Fat Suppression (and Gadolinium)



Special Imaging - MRI



Special Imaging - MRI

- Osteomyelitis:
- Marrow fat replaced by oedema & exudates
- Reduced high fat signal on T1
- Increased signal on T2
- Early detection in acute osteomyelitis, as reflects marrow cavity - ? clinical significance

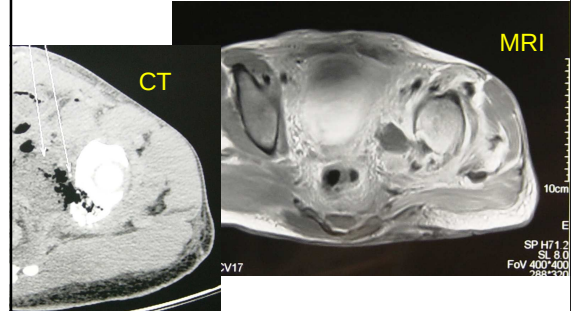
Special Imaging - MRI

- MRI = very sensitive but poorly specific
- Any pathology producing oedema or hyperaemia produces similar changes to osteomyelitis
 - Fractures
 - Tumours
 - Inflammatory processes

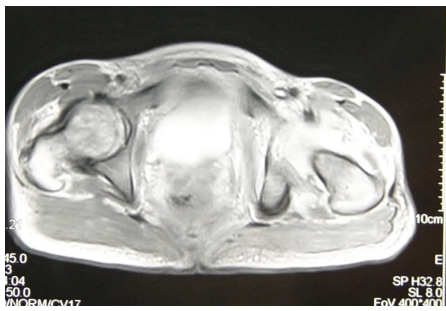
Special Imaging - MRI

- Bony definition very poor
- Limited relevance in chronic osteomyelitis
- Invaluable in defining soft tissue pathology – neoplasia

Special Imaging - MRI



Special Imaging - MRI

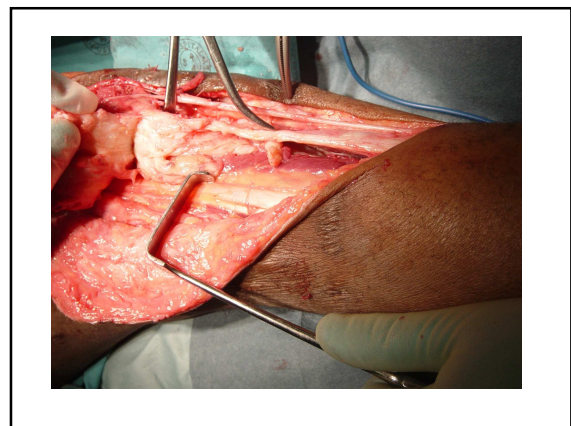
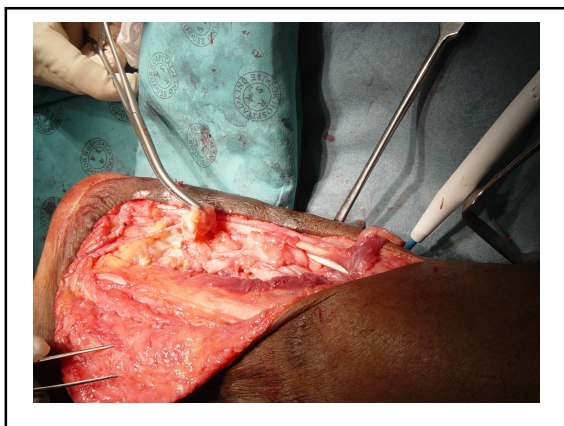
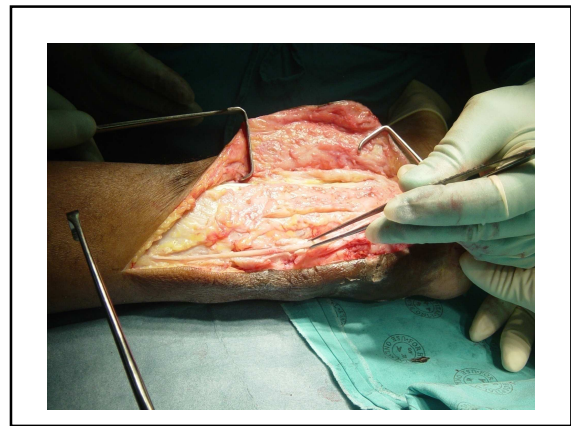
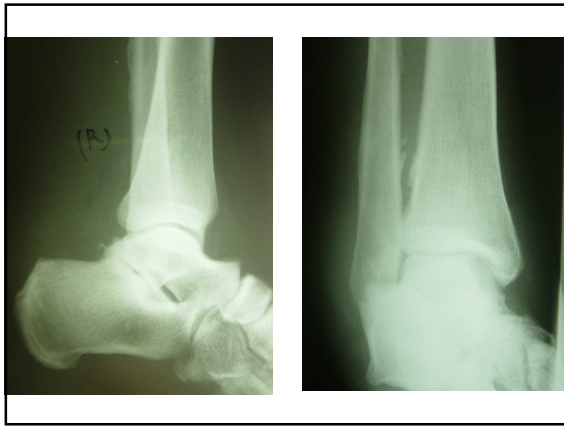


Special Imaging - MRI



Special Imaging - MRI







Special Imaging – Ultrasound Scan

- Abscess location +/- needle placement
- Joint effusion detection & echogenicity
 - Periprosthetic infection
- Inexpensive
- Operator dependent

Special Imaging – Isotope Scans

- CT, MRI and Ultrasound: “anatomical”
- Radionuclide & PET: “physiological”

Special Imaging – Isotope Scans

- No detection of infection per se
- Detects inflammatory reaction of bone to infection
- 3 commonest utilised:
 - Technetium 99m Phosphate (Tc-99)
 - Gallium 67 Citrate
 - Indium-111-labeled Leukocytes

Special Imaging – Isotope Scans: Technetium-99

- Most common
- 95% sensitivity, 74% specificity for osteomyelitis
- Osteoblastic activity
- Regional blood flow influences uptake
- Rapid uptake: >50% within 1 hour & remainder excreted by kidneys

Special Imaging – Isotope Scans: Technetium-99

- “Hot spot” = perfusion of that area
- “Cold” scan from
 - Subperiosteal pus
 - Joint effusion & Soft tissue swelling
 - Vasospasm
 - Avascular Necrosis (initial)

Special Imaging – Isotope Scans: Technetium-99

- Standard Technique: 3-phase study
 - Sensitivity unchanged (95%)
 - Specificity increased to 94% (from 74%)

1. Flow phase
2. Equilibrium phase
3. Delayed phase

Special Imaging – Isotope Scans: Technetium-99

1. Flow phase – cf radionuclide angiogram
2. Equilibrium phase – distribution to extracellular space
3. Delayed phase
 - 2 to 4 hours post-injection
 - Osteoblastic uptake / activity demonstrated
 - Remainder already excreted
 - Also positive in:
 - Tumours, degenerative joint disease, trauma, Pagets....

Special Imaging – Isotope Scans: Technetium-99

- Relative activity in 3 phases in different pathologies:
 - Osteomyelitis: ↑ uptake in all 3 phases
 - Cellulitis: ↑ in Flow & Equilibrium, ↓ (or N) in Delayed phase
 - DJD: N in Flow & Equilibrium, ↑ in Delayed phase

Special Imaging – Isotope Scans: Technetium-99

- Unreliable in infants < 6 weeks of age
- Falsely negative in 60% (bone/joint infection)

Special Imaging – Isotope Scans: Gallium

- Controversial
 - Leukocyte uptake
 - ? Bacterial uptake
 - Protein bound tissue uptake
- Localises inflammatory lesions
- Very poor specificity (56%)
- Slow clearance:
 - Imaging delayed post-injection
 - 24hrs (appendicular) – 72hrs (axial)

Special Imaging – Isotope Scans: Gallium

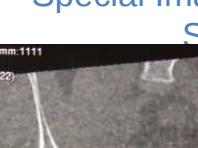
- Specificity increased when combined with Technetium (95%)
- Reactive bone formation (eg: DJD, Trauma)
 - Tc-99 uptake > Gallium
- Inflammation:
 - Gallium > Tc-99

Special Imaging – Isotope Scans: Indium

- In vitro labeled autologous leukocytes (mostly PMN's) injected & imaging 24-48hrs thereafter
- Focal accumulation in areas of osteomyelitis rather than reactive bone disease
- Acute osteomyelitis (PMN's) rather than chronic osteomyelitis (Lymphocytic – if that!)
- Expensive

- ## Special Imaging – Isotope Scans: Indium
- In vitro labeled autologous leukocytes (mostly PMN's) injected & imaging 24-48hrs thereafter
 - Focal accumulation in areas of osteomyelitis rather than reactive bone disease
 - Acute osteomyelitis (PMN's) rather than chronic osteomyelitis (Lymphocytic – if that!)
 - Expensive

Special Imaging – Isotope Scans



42yr Female

- #-Dislocation: September 2004
- R Hip Resurfaced

Special Imaging – Isotope Scans

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Special Imaging – Isotope Scans



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Special Imaging – Isotope Scans



42yr Female

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Special Imaging – Isotope Scans

Painful Limp
Intermittent night pain
Active, runs own business

Special Imaging – Isotope Scans

Painful Limp
Intermittent night pain
Active, runs own business

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Special Imaging – Isotope Scans

Gallium Scans (Left):

- Patient:** ELSCINT'S "APEX SP-488"
DOB JAN MONDAY 1947 WILMINGTON, DE
STUDY # 71 BECKER, L.
- Date/Time:** 08-22-09 12:58 PM
- Location:** PARK CLINIC
- Study:** GALLIUM SCAN 54HR IMAGES
- Images:**
 - 09-15 ANT S4: 8 50 2 1.0, TIME 542, TOST 742, RATE 1 KC, LT
 - 09-15 RT: 8 50 2 1.0, TIME 542, TOST 742, RATE 1 KC, RT
 - 09-41 POST: 8 50 2 1.0, TIME 538, TOST 742, RATE 1 KC, ANT PELVIS
 - 09-41 RT: 8 50 2 1.0, TIME 538, TOST 742, RATE 1 KC, POST PELVIS
 - 09-59 ANT S4: 8 50 2 1.0, TIME 631, TOST 463, RATE 1 KC, LT
 - 09-59 RT: 8 50 2 1.0, TIME 631, TOST 463, RATE 1 KC, RT
 - 09-59 POST: 8 50 2 1.0, TIME 430, TOST 443, RATE 1 KC, ANTERIOR
 - 09-59 POST: 8 50 2 1.0, TIME 430, TOST 443, RATE 1 KC, POSTERIOR

Bone Scans (Right):

- Patient:** WILKINSON, DEBBIE L
DOB 01-15-1947
STUDY # 71 BECKER, L
- Date/Time:** 08-22-09 12:58 PM
- Location:** PARK CLINIC
- Study:** BONE SCAN 54HR IMAGES
- Images:**
 - 09-15 ANT S4: 8 50 2 1.0, TIME 542, TOST 742, RATE 1 KC, LT
 - 09-15 RT: 8 50 2 1.0, TIME 542, TOST 742, RATE 1 KC, RT
 - 09-41 POST: 8 50 2 1.0, TIME 538, TOST 742, RATE 1 KC, ANT PELVIS
 - 09-41 RT: 8 50 2 1.0, TIME 538, TOST 742, RATE 1 KC, POST PELVIS
 - 09-59 ANT S4: 8 50 2 1.0, TIME 631, TOST 463, RATE 1 KC, LT
 - 09-59 RT: 8 50 2 1.0, TIME 631, TOST 463, RATE 1 KC, RT
 - 09-59 POST: 8 50 2 1.0, TIME 430, TOST 443, RATE 1 KC, ANTERIOR
 - 09-59 POST: 8 50 2 1.0, TIME 430, TOST 443, RATE 1 KC, POSTERIOR

Gallium

Special Imaging – Isotope Scans

- Infection or AVN?



A hand is holding a small, clear plastic vial with a white cap. The vial contains a yellow liquid. A yellow tube is inserted into the vial. The label on the vial is partially visible and reads: "Palladium", "Doctor's", "Specialty", and "Pharmacy".

- # Special Imaging – Isotope Scans
- Infection or AVN?
- 
- A hand is holding a small, clear plastic vial with a white cap. The vial contains a yellow liquid. A yellow tube is inserted into the vial. The label on the vial is partially visible and reads: "Palladium", "Doctor", "Special", and "Isotope".



Special Imaging – PET Scan

- Positron Emission Tomography
- Radionuclide image: various
- Oncology: Fluorodeoxyglucose (FDG)
 - Uptake & metabolism by rapidly-dividing tissues
 - Becomes trapped in tissues & radiolabels them until it decays
 - Helpful in diagnosis, staging & recurrence
- Unlikely usefulness in musculoskeletal infection/inflammation except by exclusion



Thank you

"Son, you're making the same mistake with
Iraq as I made with your mother.
I didn't pull out in time!"