Disclaimer

The following presentation is for informational purposes only and is not intended to provide medical advice, diagnosis, or treatment. Always seek the advice of your physician or other qualified health provider with any questions you may have regarding a medical condition. Never disregard professional medical advice or delay in seeking it because of something you have read or seen in this presentation. There is nuance in specific individual cases requiring differing clinical judgement. The information provided here cannot explain all subtleties of bone mass measurement.

This presentation was created in 2025.

How to know if you've had a good quality DXA scan?

Objectives

1. Examine technical factors impacting DXA accuracy.
2. Identify appropriate regions for diagnosis.
3. Recognize false elevations and non-structural mineralization.
4. Investigate how anatomical factors affect diagnostic validity.

DXA scans are very accurate when:

performed correctly & anatomy is normal

In the presence of normal anatomy and

"when properly performed, bone density measurements are one of the most precise quantitative measurements in use in clinical medicine today."

Baim S, et.al. Precision Assessment and Radiation Safety for Dual energy X-ray Absorptiometry White Paper of the International Society for Clinical Densitometry, *Journal of Clinical Densitometry (JCD), Winter 2005 (Vol. 8, Issue 4, Pages 371-378)*

Which factors can affect accuracy?

- Machine error
- Technologist error
- Patient factors
- Interpretation error
- A combination of these

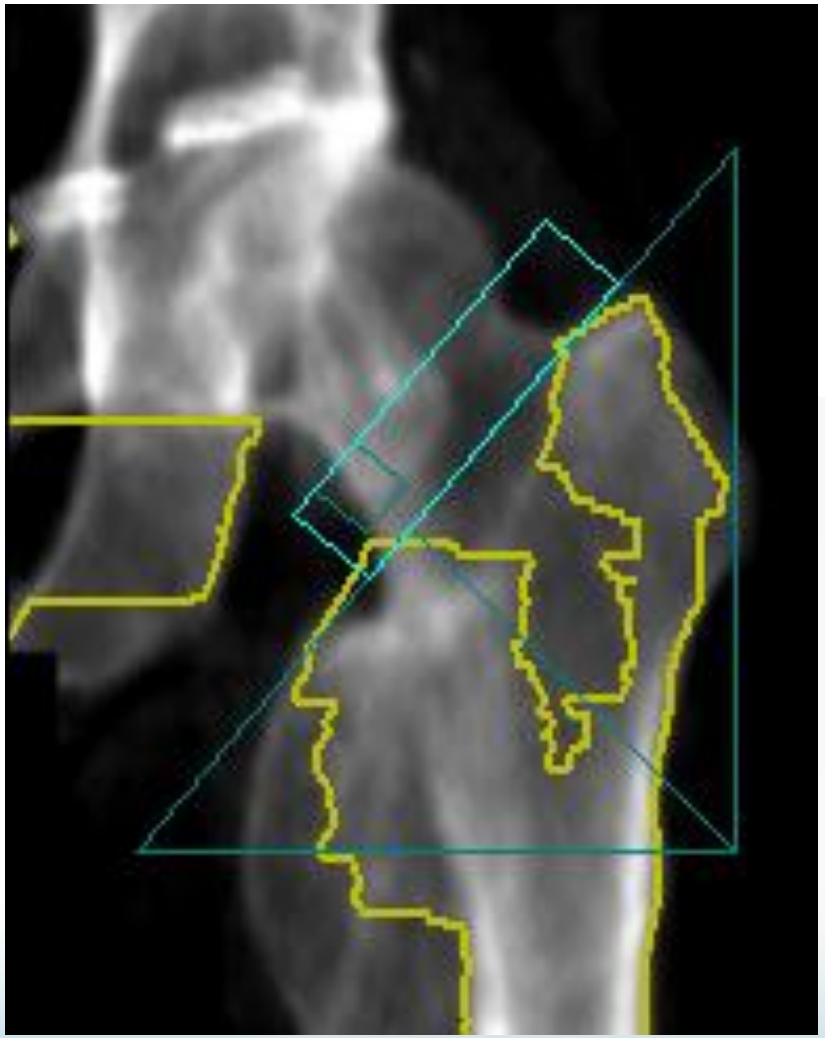
DXA Machine Error

- Measurement Noise
  - Intrinsic error in all measurement devices.
- Calibration Instability
  - Unreliable and inconsistent measurements.
- Software Algorithms
  - Improper bone edge detection.

Sometimes, the DXA software is unable to correctly identify bone

- The bone outline should include the entire thigh bone (femur) without soft tissue.

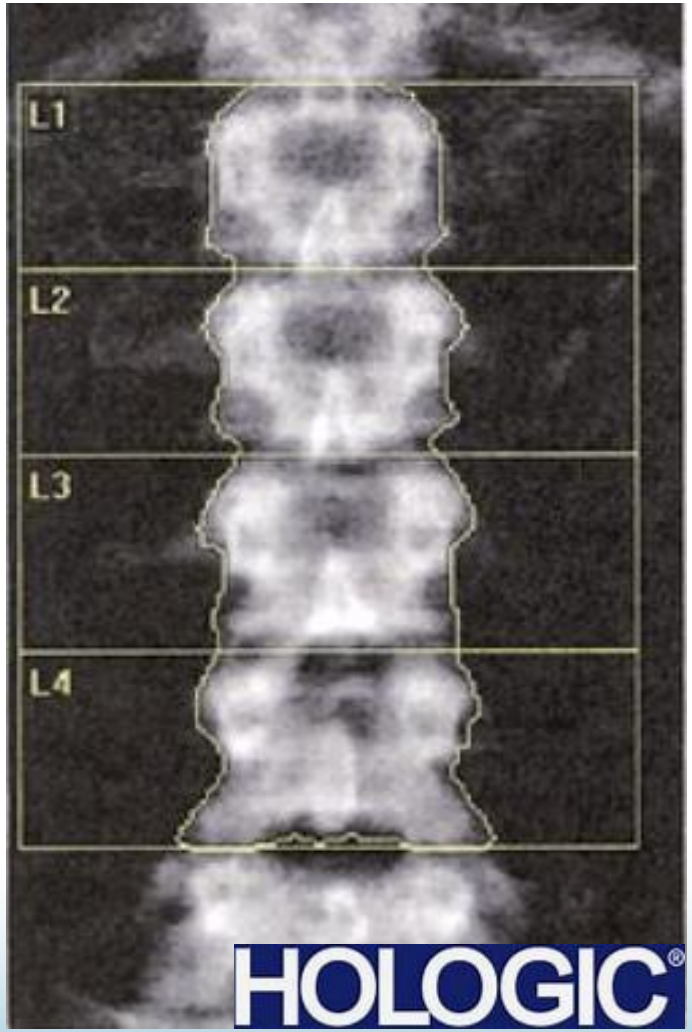
- Poor mapping may be caused by:
  - artifacts in the scan field
  - atypical anatomy
  - suboptimal positioning
  - improper scan mode selection

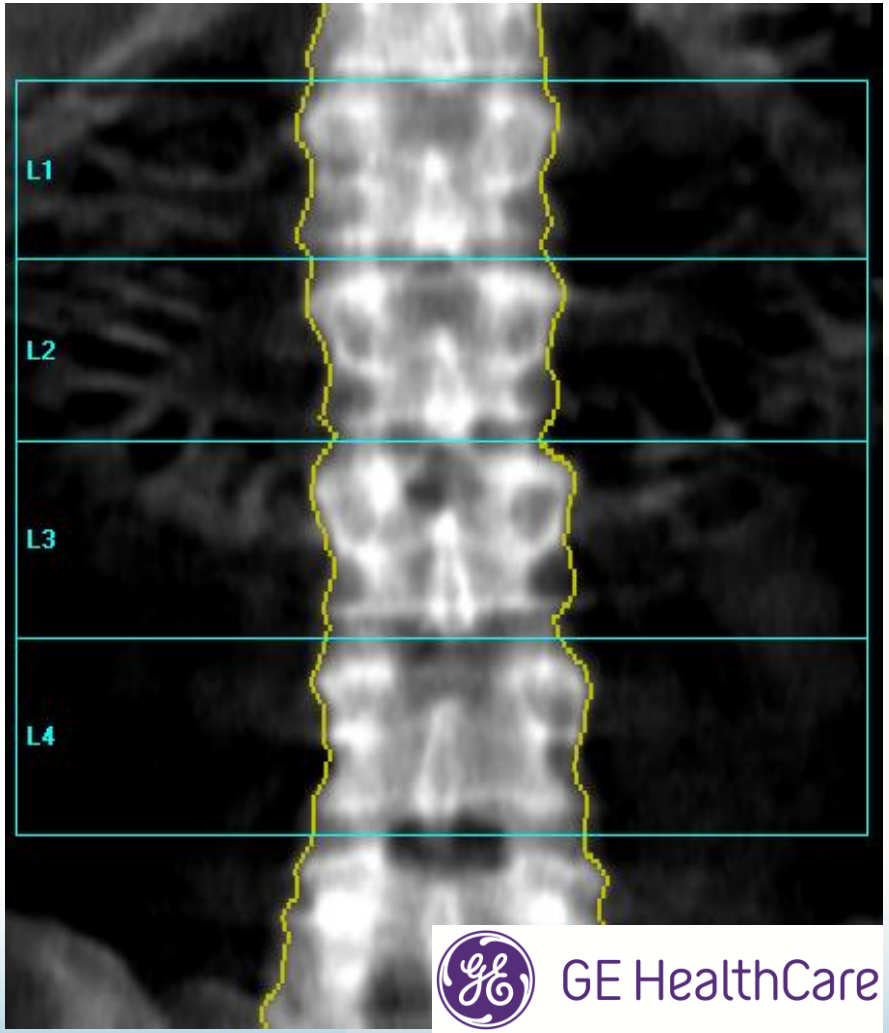


DXA Technologist Error

- Acquisition settings
  - Unsuitable scan modes/speed
- Inaccurate or inconsistent positioning
- Improper region-of-interest (ROI) line placement
- Inappropriate edits to the bone map (edge detection)

Spine scans with proper positioning, ROI placement and bone edge detection

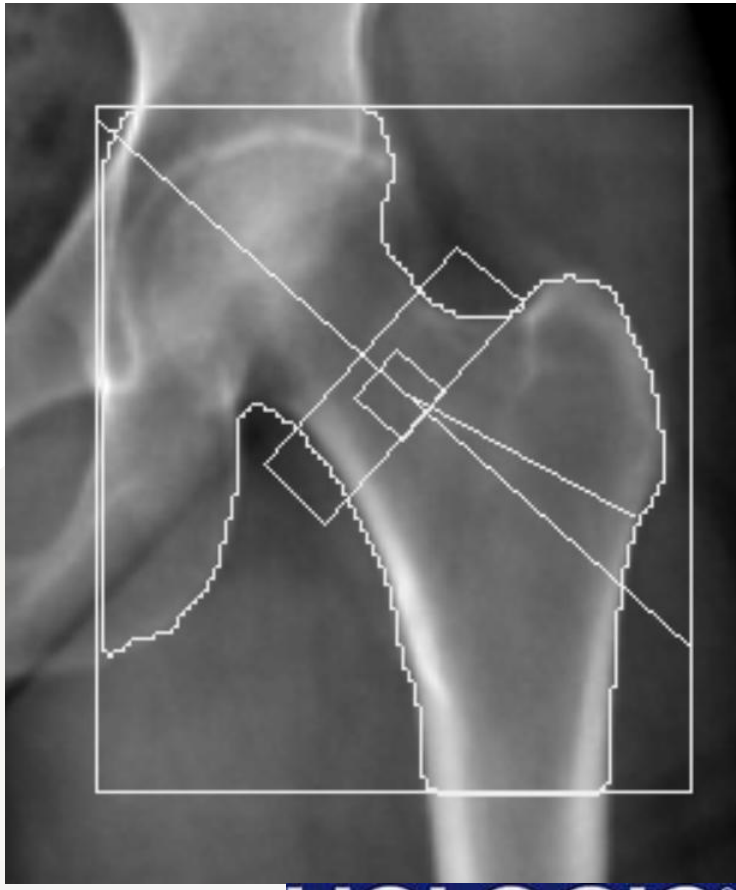




Hip (femur) ROI line placement varies dependent on the DXA manufacturer

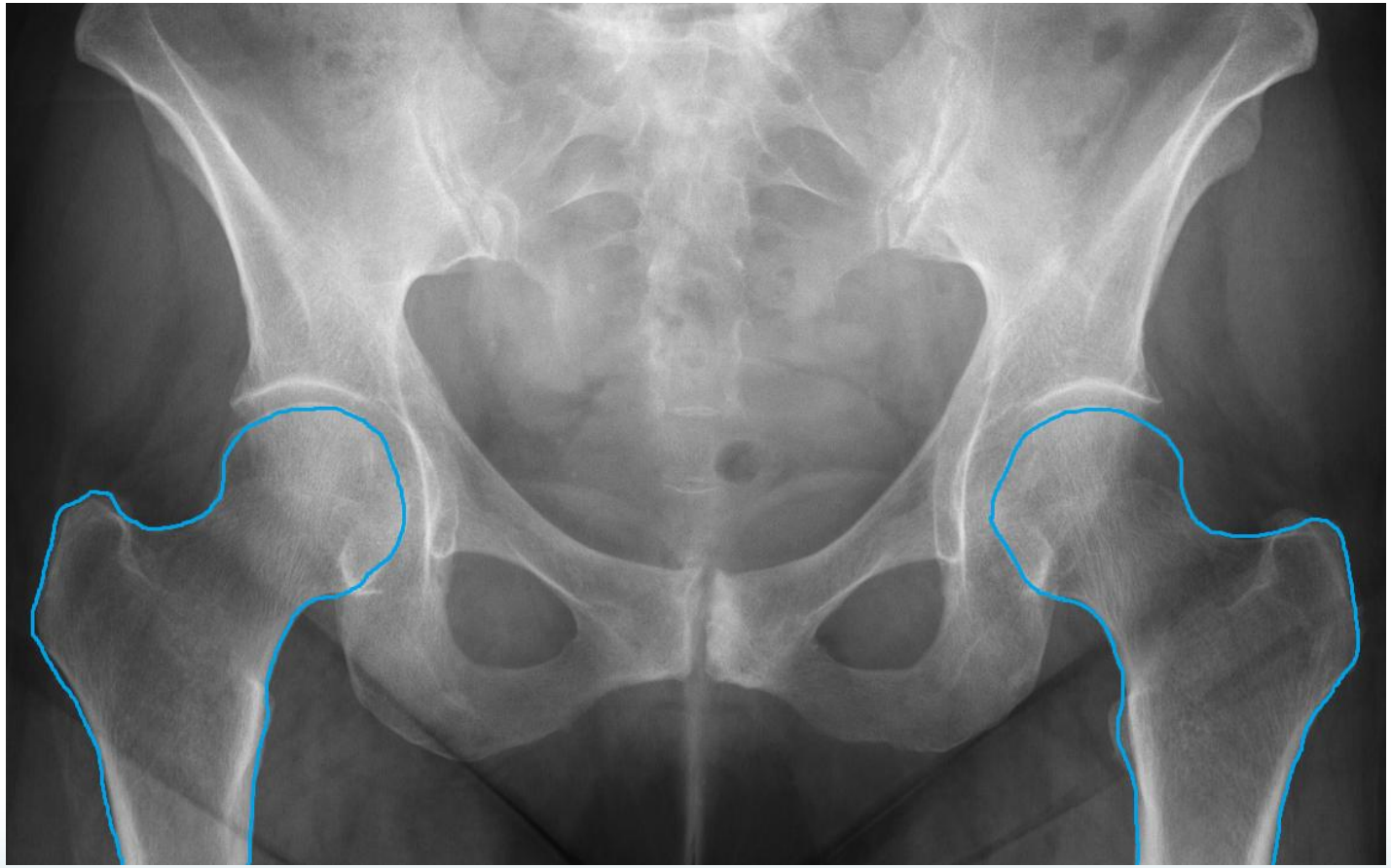
Only femoral neck bone should be included inside of the bone outline within the narrow rectangle.

GE HealthCare



HOLOGIC®

When we measure the hip, we are scanning the top of the thigh bone (femur bone)

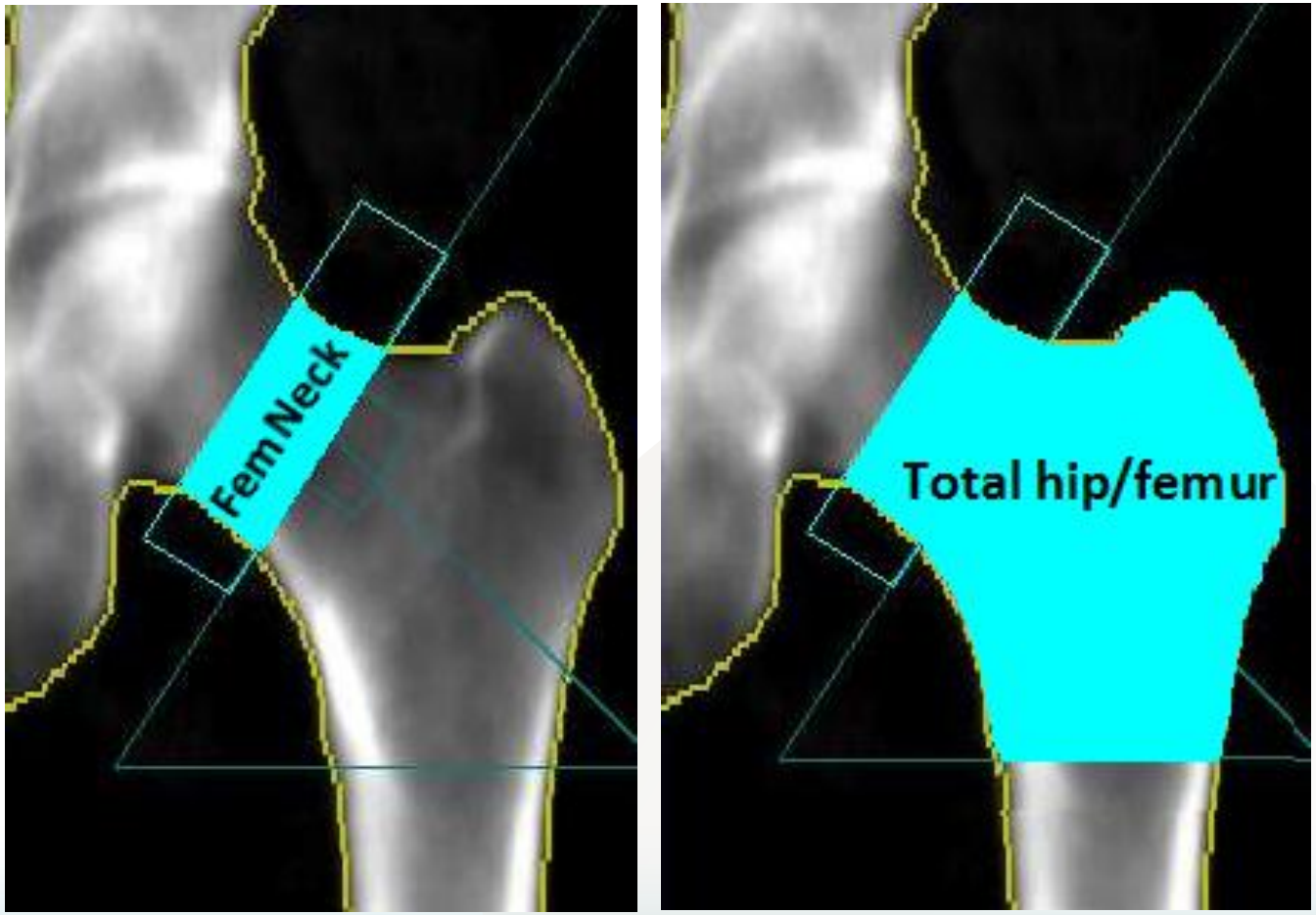


- The narrow femoral neck connects to the rounded head of the femur at the ball-and-socket joint of the hip
- When people break their hip, it is usually near the femoral neck, so that is why its an area of focus in a DXA scan.

Hip scan sites used in diagnosis

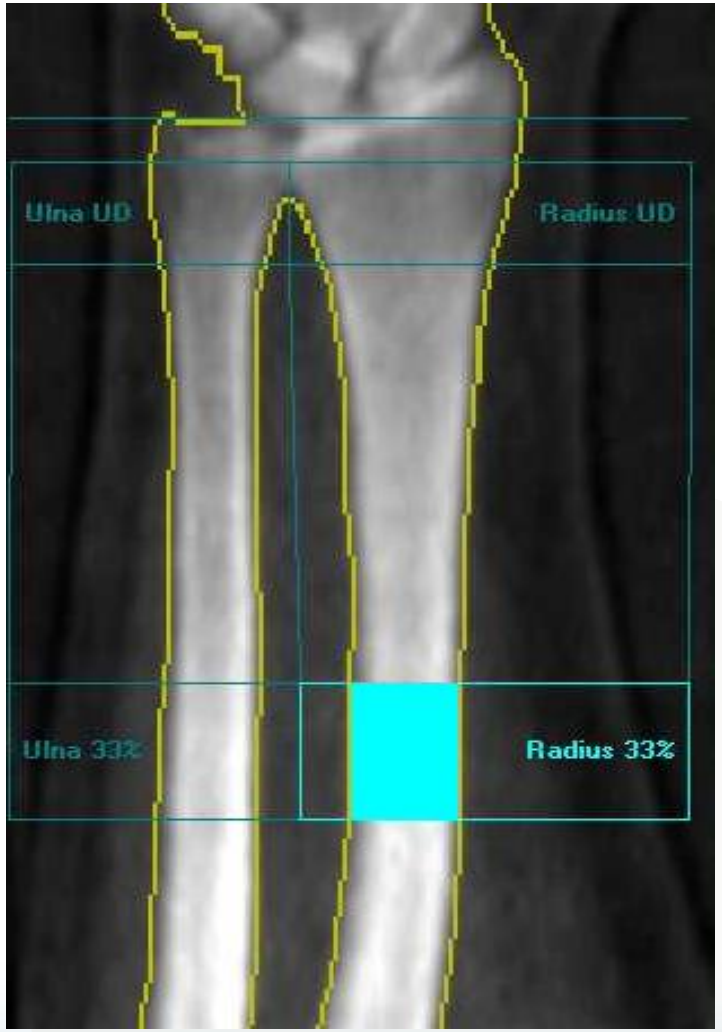
- For hip scans, the sites that may be used for diagnosis are the **Total femur** and **Femoral neck.**

- Other hip sites, such as the **Trochanter** and **Ward's Area,** should <u>not</u> be used for diagnosis.



Forearm DXA Scans

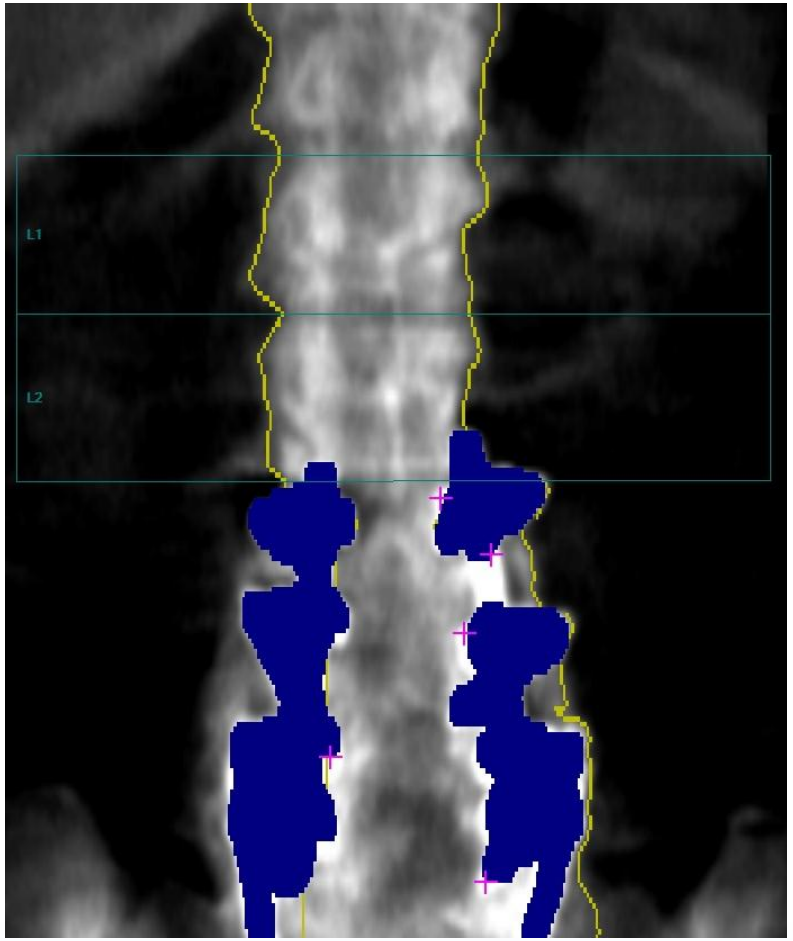
- Alternative Sites:
  - Diagnosis can be made based on the **One-third Radius** site of the forearm. Other forearm sites should not be used.
  - Less optimal for monitoring bone density change over time.
  - A low T-score score at the arm does not necessarily mean the same for fracture risk as a low score at the spine or hip sites.



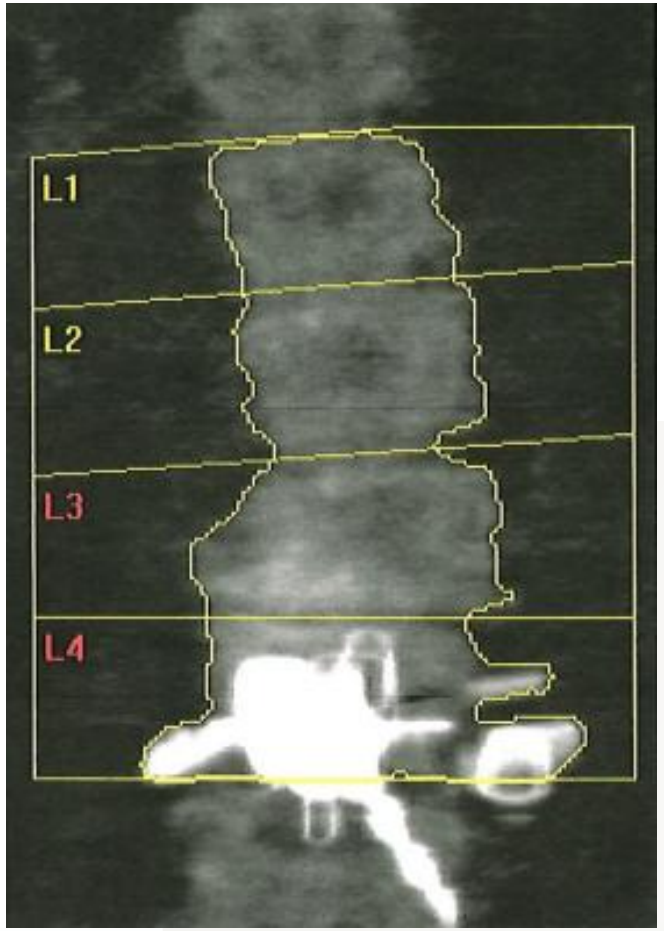
Patient-related factors that can impact DXA scan results

- Atypical Anatomy:
  - Distortions from arthritis or degenerative joint disease.
- Artifacts:
  - Implanted devices, non-uniform soft tissue densities.
- Patients at the thickness extremes
- Changes in any of these between baseline and follow-up scans.

Artifacts may limit the useable area of the scan



Surgical hardware in the lumbar spine



Car keys in the front pocket of a hoodie

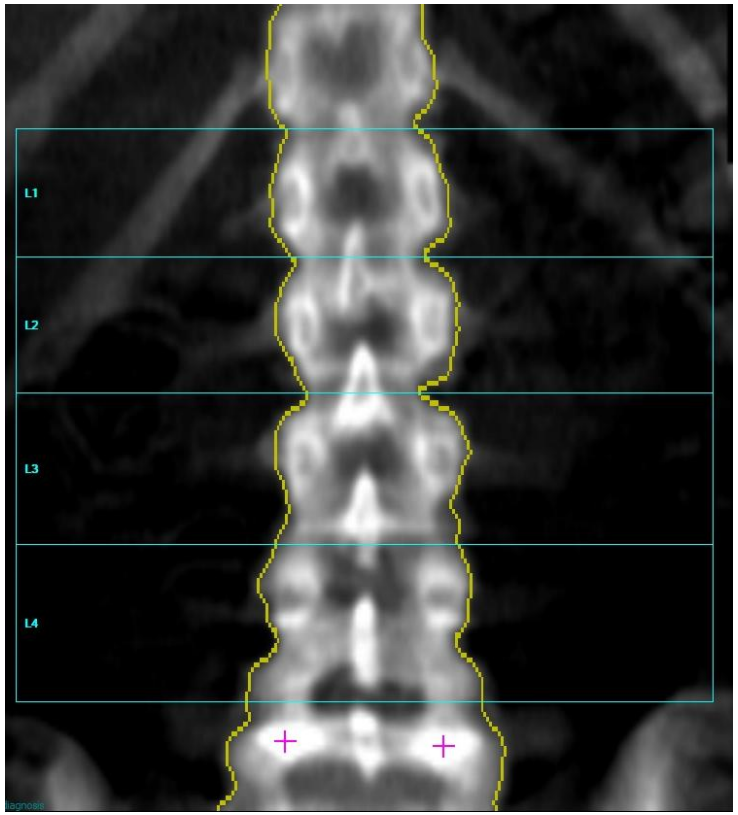
T-scores may be distorted by atypical anatomy

- Most often, this is in the form of falsely-elevated bone density
  - Bones appear "stronger" than they really are.
- DXA T-scores are based on *normal* anatomy
  - There is no "normative" database for atypical anatomy

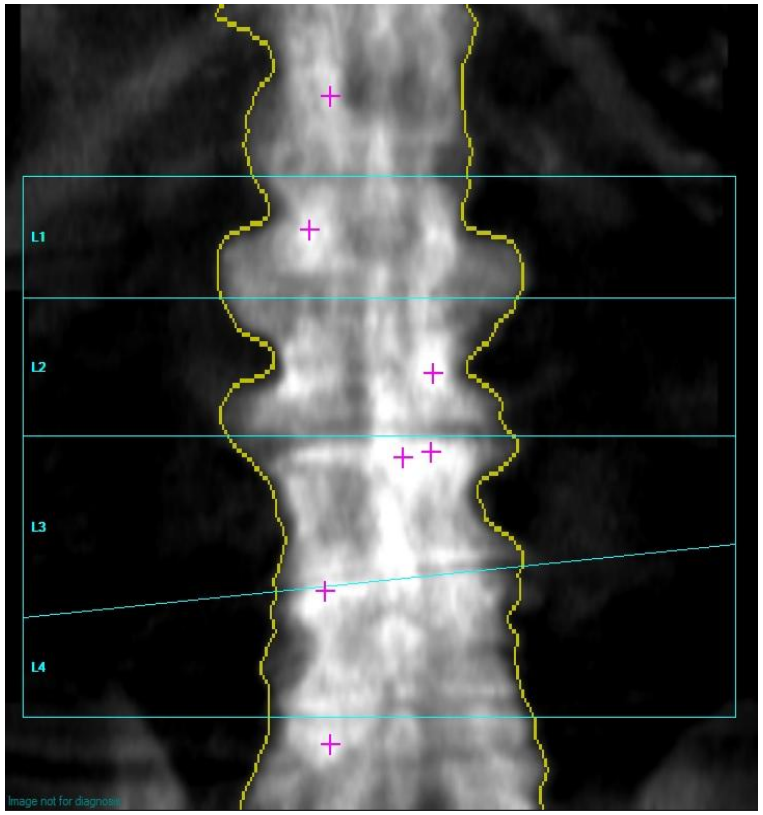
Arthritic changes and degenerative joint disease

- Arthritis and osteoporosis are very *different* conditions.
- Arthritis affects the spaces between the bones (joints).
  - Joint pain is not associated with bone loss.
- Abnormal calcium deposits in the joints are measured by the DXA scanner and added to the bone mineral density (BMD).
  - These are non-structural and unrelated to your bone strength.

Abnormal calcium deposits result in falsely elevated T-scores



Normal spine anatomy



Degenerative joint disease

Follow-up spine scans may unreliably appear "improved" if there are new non-structural calcifications within a disc or at facet joints.

DXA Scan Interpretation Error

- This can occur if interpretation is performed for DXA scan sites that are not valid for diagnosis or when skewed measurements are reported without consideration of the cause.
  - Typically, diagnosis would instead be based on a more optimal body site.

In summary

- DXA scans are accurate **if** performed correctly ***with*** typical anatomy.
- Technical factors and atypical anatomy have the potential to skew the results.
- Discuss with your provider if anatomy may distort your results.

Thank you.

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