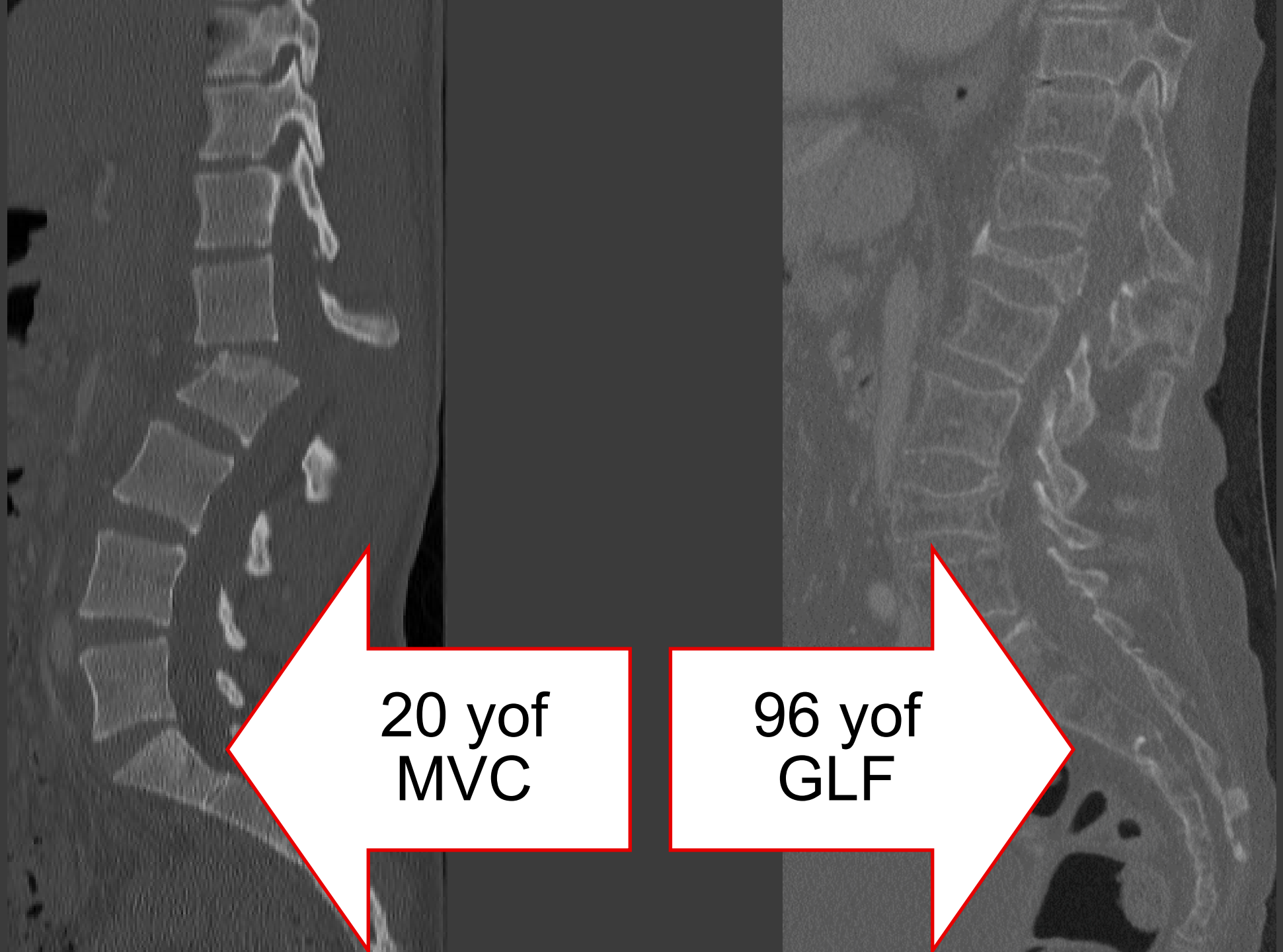
# TRAUMA OF THE ELDERLY
# NORDIC FORUM FOR TRAUMA RADIOLOGY 2024

Ken F. Linnau, MD, MS, FASER
Emergency Radiology
Harborview Medical Center – University of Washington
Seattle, WA

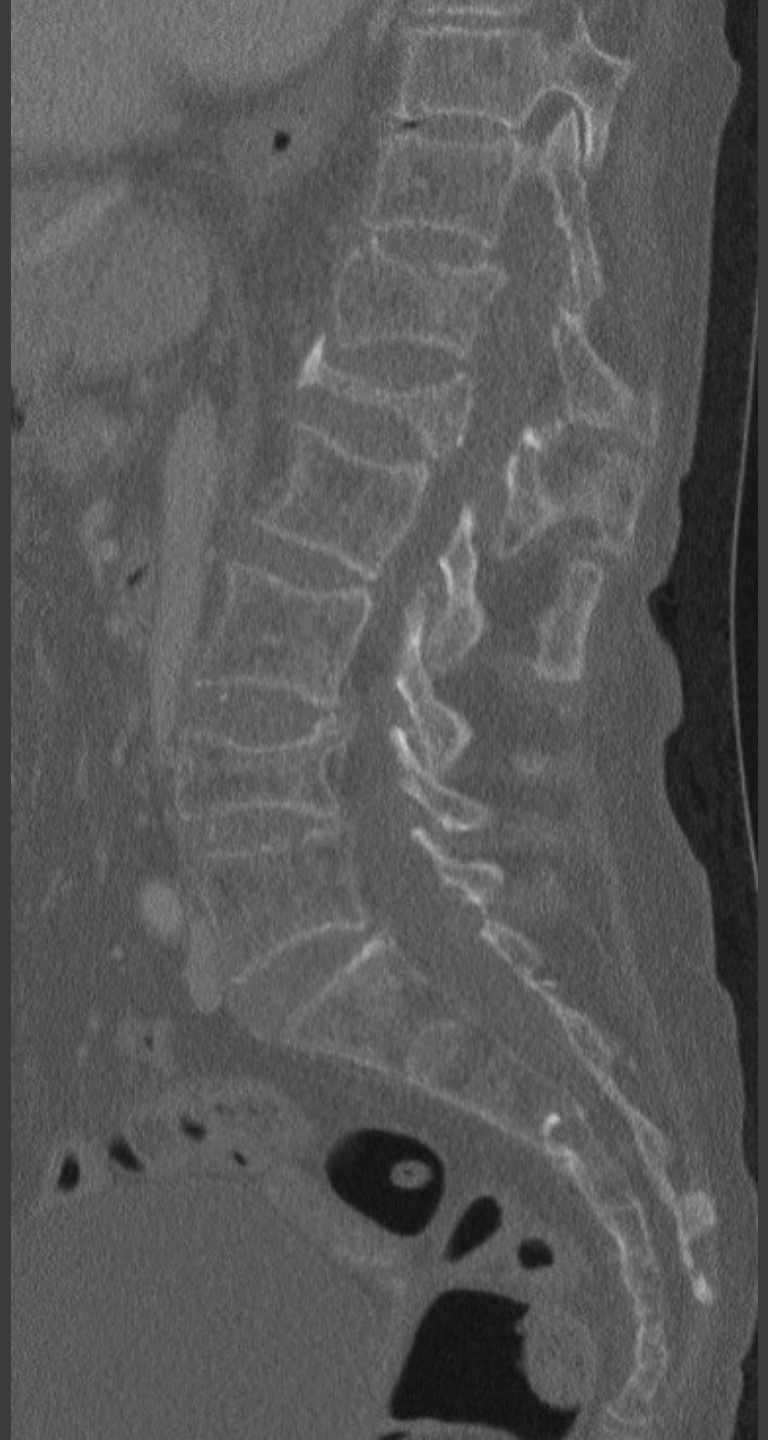
Thanks to:

Quynh T. Nguyen, MHS, PA-C
Claire K Sandstrom, MD, FASER
Carlo Bellabarba, MD
UW Medicine Harborview Radiology
Seattle, WA


20 yof
MVC
96 yof
GLF

# ELDERLY TRAUMA

- Physiology of aging
- Epidemiology
- Risk: Ankylosis
- Risk: Osteoporosis
- Cases
- Take home points



# PHYSIOLOGY OF AGING

- Decreased bone mass and density
- Stiffening of ligaments, vessels and joints
- Joint degeneration and cartilage thinning
- Loss of muscle bulk
- Disc degeneration
- Decreased bowel absorption
- Decreased cardiac output
- Diminished control of acid-base balance

Atinga-A et.al. Br J Radiol 2018; 91: 201707739

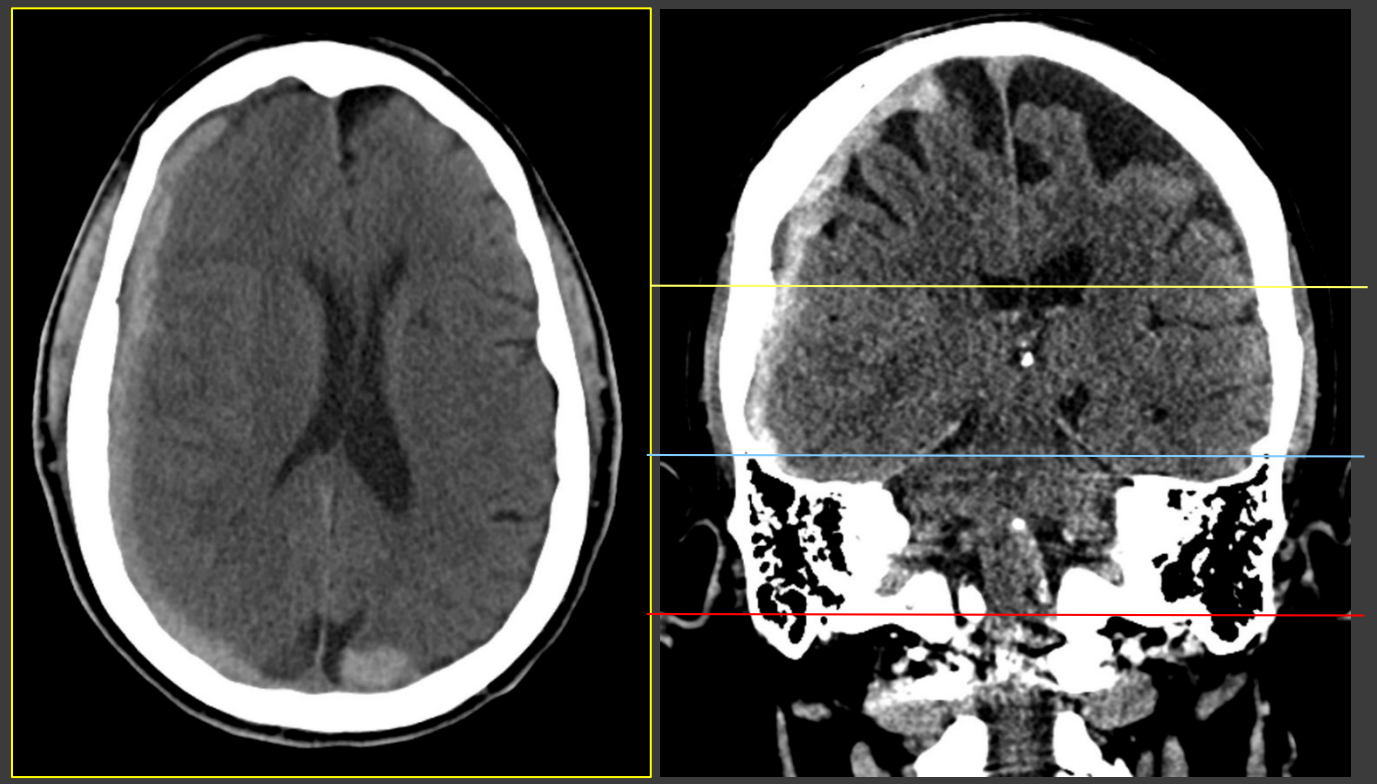
# PATHO-PHYSIOLOGY OF AGING

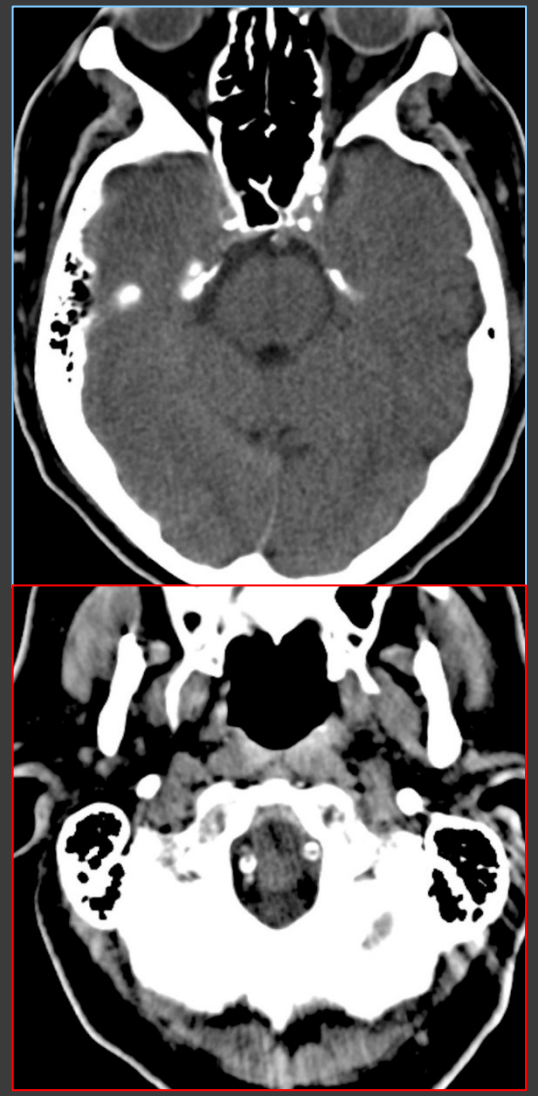
- Hypertension 50%
- Heart disease 30%
- Diabetes 10%
- Arrythmia 10%
- Stroke 10%
- Chronic obstructive pulmonary disease 10%
- Endocrine dysfunction 10%

- Aspirin, metoprolol, cortisone
- Blood thinners, beta-blockers, corticosteroids

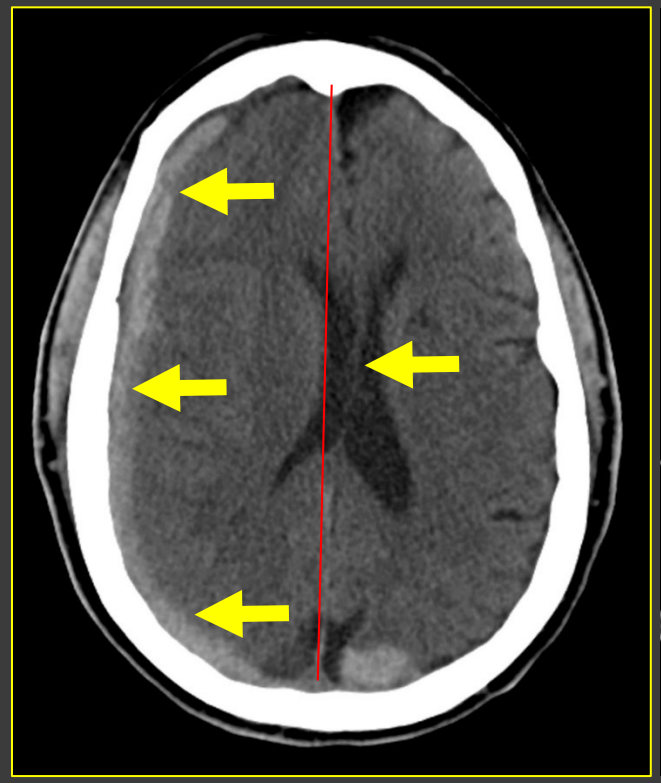
Sadro-CT, et al., Radiographics 2015; 35; 1263-85
Atinga-A et.al. Br J Radiol 2018; 91: 201707739

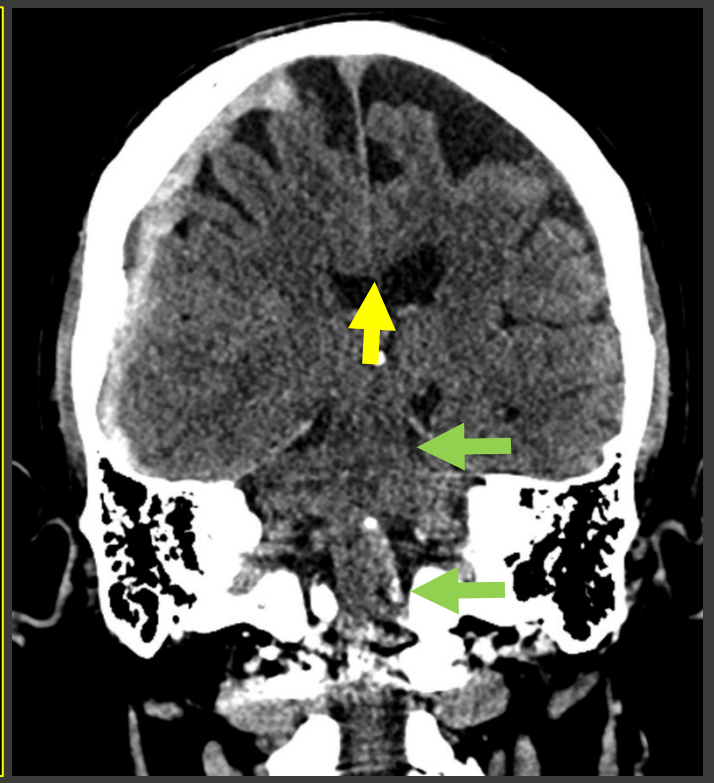
# 76 YOM NEW RT SIDED WEAKNESS ON THINNERS

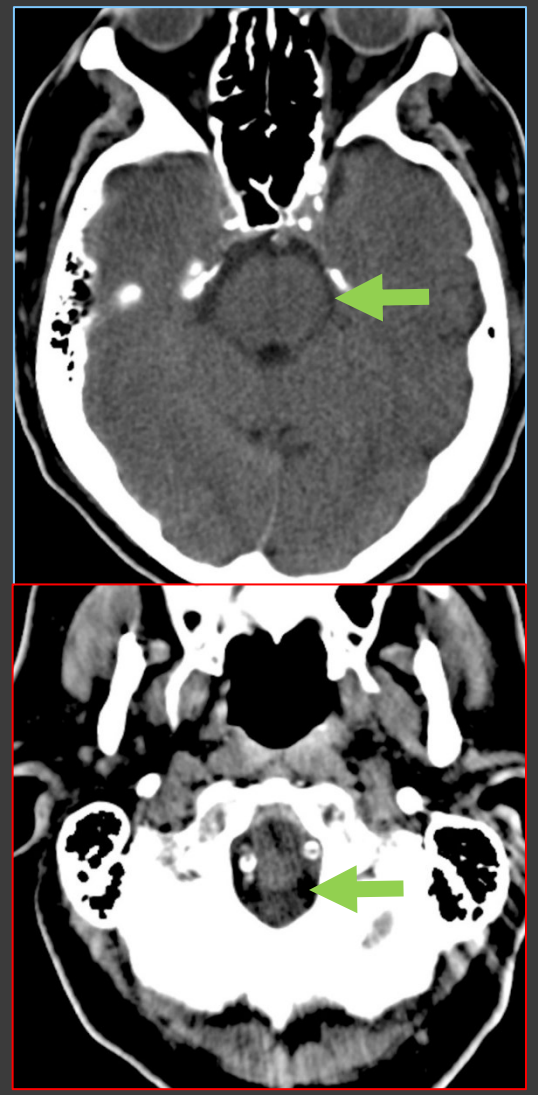




# 76 YOM NEW RT SIDED WEAKNESS

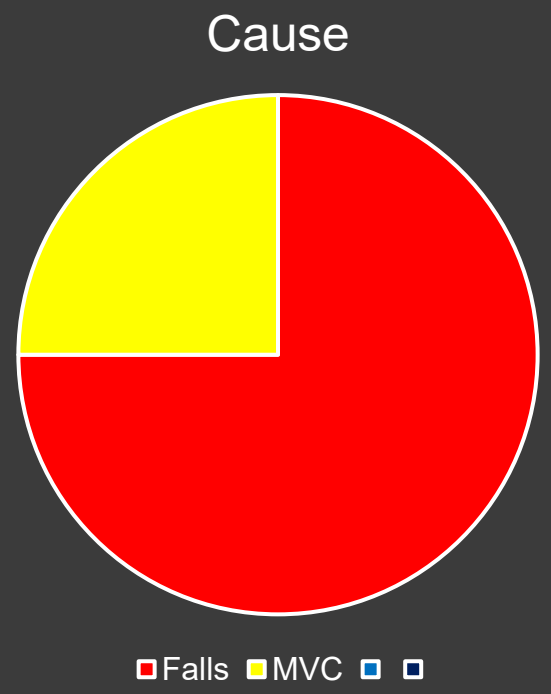






# EPIDEMIOLOGY OF ELDERLY TRAUMA

- 20% US population older than 65 years by 2030
- Trauma 5th leading cause of death in elderly
- Falls 75% of all elderly trauma
- Falls from standing most common
- Higher mortality for same injury severity (ISS)
  - Avoid undertriage of elderly patients
  - Beta blockers may mask vital sign change
  - Vigilant to eval for occult hypoperfusion
    Base deficit, serum lactate




Sadro-CT, et al., Radiographics 2015; 35; 1263-85
Atinga-A, et al., Br J Radiol 2018; 91: 201707739
Lomoschitz-FM, et al.; AJR 2002; 178: 573-77

# EPIDEMIOLOGY OF ELDERLY TRAUMA

Head trauma:
- Cave blood thinners: CT!!!!

Spine injury
- Rate doubles each decade
- High prevalence of C0-C2 injuries (like kids), 40% multilevel spine injury

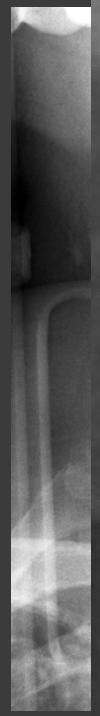
Ribs:
- Very common

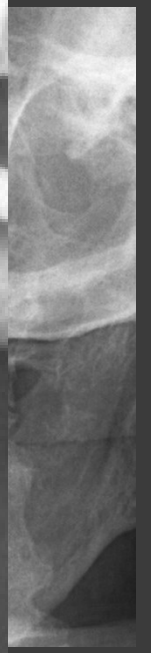
Abdomen:
- Unlikely injured from standing or sitting height: MVC (higher energy)

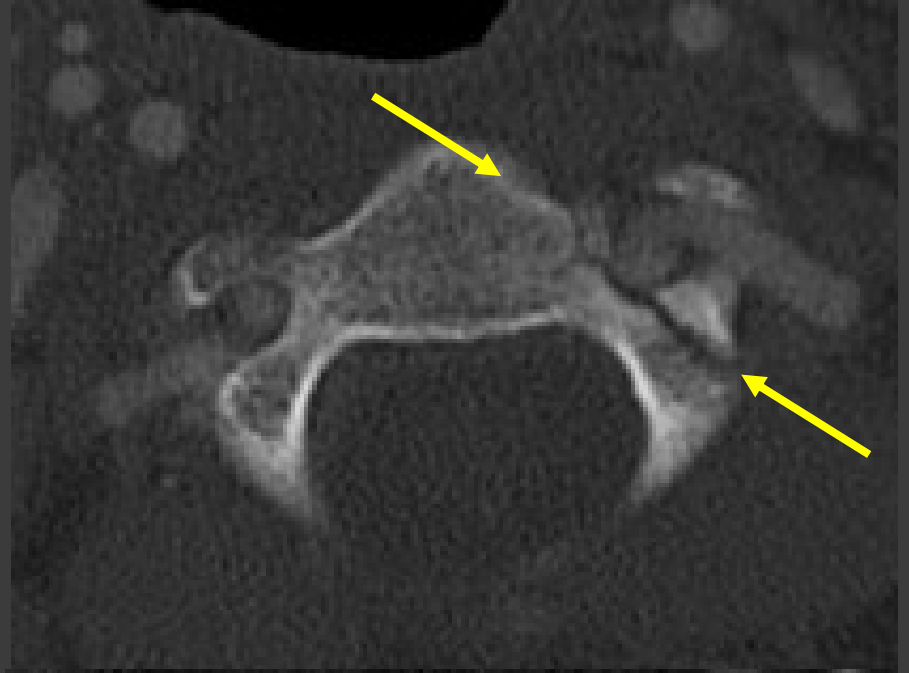
Extremities:
- Very frequently after minor trauma
- High grade injuries from GLF
- Periprosthetic injuries

Sadro-CT, et al., Radiographics 2015; 35; 1263-85
Atinga-A, et al., Br J Radiol 2018; 91: 201707739
Lomoschitz-FM, et al.; AJR 2002; 178: 573-77

85YO





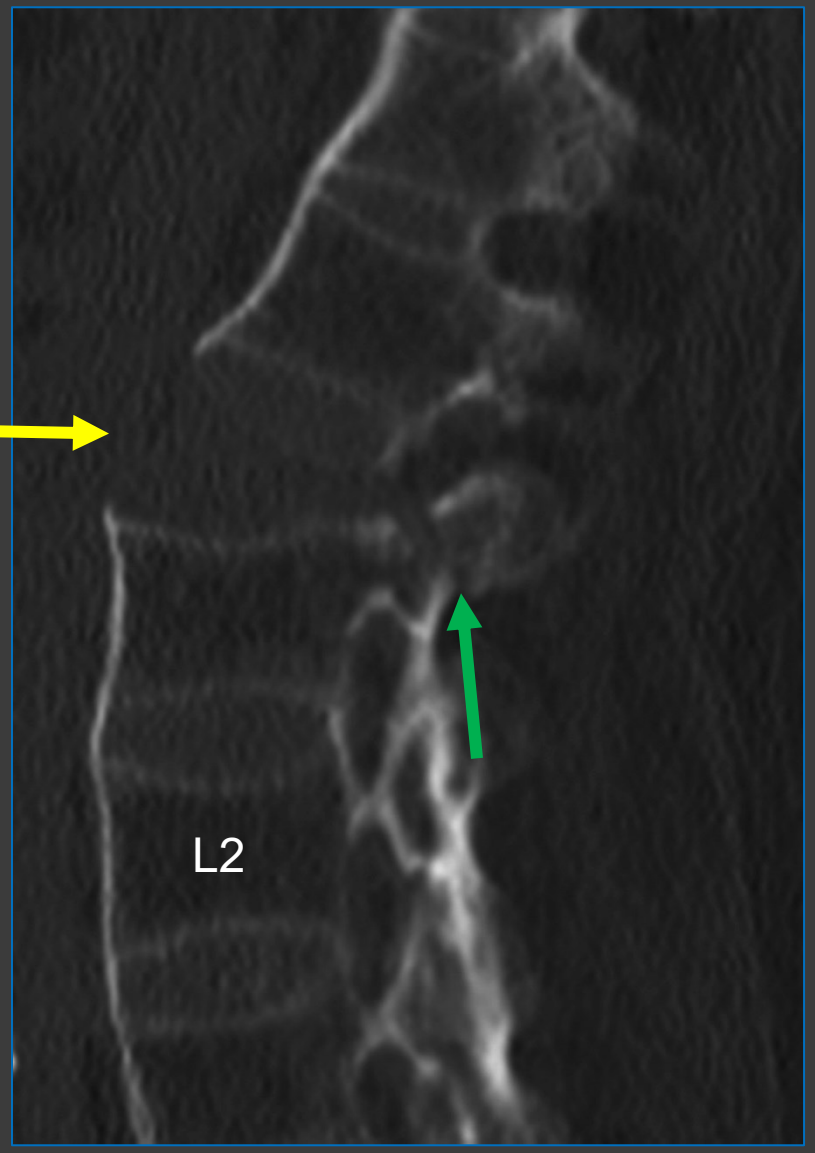


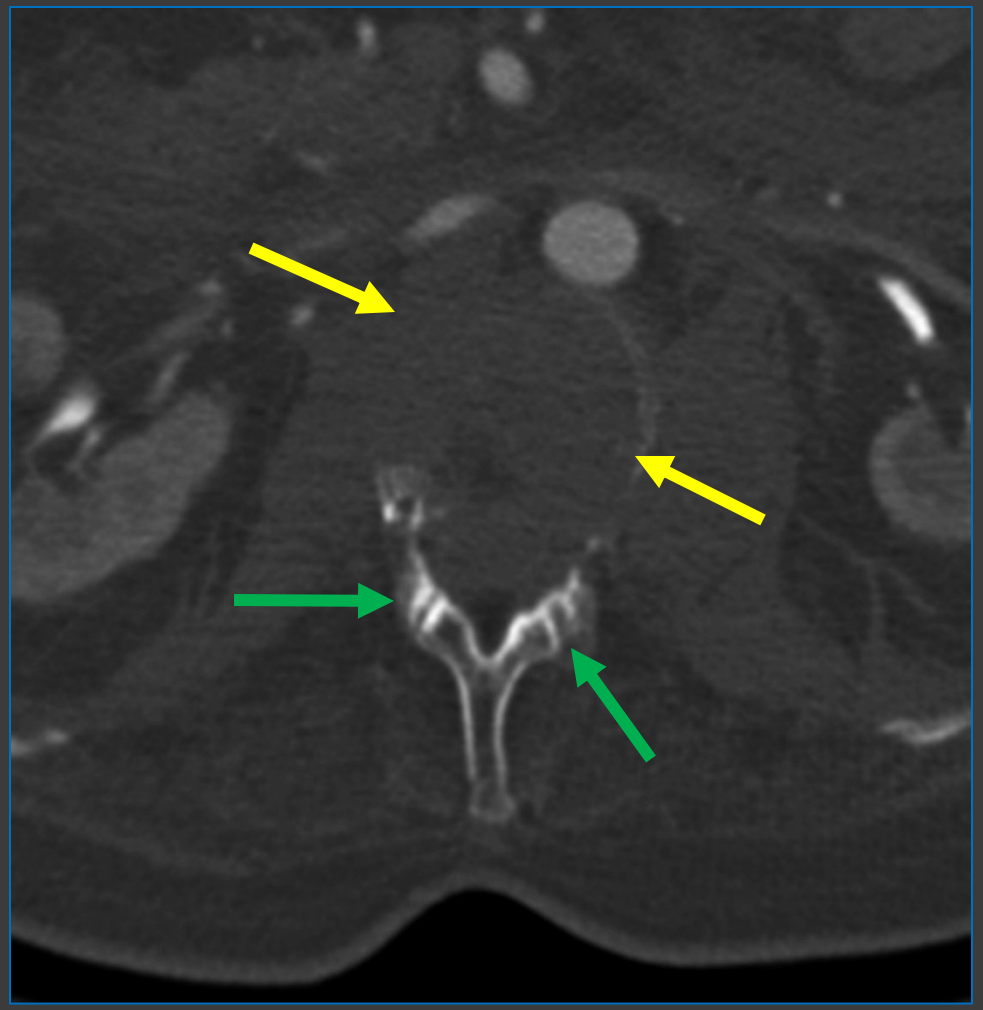
Type III dens fracture
No vertebral artery injury

# ELDERLY SPINE IMAGING

- Use CT
  - Highest sensitivity for fracture
- Consider evaluation of the entire spine
  - 40% multilevel injury in cervical spine
  - 10% cervical and thoracolumbar injury
  - 8% multilevel injury in ankylosis
- Whole Body CT scanning in elderly patients
- CTA neck for high-energy injury of the cervical spine or injury at C0-C2

# 71YOM FALL, NO NEURO DEFICITS, AS

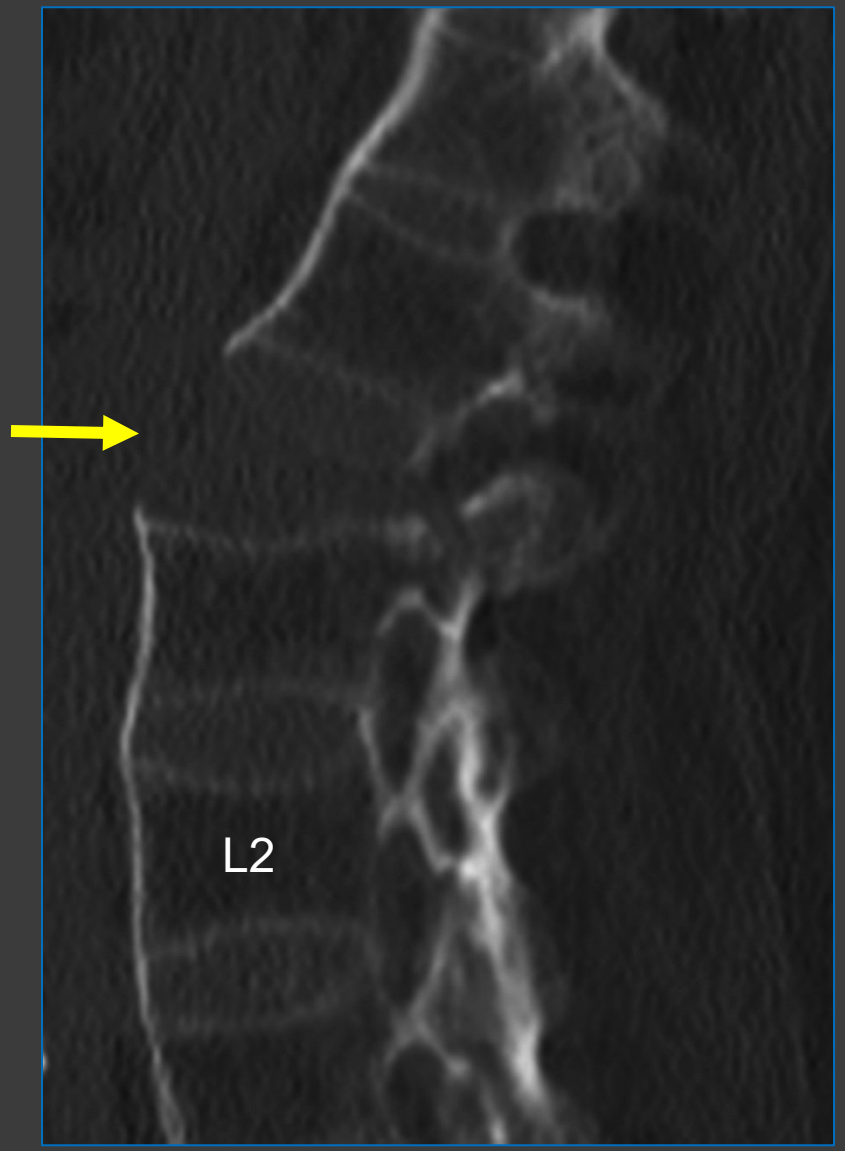


# MECHANICS OF ANKYLOSED OLD SPINE

https://www.pinterest.com/pin/683069468476254164/

# 71YOM FALL




Anterior Tension Band disrupted:
Hyperextension injury
Frequently associated with DISH or AS

T12-L1: AO B3

# MECHANICS OF MOBILE YOUNG SPINE

https://en.wikipedia.org/wiki/Slinky

# MECHANICS OF ANKYLOSED OLD SPINE

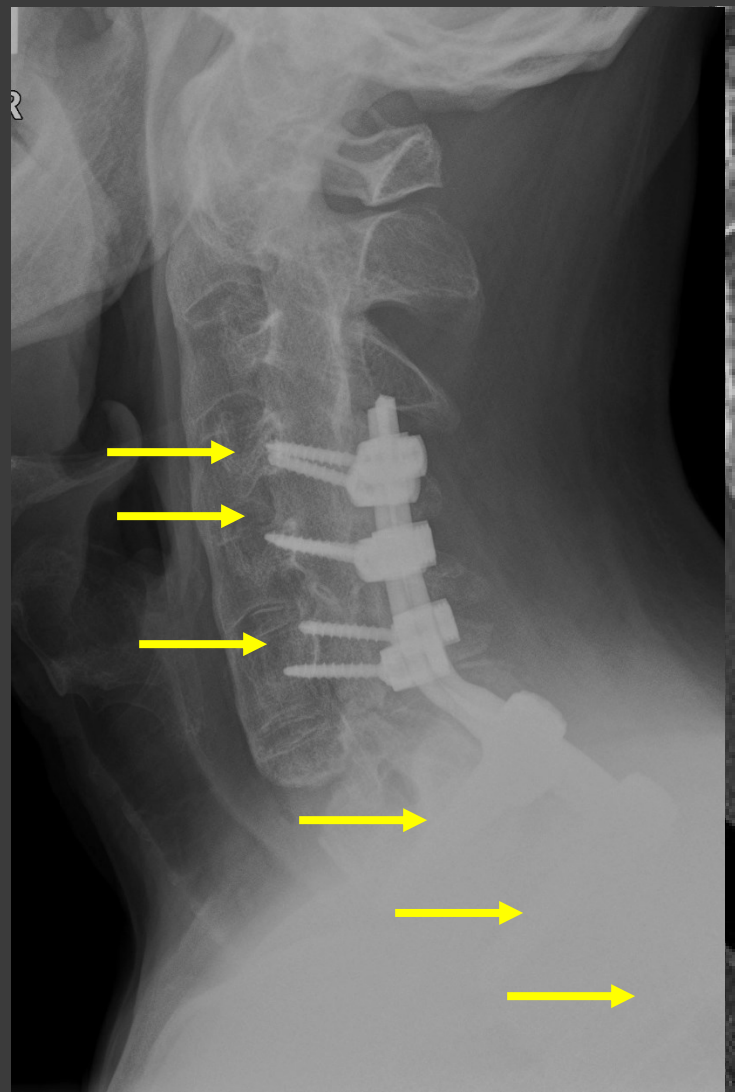
https://www.pinterest.com/pin/683069468476254164/

# SPINAL FRACTURE IN PATIENTS WITH ANKYLOSING SPINAL DISORDER

  - Disseminated Idiopathic Skeletal Hyperostosis (DISH)
  - Ankylosing Spondylitis (AS), degenerative change
- Share clinical features:
  - Functional spinal ankylosis, poor bone quality, **old age**
- Altered biomechanics:
  - Long lever arms due to spinal stiffness
- More susceptible to unstable injuries (3-column hyperextension)
- Delayed diagnosis in 20% of cases, 8% multilevel injury
  - CT or MR of entire spine
- Require long segment Posterior Segmental Instrumentation and Fusion (PSIF)

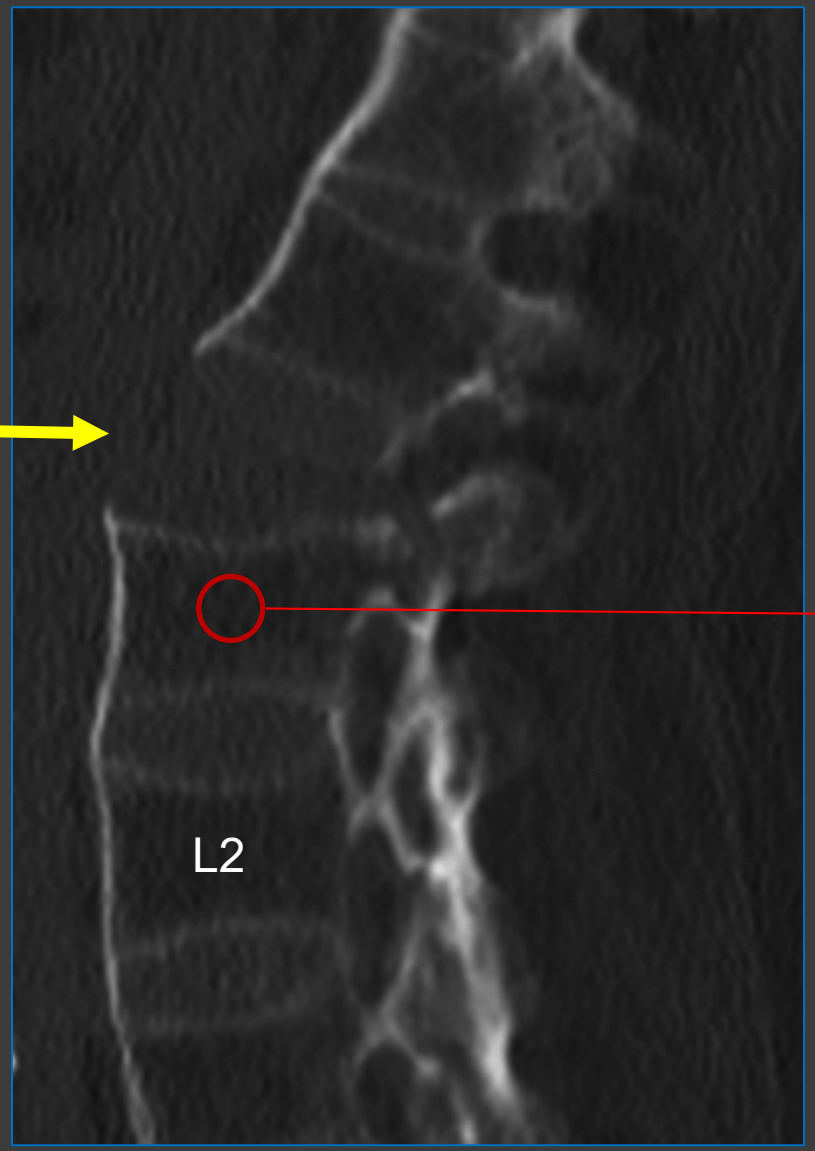
Caron-T et al. Spine. 2010 May15; 35(11): E458-64, PMID:20421858

# 67YOM, 6 FT FALL FROM LADDER, DISH



- Long lever arms
- Poor bone quality, older
- Requires long, multisegment PSIF

# 71YOM FALL




Anterior Tension Band disrupted:
Hyperextension injury
Frequently associated with DISH or AS

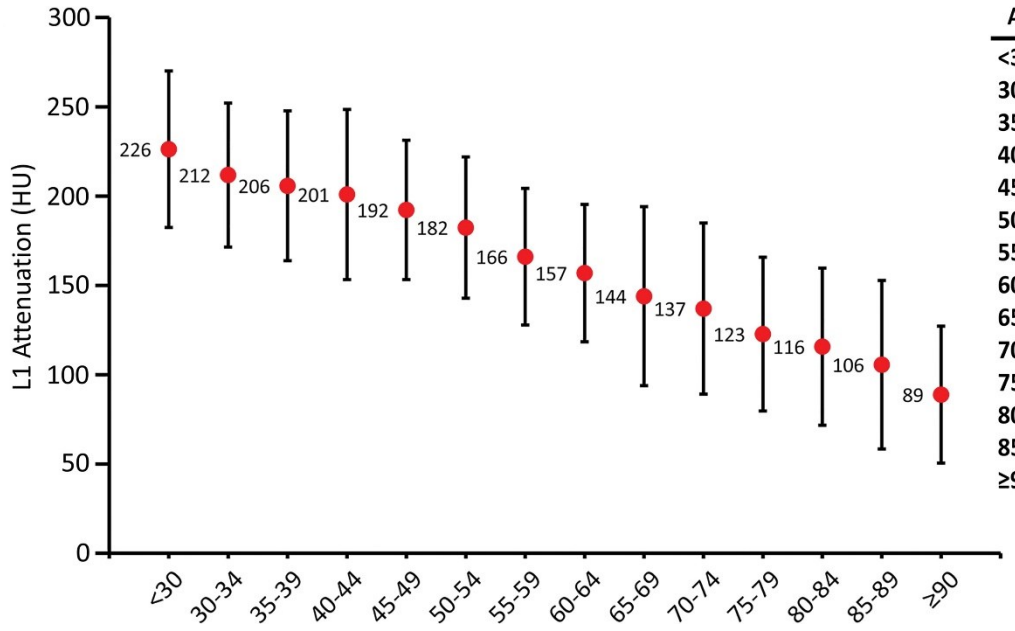
T12-L1: AO B3

90 HU

# OPPORTUNISTIC OSTEOPOROSIS SCREENING AT CT

- Osteoporosis diagnosis:
  - Clinical risk factors
  - DXA to assess Bone Mineral Density (BMD)
- Osteoporosis remains underdiagnosed
- CT attenuation values
  - Correlate with DXA T-scores
  - Decrease in patients with compression fractures
- Population-based age-related bone density loss @ L1 on CT averages 2.5 HU per year

Jang-S, et al.; Radiology 2019: 291; 360-67.



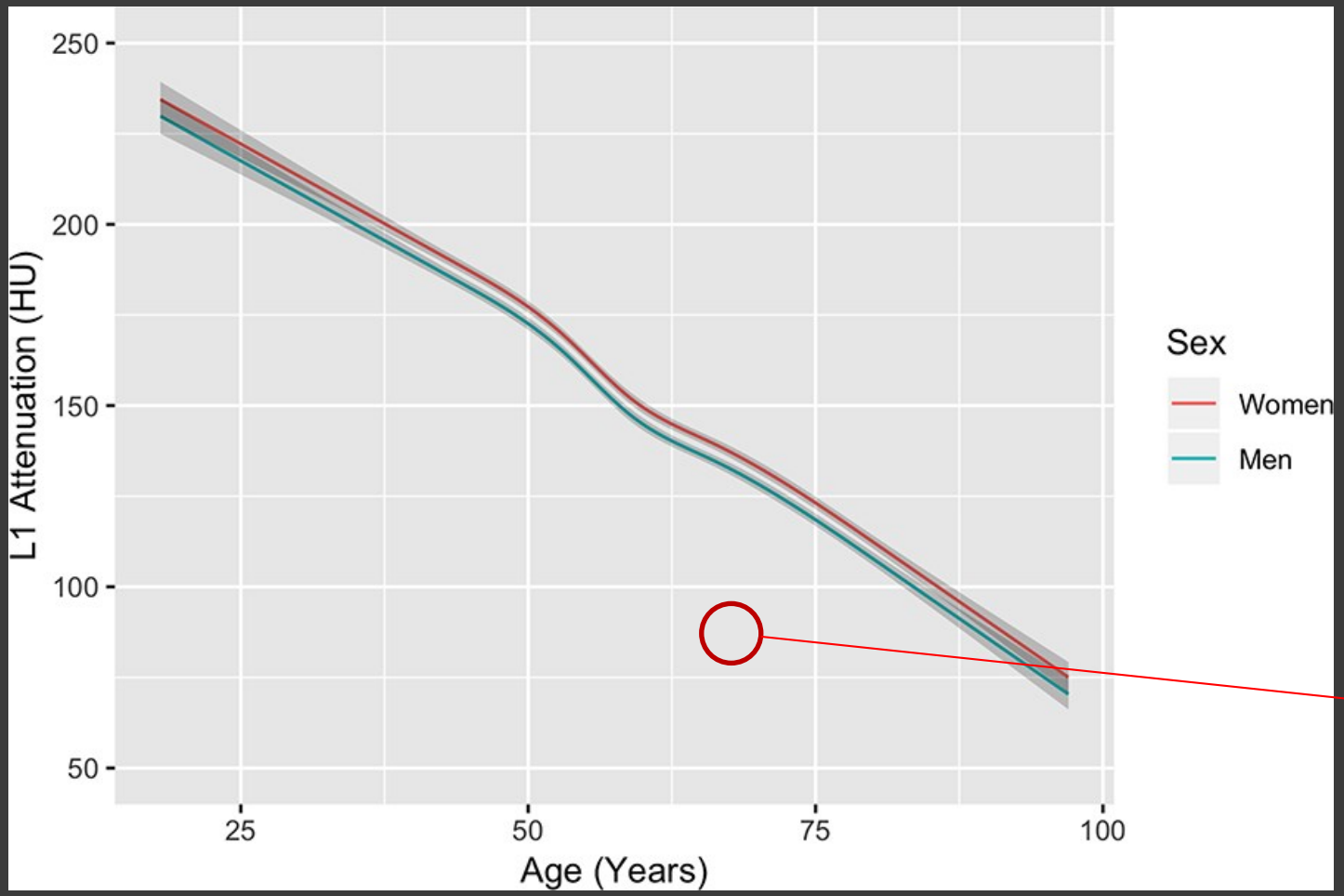

| Age | Median | Mean | SD |
|---|---|---|---|
| **<30** | 223 | 226 | 44 |
| **30-34** | 212 | 212 | 40 |
| **35-39** | 206 | 206 | 42 |
| **40-44** | 202 | 201 | 48 |
| **45-49** | 191 | 192 | 39 |
| **50-54** | 179 | 182 | 40 |
| **55-59** | 163 | 166 | 38 |
| **60-64** | 153 | 157 | 38 |
| **65-69** | 139 | 144 | 50 |
| **70-74** | 132 | 137 | 48 |
| **75-79** | 117 | 123 | 43 |
| **80-84** | 111 | 116 | 44 |
| **85-89** | 98 | 106 | 47 |
| **≥90** | 84 | 89 | 38 |

Figure 3: Plot shows normative reference values for trabecular L1 attenuation values for opportunistic osteoporosis screening. The median and the mean ± standard deviation (SD) values for L1 trabecular attenuation in Hounsfield units are shown for each age group (x-axis). The plot of the mean Hounsfield units (red dots) shows that age-related L1 trabecular bone loss is fairly linear. The normative reference ranges can serve as a quick reference while performing CT examination for other clinical indications. Error bars indicate standard deviations, which are fairly uniform across the age spectrum.

**Jang S. Published Online:** March 26, 2019
https://doi.org/10.1148/radiol.2019181648

Radiology

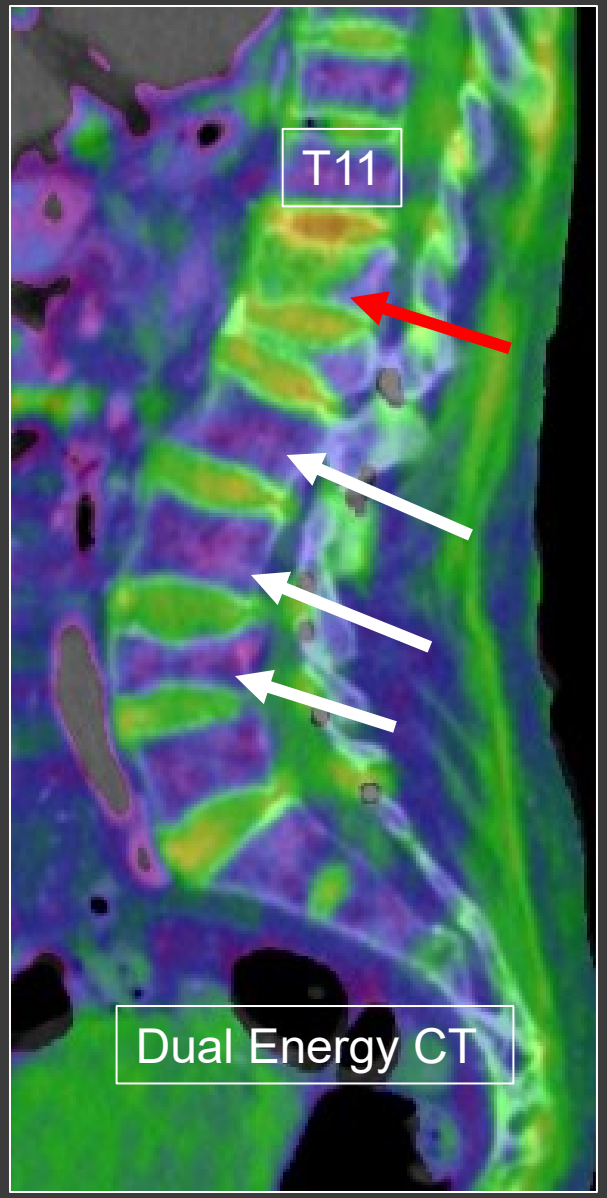
# OPPORTUNISTIC OSTEOPOROSIS SCREENING



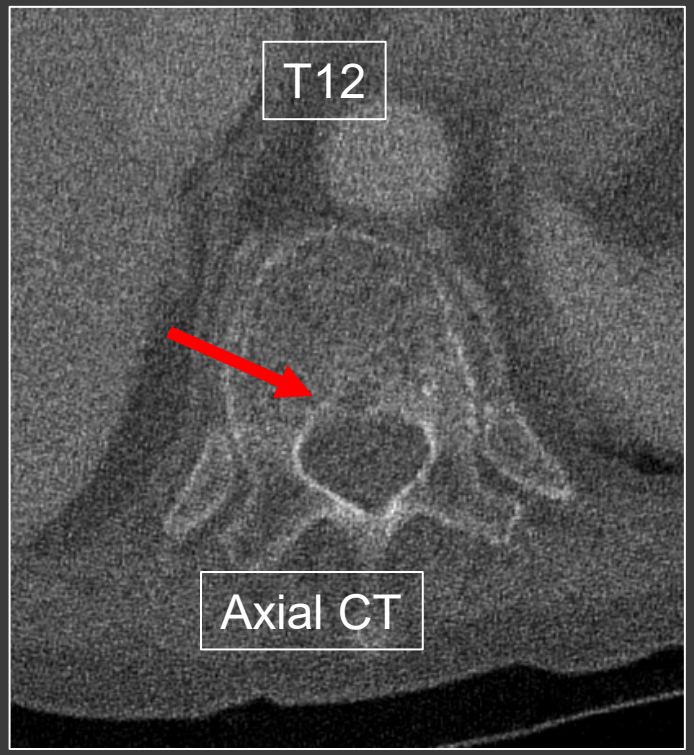


Jang-S, et al.; Radiology 2019: 291; 360-67.

# 96 YOF GLF







# EPIDEMIOLOGY OF ELDERLY TL SPINE

- Osteoporotic compression fractures
- 3.8% of ground level falls (GLF) cause TL spine fxs
  - 75% non-operative treatment
  - vertebral augmentation most common invasive treatment
- 25% postmenopausal women
- 33% of men over 75 yrs have osteoporosis
- Mortality increases with # of osteoporotic fractures
  - Compression fx: 20% chance of additional in 1 yr

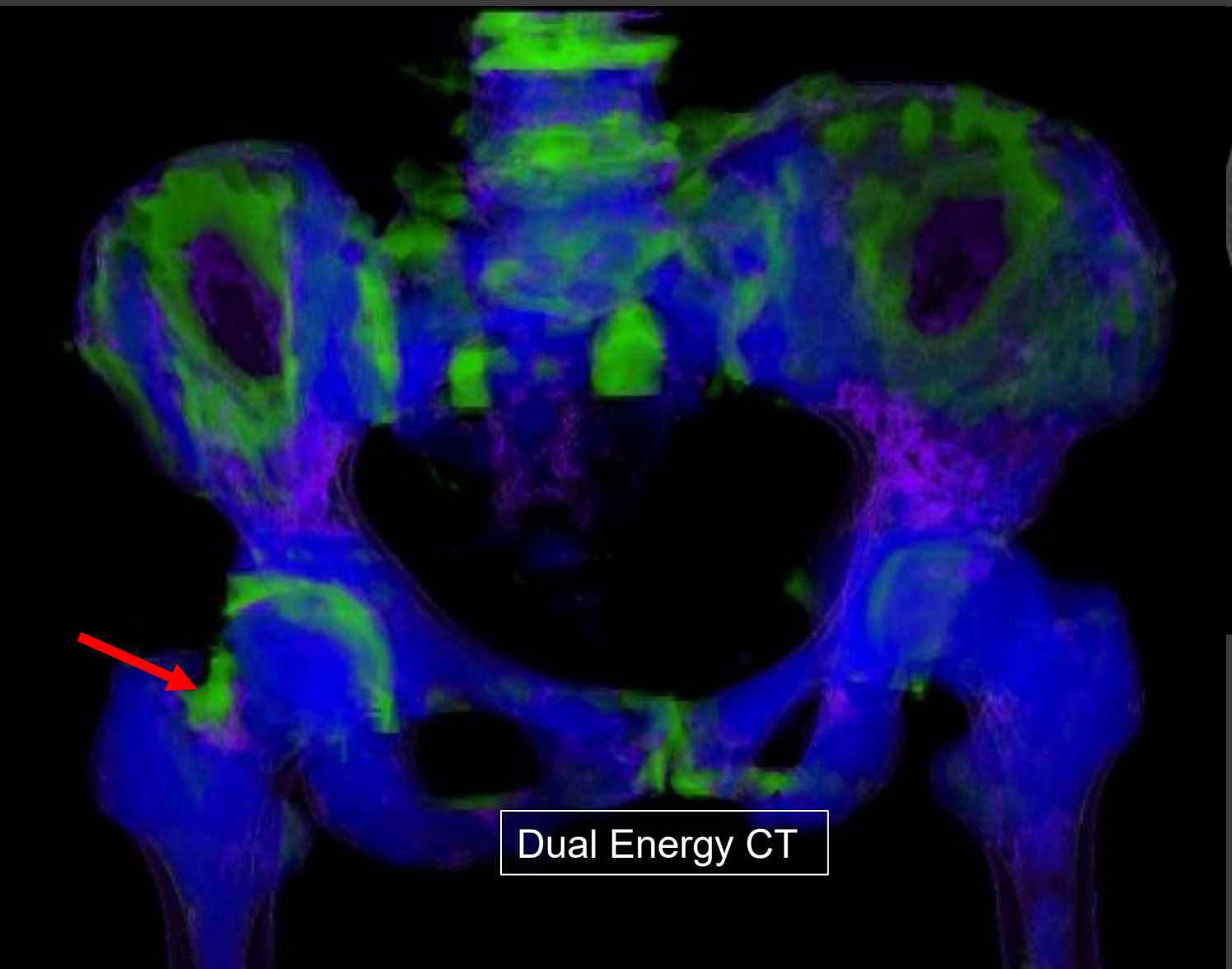
Grabel-ZJ, et al., J Clin Orthop Trauma 2020: 11; 916-20
Sadro-CT, et al., Radiographics 2015: 35; 1263-85

# BONE MARROW EDEMA ON DECT

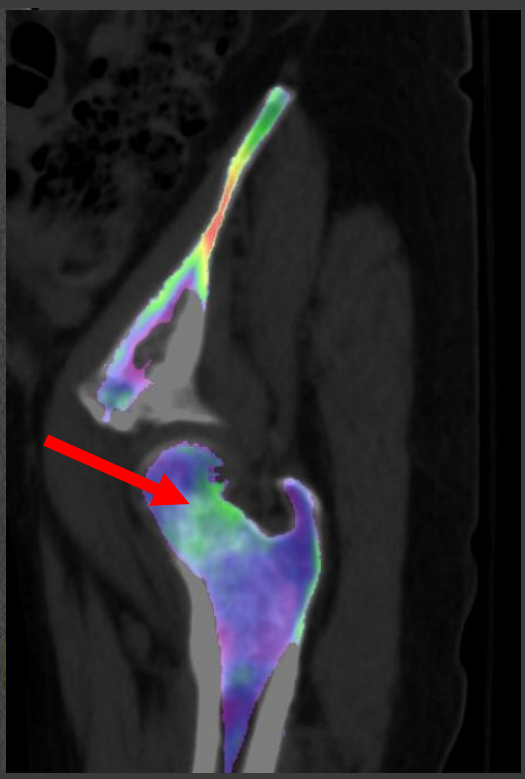
- VNCa (Virtual Non Calcium imaging).
- Related to anatomic weight and electron density of calcium.
- Three-material DE decomposition:
  - Removing contribution of calcium.
  - Then comparing relative water content (HU)
- Bone Marrow Evaluation at different x-ray energies:
  - Presence or absence of edema (bone bruise of fracture).
- Sensitivity: 85%; Specificity: 97% (qualitative).

Suh-CH, et al.,Eur Radiol. 2018 Oct;28(10):4182-4194

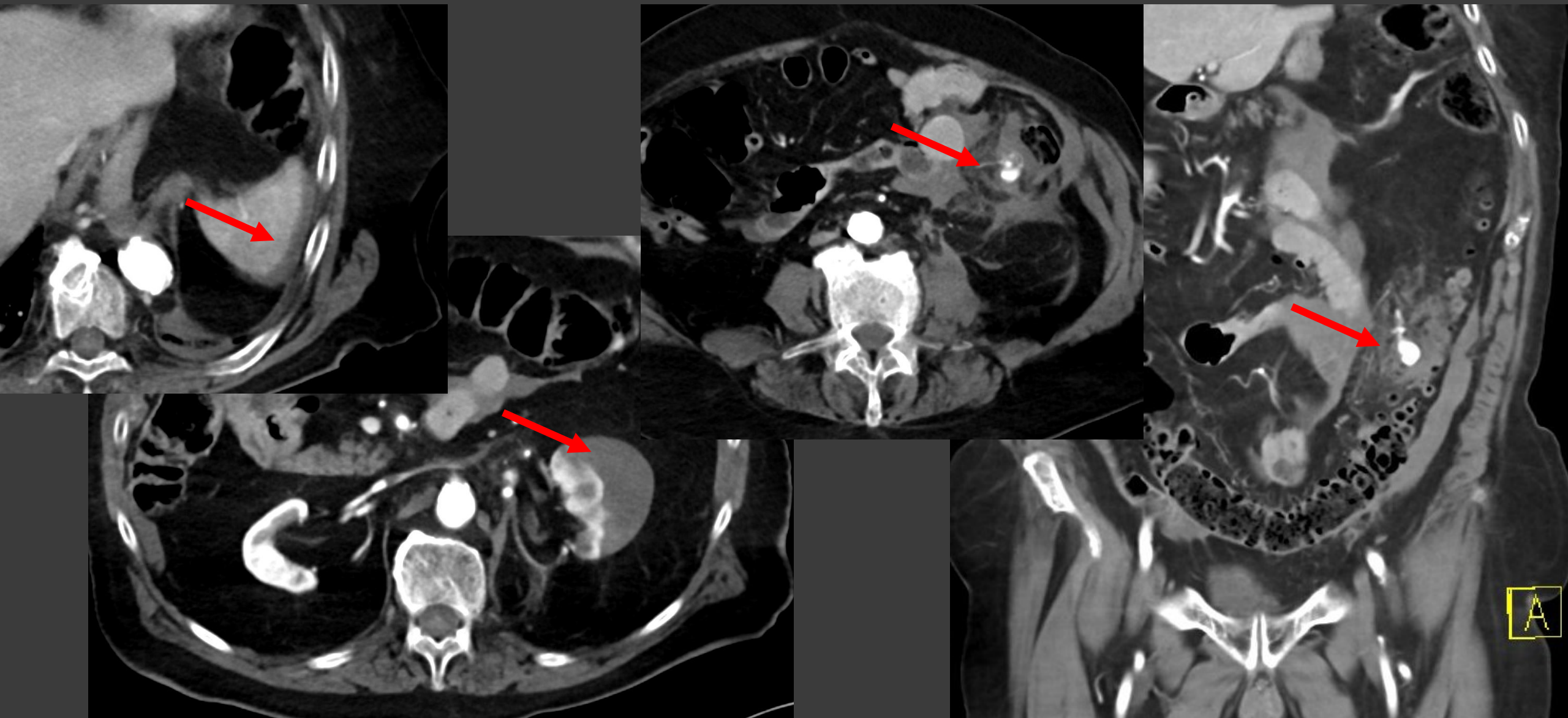
# 88YOF FELL ONTO RIGHT HIP







# 98YOM MVC (REAR SEAT): MILD LEFT PAIN



# SUMMARY – GERIATRIC TRAUMA

- 20% of Americans will soon be >65 years or older
- 75% of elderly injuries are from falls
- Senescent changes affect connective tissues:
  - Osteoporosis
  - Ankylosis
- Craniocervical junction: C2 most common injury
- Thoracolumbar:
  - Osteoporotic compression fractures
  - Hyperextension if ankylosis
- Multilevel spine injury in up to 40% of cases
- CT CT CT CT CT CT WBCT DECT
  - Opportunistic osteoporosis screen
  - Marrow edema
- Aspirin, metoprolol, cortisone.

# SELECTED REFERENCES


- Sadro CT, Sandstrom CK, Verma N, Gunn ML. Geriatric Trauma: A Radiologist's Guide to Imaging Trauma Patients Aged 65 Years and Older. Radiographics. 2015;35(4):1263-1285. doi:10.1148/rg.2015140130
- Lomoschitz FM, Blackmore CC, Mirza SK, Mann FA. Cervical spine injuries in patients 65 years old and older: epidemiologic analysis regarding the effects of age and injury mechanism on distribution, type, and stability of injuries. AJR Am J Roentgenol. 2002;178(3):573-577. doi:10.2214/ajr.178.3.1780573
- Katsuura Y, Osborn JM, Cason GW. The epidemiology of thoracolumbar trauma: A meta-analysis. J Orthop. 2016;13(4):383-388.
- Jang S, Graffy PM, Ziemlewicz TJ, Lee SJ, Summers RM, Pickhardt PJ. Opportunistic Osteoporosis Screening at Routine Abdominal and Thoracic CT: Normative L1 Trabecular Attenuation Values in More than 20 000 Adults. Radiology. 2019;291(2):360-367. doi:10.1148/radiol.2019181648
- Caron T, Bransford R, Nguyen Q, Agel J, Chapman J, Bellabarba C. Spine fractures in patients with ankylosing spinal disorders. Spine (Phila Pa 1976). 2010;35(11):E458-E464. doi:10.1097/BRS.0b013e3181cc764f
- Suh CH, Yun SJ, Jin W, Lee SH, Park SY, Ryu CW. Diagnostic performance of dual-energy CT for the detection of bone marrow oedema: a systematic review and meta-analysis. Eur Radiol. 2018;28(10):4182-4194. doi:10.1007/s00330-018-5411-5

Thank you.

klinnau@uw.edu

# 67YOM, 6 FT FALL FROM LADDER

# 67YOM, 6 FT FALL FROM LADDER