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.

Are the comparisons of your DXA scans reliable?

Objectives

1. Explain differences between DXA system manufacturers.
2. Discuss the use of Least Significant Change (LSC) values.
3. Recognize how technical and anatomical factors affect comparability.
4. Understand how body changes between scans affect comparisons.

Real biological bone change

- **All** measurement devices have some intrinsic error.
- We need to know when your bone density change is greater than the normal day-to-day fluctuation in the measurement itself.
- Measurement “noise” has multiple factors including DXA scanner calibration, how the test is performed, and how the anatomy is detected by the system’s software.

Bone density typically changes by only a few percentage points per year

- Consistent procedures are essential to recognizing these small differences.
- To make a reliable comparison, baseline and follow-up scans should be performed identically each time.
  - Same DXA machine with stable long-term calibration
  - Same positioning, line placement and bone mapping

LSC values are used in the process of comparing your current and previous DXA scans.

- To determine if there has been real change in your bone density, the facility should have calculated their own **L**east **S**ignificant **C**hange (LSC) values via a procedure called a "precision assessment".

LSC = the smallest amount of change that can be considered real

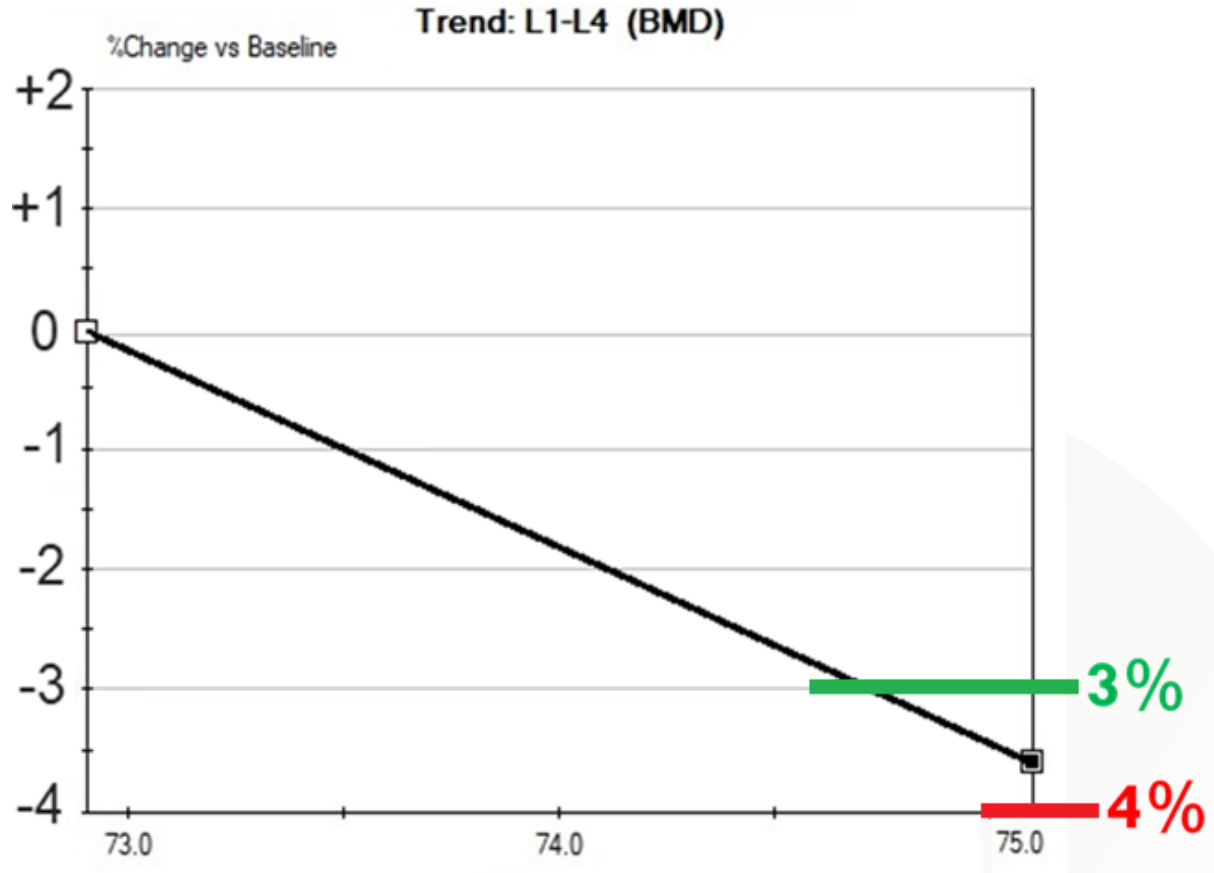
Envision the "LSC" as representing an *error margin*

- Depending on the size of the LSC, a few percent change may not be a real biological change.
- Changes less than LSC should state that "no significant change" has occurred.
- *If a DXA facility has not calculated their own LSC values, it is* ***difficult to determine*** *true change.*

Did the bone density really go down?

Example of using the LSC:

- If the LSC is **3%**?
  - Yes, a real change has occurred.
- If the LSC is **4%**?
  - No, there has been no significant change in bone density.



LSC units are often reported as g/cm^2

T-scores should not be used for comparison

- A T-score is a calculated value dependent on the reference population selected *and any updates to it*.
  - Reference populations sometimes change with manufacturer updates, changes in guidelines, or the options selected by individual facilities.
  - When the reference has changed, it may appear that the T-score is going in one direction and the BMD is going in the other.

- **B**one **M**ineral **D**ensity (BMD in g/cm^2) change should be used for comparisons.

It's best to return to the same DXA scanner

Excerpt from the ISCD Official Positions:

BMD Comparison Between Facilities

- Patients should return to the same DXA device that was used to perform their most recent prior study, provided that the facility in vivo precision and LSC values are known and do not exceed established maximum values.

Official Positions 2023 - ISCD

There are challenges in comparing results from different DXA systems

- "Inter-system quantitative comparisons can only be made if cross-calibration is performed for each skeletal site commonly measured for monitoring."
- "If a cross-calibration assessment is not performed, no quantitative comparison to the prior machine can be made."
- "Do not…report change between instruments that are not cross-calibrated."

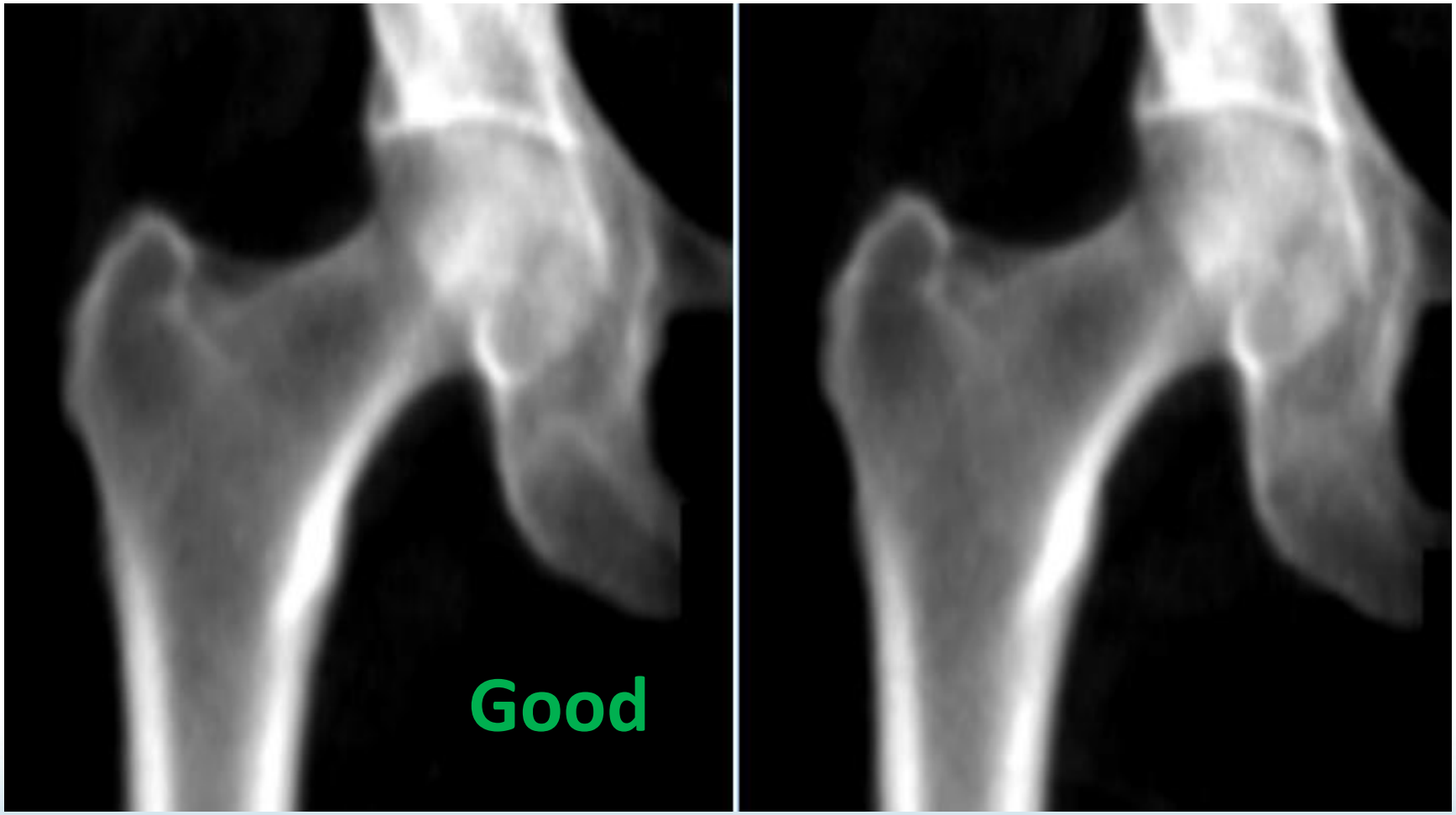
Official Positions 2023 - ISCD

Factors Affecting DXA Scan Comparison

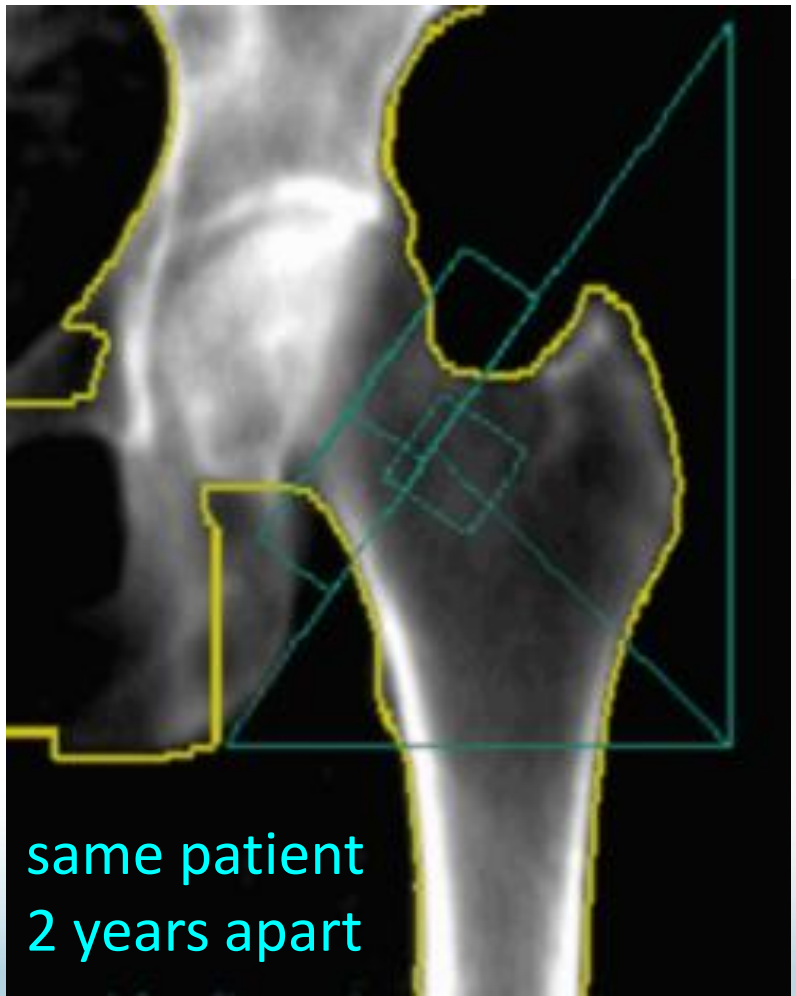
- **Equipment factors**
  - Calibration differences of different machines
  - *Different manufacturers use different methods of dual-energy production, different calibration methods, different types of detector systems, and different bone edge algorithms.*

- **Technologist factors**
  - Differences in the positioning
  - Differences in region-of-interest (ROI) line placement
  - Differences in the bone outline (bone map/edge detection)

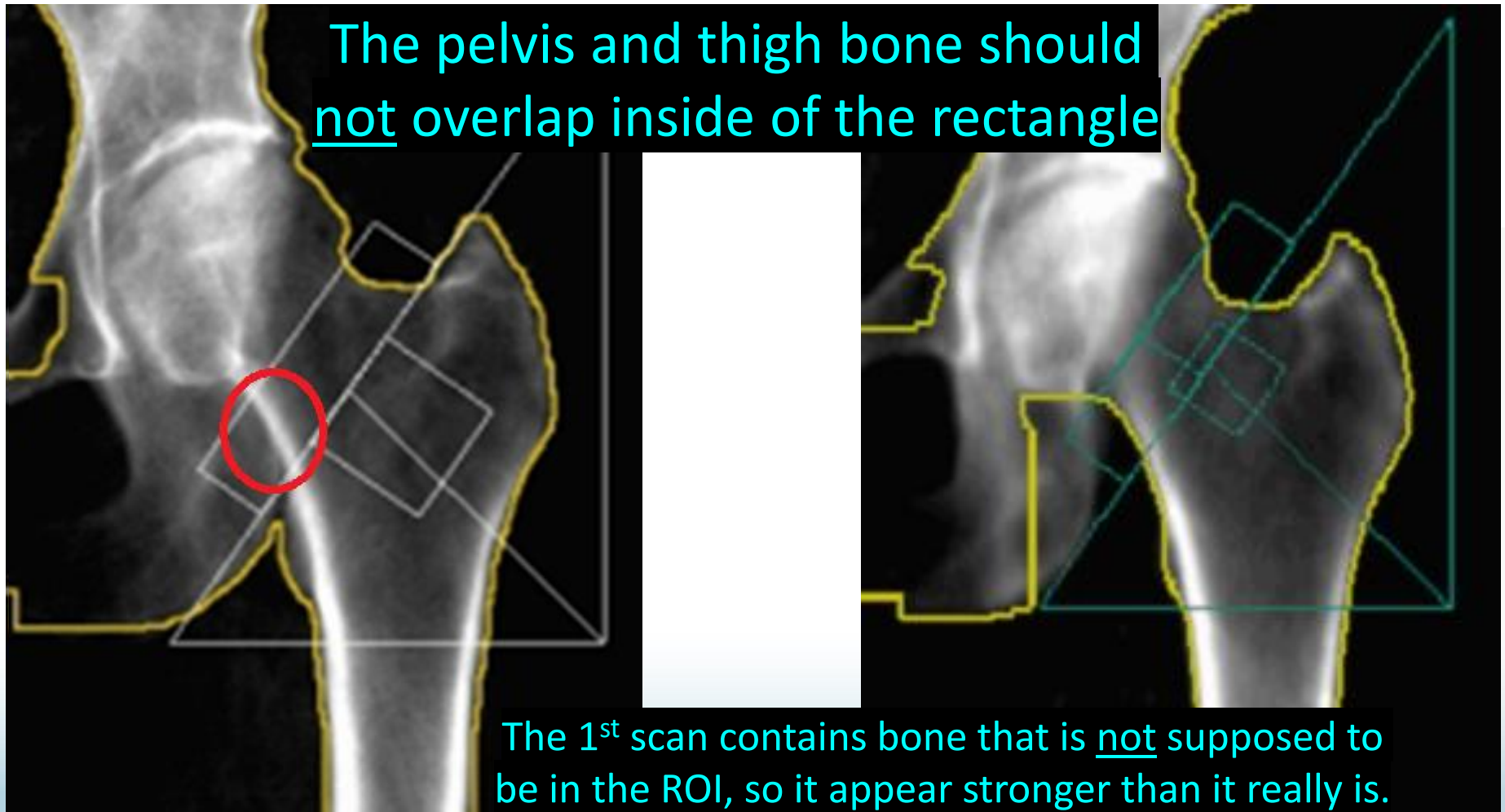
With consistent positioning, the images for your baseline and follow-up scans should visually look nearly identical



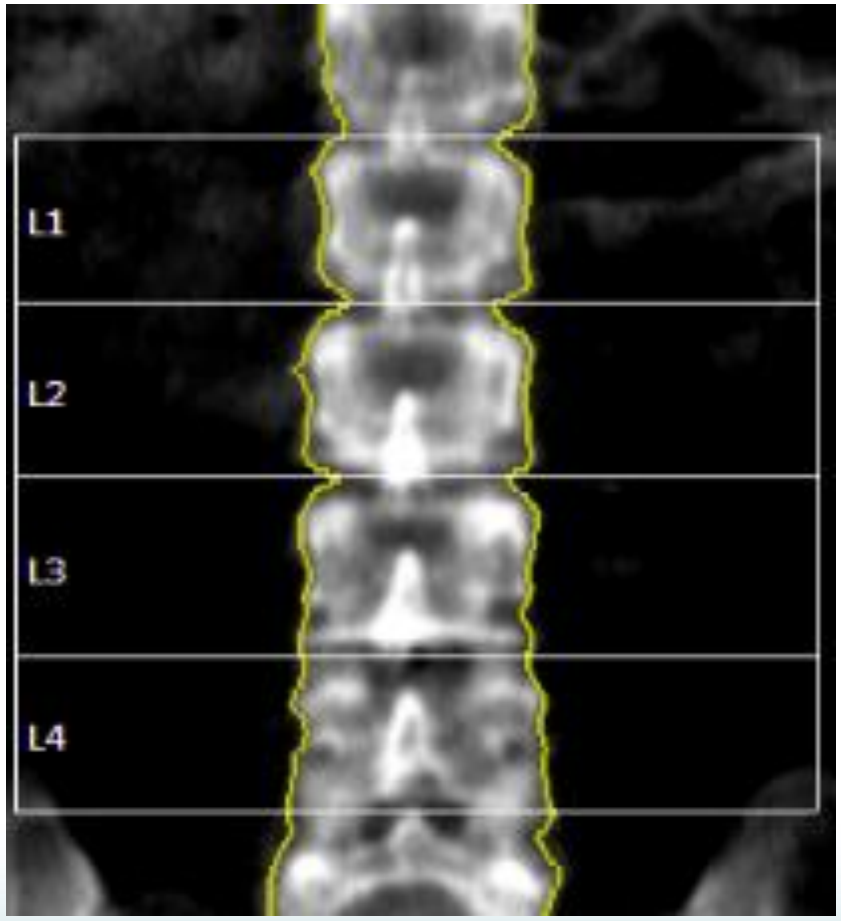
Is this reported 25% decrease in Total Hip bone density *a real change?*

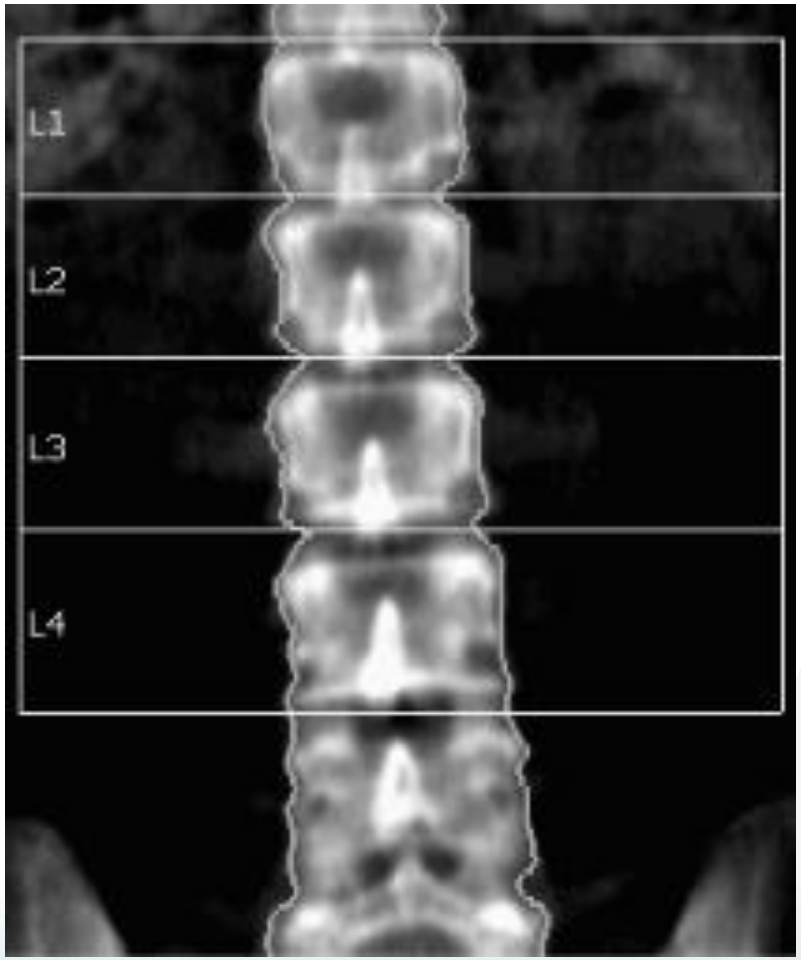


No. We are unable to determine if there is any real change in bone density due to positioning differences.



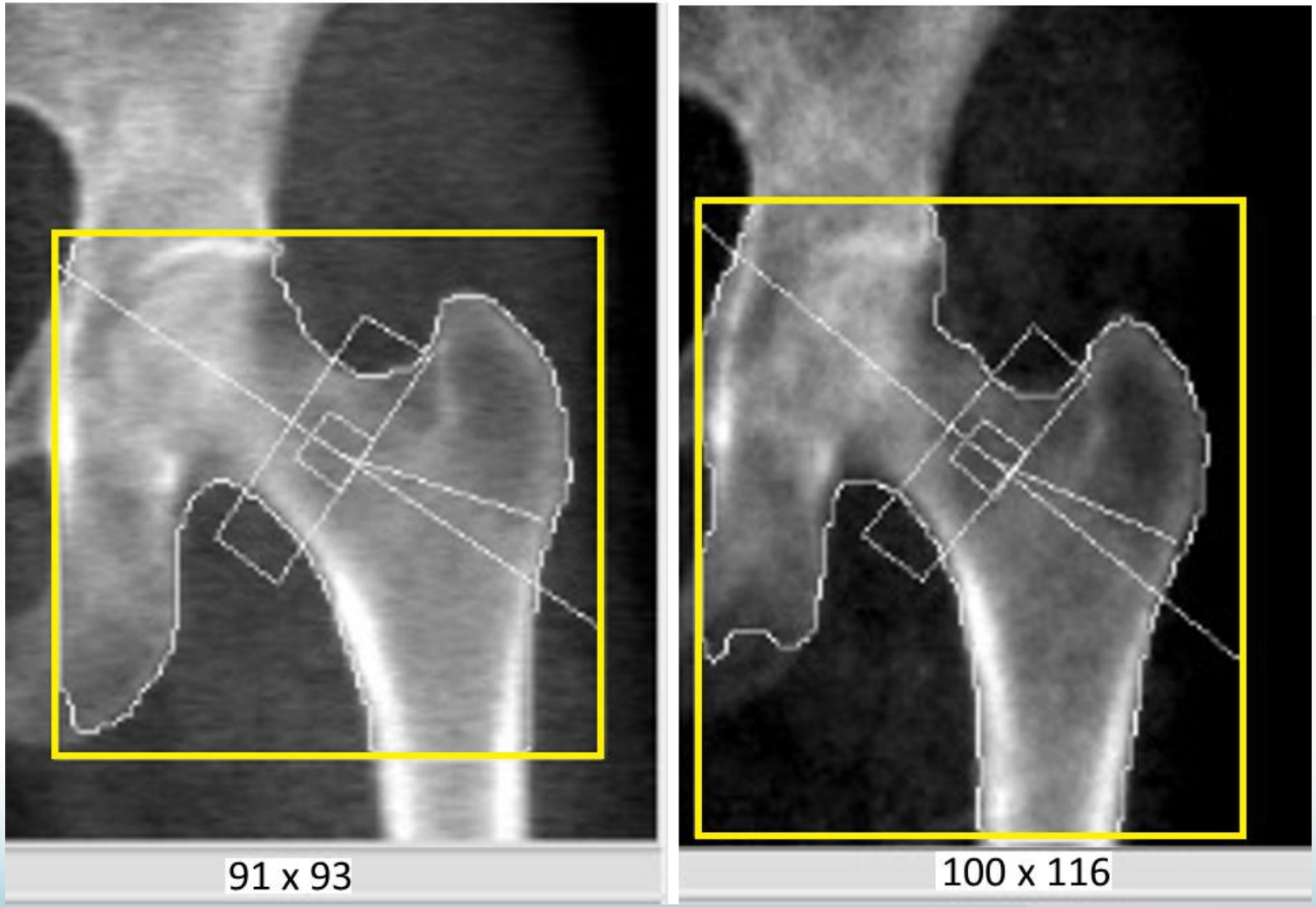
The vertebrae should be identified the same way on the Baseline and Follow-up scans





ROI lines are shifted-up 1 vertebra higher in the 2nd scan

The size and placement of the large square (global ROI) should be the same on your Baseline and Follow-up scans (Hologic systems)



More Factors Affecting DXA Scan Comparison

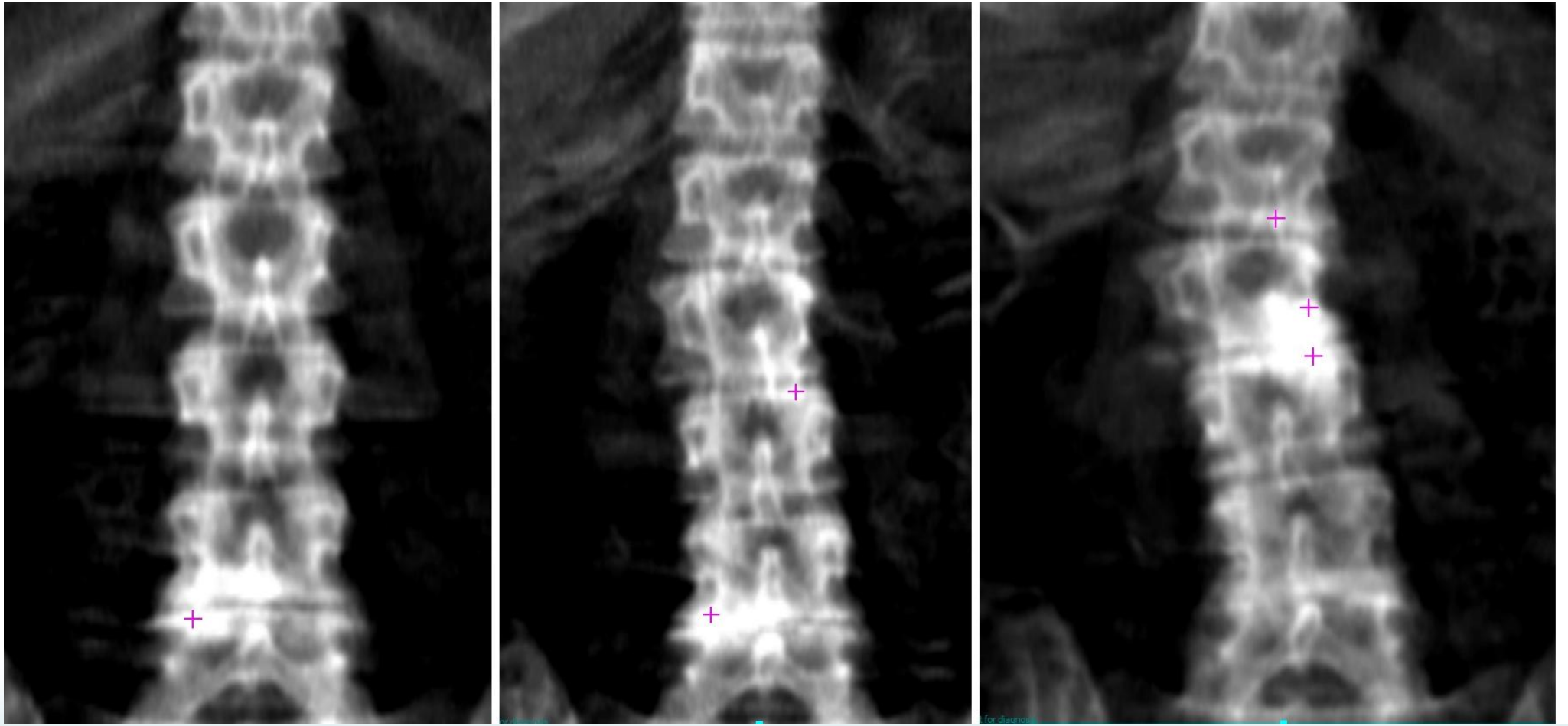
Changes in the patient's own body between scans

- Internal or external artifacts present for one scan but not the other
- New bone fractures or surgeries at the measurement sites
- Worsening degenerative joint conditions
- Large weight changes

Follow-up spine scans may misleadingly appear "improved"

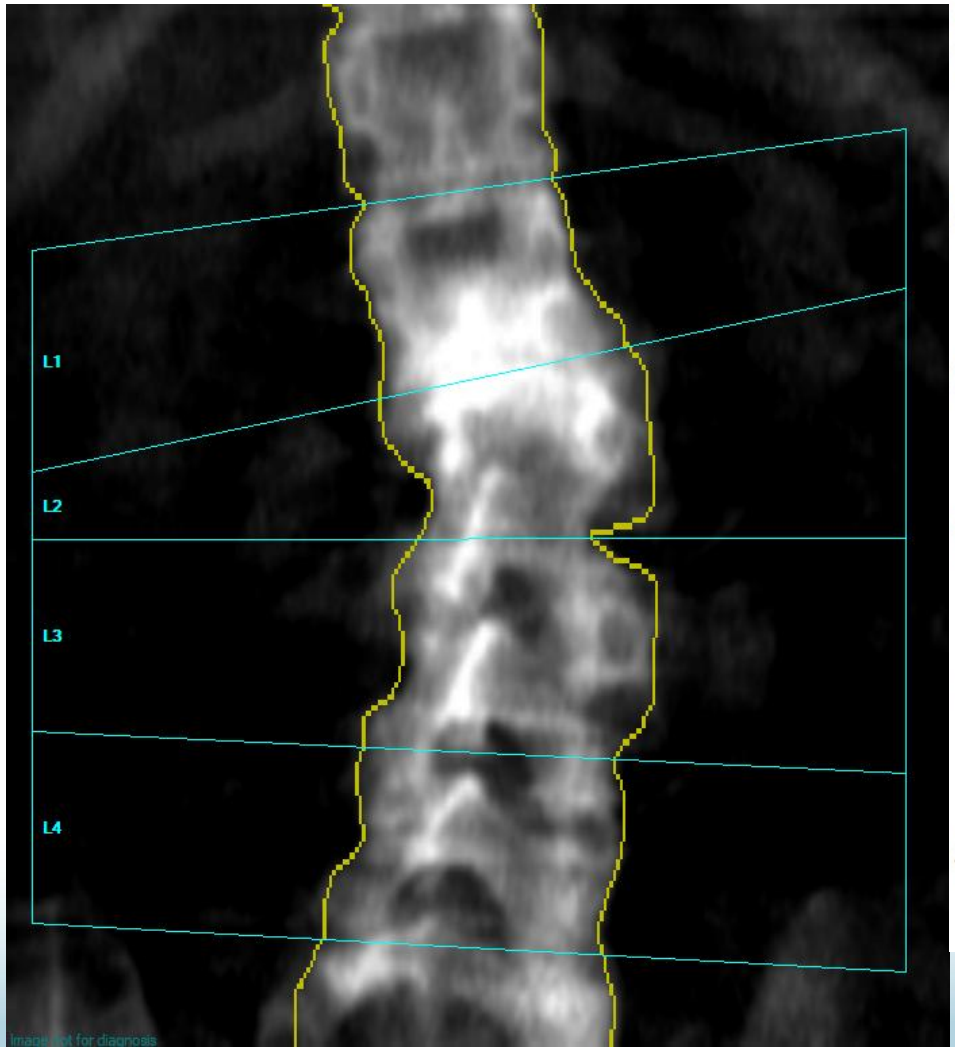
- If there are new non-structural calcifications within a disc or at facet joints

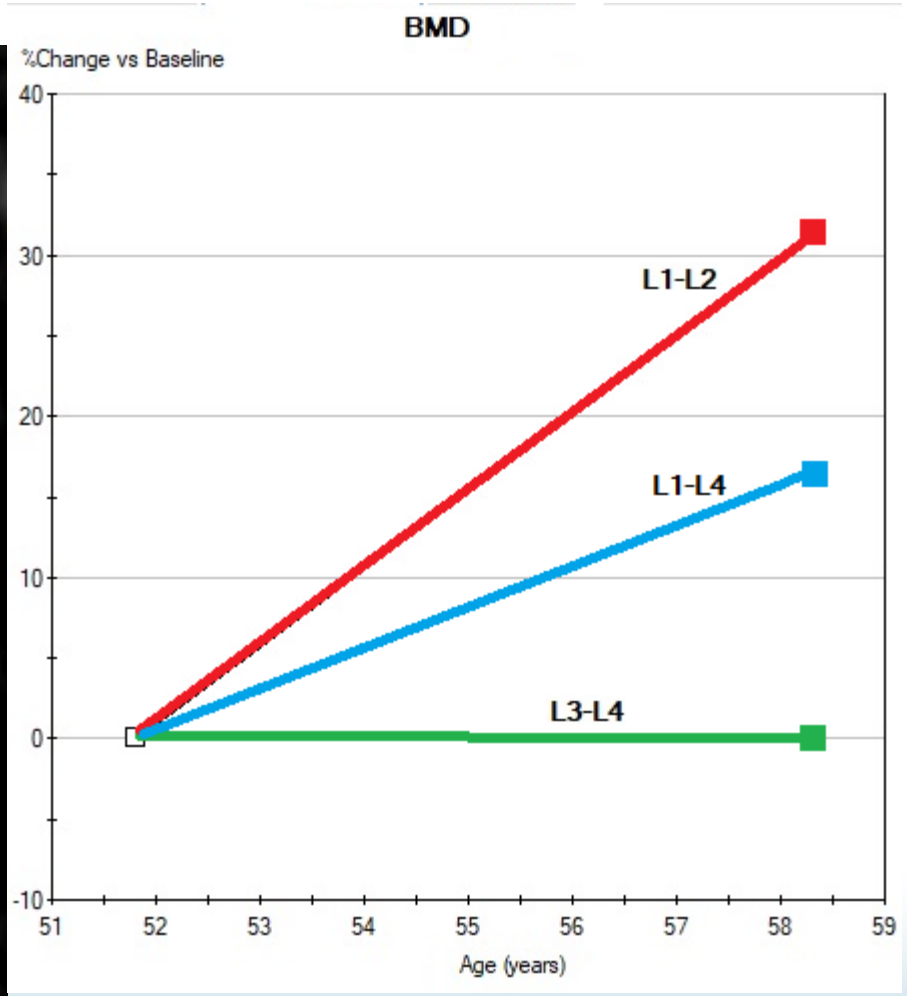
Visual changes in your anatomy over time will impact the validity of the comparison between serial scans



Same patient for all 3 scans. Each is several years apart.

Worsening degenerative changes impact serial comparisons





The L1-L2 anatomy is skewing the L1-L4 bone density.

Here, L3-L4 is more appropriate.

Rely on experienced providers to interpret your DXA scans

- The performance and interpretation of certain DXA cases may have more subtle complexities which cannot all be described here.
  - A facility with staff primarily dedicated to DXA as their specialty is more likely to be reliable.
  - Higher levels of experience or oversight by someone with specific DXA-related qualifications can help to ensure that your scan comparisons are appropriate.

In summary...

- To reliably monitor bone density changes over time, everything should be "apples-to-apples" for a direct and reasonable comparison.

- Identical machine, settings, and positioning is important.
  - *Differences* reduce the validity of the comparison to the follow-up scan.

- Changes in your anatomy over time may impact the comparison of your DXA scans.

Thank you.

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