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Best Practice in DXA scanning

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Professional Education Lead

Royal Osteoporosis Society

18 March 2021

Topics

- Introduction- why?
- Best Practice in DXA technique
  - Acquisition
  - Analysis
- Standardising practice

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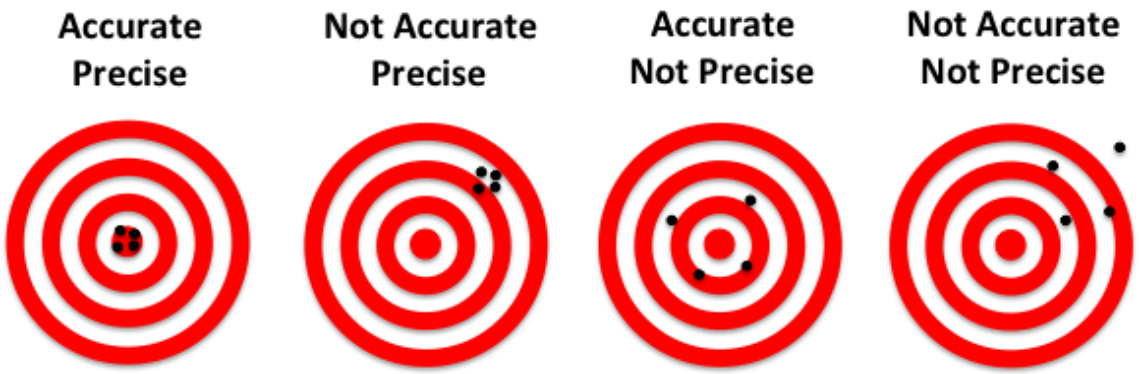
Best practice WHY?

PRECISION
PRECISION
PRECISION



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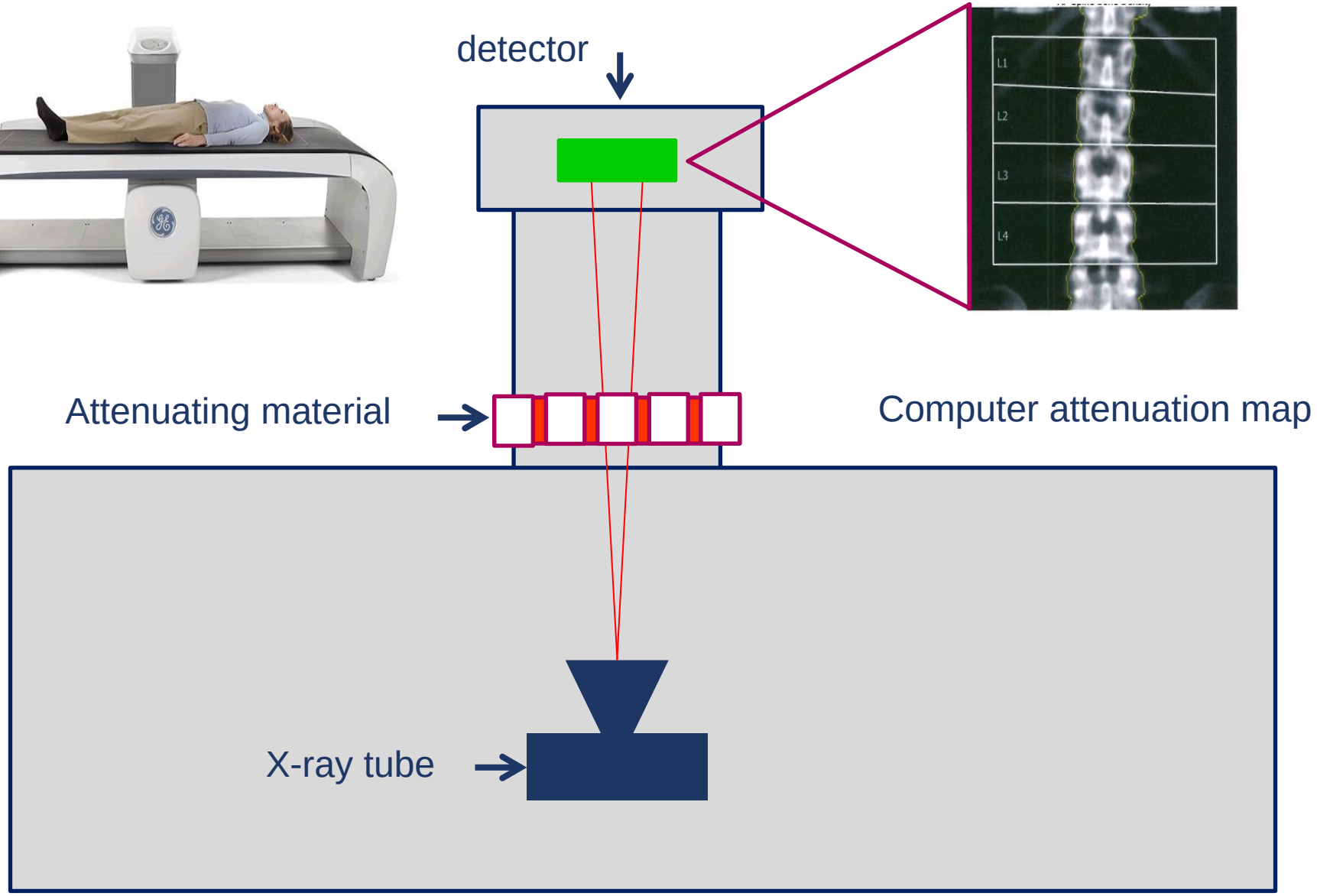
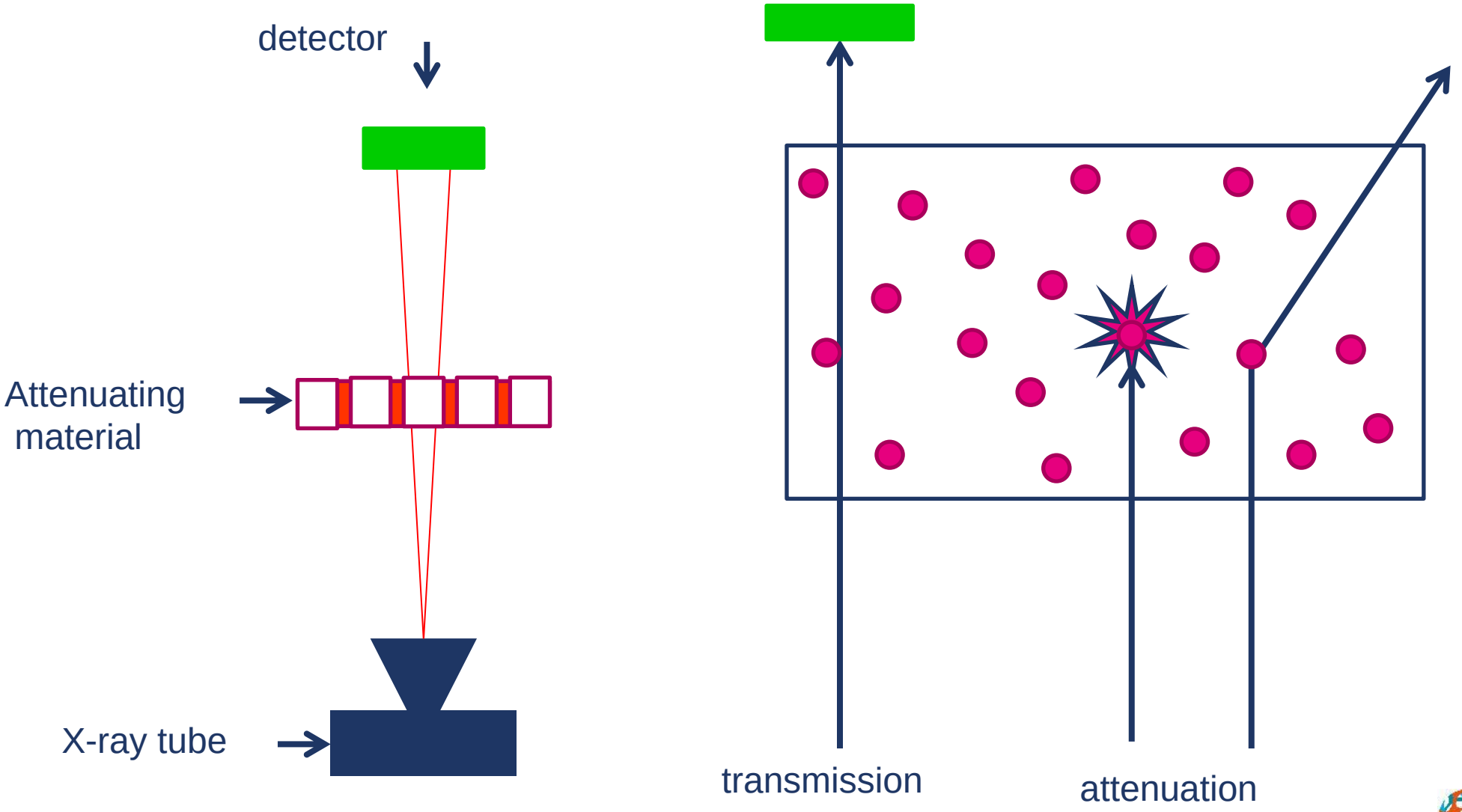
BMD & DXA


detector
L1
L2
L3
L4
Attenuating material
Computer attenuation map
X-ray tube

DXA physics



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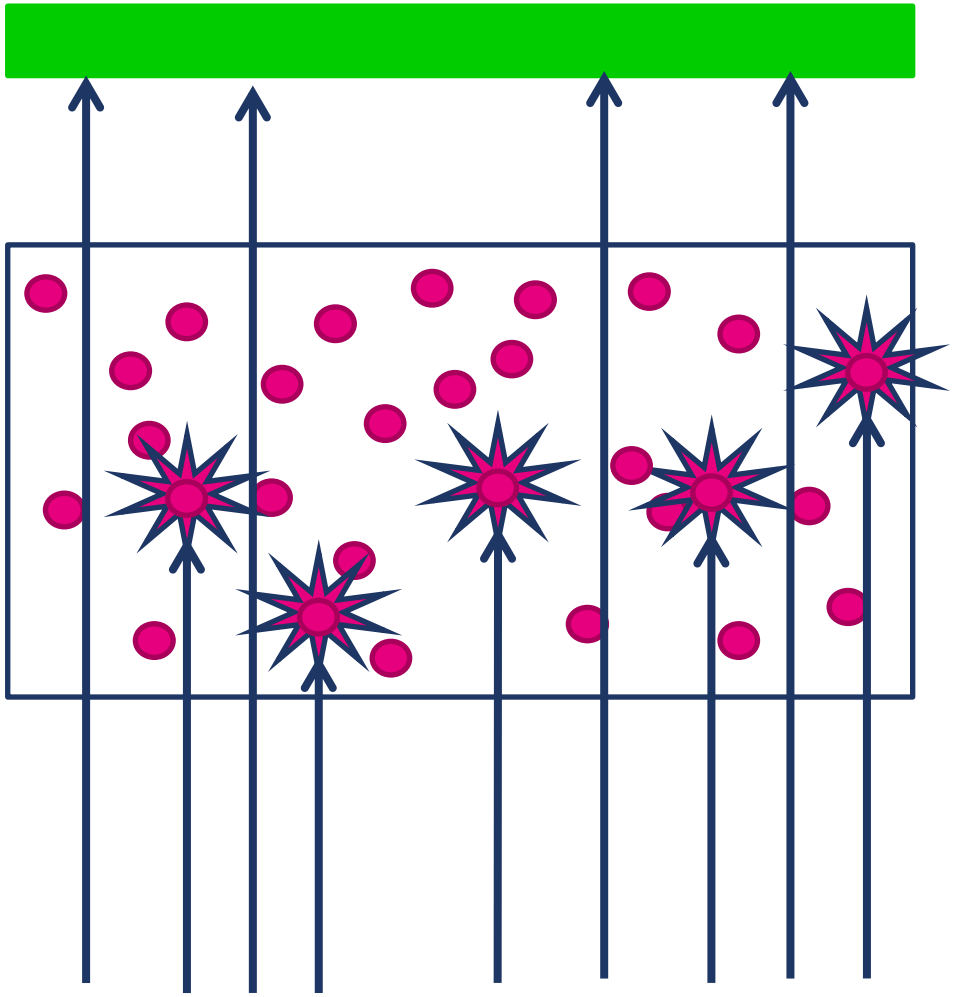
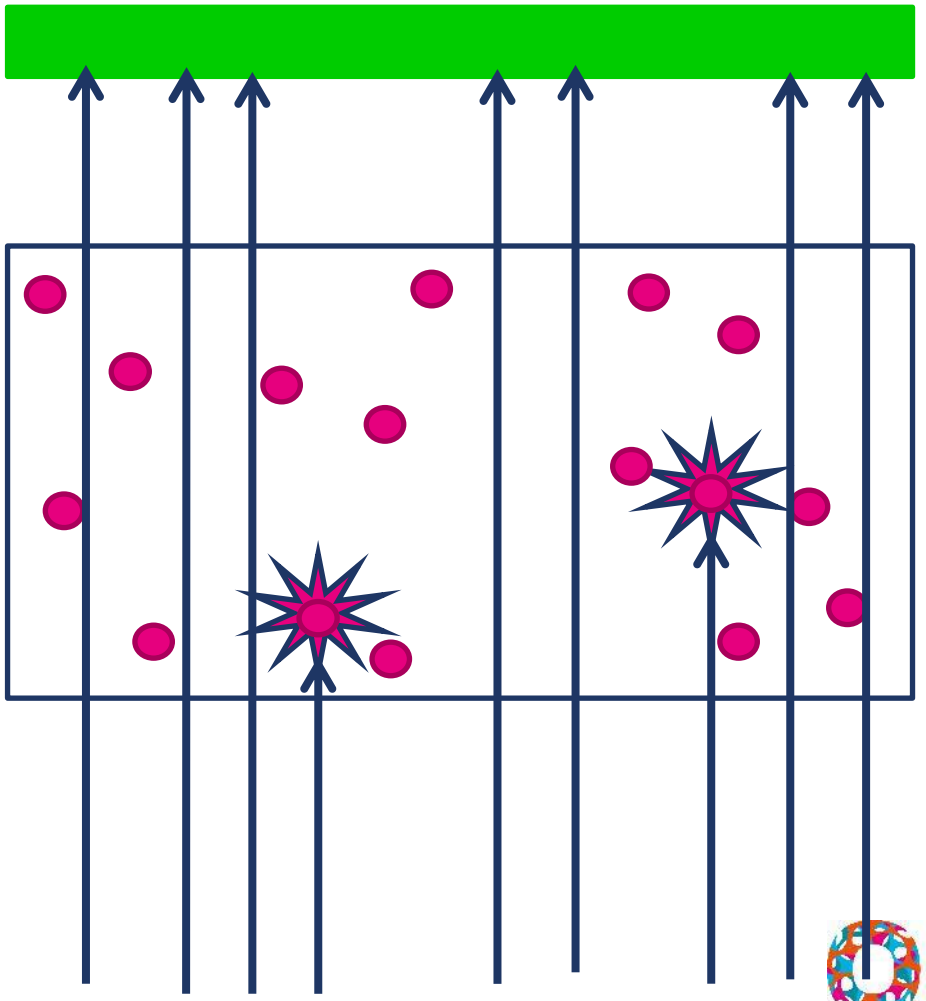
DXA physics

More dense



Less dense



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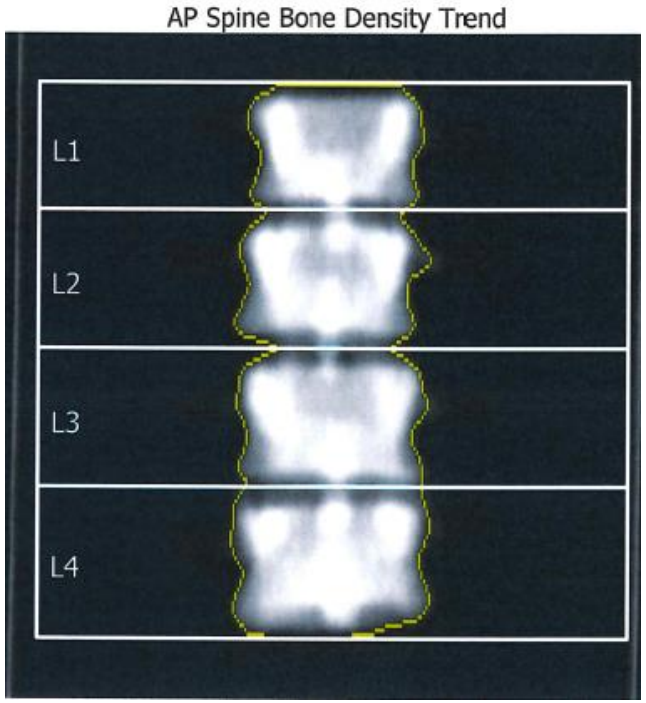

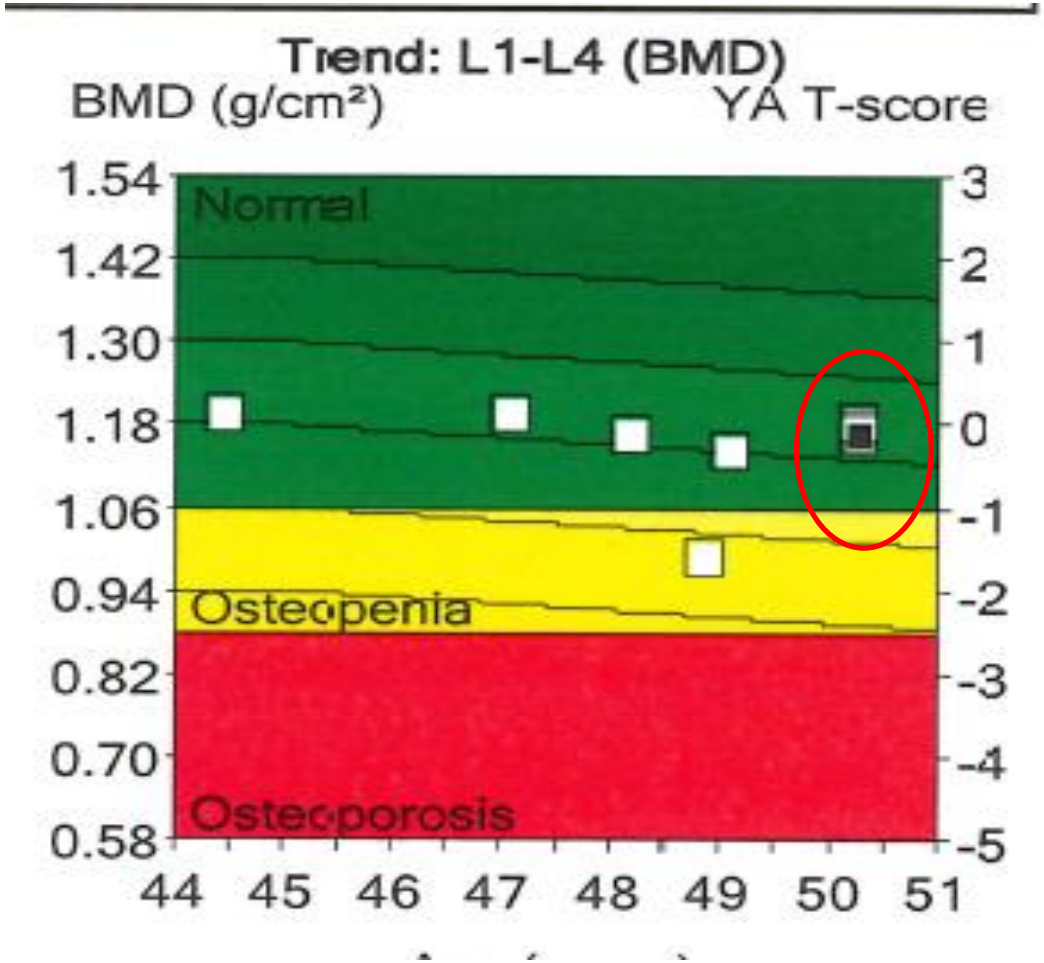

Measurement date	BMD g/cm2	% change against previous
19.04.2019	1.172	0.4
19.04.2019	1.167	0.3
19.04.2019	1.163	-0.2
19.04.2019	1.165	-0.2
19.04.2019	1.167	-0.3

0.7% change

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Precision

Measurement date	BMD g/cm2	% change against previous
19.04.2019	1.188	-0.3
18.04.2019	1.192	-0.3
15.04.2019	1.196	0.6
14.04.2019	1.189	0.8
13.04.2019	1.180	-0.2

1.1% change over 5 samples

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Rates of Change

Least significant change:

The least significant change is the minimum change in BMD between two scans on the same individual that indicate a real increase or decrease in BMD.

It is calculated as 2.77 times the long-term precision error (co-efficient of variation) of the Equipment (3)

3. Glüer C-C. Monitoring skeletal changes by radiological techniques. J Bone Miner Res 1999;14(11):1952–62. http://dx.doi.org/10.1359/jbmr.1999.14.11.1952

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Rates of change

Long term precision errors- in a clinical cohort- for lumbar spine and total femur BMD = 1.6% (4)

LSC in clinical practice = 4.5%

(4) Patel R, Blake GM, Rymer J, Fogelman I. Long-term precision of DXA scanning assessed over seven years in forty postmenopausal women. Osteoporos Int 2000; 11: 68-75

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Pitfalls

- **Precision errors can be increased by:**
- many operators/not following tight protocols- poor positioning for scans
- Equipment drift
- Patient condition
- Obesity
  - Spine – inhomogeneity
  - Hip – fat panniculus

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Pitfalls

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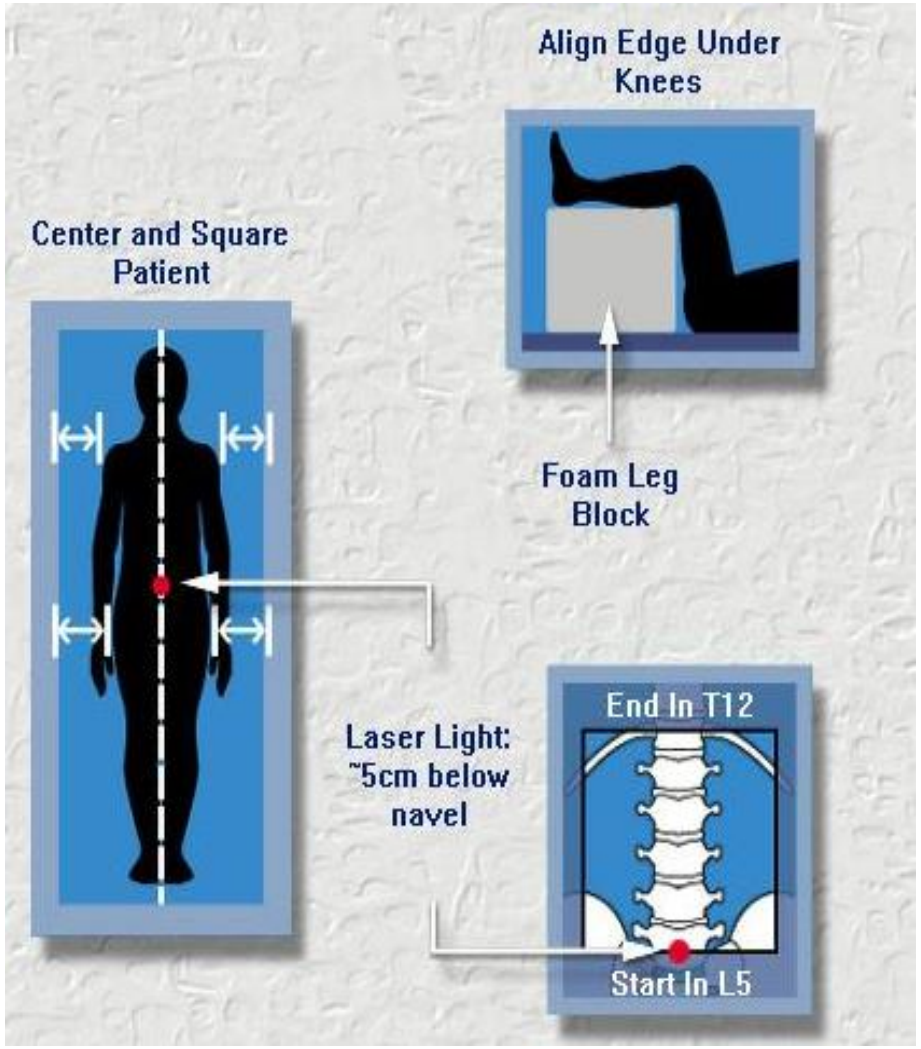
Best Practice- positioning



- Centre laser 5cm superior to the ASIS in the patients midline
  - To start in the body of L5

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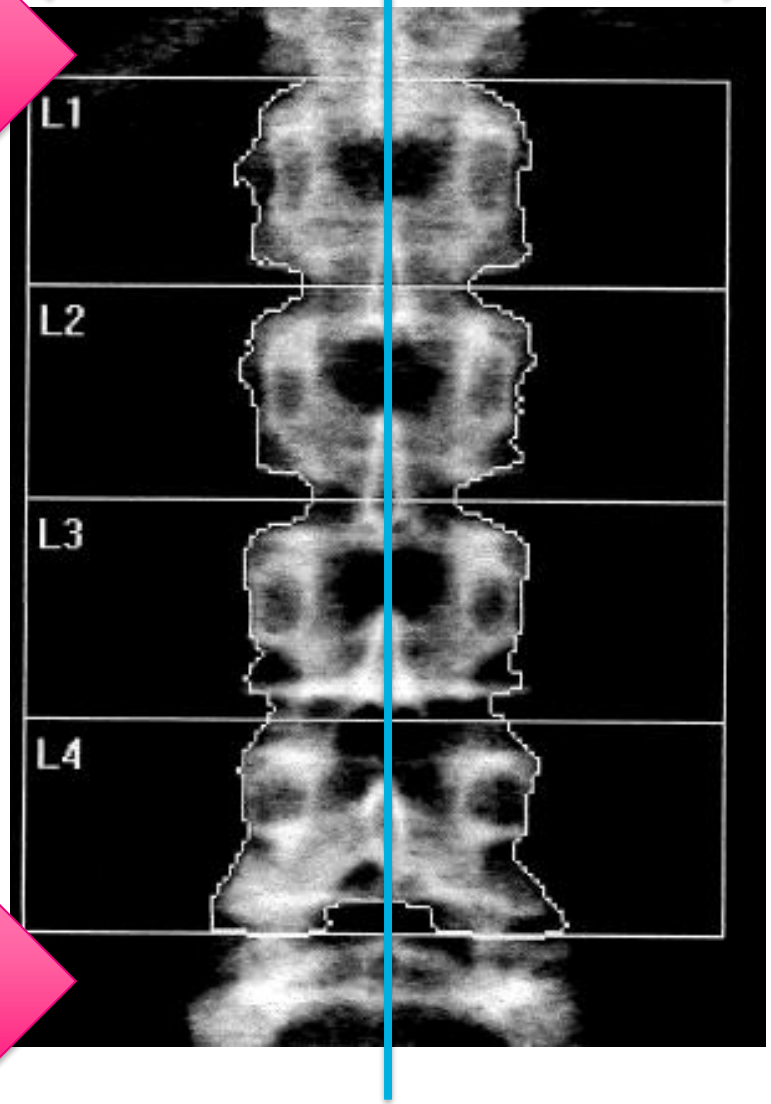
Best Practice- positioning

Spine is straight and central in the field of view

Scan ends in the body of T12



There are important reasons for this in the calculation of soft tissue values in GE scanners *

There may be:
- rib identified at T12
- Iliac crest identified adjacent to L4/5

Scan starts in the body of L5

* And IR(ME)R implications with 'optimization'

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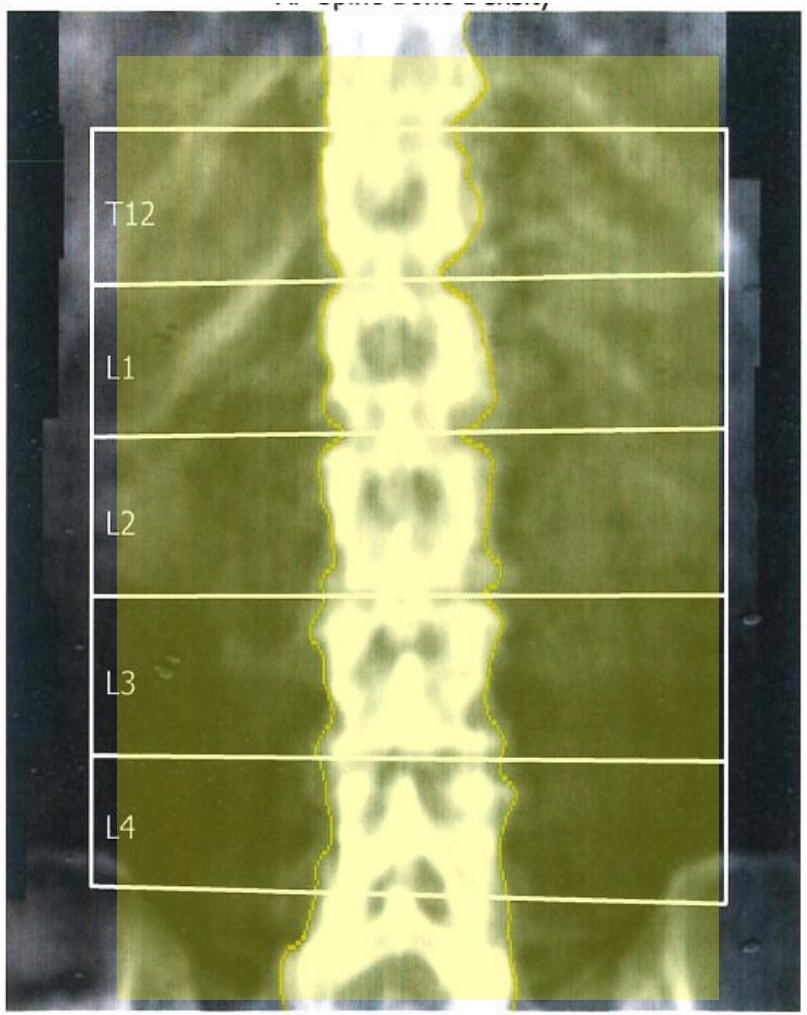
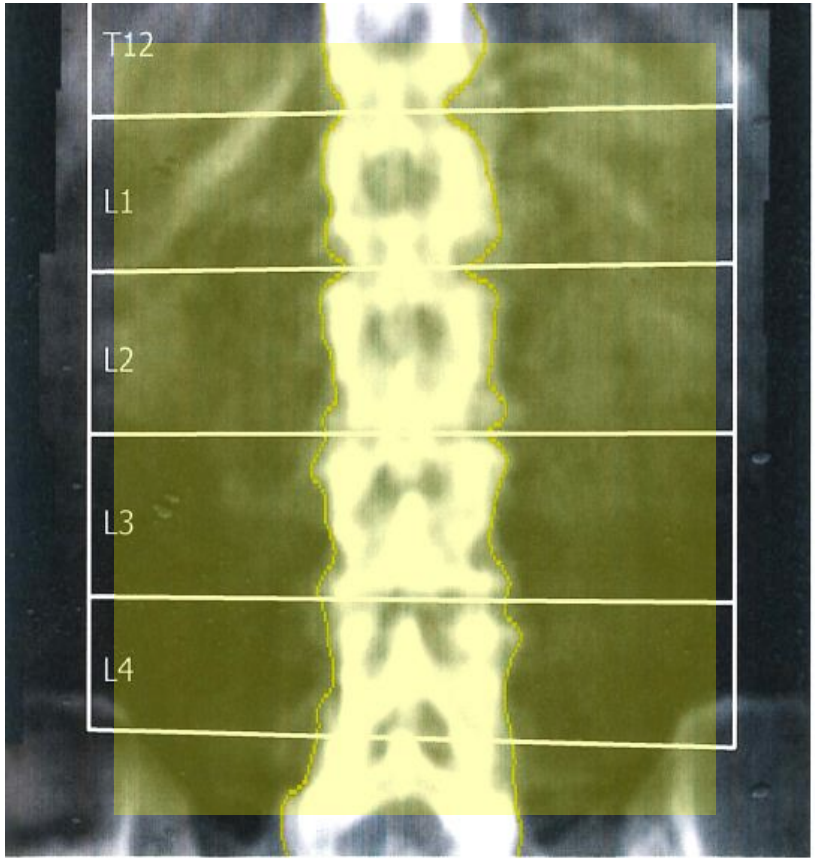


Region	BMD g/cm2
L1-4	0.940



Region	BMD g/cm2
L1-4	0.964

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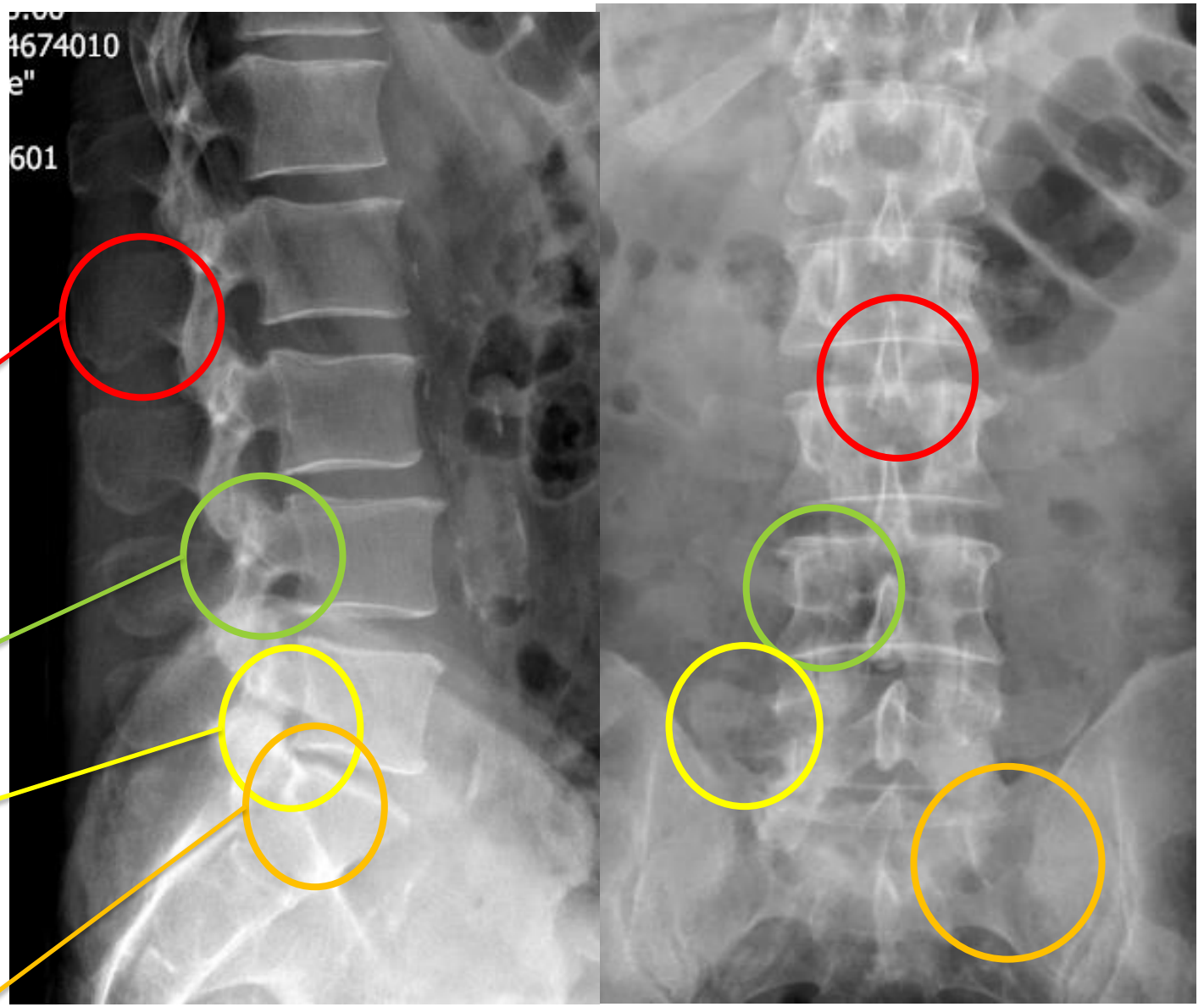
Identifying L5:

Understanding projectional anatomy:

- Spinus processes
- Facet joints
- Transverse processes
- Sacro-iliac joint



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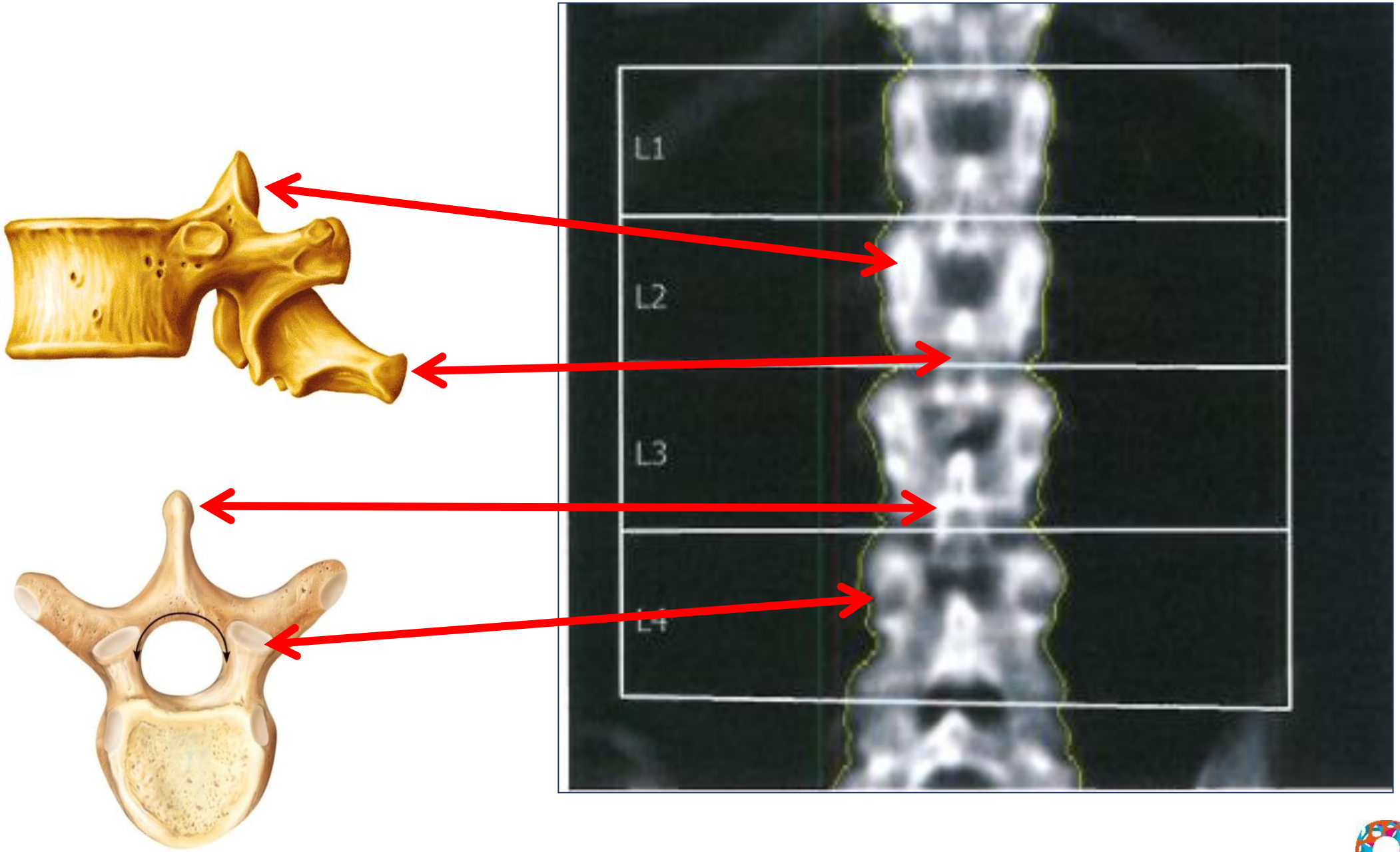

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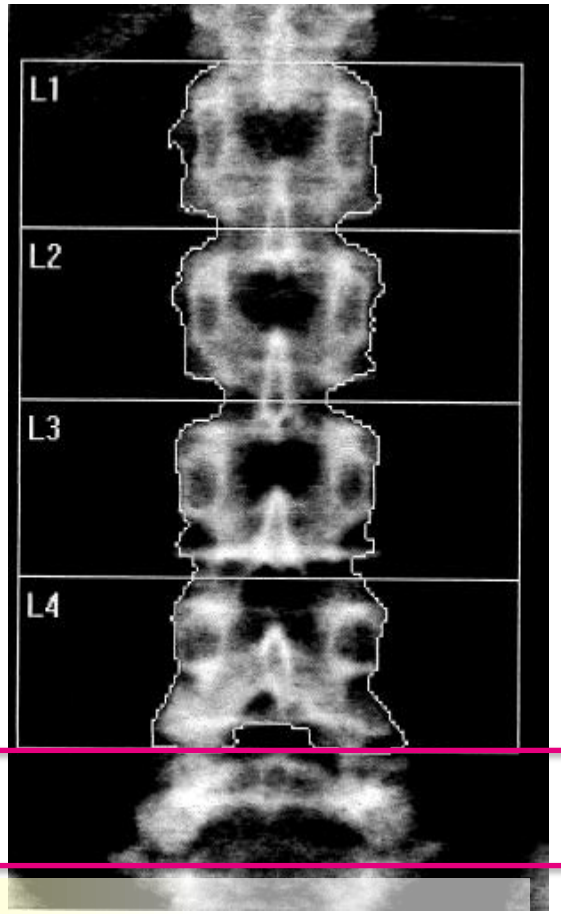

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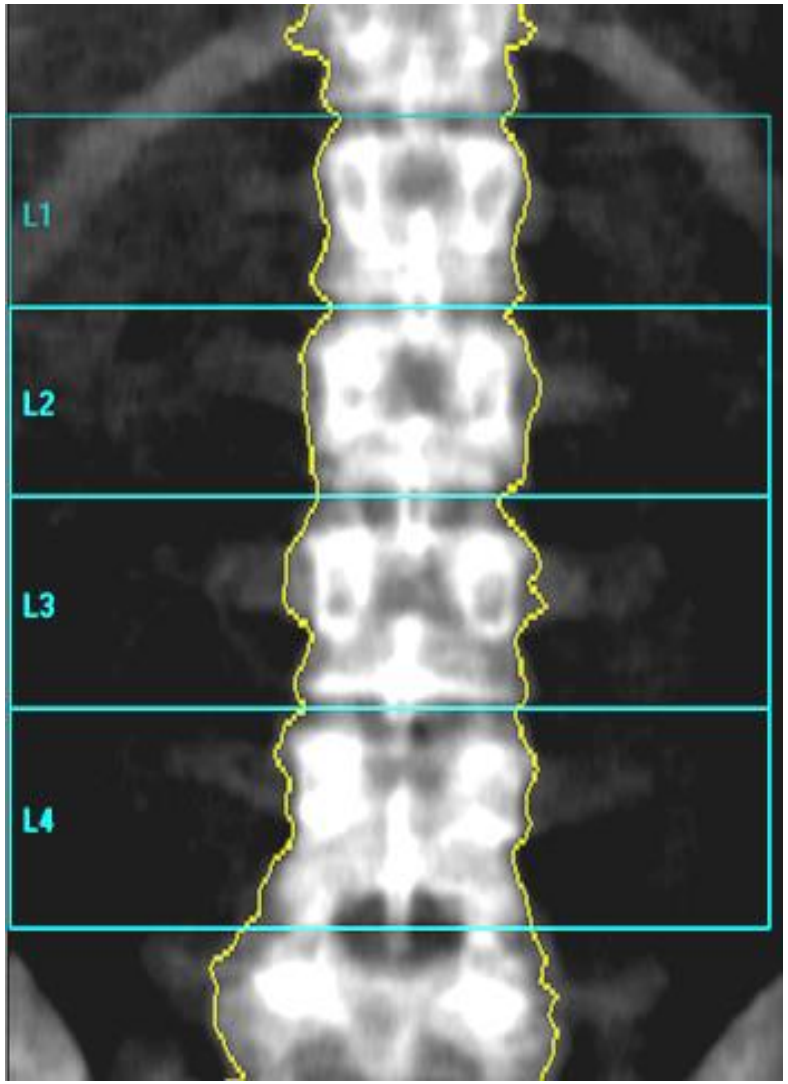
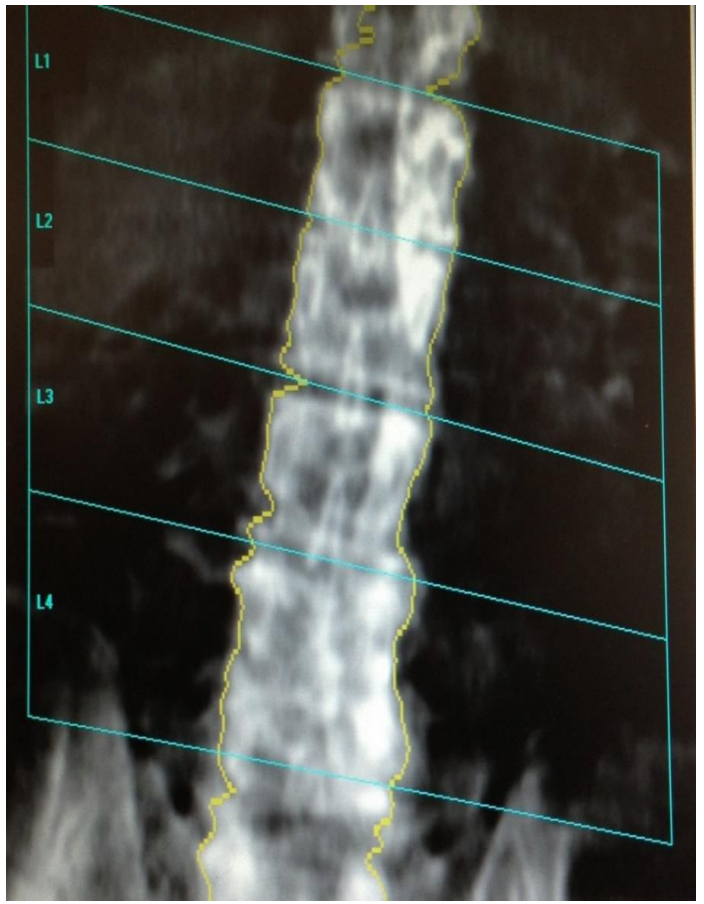
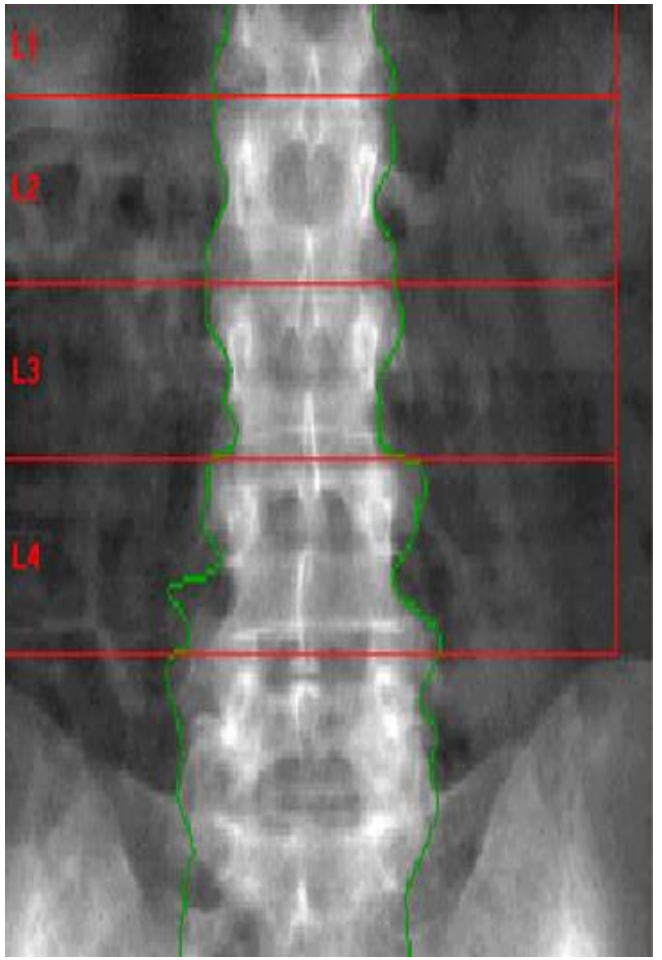
Good and poor positioning







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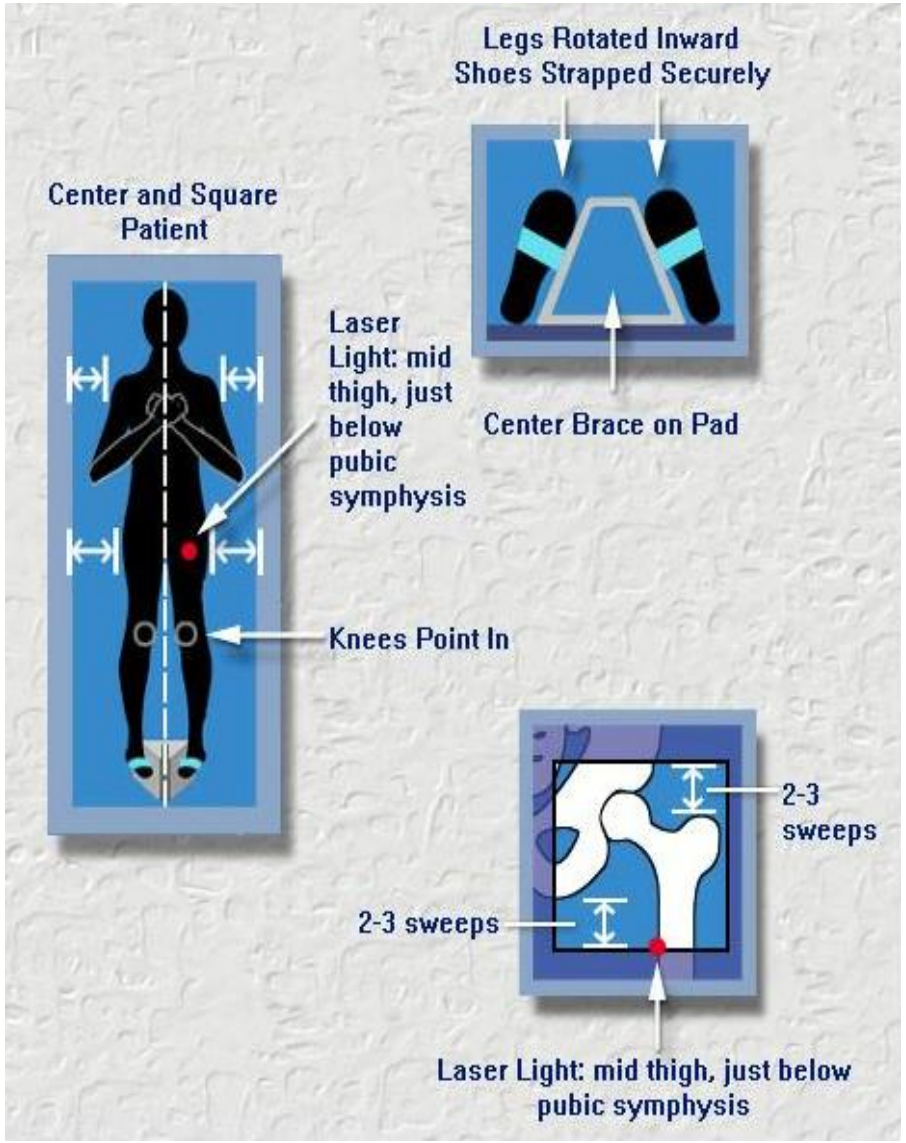
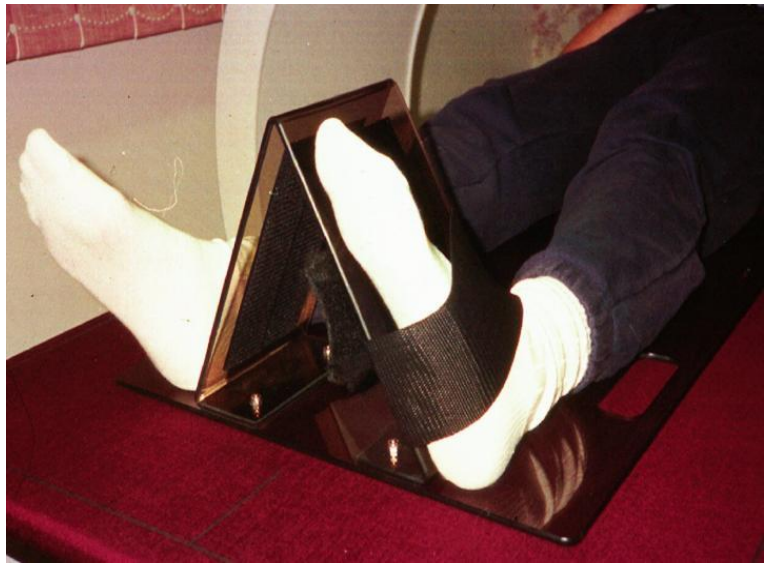
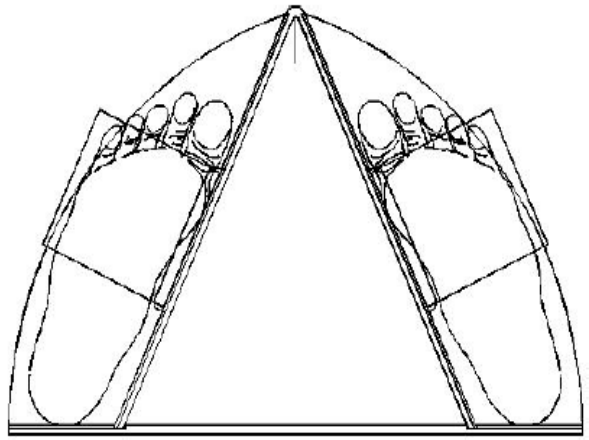
Best Practice- positioning







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Best Practice- positioning

- Abduct leg approx. **15°<u>FROM THE MIDLINE</u>**. Femur parallel to the long axis of the table
  - To separate ischium from lesser trochanter
- Internally rotate the leg 25°– The whole leg is rotated **<u>FROM THE HIP</u>** keeping knee straight
  - Femoral neck parallel to table
  - Moves greater trochanter anteriorly and lesser trochanter posteriorly
- **Centring:** 5cm below the greater trochanter (15cm below ASIS) and in the midline of the femur.

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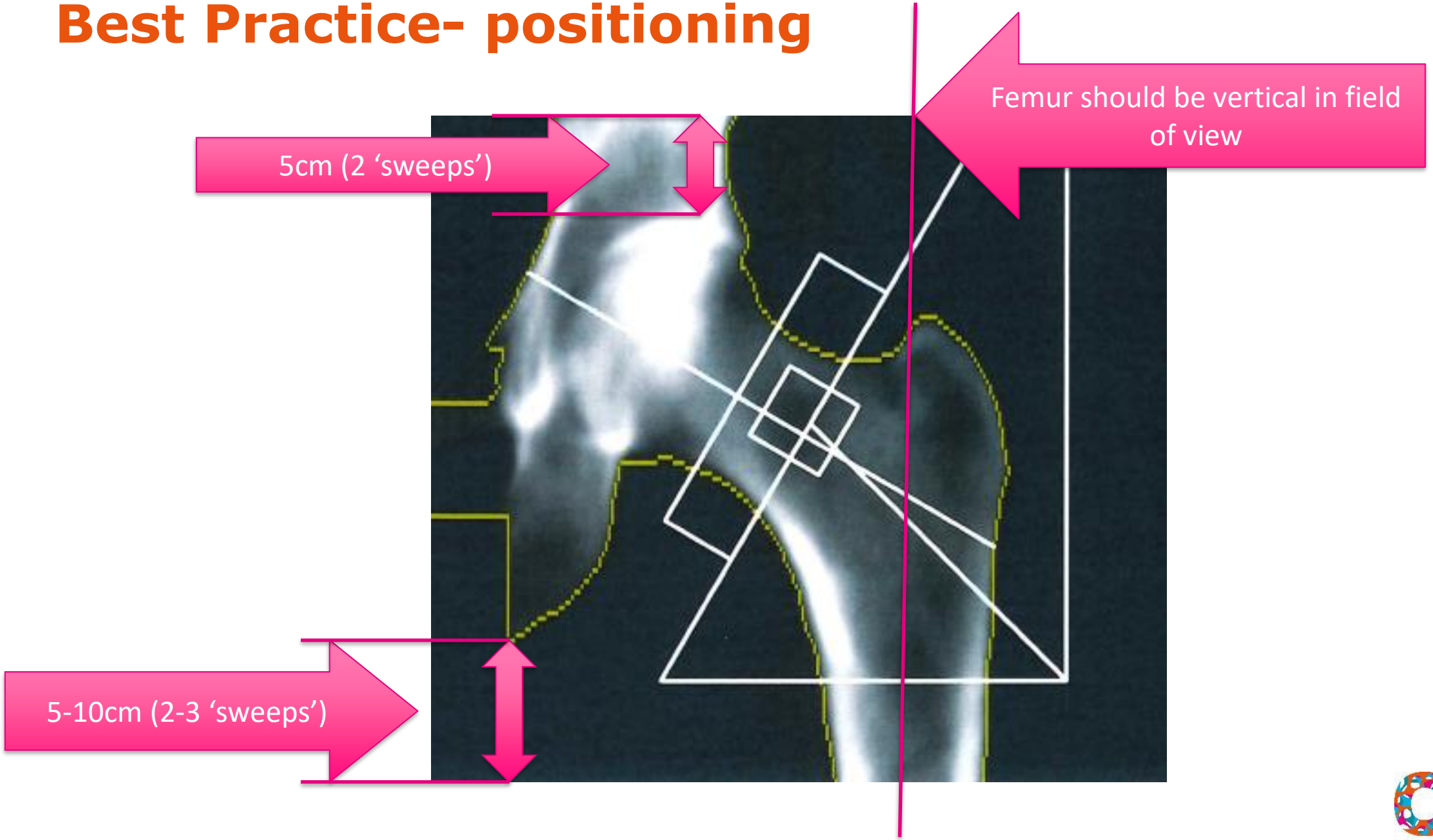
Best Practice- positioning



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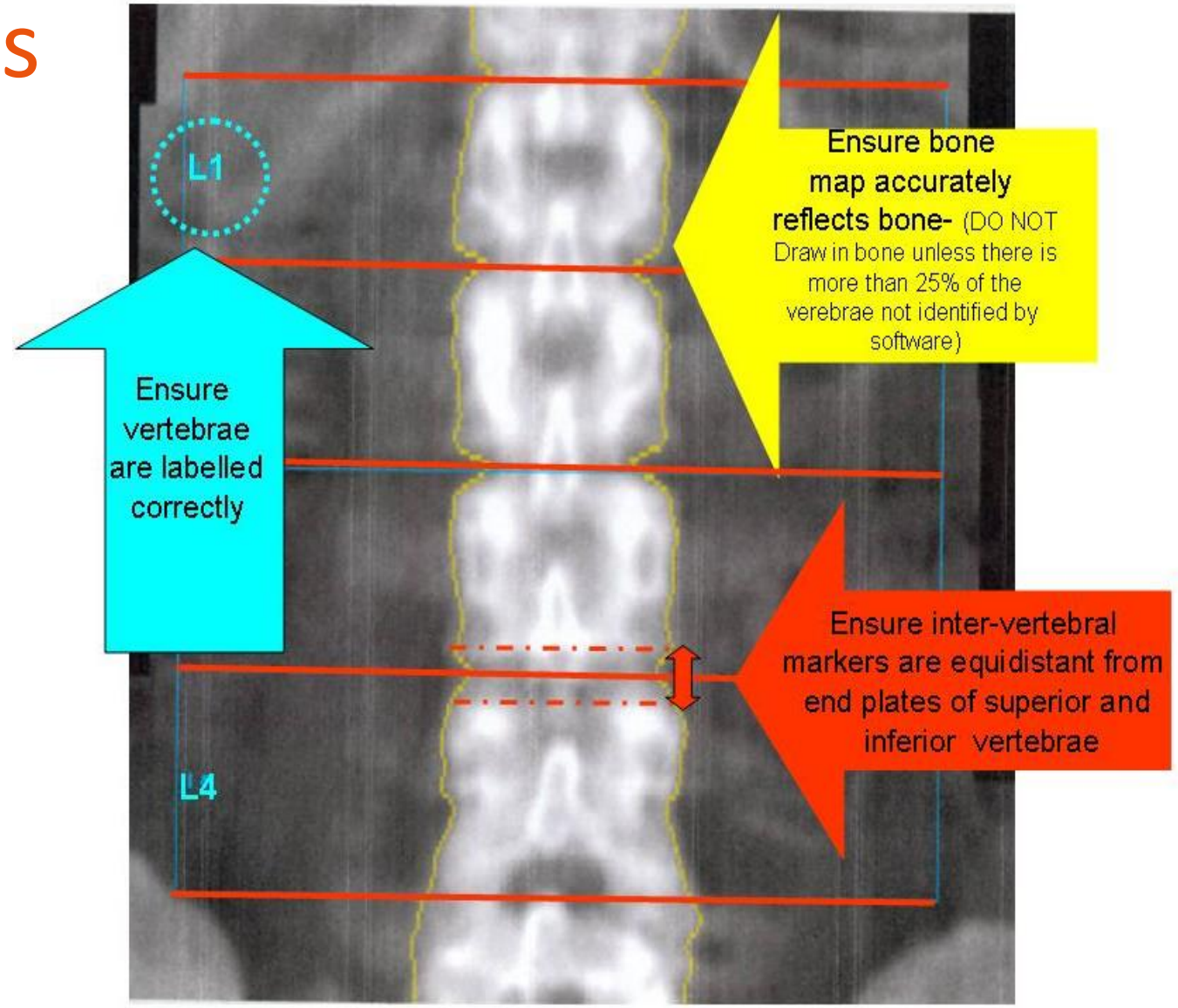
Best Practice- analysis

- **Bone map**
- **Nomenclature**
- **IVM**



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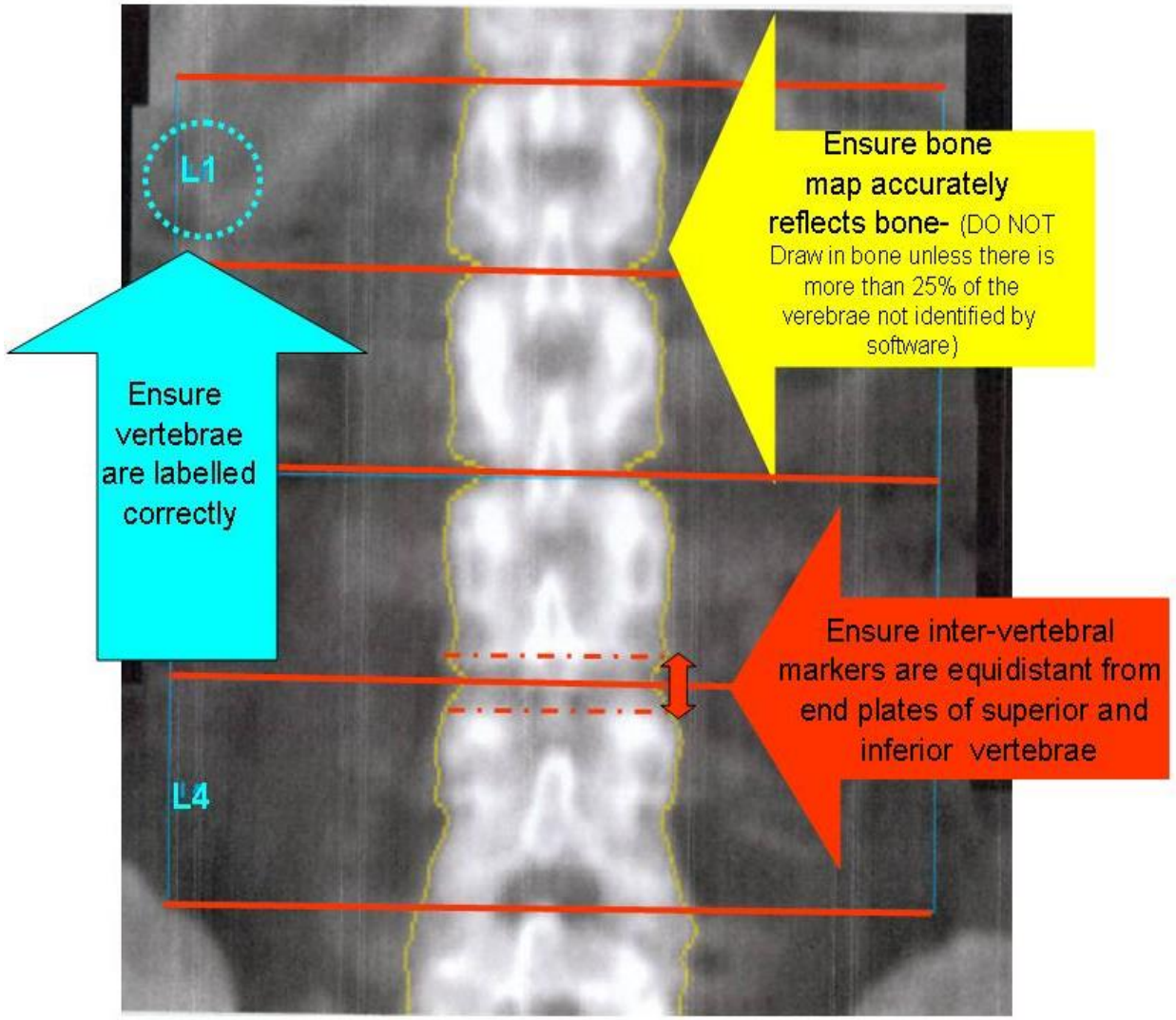
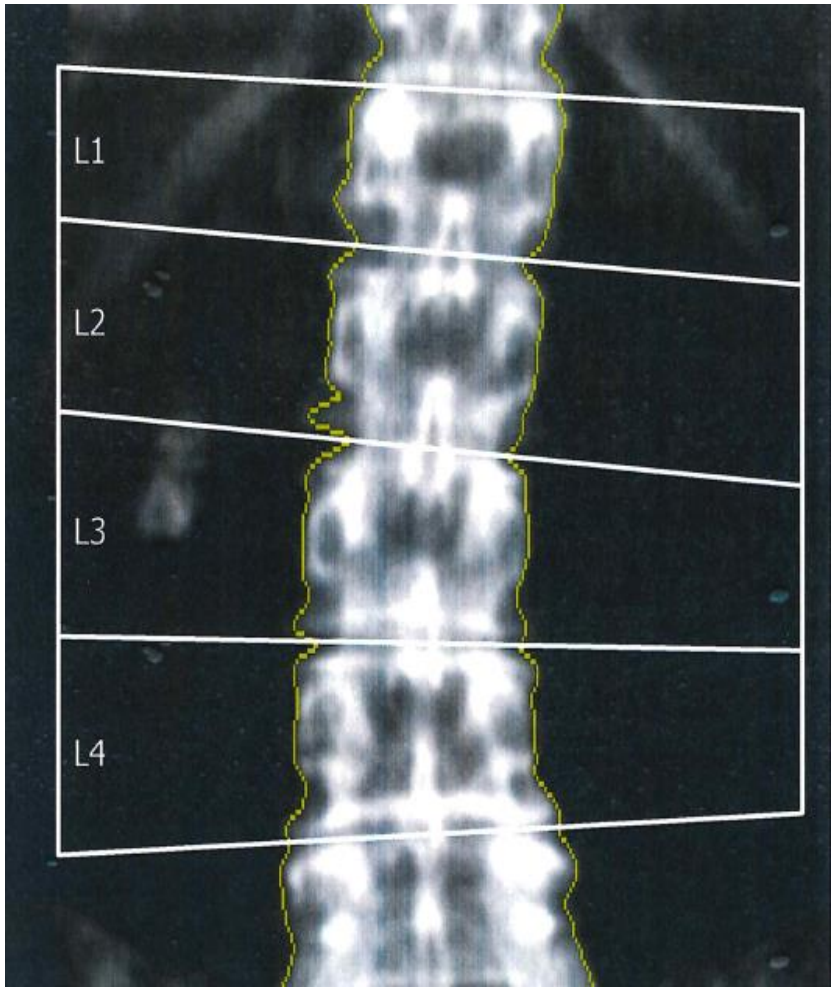
Best Practice- analysis Identifying intervertebral levels





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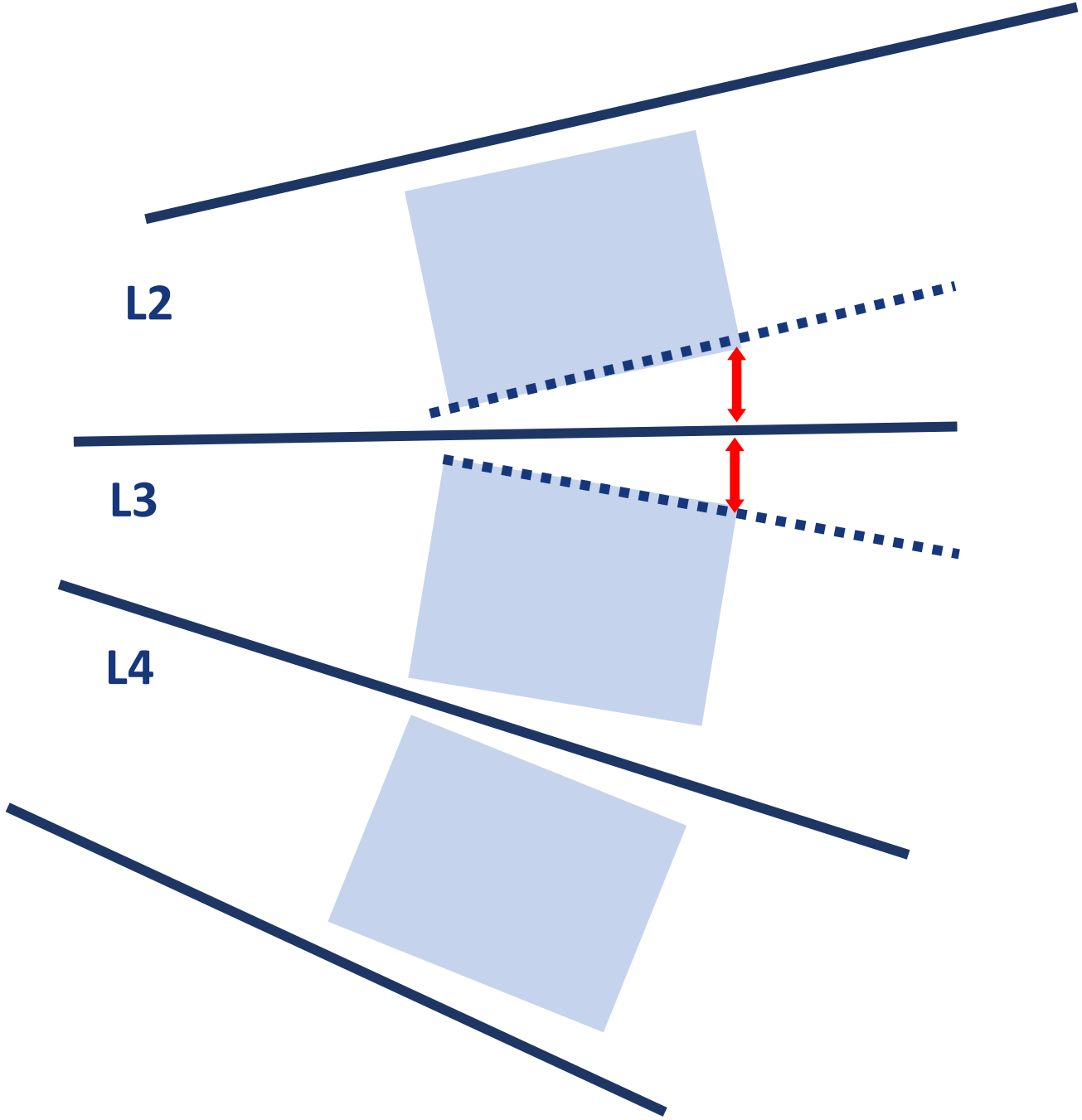

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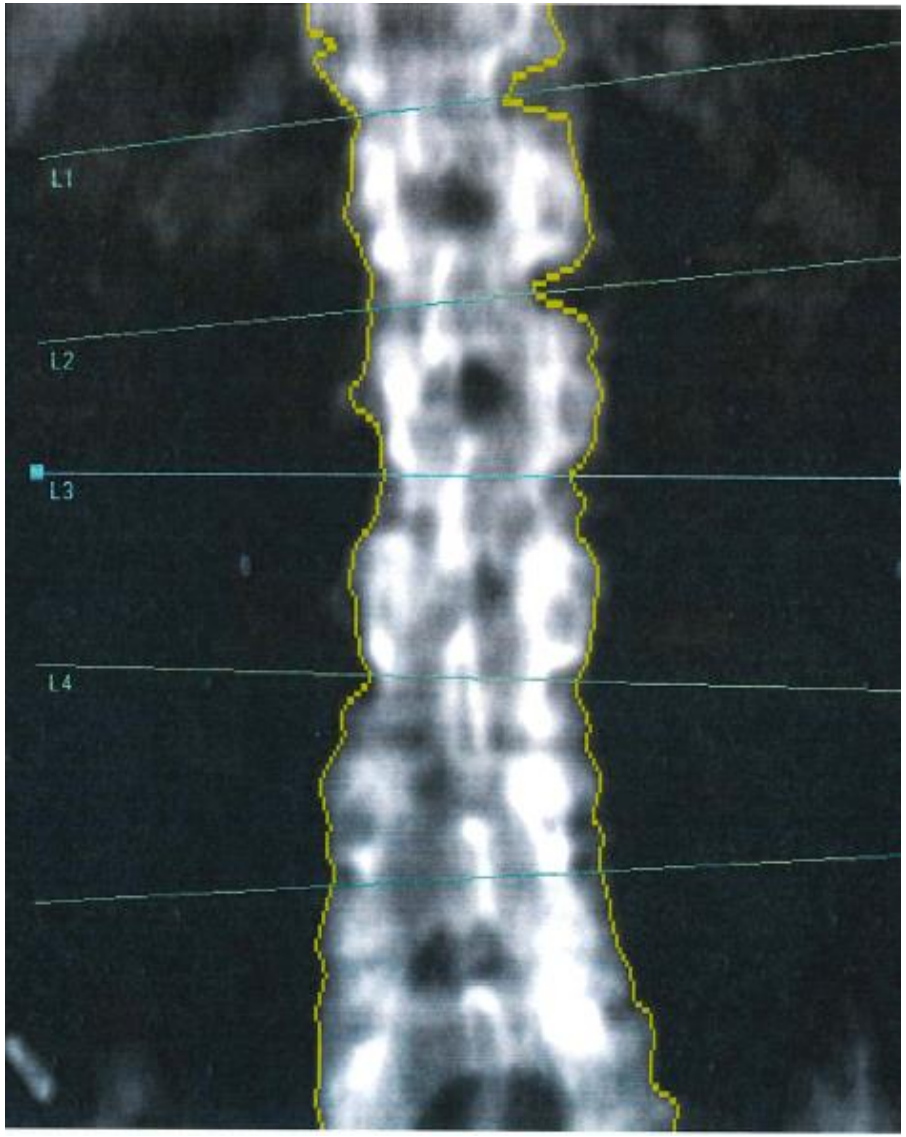
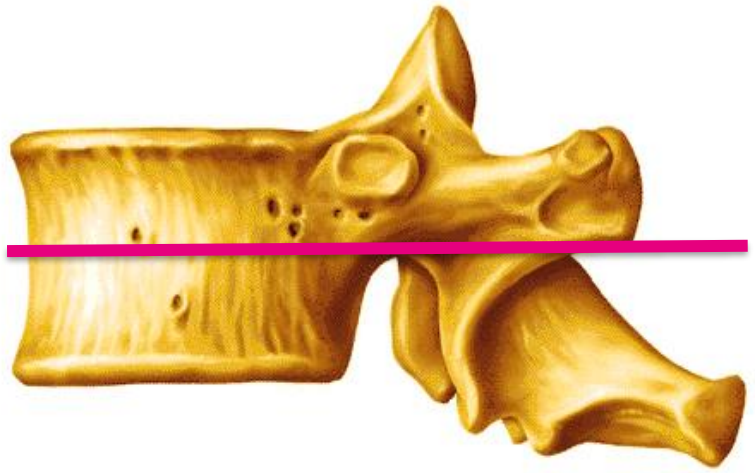
Best Practice- analysis False IVM sign





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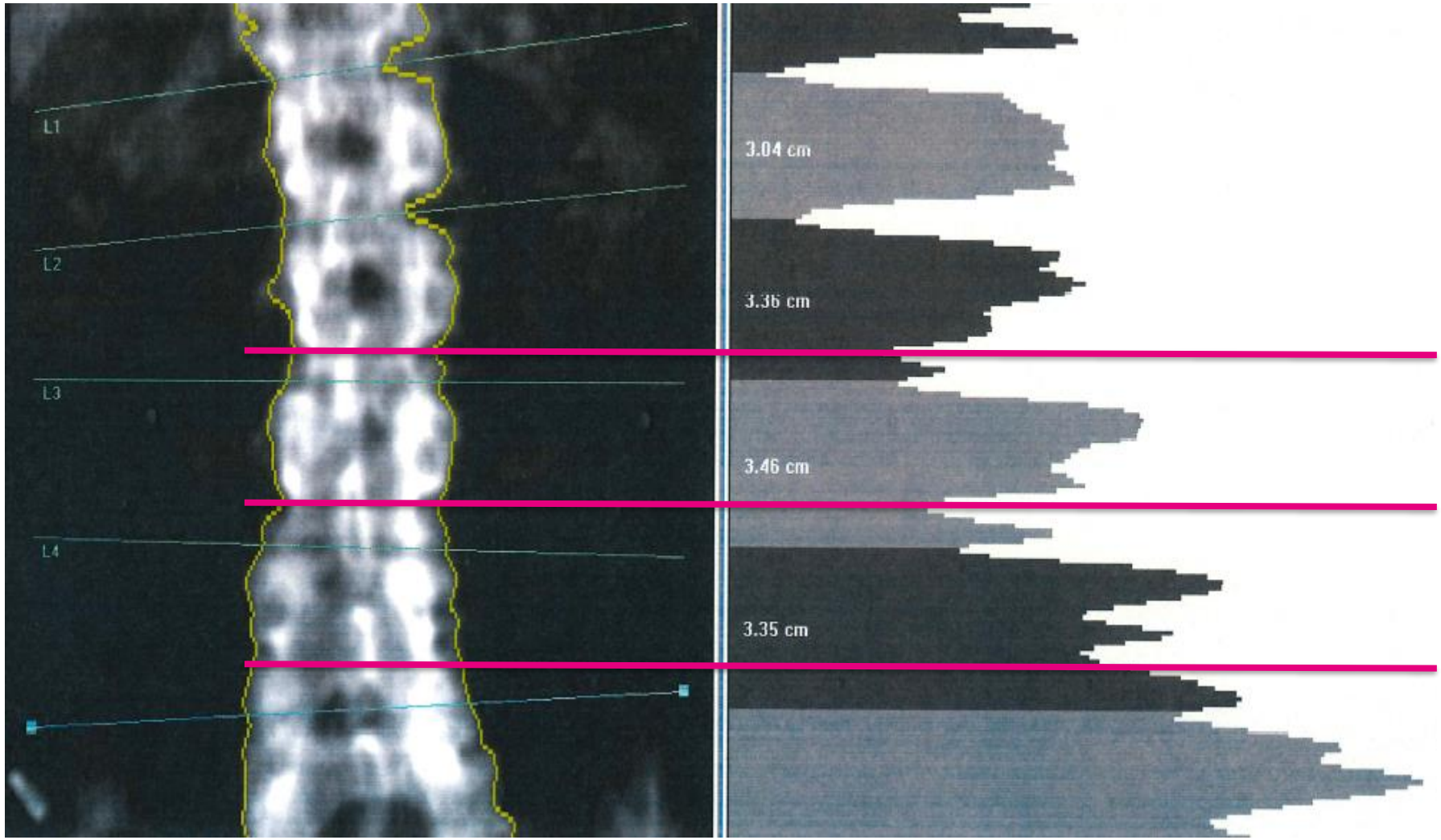
Best Practice- analysis



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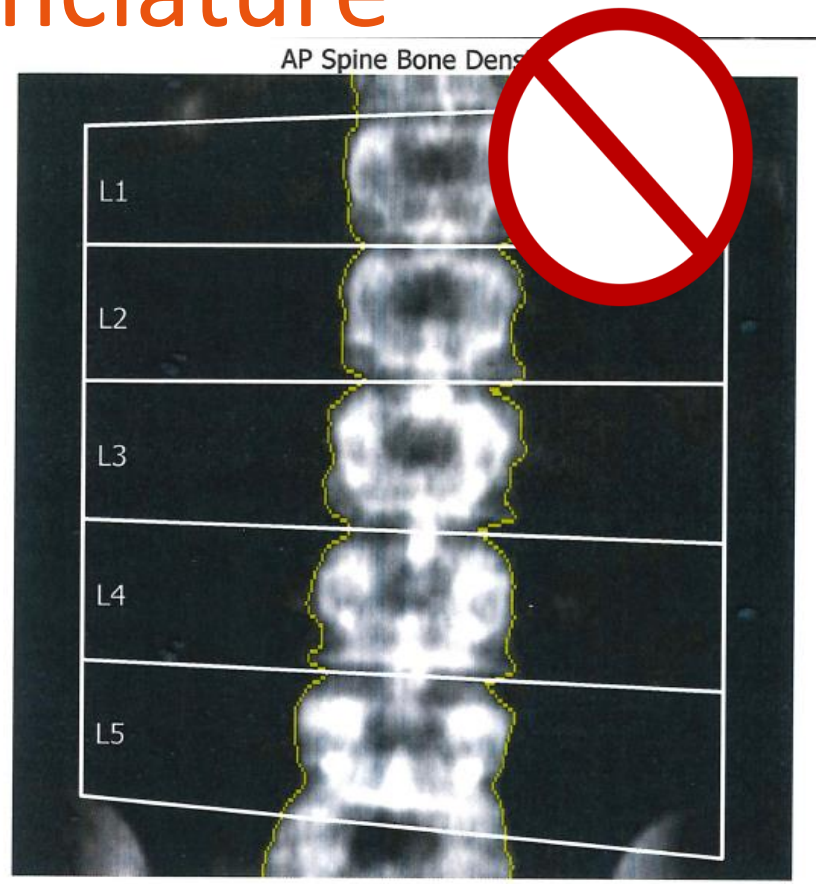
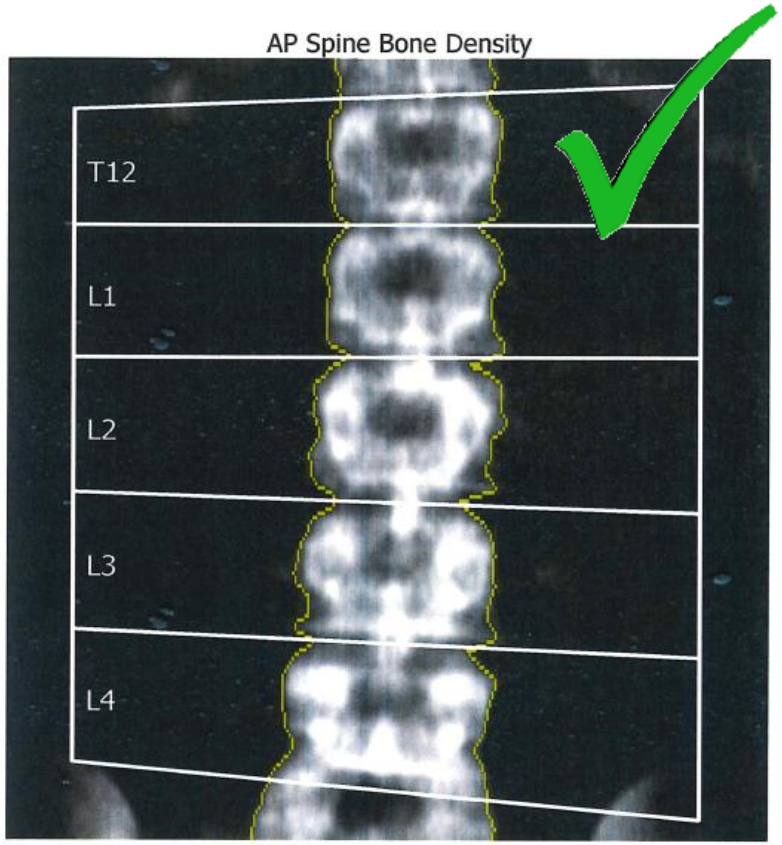
Best Practice- analysis- nomenclature



Region	BMD g/cm2	T-score
L1-L4	0.963	-2.1



Region	BMD g/cm2	T-score
L1-L4	1.029	-1.6

Best Practice- analysis

Exclusion of vertebral levels - 1

- **ISCD Official positions 2015- vertebral exclusions:**
  - **EXCLUDE WHEN:**

1) Visible focal structural defects

- Vertebral fractures
- OA/Degenerative and sclerotic changes
- Artefacts

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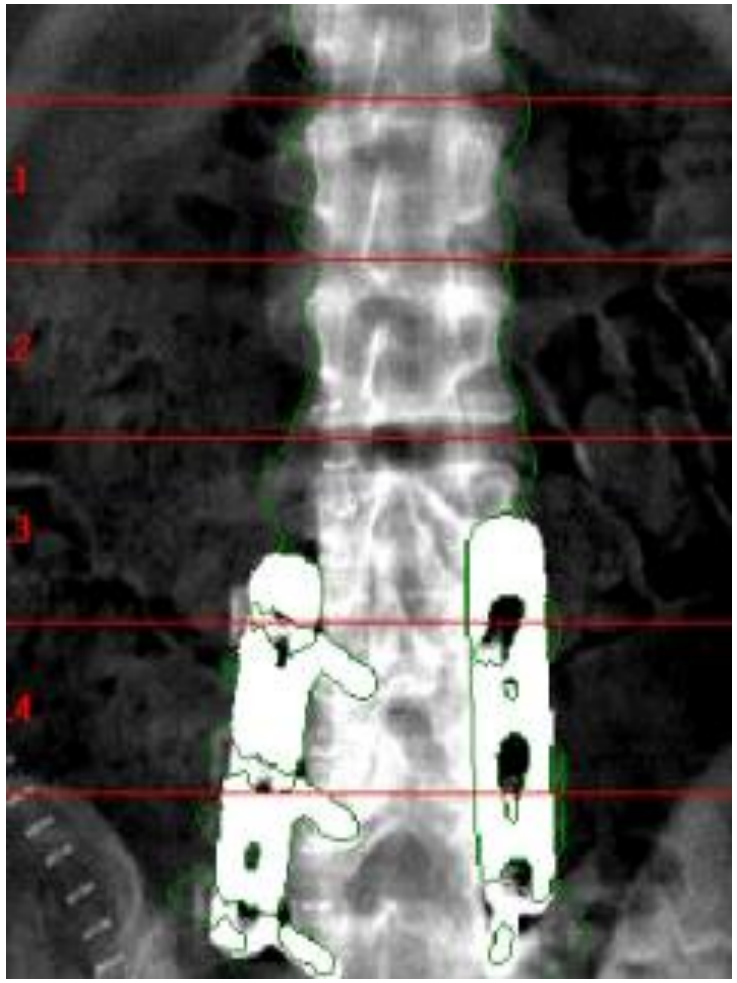
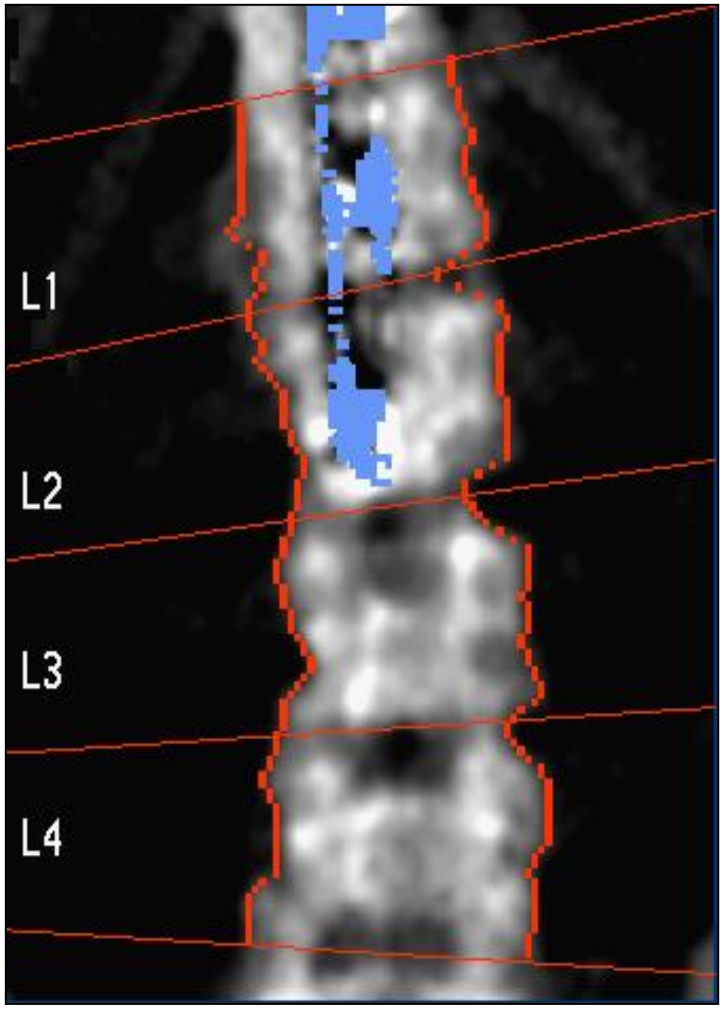
Best Practice- analysis

Ironmongery – exclude effected levels



Spinal fusion



Harrington rods

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Best Practice- analysis

Exclusion of vertebral levels- 2

- **ISCD Official positions 2015- vertebral exclusions:**
  - **EXCLUDE WHEN:**

    2) There is a **>1SD T-score** discrepancy between adjacent vertebrae **AND** evidence of sclerotic defect on the image

    - **Exclude all vertebrae with the defects and the higher BMD**
    - Leads to improvement in fracture prediction
    - Min 2 levels required to base a diagnostic statement.

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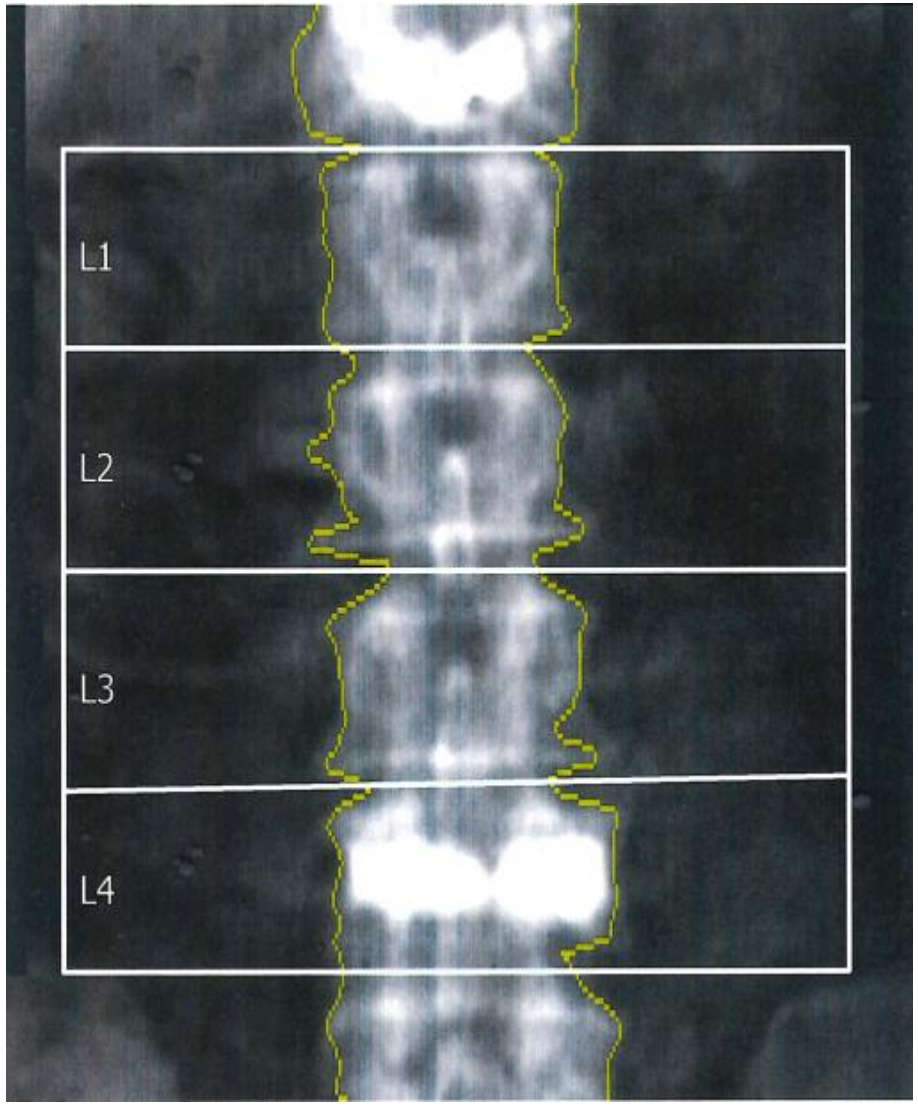
Best Practice- analysis



Region	BMD g/cm2	T-score
L1	0.976	-1.5
L2	1.033	-1.7
L3	1.007	-1.9
L4	1.636	3.3

Region	T-score
L1-4	-0.4
L1-3	-1.7

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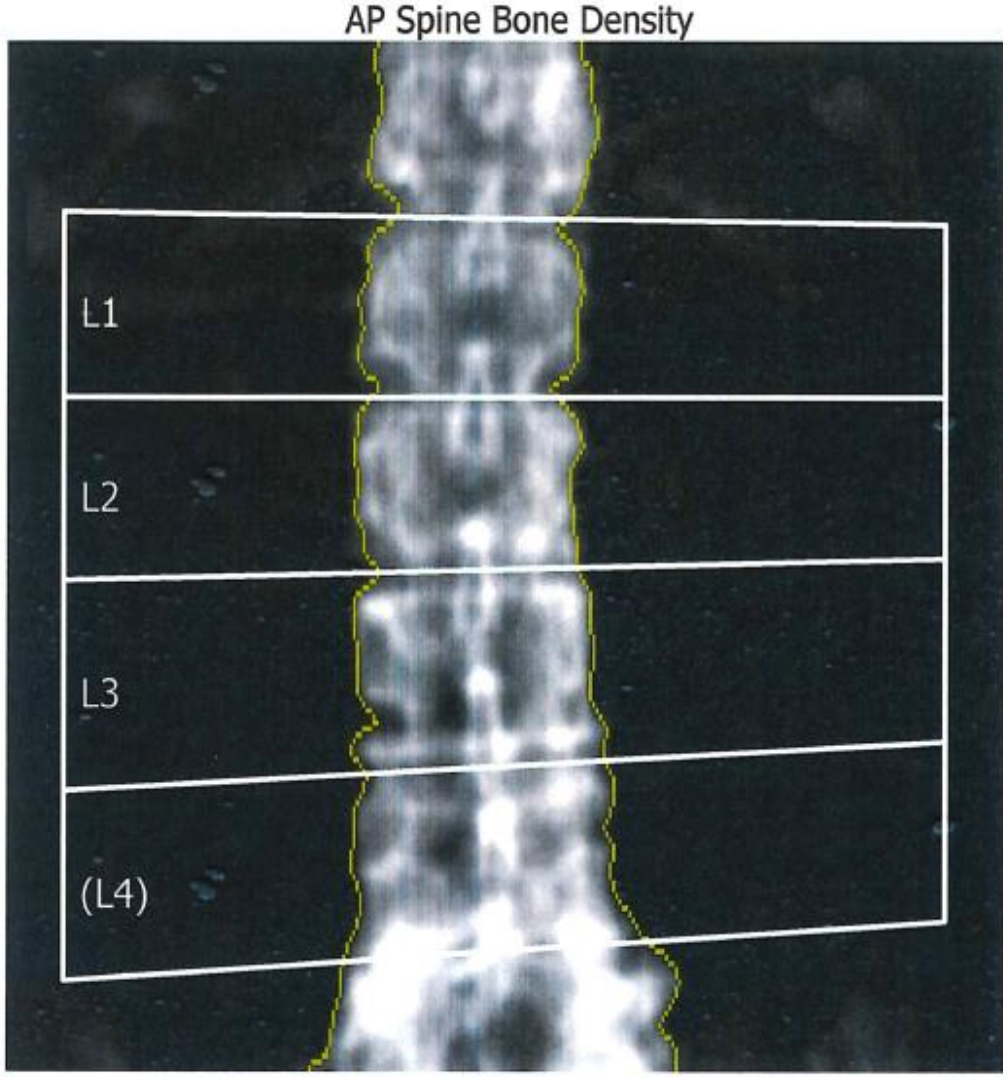
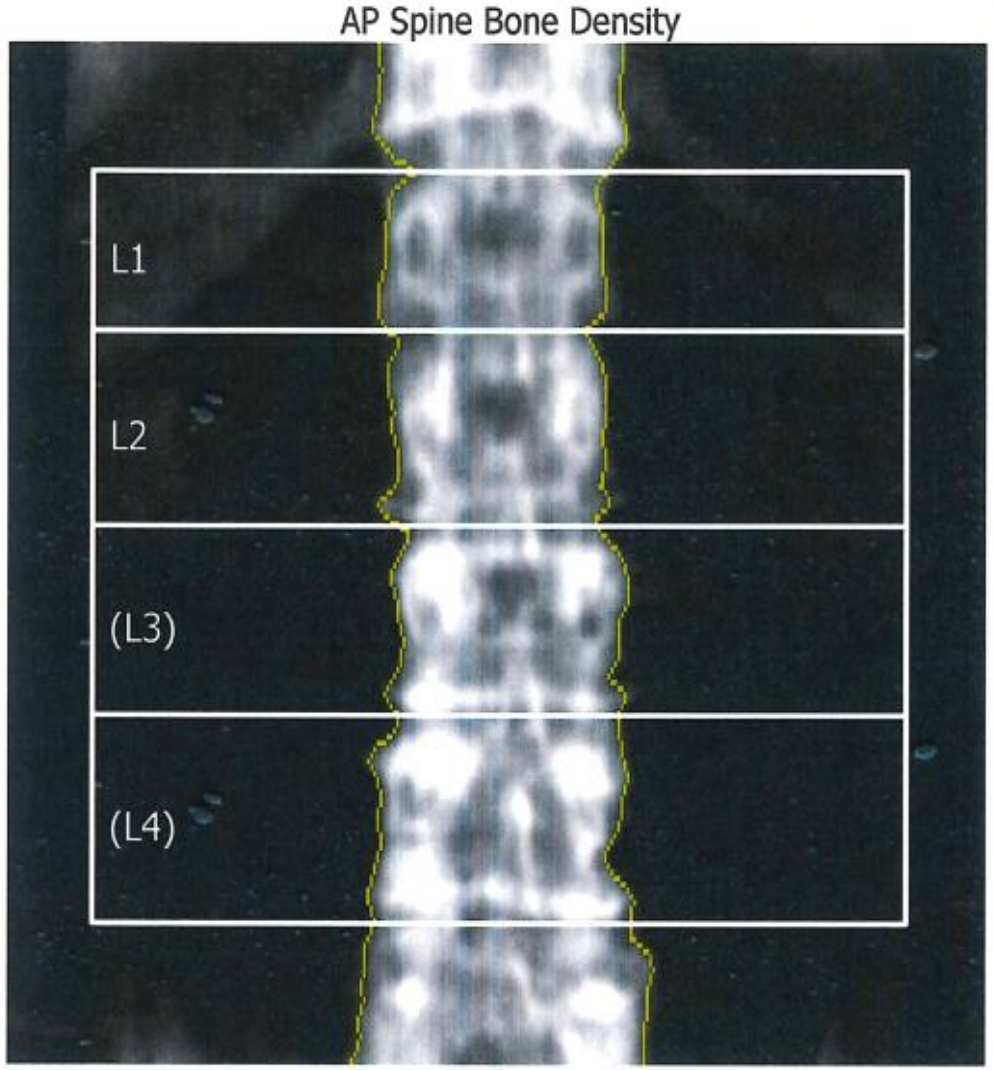
Best Practice- analysis





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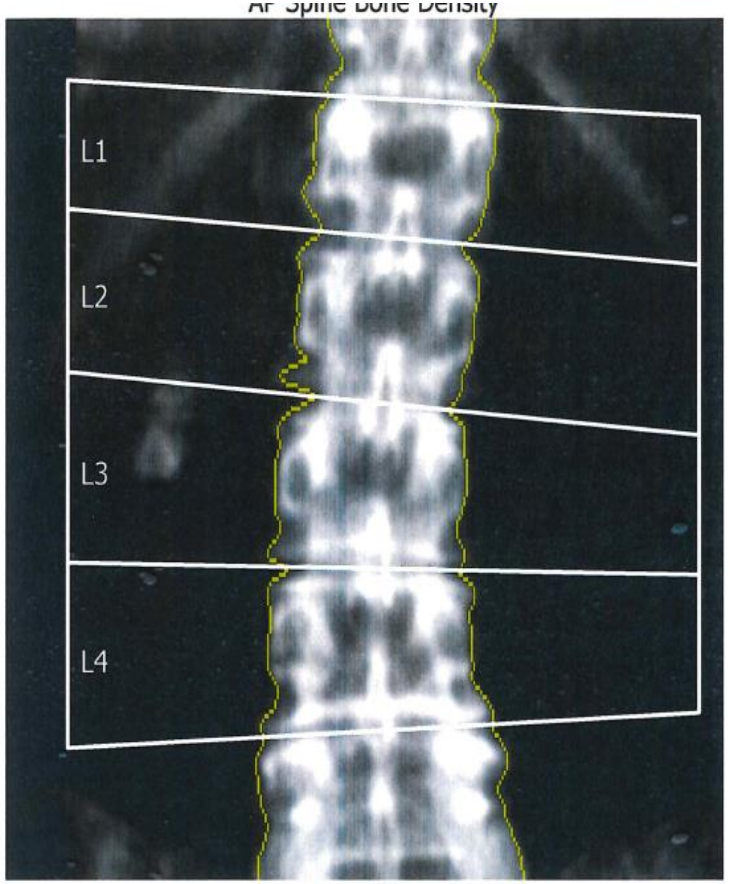
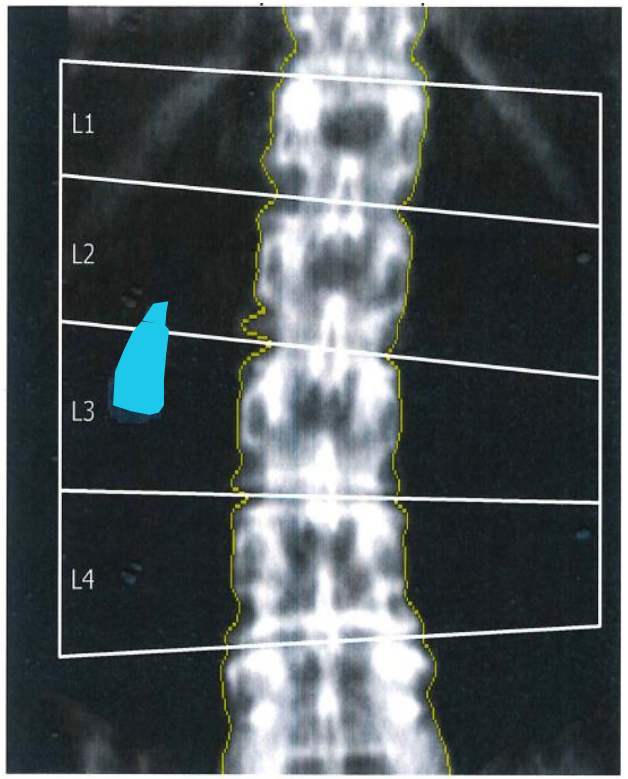
Best Practice- analysis

ST artefacts

- **Management of artefacts GE lunar scanners:**

Artefact	Action
Soft tissue only	Point type as artefact assigning a neutral value
Over bone	Exclude the vertebra





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ST artefacts

HOLOGIC Management of artefacts:

Artefact	Management	Effect on measurements
Soft tissue only	Use 'UNDO' at bone map	none
Over **bone/vertebral** body	**Delete** vertebra	None- caution with rates of change
Over soft tissue & **bone**	**Delete** vertebra	none
Small artefact in soft tissue e.g. clips, catheter	none	Little or none
Small artefact over **bone** e.g. clips, belly bar/ring	If abnormal- **delete** bone	Small effect
Large artefact over soft tissue	none	Possible effect- interpret with caution
Large artefact over soft tissue and **bone**	**Delete** vertebrae or exclude from global ROI	Definite effect- interpret with caution.

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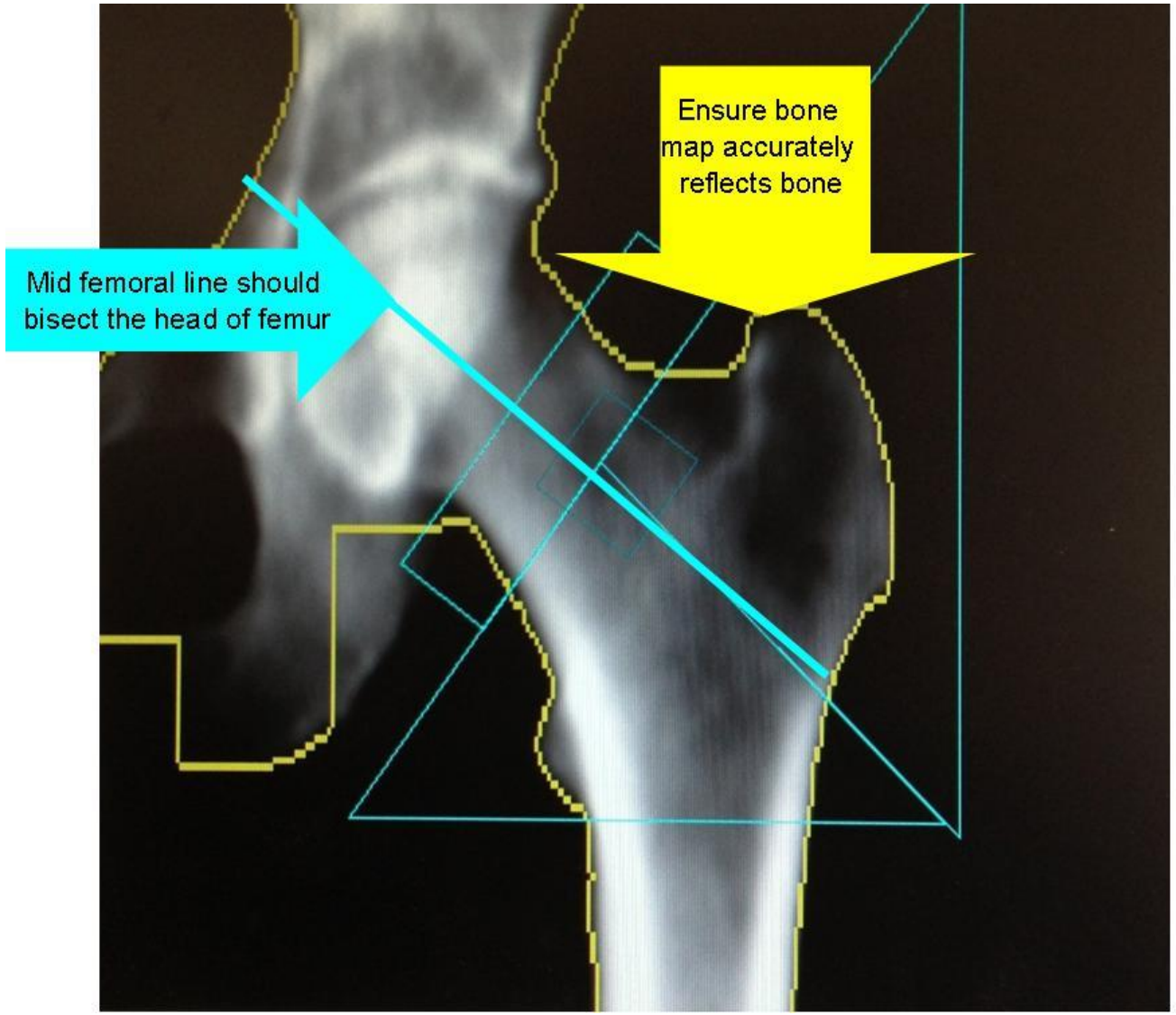

GE Lunar
& Hologic scanner differences

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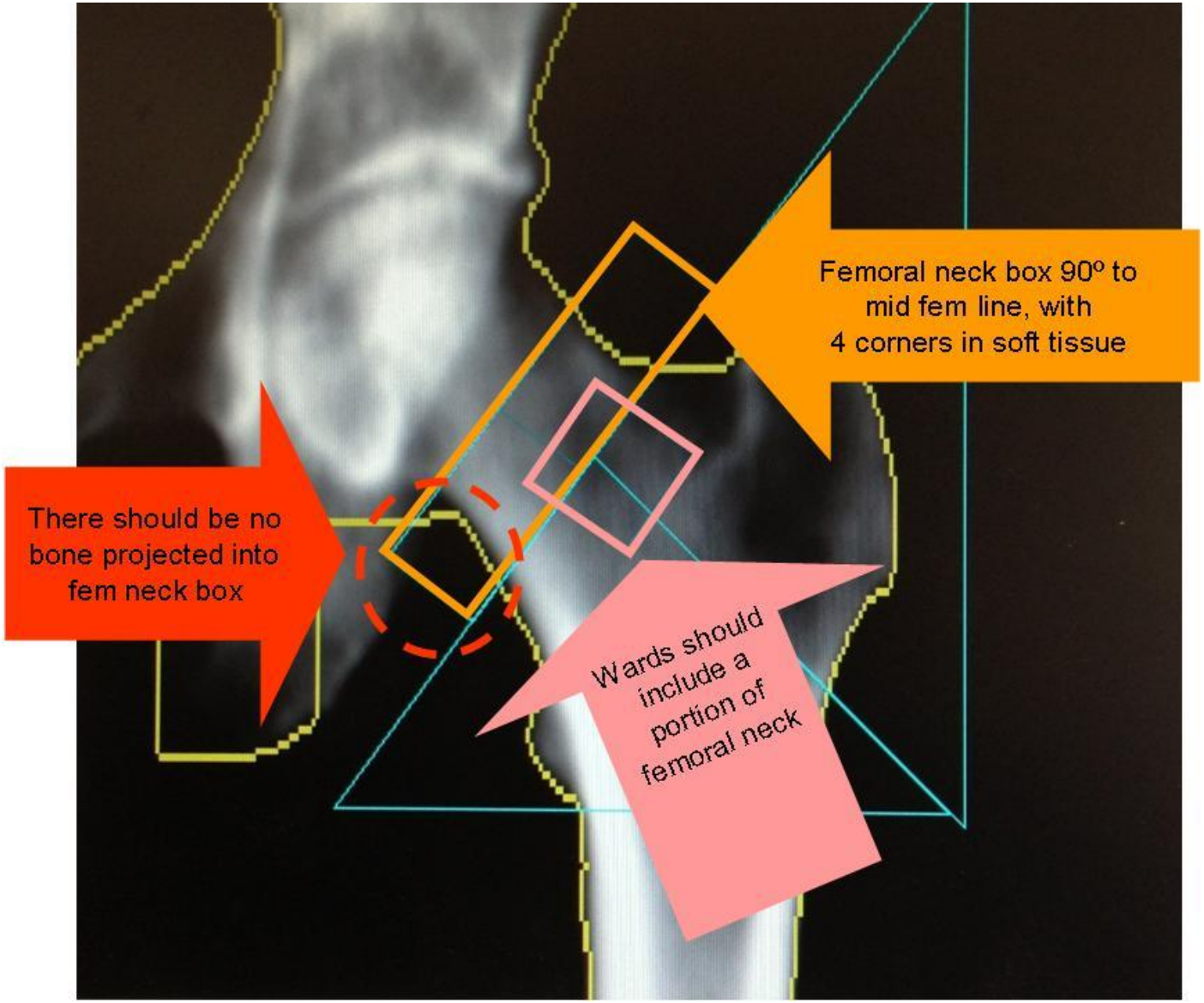

GE Lunar
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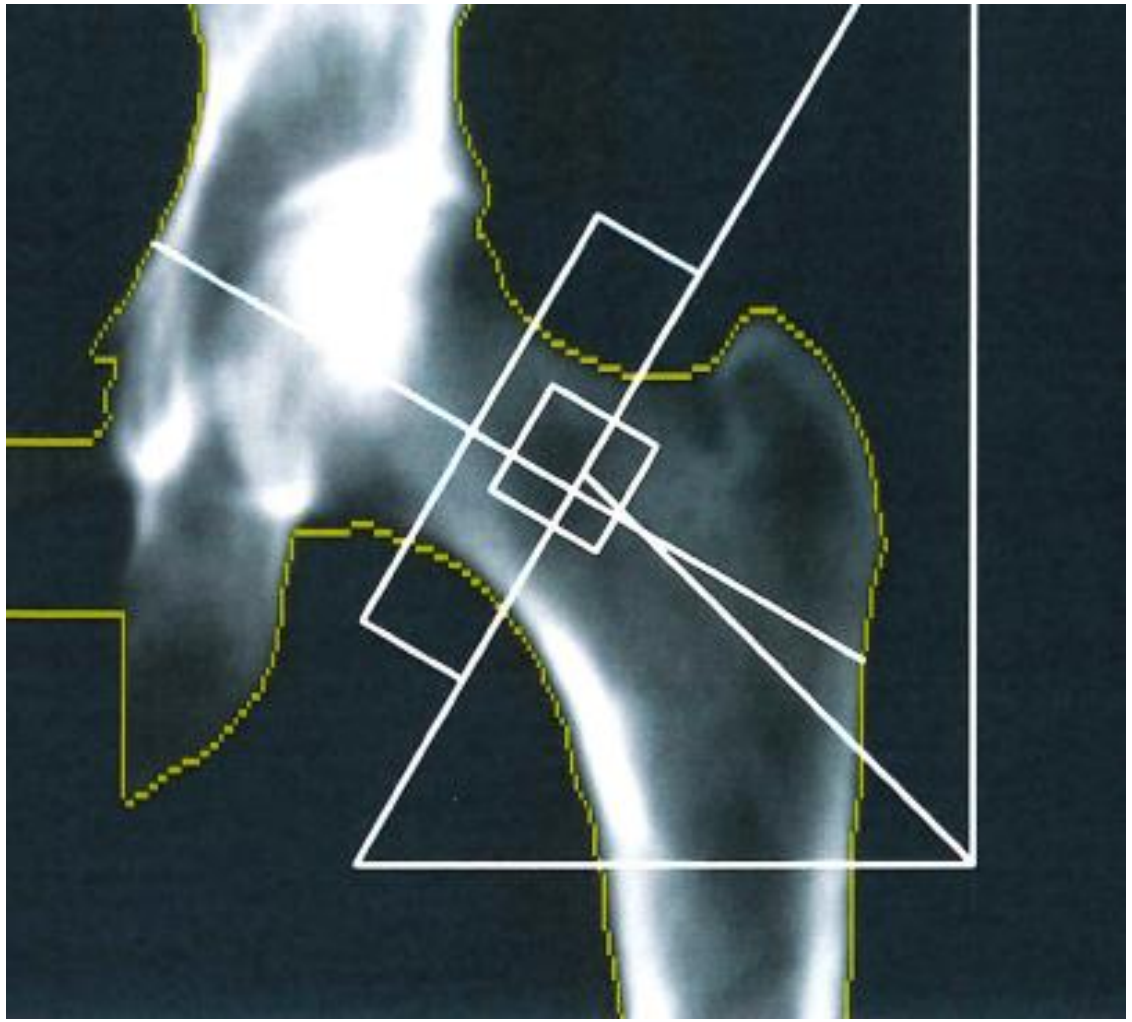

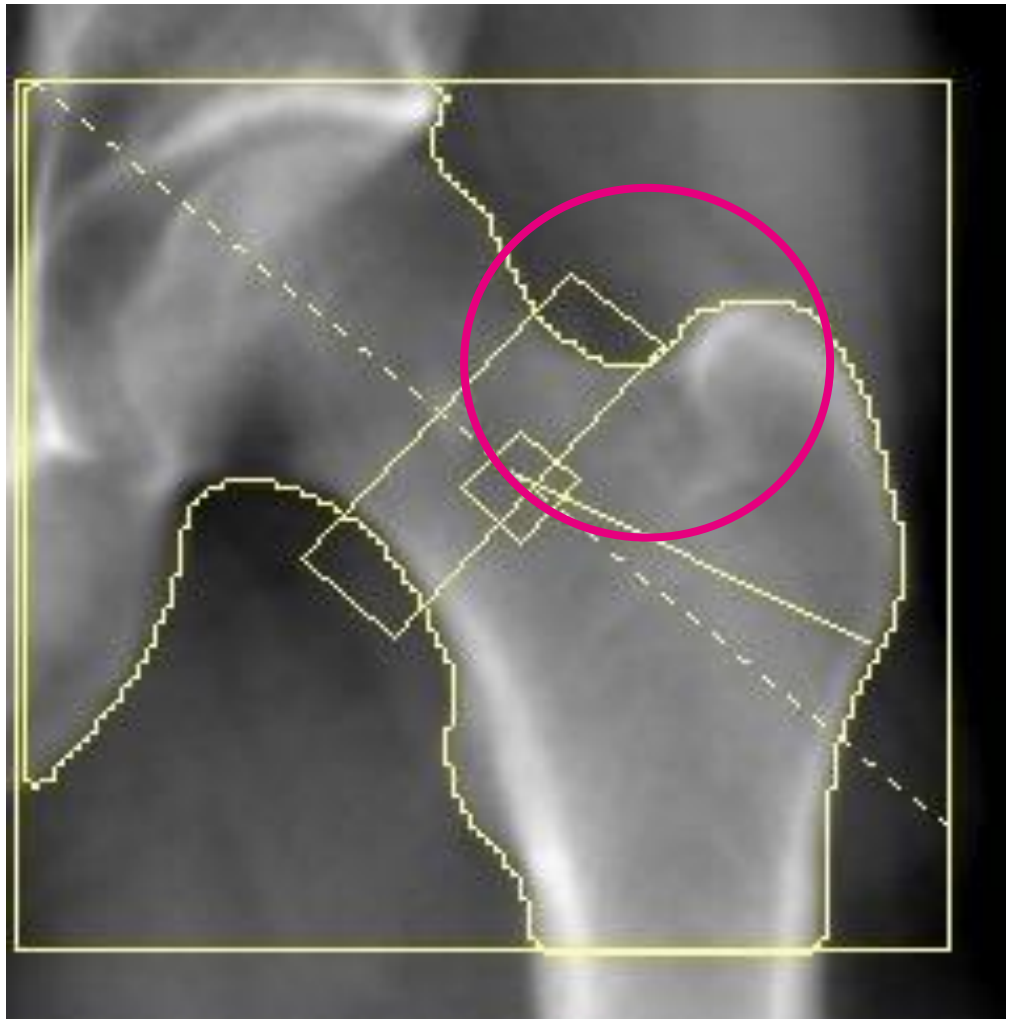

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Reducing precision errors: Standardising Practice

HOW??

- Protocols
- Training
- Competency
- Audit

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Standardising Practice

- Protocols
  - should cover aspects that are legislated for under IR(ME)R
  - should include clear work instructions that describe what areas are scanned and how this is done
  - should include what correct positioning and analysis look like

Standardising Practice

- Training
  - Operators and those analysing scans should have specific training
  - Should be manufacturer specific
  - Should be competency tested

Standardising Practice

- Competency
  - Defines scope of practice
  - Specific and detailed
  - Standardises practice
  - Should be reviewed regularly

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Audit

- Audit of scan and analysis technique
  - Evidences competency
  - Benchmark service quality and effectiveness
  - Un-masks common lapses in technique or factors effecting precision

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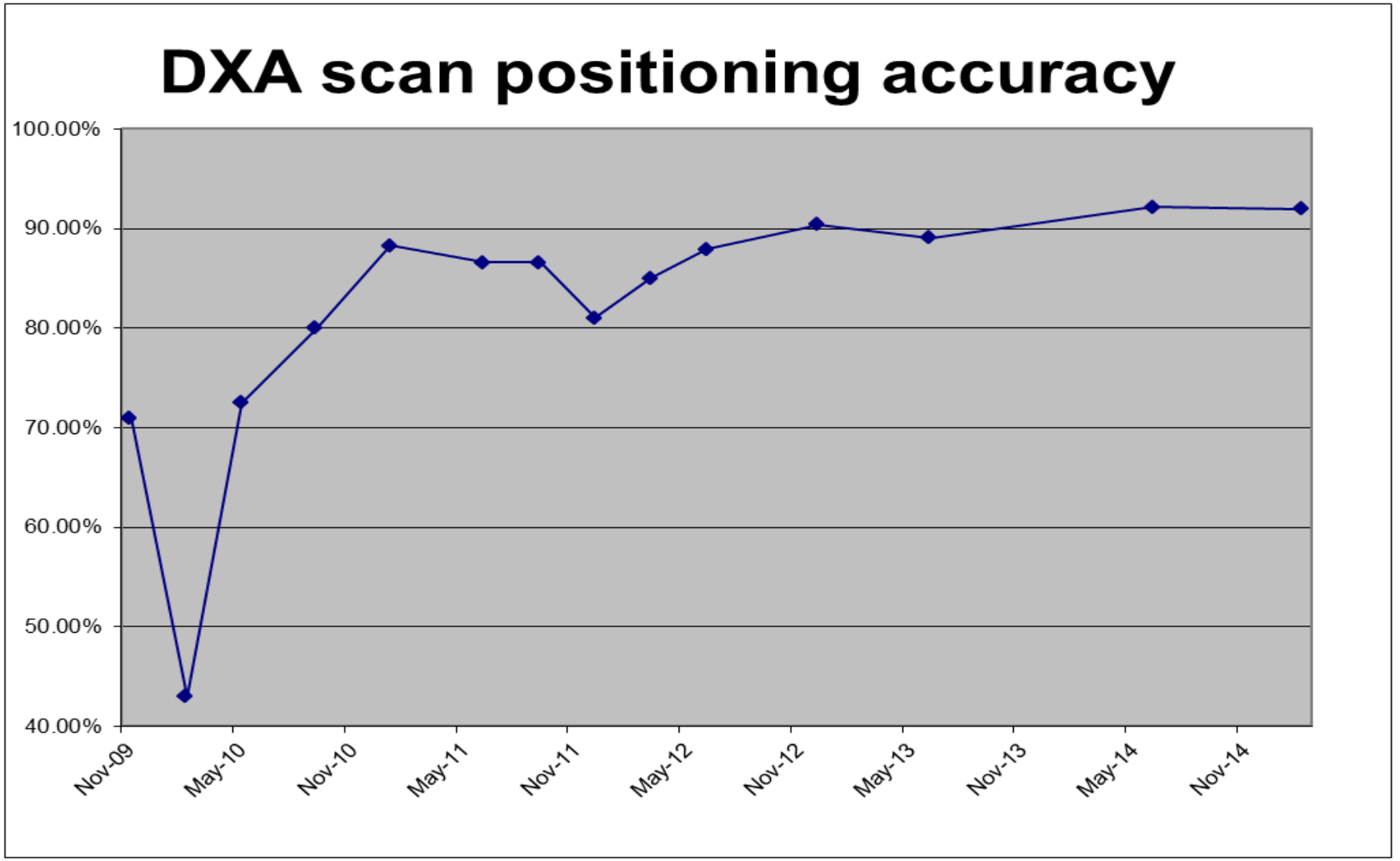
Audit



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What?
Have we learned?

- Precision- least significant change
- Best practice in positioning and analysing spine and hip DXA
- Importance standardisation in precision
- Steps towards standardised best practice

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Questions & discussion

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