

JUNE 2023



INTRO TO MUSCULOSKELETAL RADIOLOGY

All of Orthopedic Radiology you need to know in 90 min...well, at least a start!

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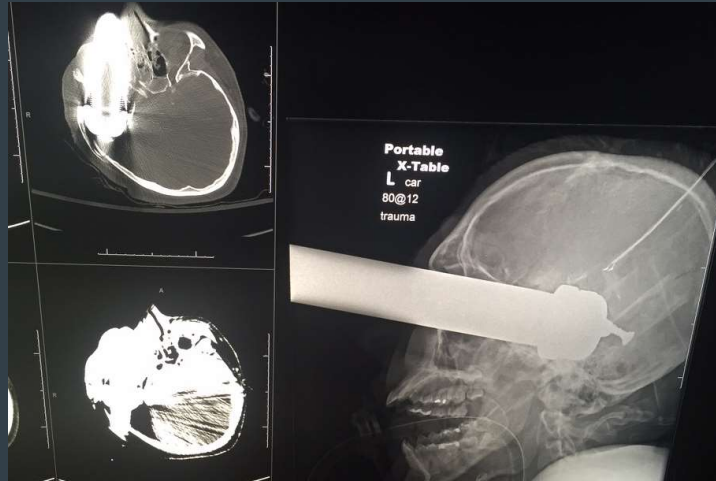


Background

- Master's Ex Phys and Sport Performance
- Medical School Univ of New Mexico
- 5 yr Radiology Residency Univ of New Mexico
- 1 yr MSK fellowship Stanford Univ
- 6 yr Faculty UT Austin/ARA - MSK

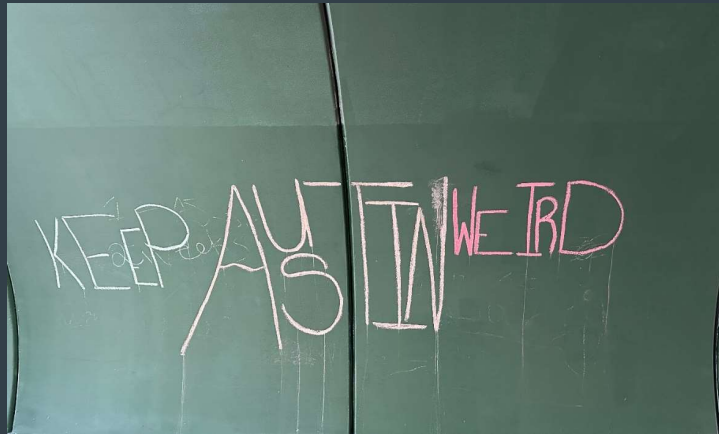


As I tell the rotating students...



Disclosure:

*I have no relevant relationships with ineligible companies to disclose within the past 24 months.
(Note: Ineligible companies are defined as those whose primary business is producing, marketing, selling, re-selling, or distributing healthcare products used by or on patients.)*



IMPORTANT



Outline

- Imaging Modalities
- Classic Bone/Joint Pathologies
- Arthroplasty/ORIF
- Muscle/Tendon Injury
- Tumor
- Spine

Outline

- **Imaging Modalities**
- Classic Bone/Joint Pathologies
- Arthroplasty/ORIF
- Muscle/Tendon Injury
- Tumor
- Spine

Imaging Modalities

- Plain Film/Radiographs
- CT
- MRI
- Ultrasound
- Nucs



Imaging Modalities

- Plain Film/Radiographs
- CT
- MRI
- Ultrasound
- Nucs



Plain Film –



Plain Film –

- "2 views is no view"
- Alignment – can use weight bearing or symmetry
- Soft tissues are your friend!
- Improve with the "Retrospectoscope"

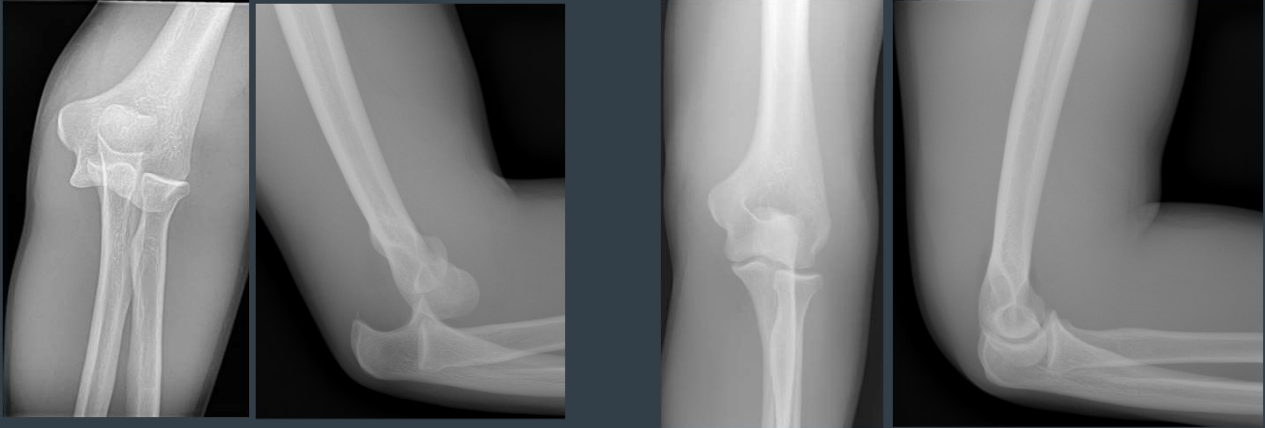


Plain Film

- Alignment
- Bones / Mineralization
- "Cartilage" (joints)
- Densities / Foreign Bodies
- Extras – Soft Tissues
- Fractures



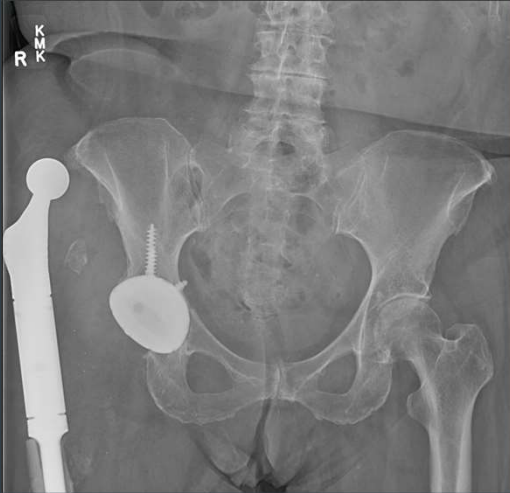
Alignment



Alignment



Alignment



Alignment



Alignment



Bones



Bones



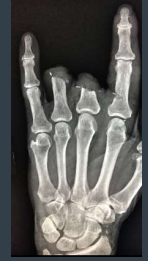
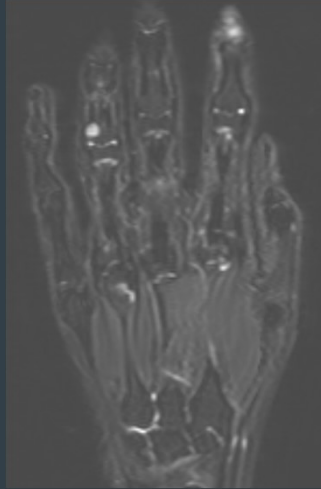
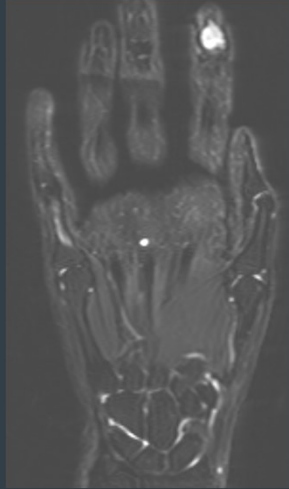
Bones



Bones



Bones



*Satisfaction
Of
Search

- Densities / Foreign Bodies



- Densities / Foreign Bodies



- Densities / Foreign Bodies



- Densities / Foreign Bodies

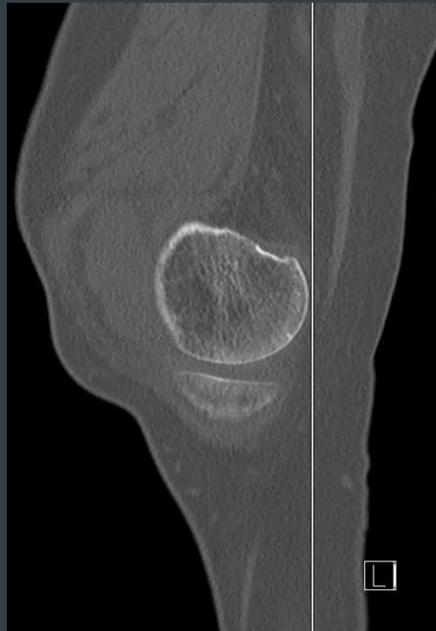
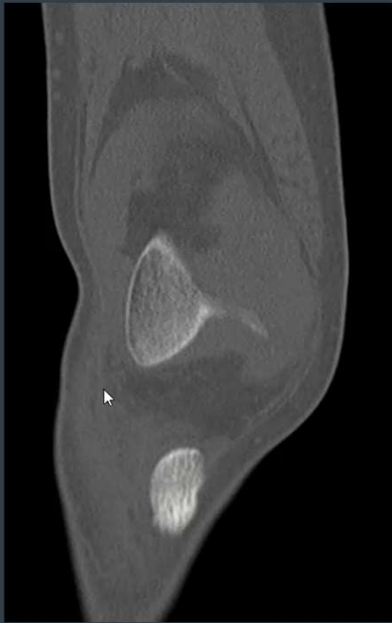


Extras – Soft Tissues

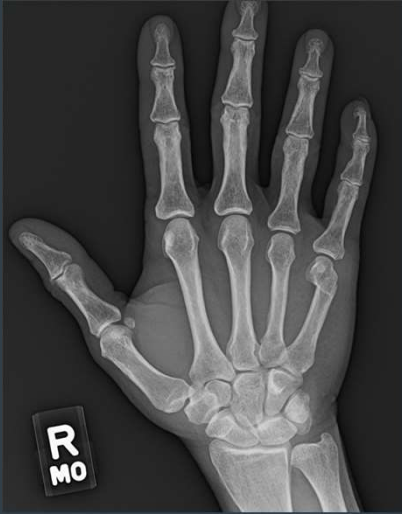


Fractures





Fractures



Fractures



Dorsal ST swelling

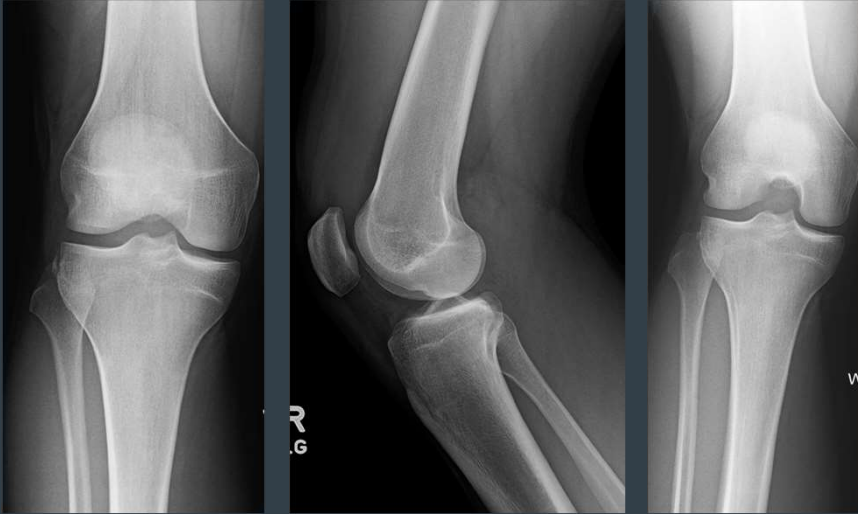


*Symmetry
*Weight-bearing

Fractures



Fractures



Imaging Modalities

- Plain Film/Radiographs
- **CT**
- MRI
- Ultrasound
- Nucs



CT



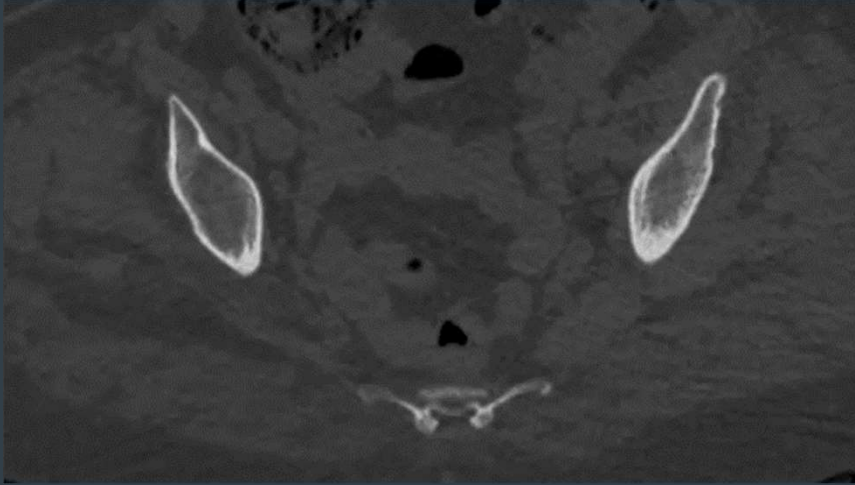
CT

- Quick
- Trauma/Pre-op for surgery
- Contraindication to MRI (+/- contrast/arthro)
- CT Angio
- Tumor (calcifications or chondroid)
- Hardware Eval
- Gas

CT

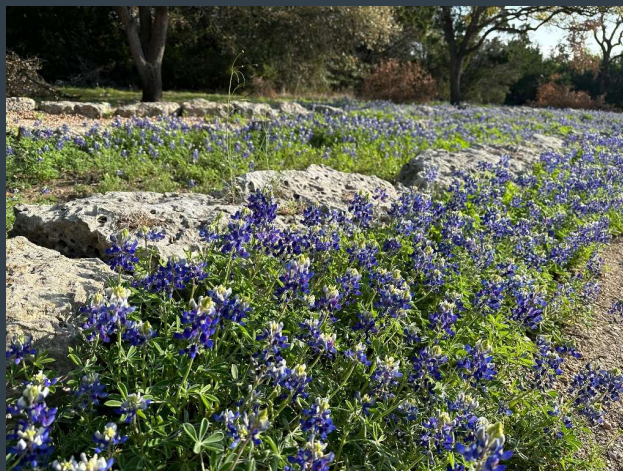
- Alignment
- Bones
- Cartilage (joints)
- Densities (FB's and Mineralization)
- Extras
- Soft Tissues

CT

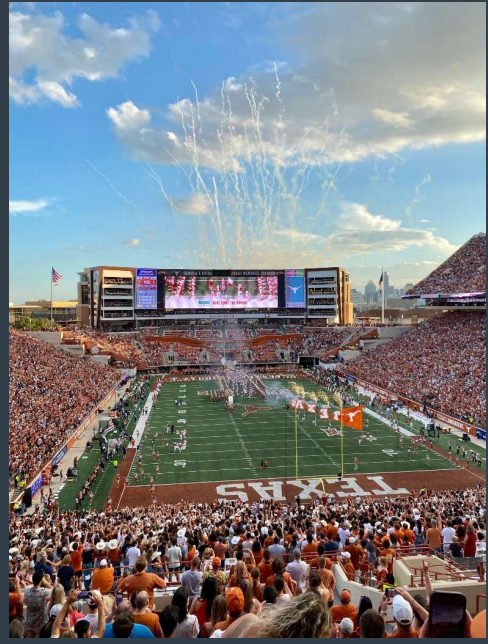


Imaging Modalities

- Plain Film/Radiographs
- CT
- **MRI**
- Ultrasound
- Nucs



MRI



MRI

- Great for soft tissues
- Internal derangement
- Great in synergy with PFs (punctate avulsions)
- Expensive and time intensive
- Implants
- Infection/Inflammation/Tumor

MRI

- T1/T2/STIR/PD – say what?!
- “Fluid Sensitive”
- Marrow – Muscle Rule
- Edema is your friend
- Contrast

MRI

T1

Fat Bright

Fluid Dark

T2

Fat Bright

Fluid Bright

PD

Fat Bright

Fluid Bright

STIR

Fat Dark

Fluid Bright

T2 FS

Fat Dark

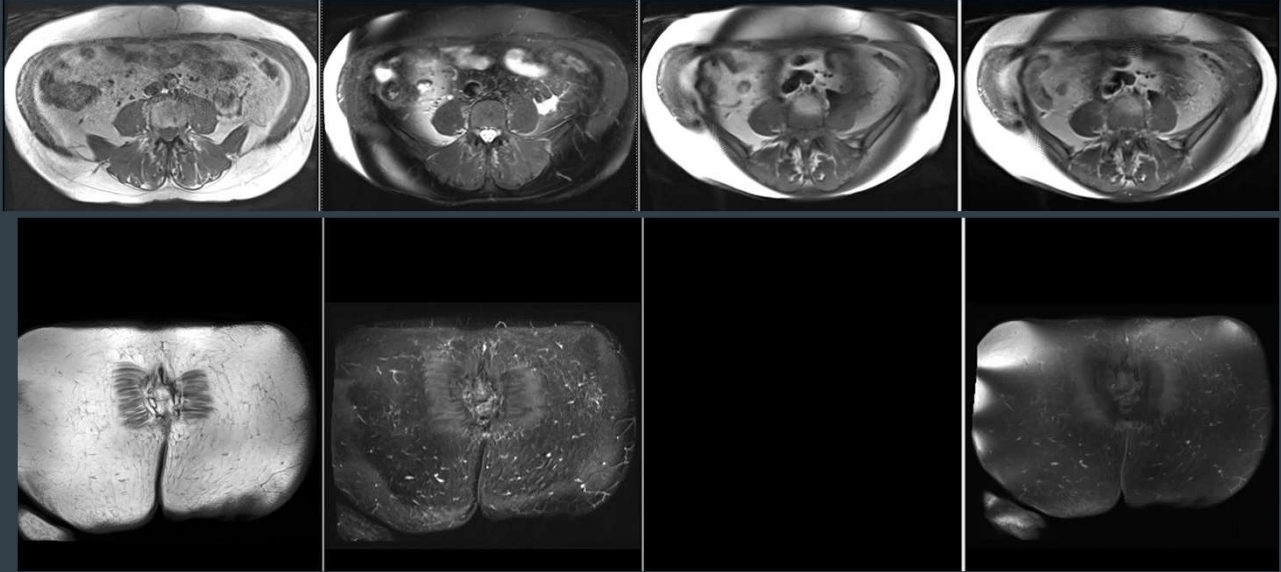
Fluid Bright

PD FS

Fat Dark

Fluid Bright

MRI



Imaging Modalities

- Plain Film/Radiographs
- CT
- MRI
- **Ultrasound**
- Nucs



Ultrasound



Ultrasound

- Real Time
- User dependent
- Procedures
- Dynamic Imaging
- Cheap
- Ubiquitous
- Bones/Air



Imaging Modalities

- Plain Film/Radiographs
- CT
- MRI
- Ultrasound
- Nucs



Nucs

- Specialty
- Contraindication to MRI (hardware loosening or infection)
- Tumor (PET)



Outline

- Imaging Modalities
- **Classic Bone/Joint Pathologies**
- Arthroplasty/ORIF
- Muscle/Tendon Injury
- Tumor
- Spine

Classic Bone/Joint Pathologies

- Trauma
- Infection
- Arthritis
- Repetitive Stress



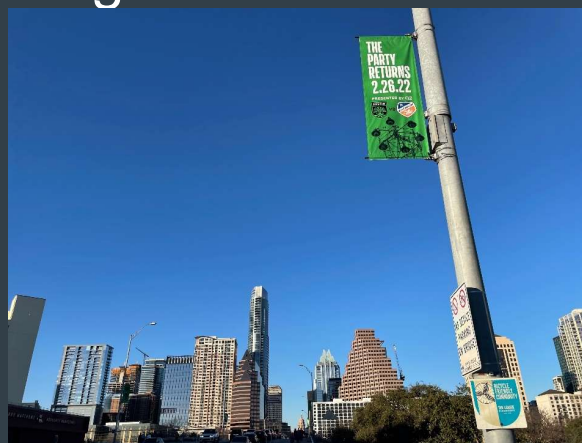
Trauma

- Joint effusion
- Dislocation/Alignment
- Fracture
- Displacement
- Angulation
- Articular extension
- Additional Fracture
- Pathologic/insufficiency



Arthritis

- Productive vs Erosive change
- Distribution
- Soft tissues



Infection

- Soft Tissue wound
- Gas
- Erosion/Periosteal Rxn
- Septic Arthritis
- Abscess/Sinus Tract
- Tenosynovitis

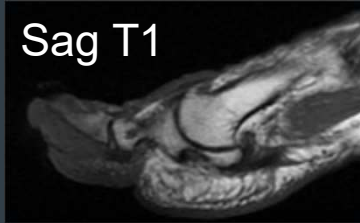


Infection

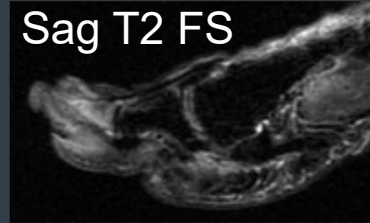


Infection

Sag T1



Sag T2 FS



Ax T1



Ax T2 FS



Ax T1 FS Pre

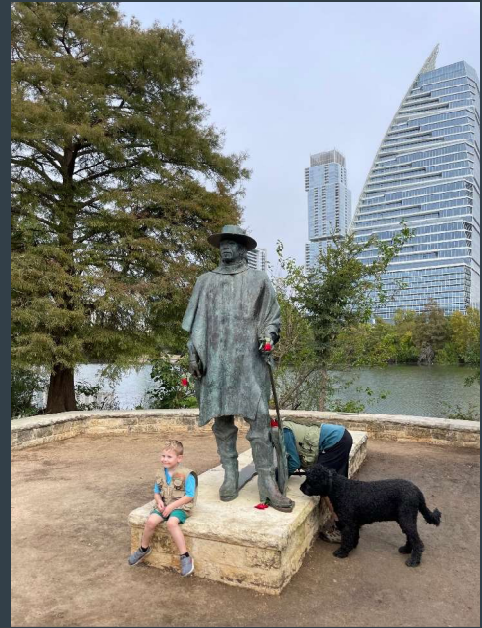


Ax T1 FS Post



Repetitive Stress

- Stress Reaction
- Stress Fracture
- Apophysitis
- Tendinitis/Tenosynovitis
- Epicondylitis
- Bursitis



Outline

- Imaging Modalities
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Arthroplasty/ORIF

- Alignment
- Hardware fracture
- Loosening
- Infection/Soft tissue
- Periprosthetic Fluid collection/AVAL/osteolysis



Outline

- Imaging Modalities
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- **Muscle/Tendon Injury**
- Tumor
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Muscle/Tendon Injury

- Background Tendon/Muscle
- Location
- Size
- Severity
- Chronicity
- British Athletics Muscle Injury Classification
- Intervention

Muscle/Tendon Injury

- Background Tendon/Muscle



Muscle/Tendon Injury

- Location

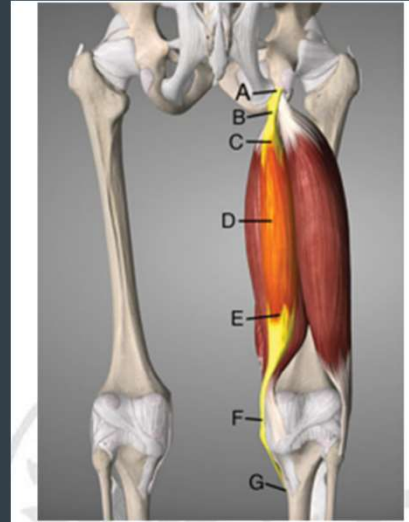


Fig. 1 Musculotendinous zones. Three-dimensional illustration of posterior right thigh revealing the semimembranosus (medial), semitendinosus (lighter color, superficial to the semimembranosus), and biceps femoris (lateral). (a) Muscle origin. (b) Proximal free tendon. (c) Proximal musculotendinous junction. (d) Muscle belly. (e) Distal musculotendinous junction. (f) Distal free tendon. (g) Insertion. Image created with Essential Anatomy. 3D4Medical, Dublin, Ireland.

Muscle/Tendon Injury

Size

Severity



<25%



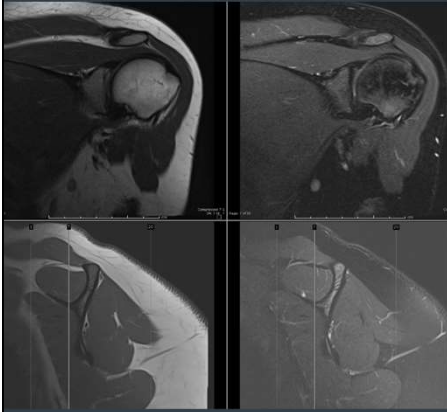
25-75%



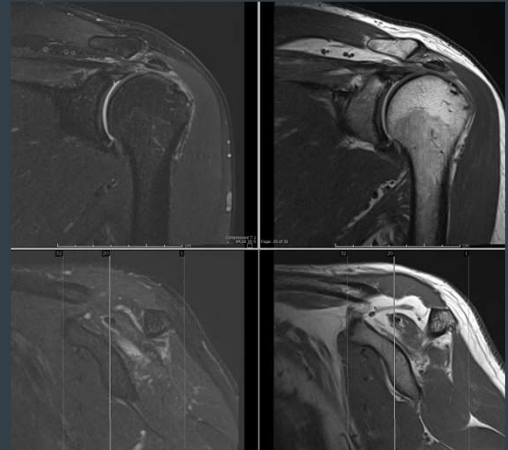
>75%



Muscle/Tendon Injury - Chronicity



Normal



Atrophy

Add Acute Cuff strain supra

Muscle/Tendon Injury

British
 Athletics
 Muscle
 Injury
 Classification

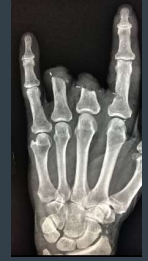
Grade	MRI
Grade 0	- MRI normal or - Patchy high signal in one or more muscles.
Grade 1 small tear	- High signal cross section <10% - Length < 5 cm - Fibre architectural disruption < 1cm
Grade 2 moderate tear	- High signal cross section 10% - 50% - Length 5 -15cm - Fibre architectural disruption < 5cm
Grade 3 extensive tear	- High signal cross section > 50% - Length >15cm - Fibre architectural disruption > 5cm
Grade 4 full-thickness tear	- Complete discontinuity of tendon or muscle with retraction

Outline

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Tumor - Takeaway

- Aggressive vs Non-aggressive
- Bone
 - “Do not touch” – slam dunk B9 lesions;
Hooray nothing further!
 - Malignant – Aggressive/Irregular/Enhancing;
Further imaging with PET/Bone scan and/or
Bx



Tumor

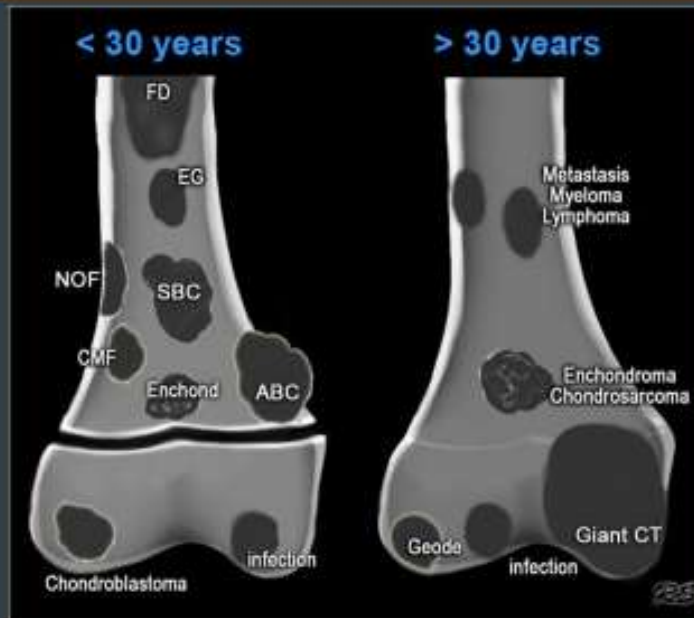
- “Aggressive vs Non-aggressive”
 - Age
 - Prior Hx
 - Single or multiple
 - Lytic or sclerotic
 - Zone of Transition (can you draw a line around)
 - Periosteal Rxn/Cortical Destruction/Soft tissue Ext
 - Location
 - Enhancement?

Tumor

- Aggressive vs Non-aggressive
- Bone
 - Do not touch - Fibro-osseous lesions
 - Malignant - Primary Lesion
- Mets/Myeloma/Lymphoma

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<https://radiologyassistant.nl/musculoskeletal/bone-tumors/osteolytic-well-defined>

- F**ibrous Dysplasia
- E**osinophilic granuloma
Enchondroma
- G**iant Cell Tumor
- N**OF
- O**steoblastoma
- M**etastasis Myeloma
- A**BC
- S**BC
- H**yperparathyroidism
- I**nfection
- C**hondroblastoma
CMF

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<https://radiologyassistant.nl/musculoskeletal/bone-tumors/osteolytic-ill-defined>

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<https://radiologyassistant.nl/musculoskeletal/bone-tumors/sclerotic-tumors>

Outline

- Imaging Modalities
- Classic Bone/Joint Pathologies
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Spine

- Counting
- Alignment
- Discs
- Vertebral Bodies
- Facets/Neural Foramina
- Extras



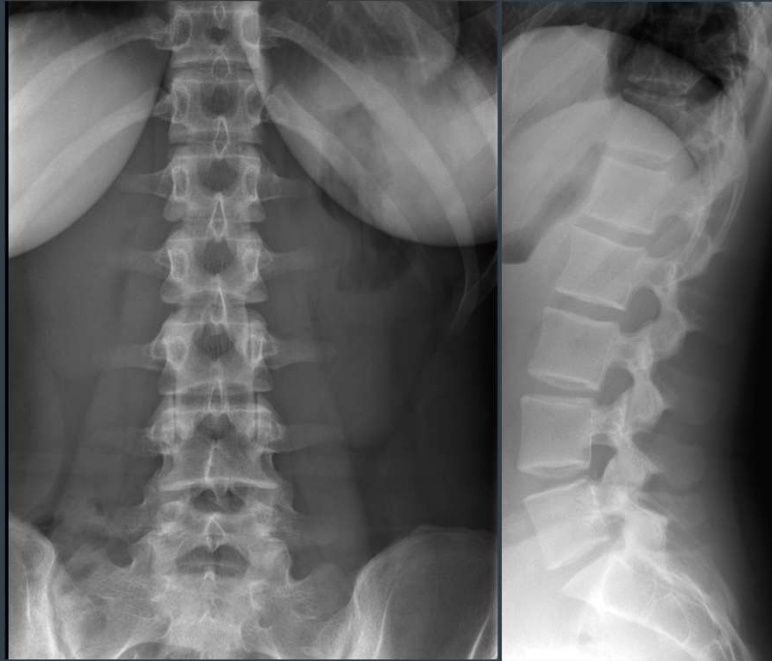
Spine

- **Counting**
- Transitional Anatomy
 - Goal L5-S1
- Bertolotti's Disease



Spine

- Counting



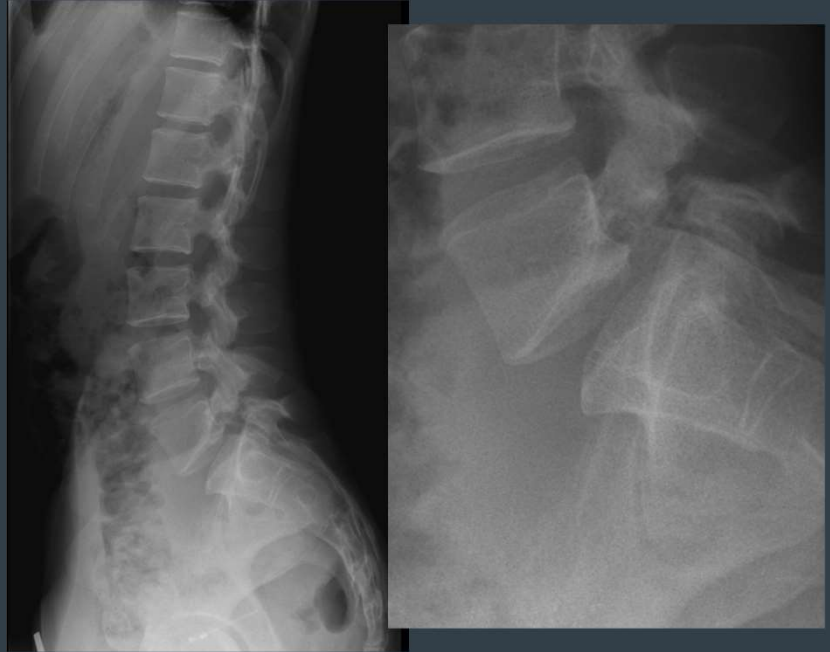
Spine

- Counting



Spine

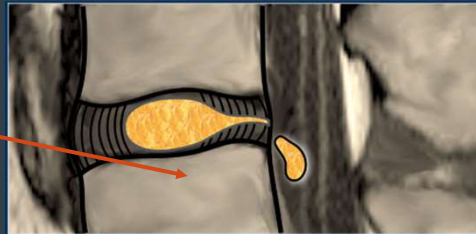
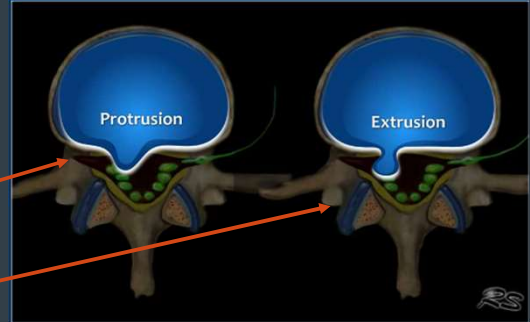
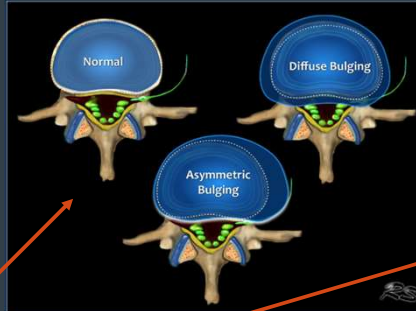
- Spondylolysis
- Spondylolisthesis



Spine

- Discs

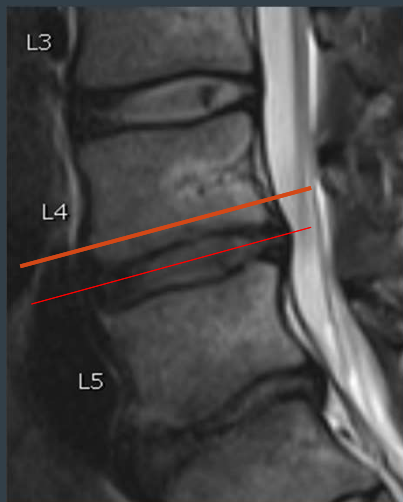
- Bulge
- Protrusion
- Extrusion
- Sequestration



<https://radiologyassistant.nl/neuroradiology/spine/lumbar-disc-nomenclature-2-0>

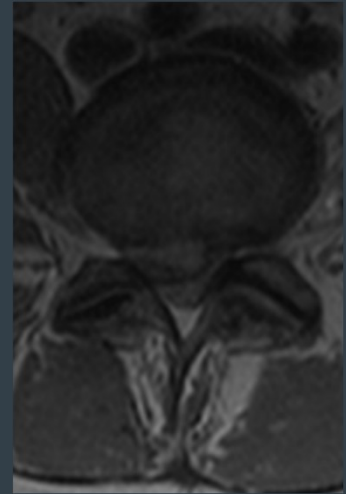
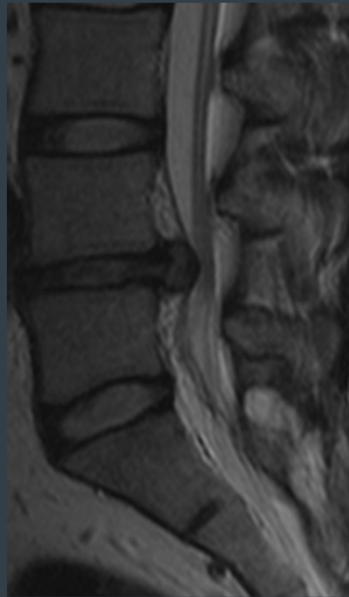
Spine

Bulge



Spine

Protrusion



Spine

- **Fractures**
 - Compression
 - Burst
 - Flexion-Distracton
 - Rotation



Spine

Compression



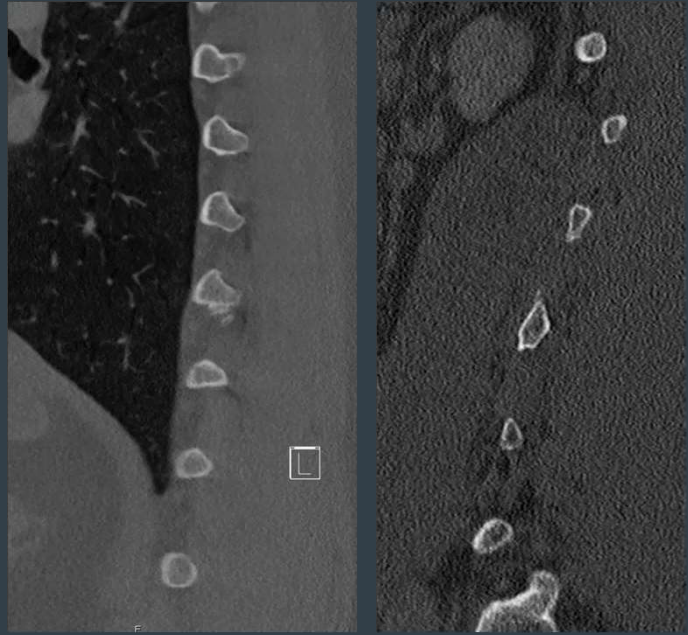
Spine

Burst Fracture



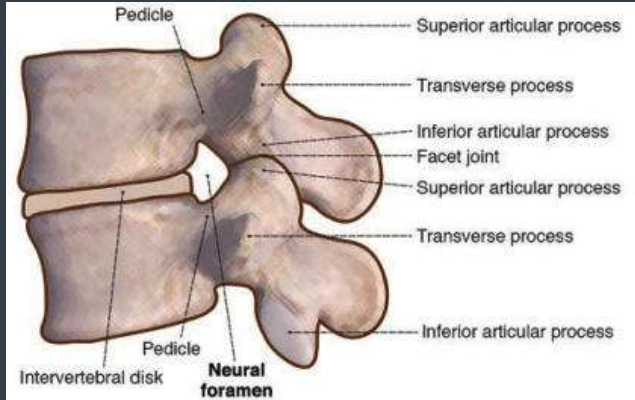
Spine

Flexion-Distraction fracture



Spine

• Facets/Neural Foramina



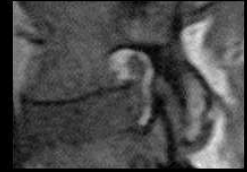
Normal

No fat effacement
Keyhole appearance



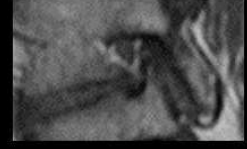
Mild

Some effacement of fat
in vertical or transverse
direction



Moderate

Near total effacement of
fat



Severe

Total effacement of fat
and/or nerve deformity



“Go-To” Websites:

- <https://radiologyassistant.nl/musculoskeletal>
- <https://radsourc.us/category/web-clinic/>
- <https://radiologycorelectures.org/msk/>

Questions? Comments? Answers?



References:

- <https://radiologyassistant.nl/musculoskeletal/muscle/hamstring-injury>
- <https://www.ajronline.org/doi/pdfplus/10.2214/AJR.16.17471?src=recsys>
- <https://www.grepmed.com/images/5811/spinal-foraminal-radiology-central-grading>