Case Studies:
Promoting precision and clinical reliability in DXA

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Royal Osteoporosis Society

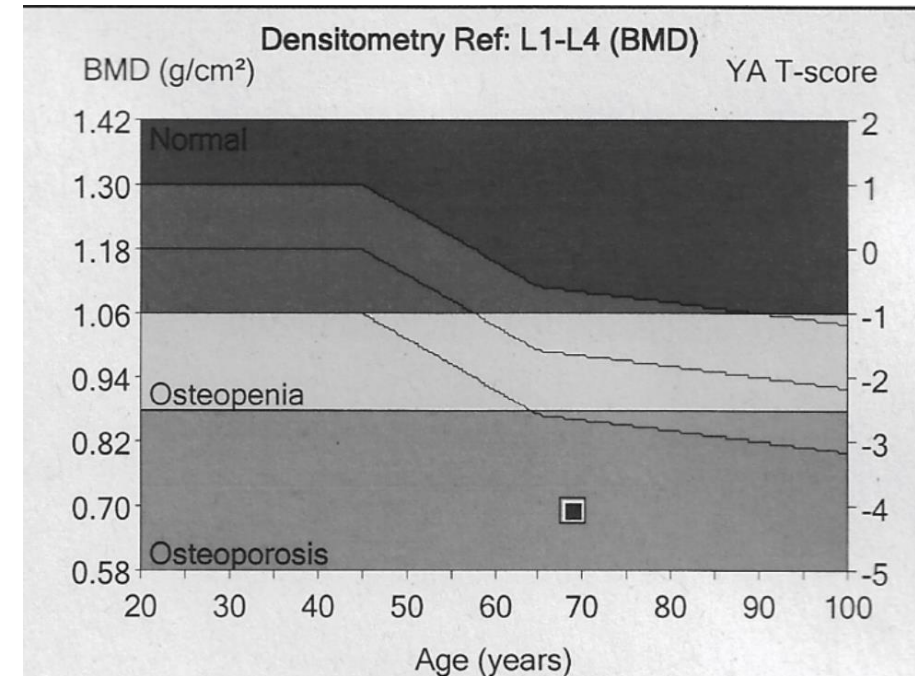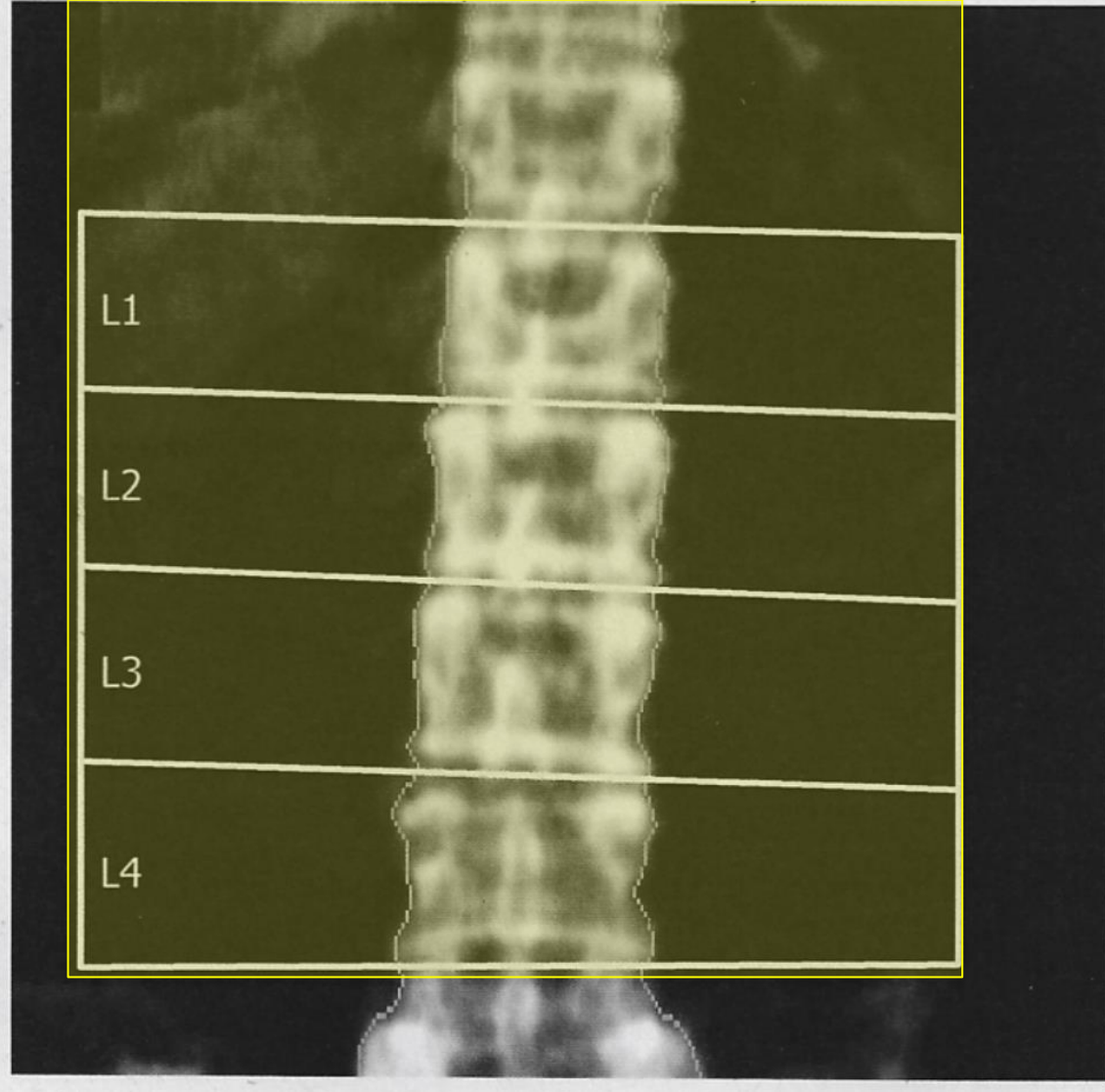18 March 2021

Case Studies

Spine 1

AP Spine Bone Density

Region	BMD g/cm2	T-score	Z-score
L1-4	0.689	-4.1	-2.4

Densitometry Ref: L1-L4 (BMD)

Spine 1

AP Spine Bone Density

Region	BMD g/cm2	T-score	Z-score
L1-4 excess ST value	0.689	-4.1	-2.4

Densitometry Ref: L1-L4 (BMD)

Spine 1

AP Spine Bone Density

L1
L2
L3
L4

Region	BMD g/cm2	T-score	Z-score
L1-4 excess ST value	0.689	-4.1	-2.4
L1-4 corrected	0.699	-4.0	-2.4

Densitometry Ref: L1-L4 (BMD)

Densitometry Ref: L1-L4 (BMD)

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Spine 1

AP Spine Bone Density

Region	BMD g/cm2	T-score	Z-score
L1-4 excess ST value	0.689	-4.1	-2.4
L1-4 corrected	0.699	-4.0	-2.4

Error effect Increased soft tissue area

Increased precision error

Decreased BMD

Decreased reliability

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Spine 2

AP Spine Bone Density

Region	BMD g/cm2	T-score	Z-score
L1-4	1.277	0.8	2.2

Densitometry Ref: L1-L4 (BMD)

Spine 2

AP Spine Bone Density

L1
L2
L3
L4

- Auto analysis and scanner software compensation of metallic artefact (mixed interpretation)

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Spine 2

AP Spine Bone Density
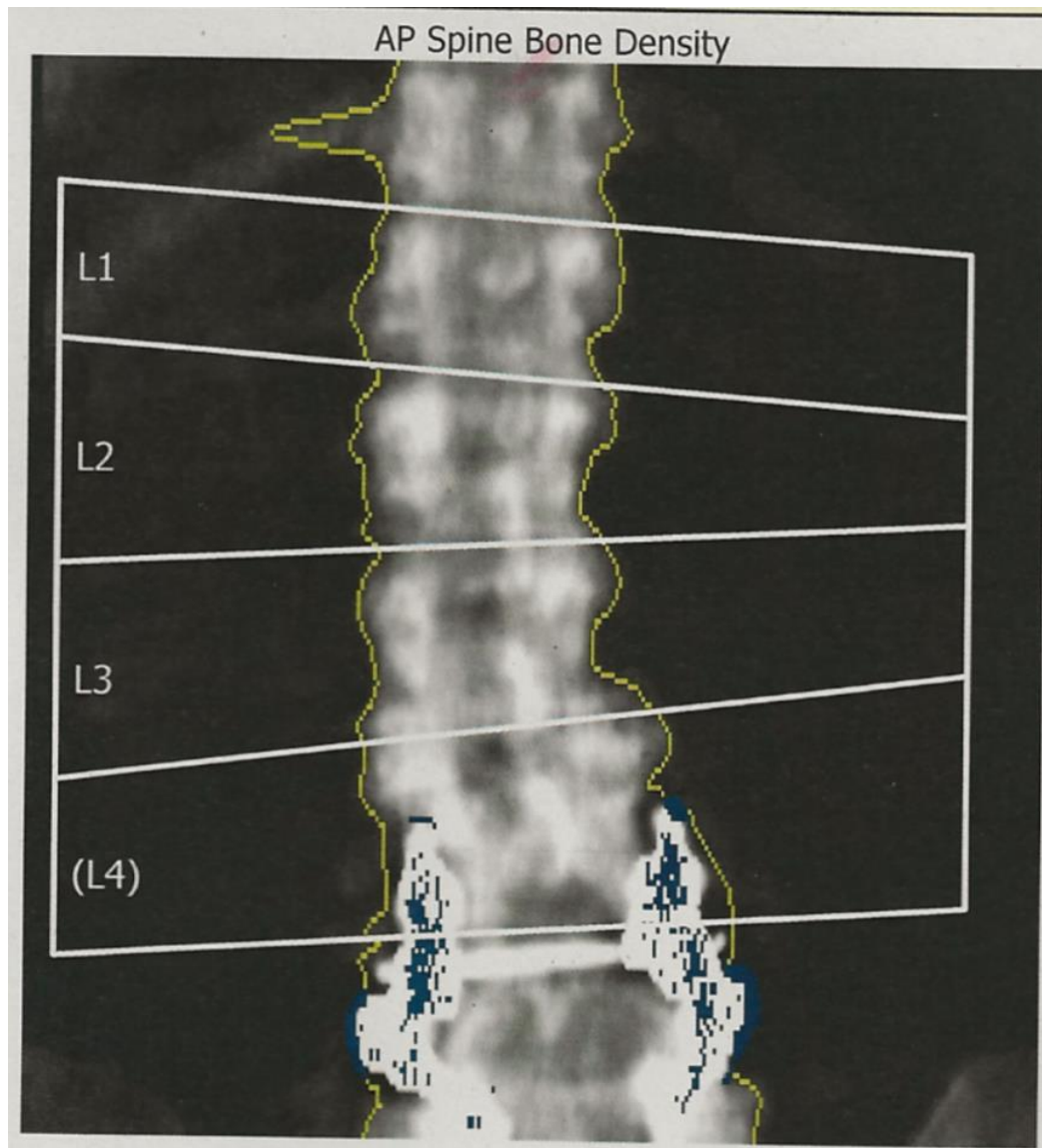
Region	BMD g/cm2	T-score	Z-score
L1-4	1.277	0.8	2.2
L1-3 corrected	1.394	1.9	3.3
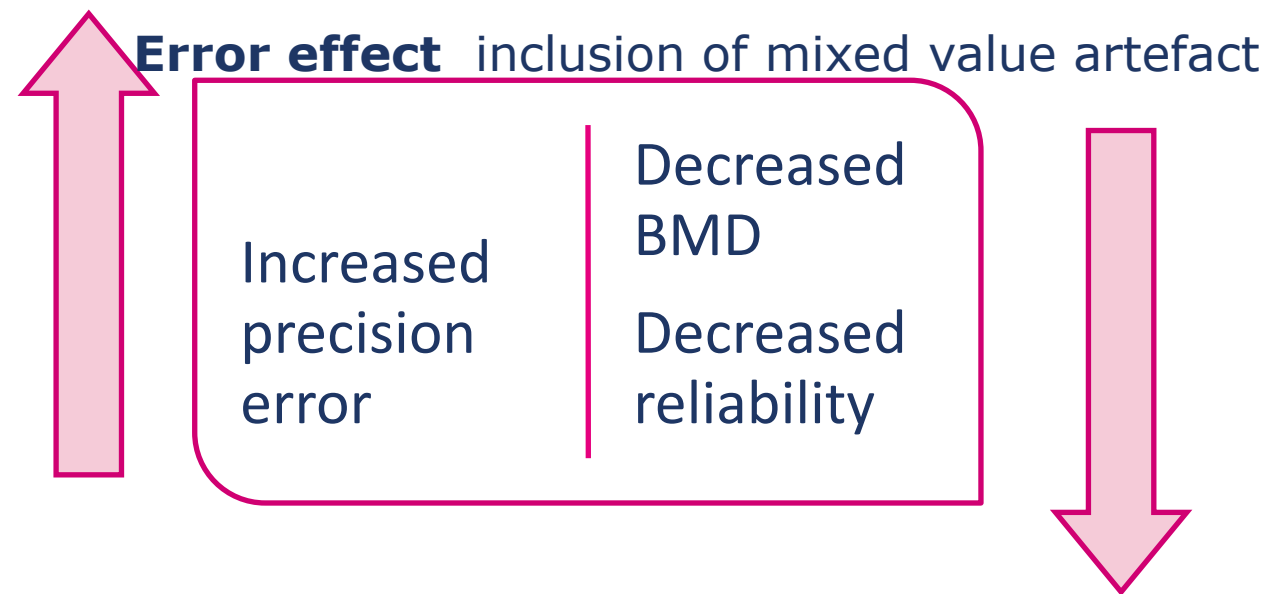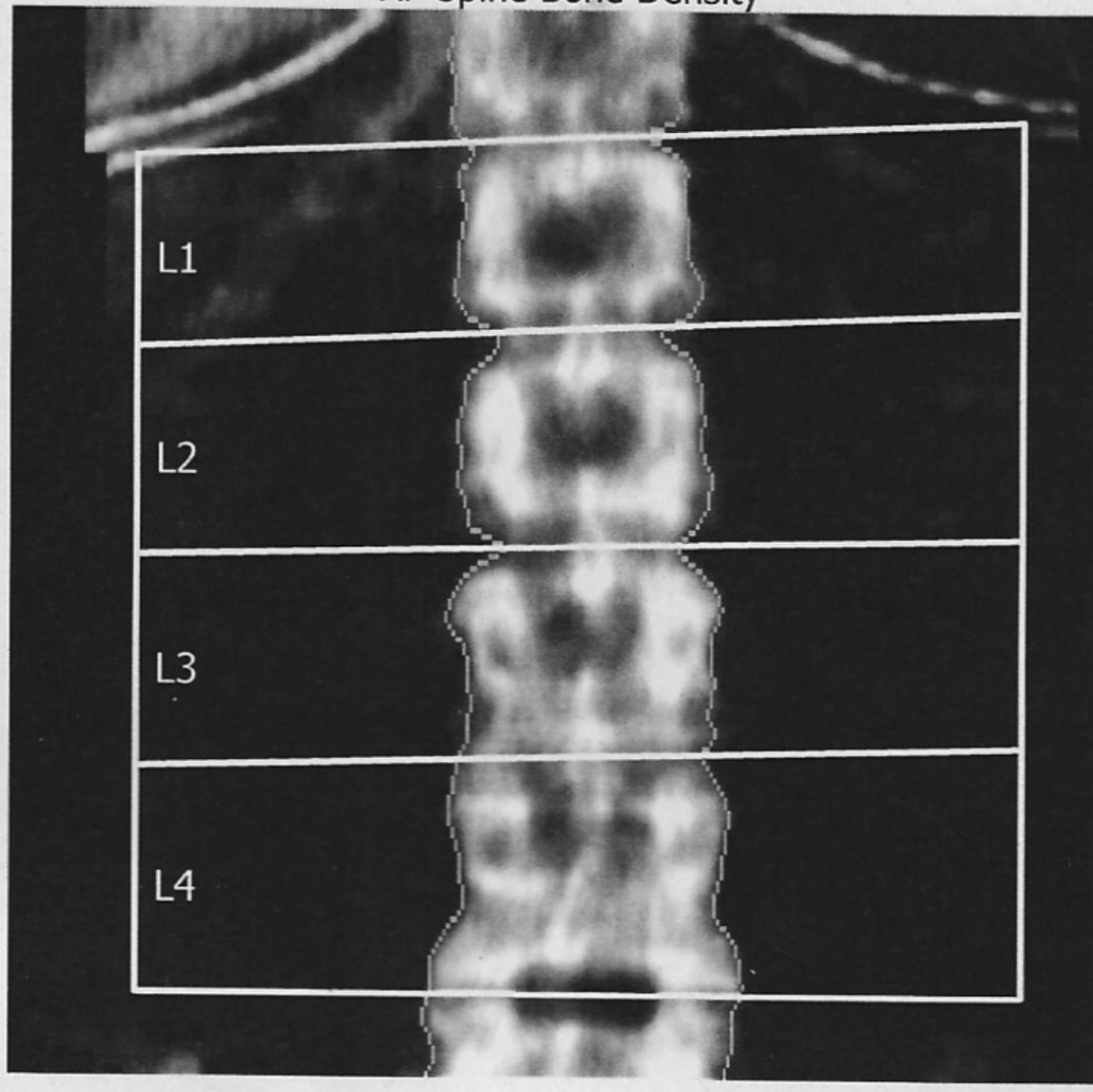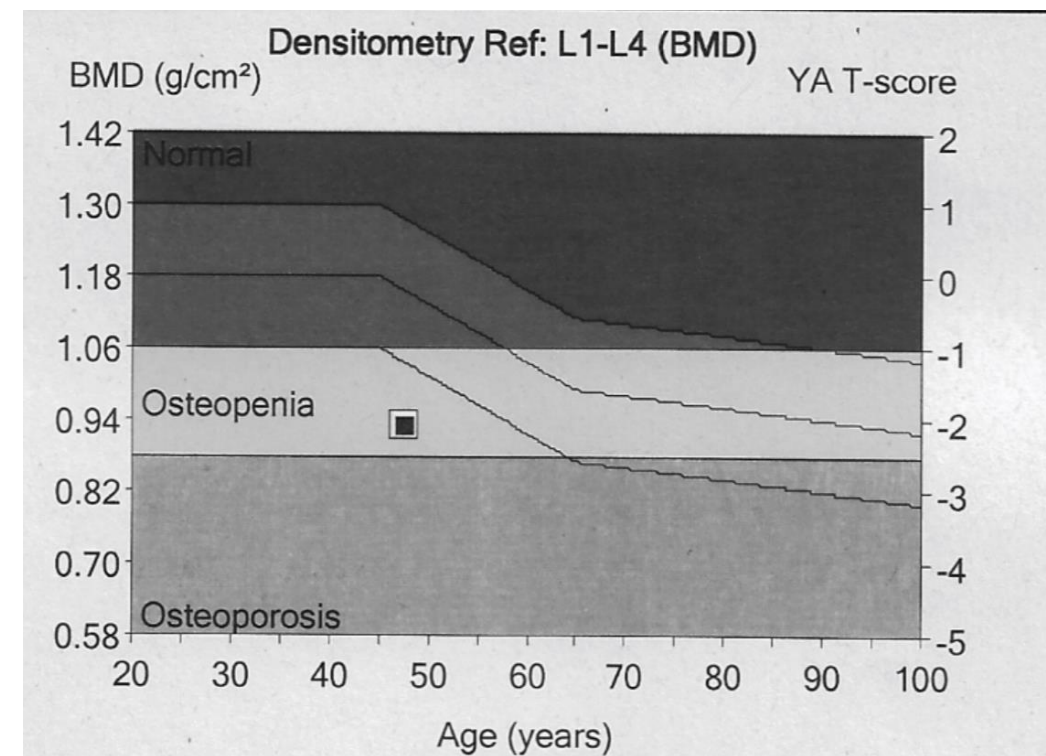
Error effect inclusion of mixed value artefact

Increased precision error

Decreased BMD

Decreased reliability

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Spine 3

AP Spine Bone Density

Region	BMD g/cm2	T-score	Z-score
L1-4	0.932	-2.1	-1.9

Densitometry Ref: L1-L4 (BMD)

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Spine 3

AP Spine Bone Density

L1
L2
L3
L4

Region	BMD g/cm2	T-score	Z-score
L1-4	0.932	-2.1	-1.9

Densitometry Ref: L1-L4 (BMD)

BMD (g/cm²) — YA T-score

Normal
Osteopenia
Osteoporosis

Age (years)
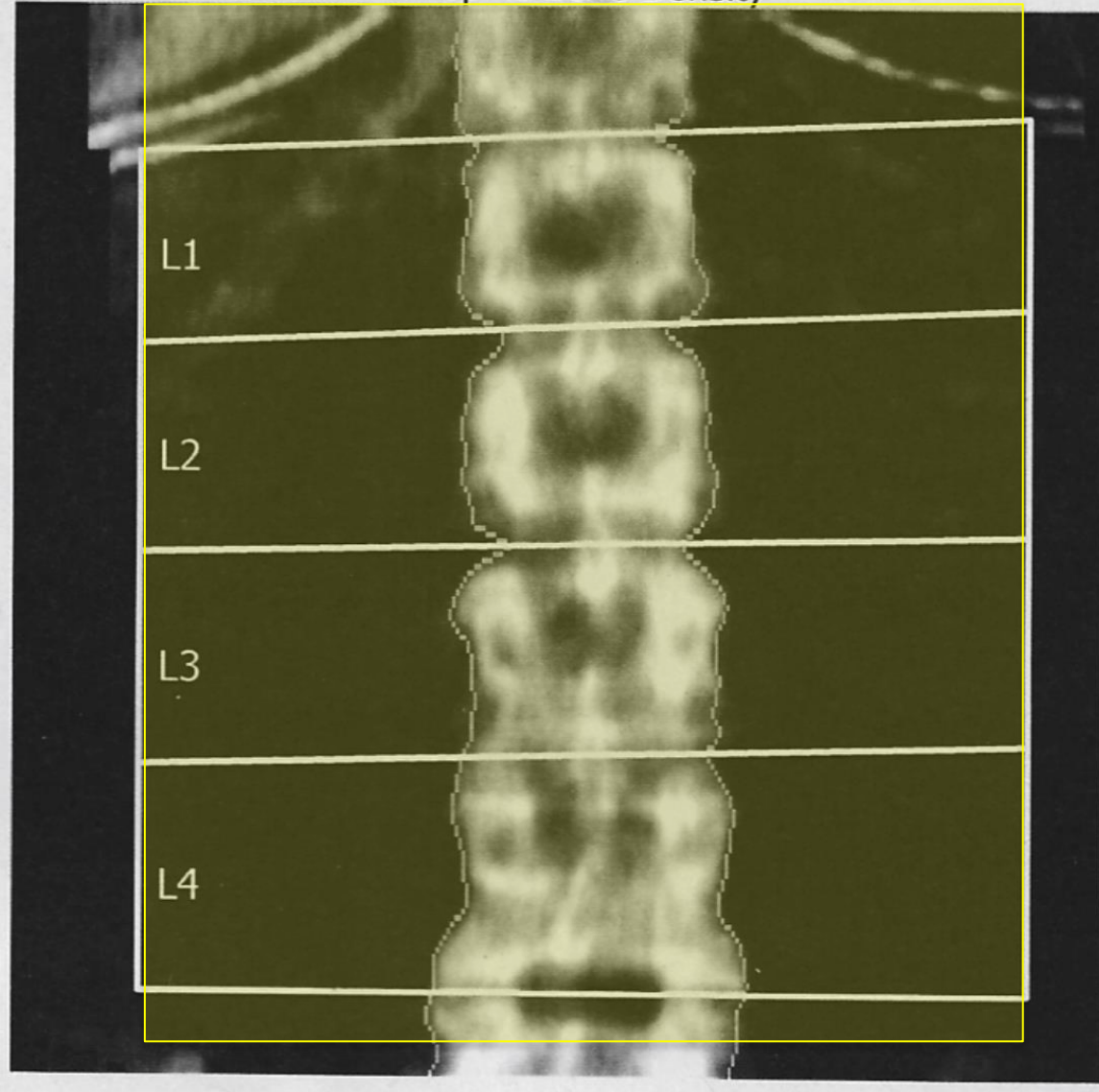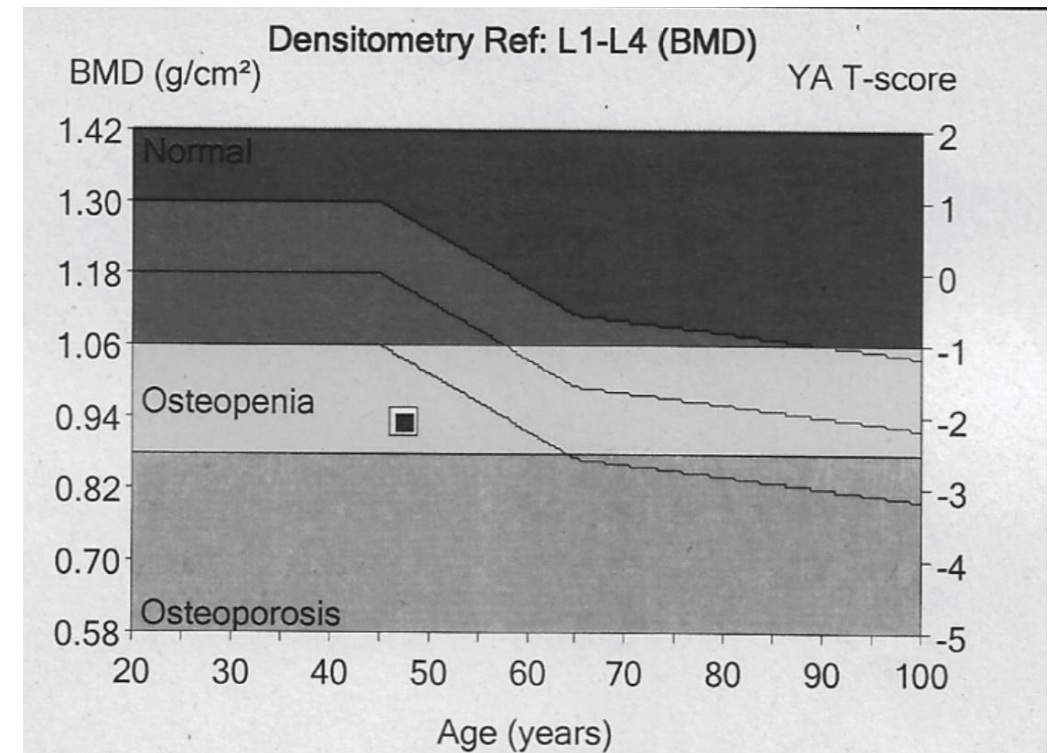
Spine 3

AP Spine Bone Density
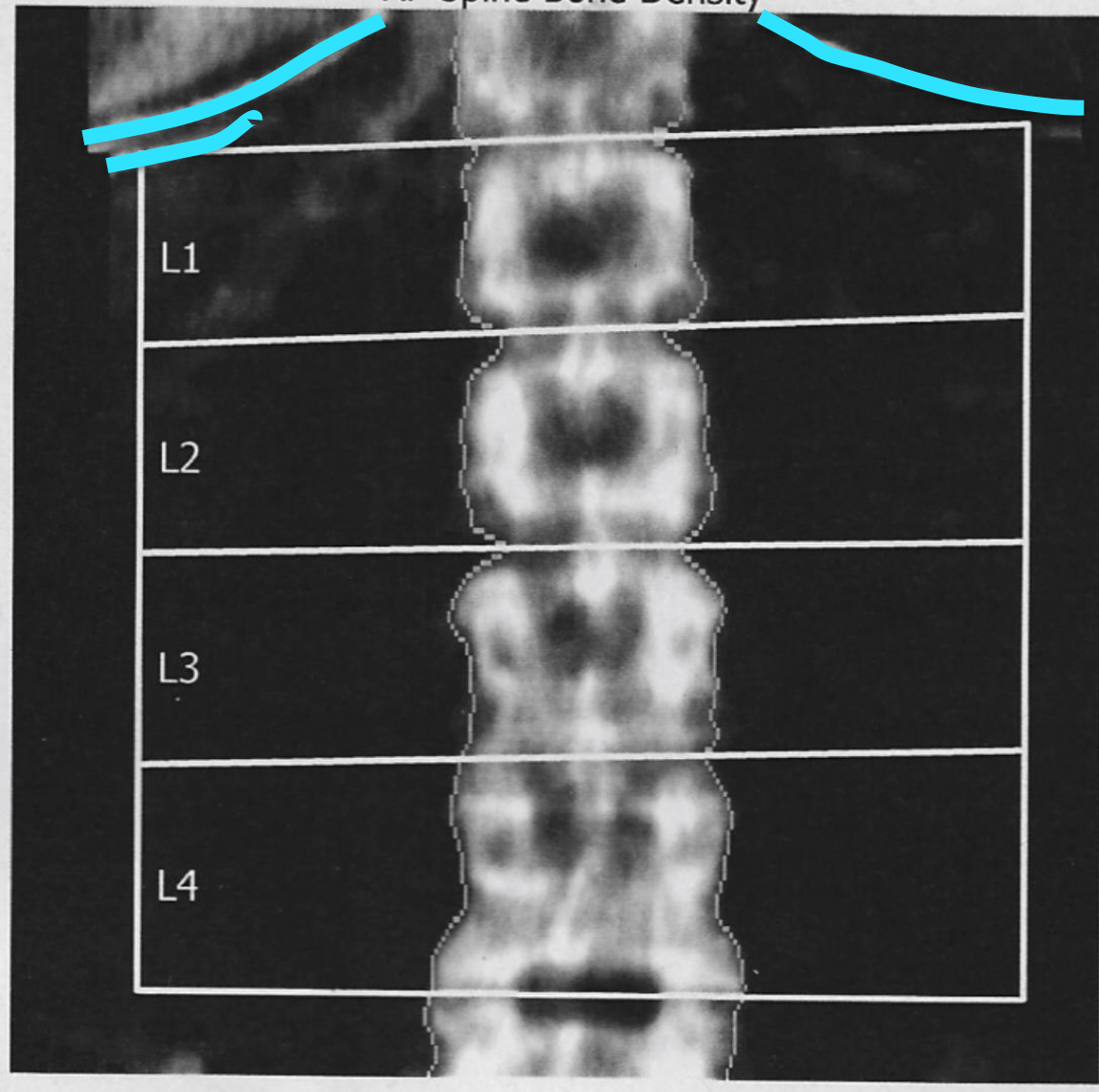
Region	BMD g/cm2	T-score	Z-score
L1-4 unmarked artefact	0.932	-2.1	-1.9
L1-4 artefact corrected	0.941	-2.0	-1.8

Error effect Including metal in soft tissue

Increased precision error

Decreased BMD

Decreased reliability

Spine 4

AP Spine Bone Density

L1
L2
L3
L4

Region	BMD g/cm2	T-score	Z-score
L1-4	0.685	-4.1	-2.4

Densitometry Ref: L1-L4 (BMD)

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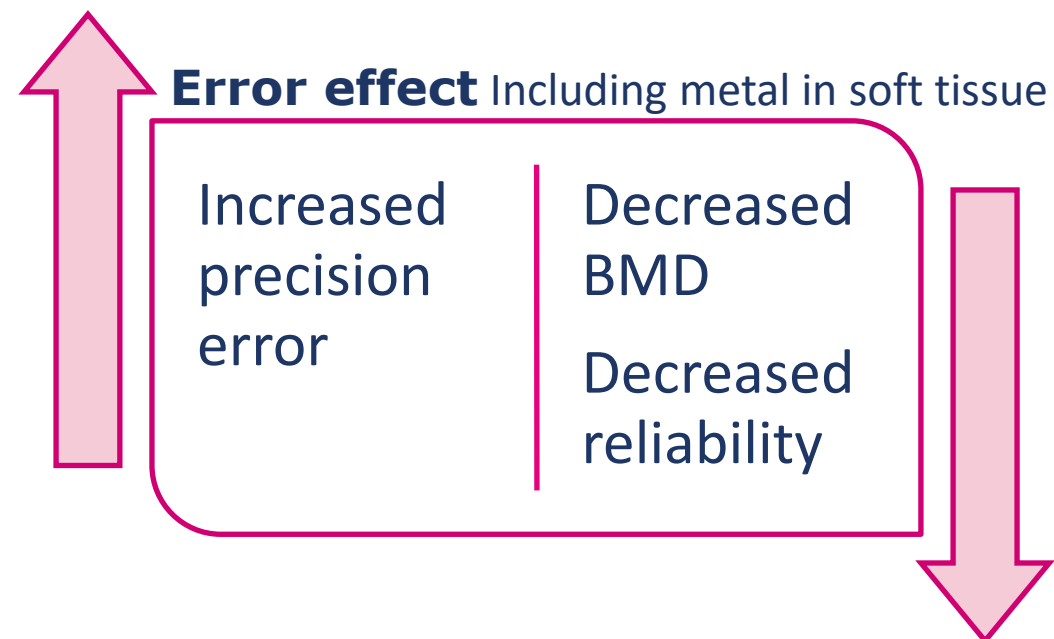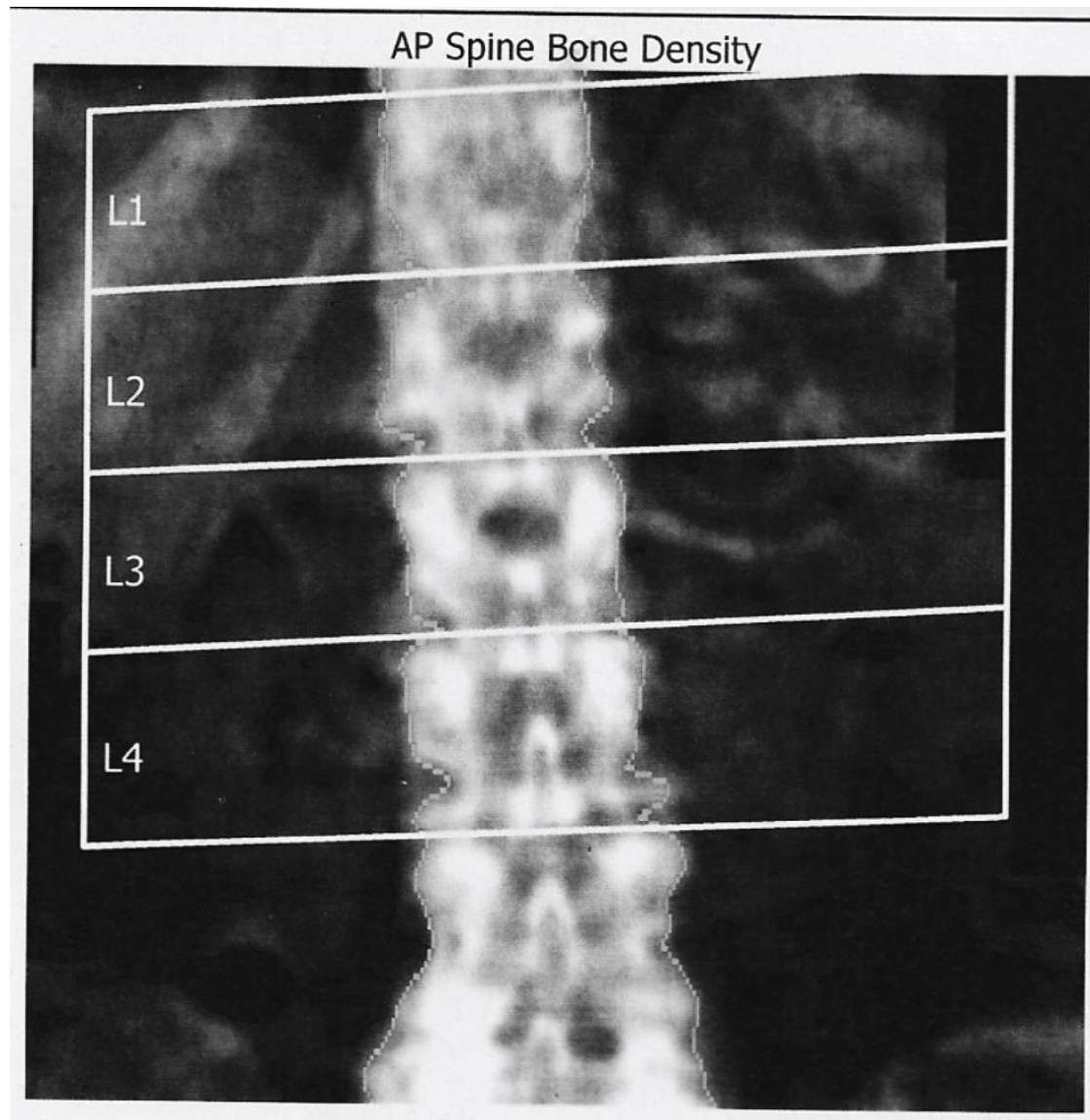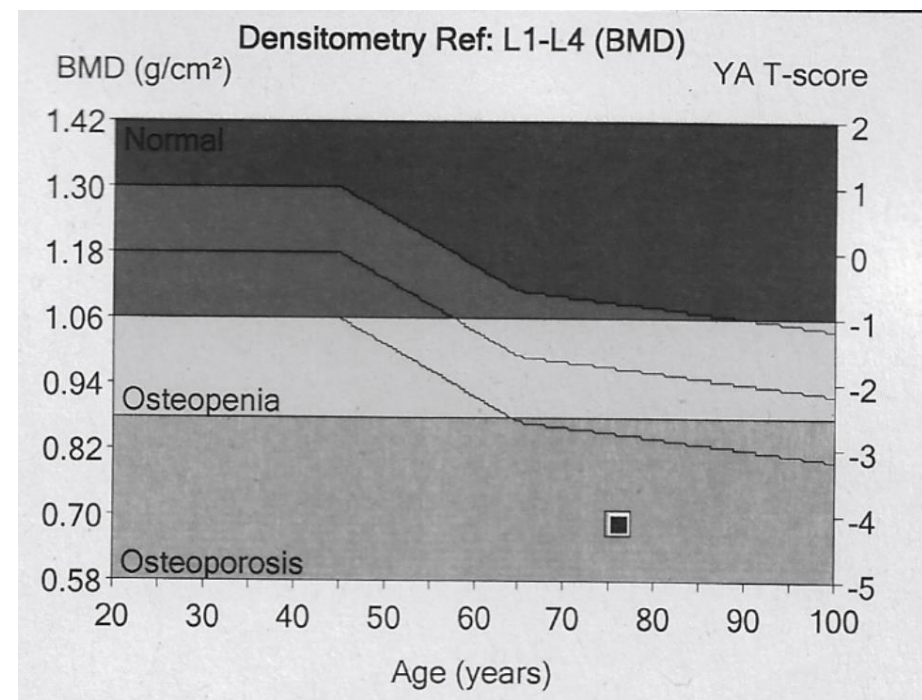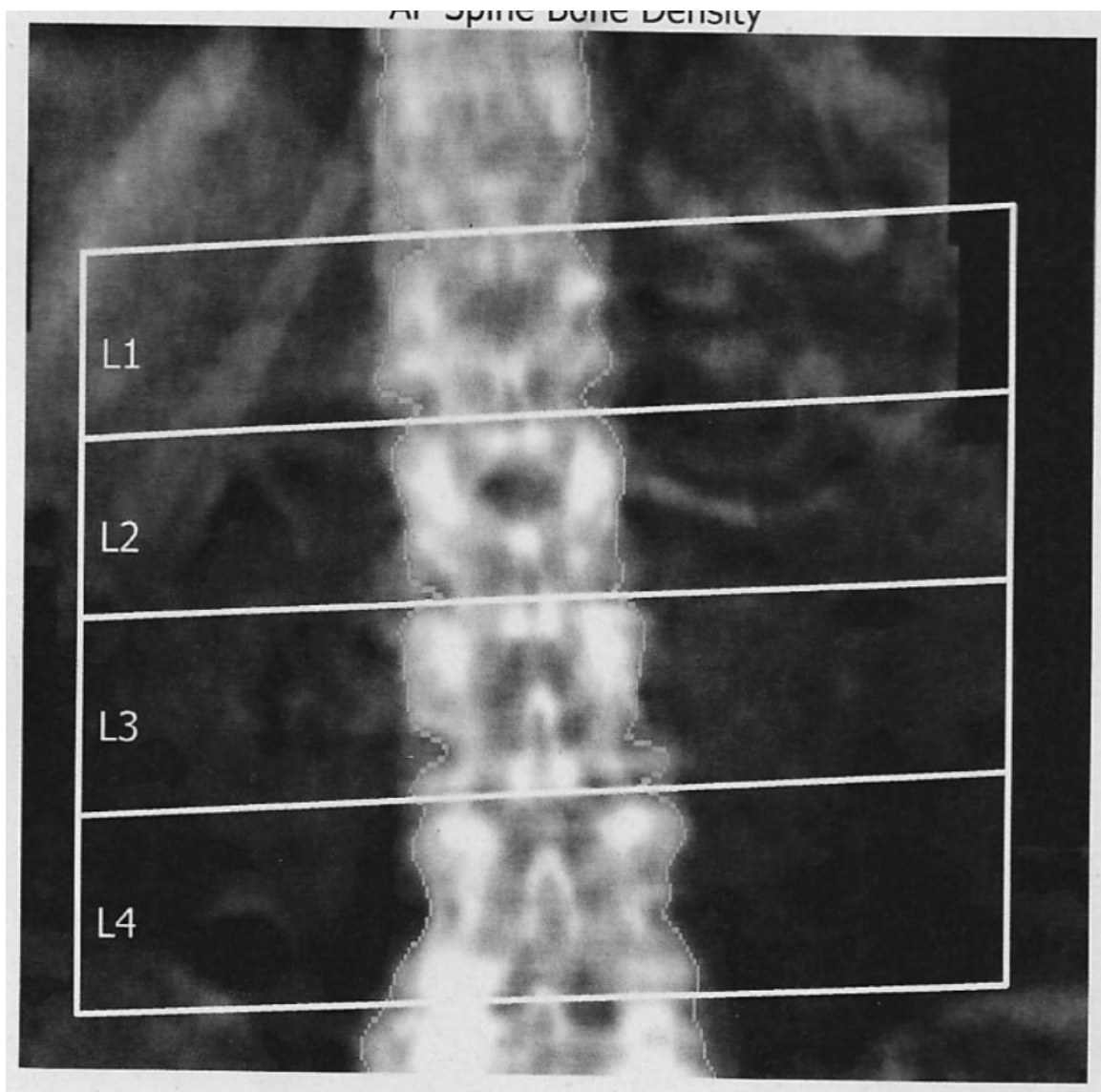
Spine 4

Region	BMD g/cm2	T-score	Z-score
L1-L4 incorrectly labelled	0.685	-4.1	-2.4
L1-4 corrected	0.746	-3.6	-1.8

Error effect labelling T12 as L1

Increased precision error

Decreased BMD

Decreased reliability

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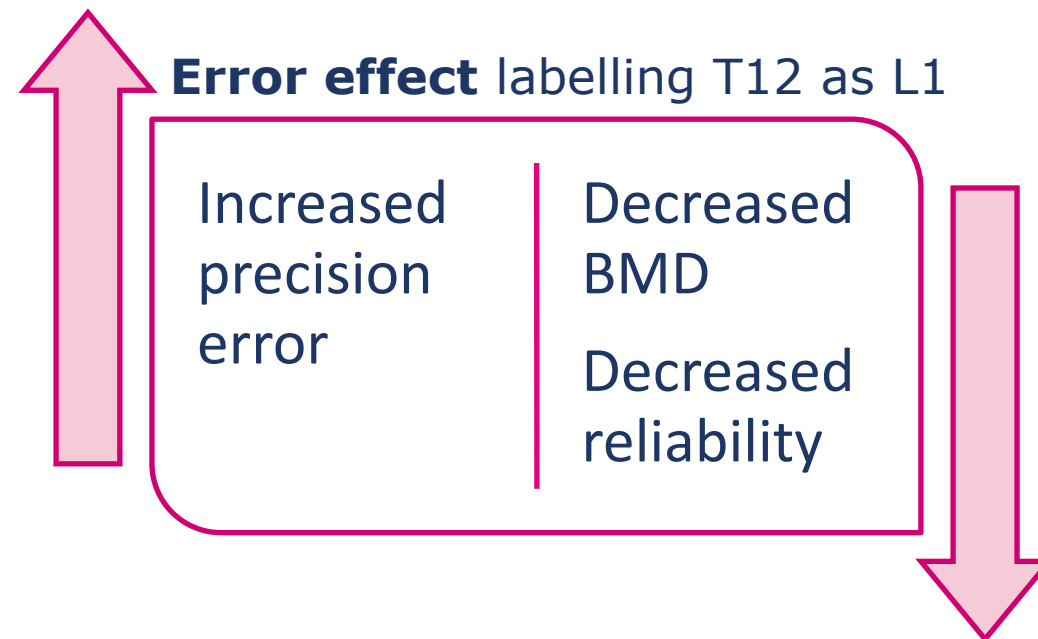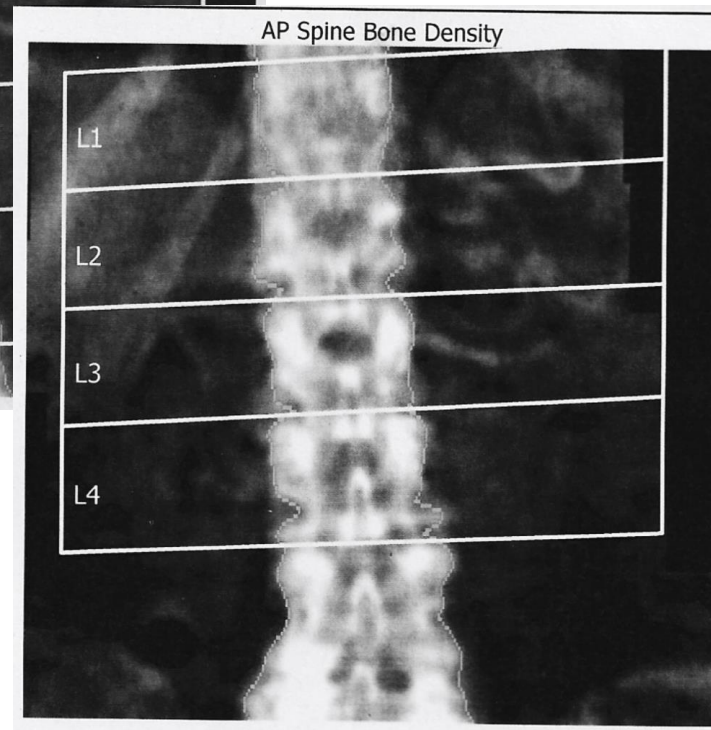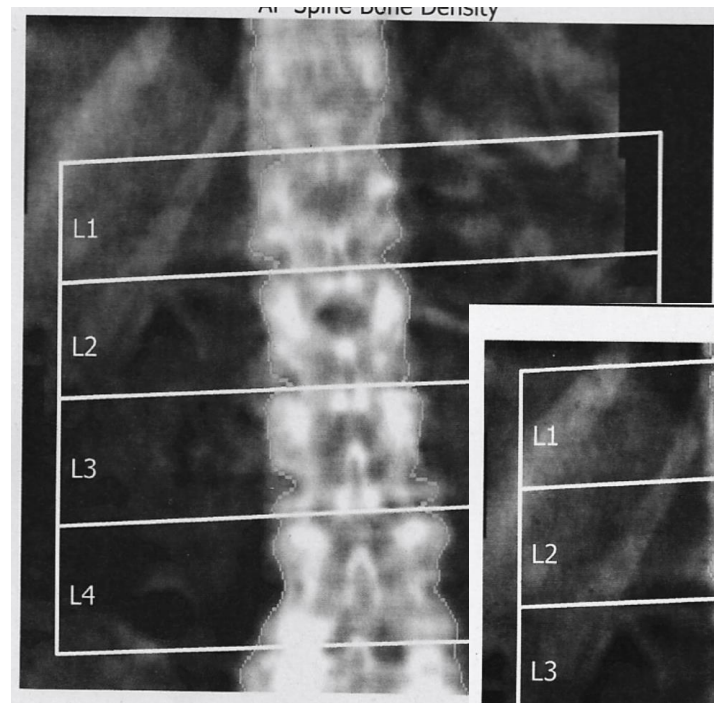
Spine 4

Region		BMD g/cm2	T-score	% change
T12-L3	Follow-up	0.685	-4.1	8%
L1-4 corrected	baseline	0.746	-3.6	

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Spine 4

AP Spine Bone Density
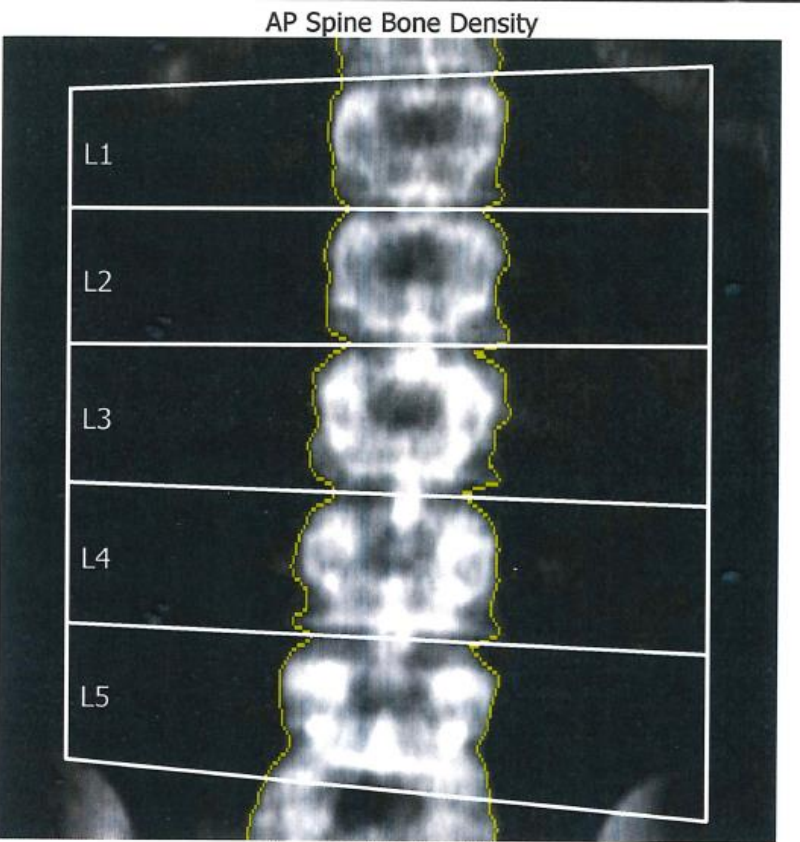
Region	BMD g/cm2	T-score
L1-L4	0.963	-2.5
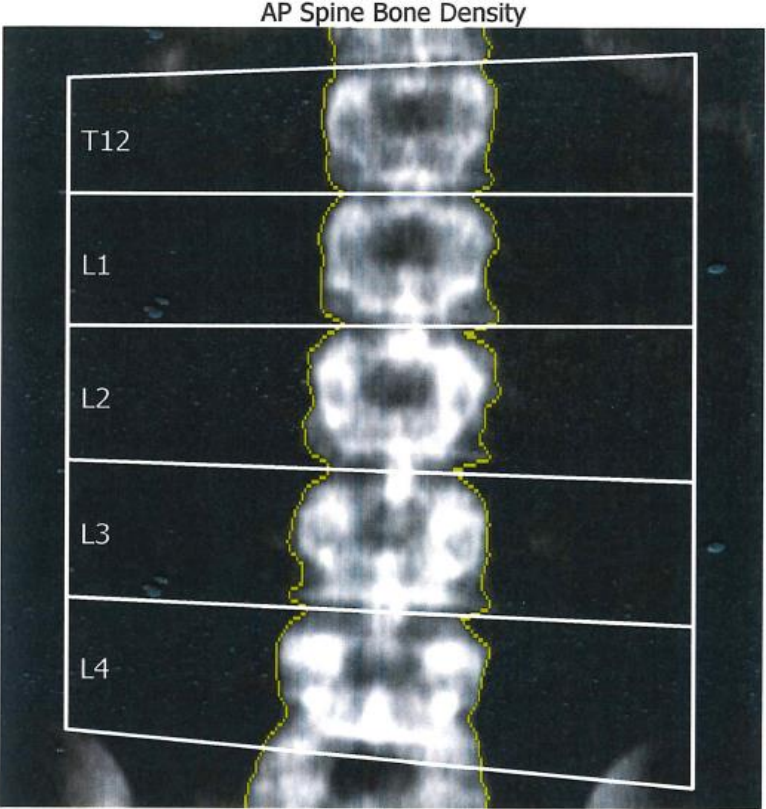
Region	BMD g/cm2	T-score
L1-L4	1.029	-1.7

TREATMENT ALERT

Spine 5

AP Spine Bone Density

Region	BMD g/cm2	T-score	Z-score
L1-4	0.992	-1.6	0.1

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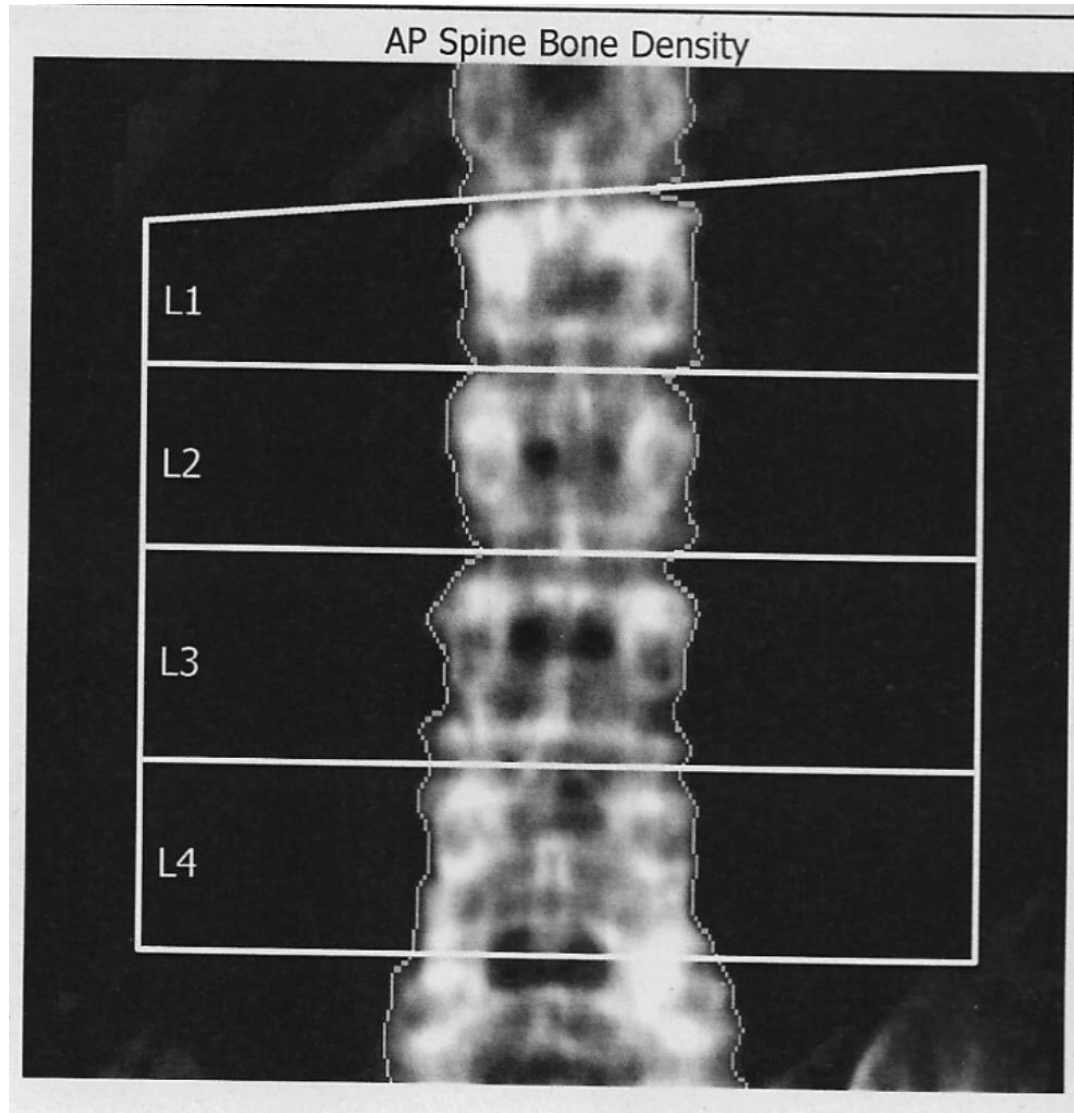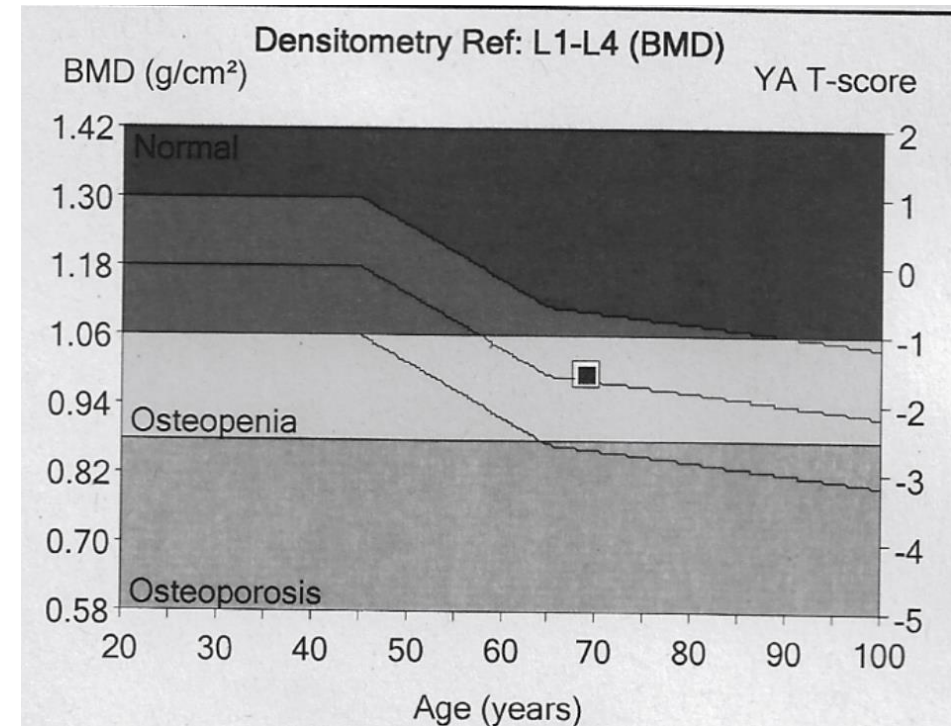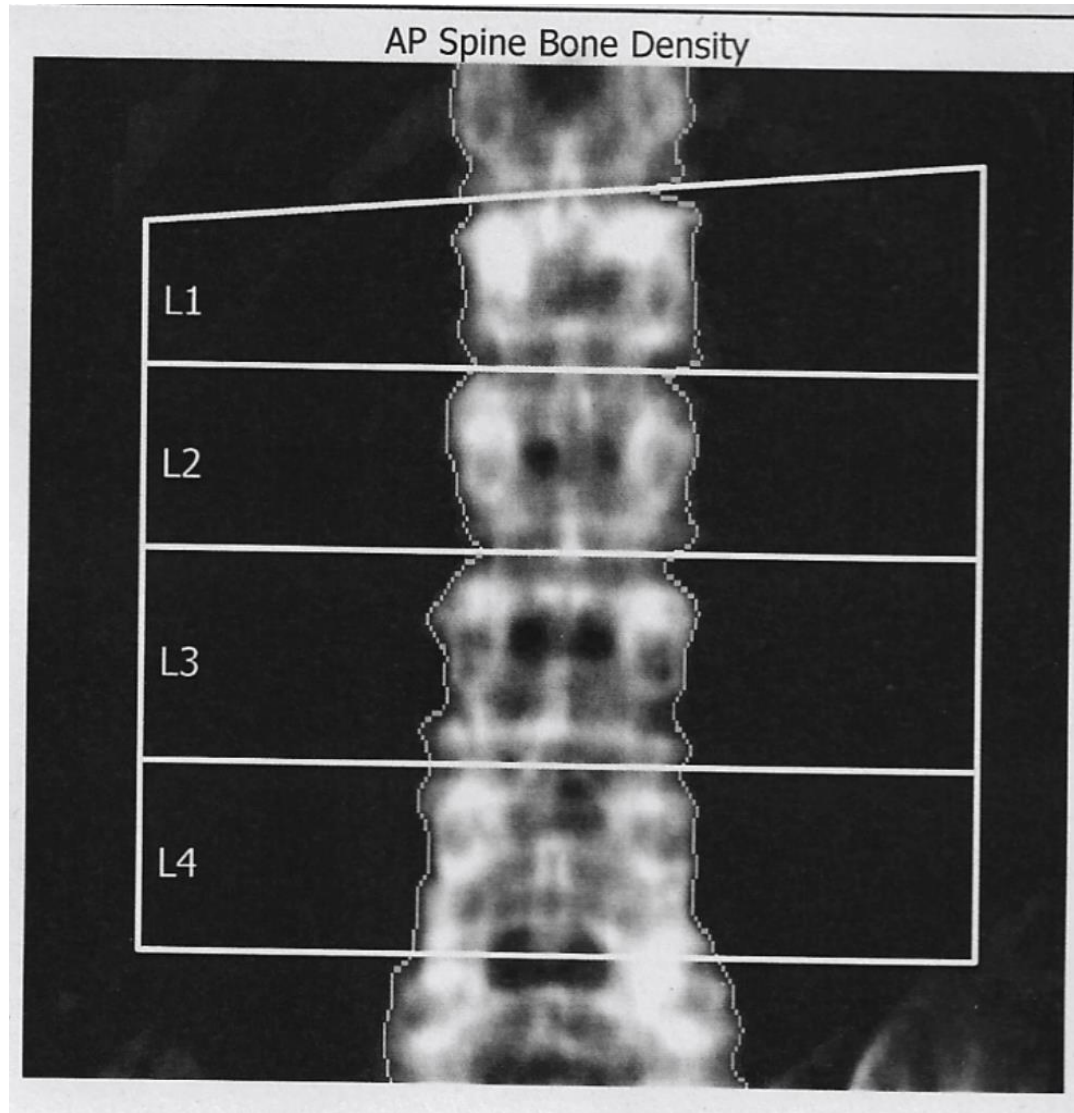
Spine 5

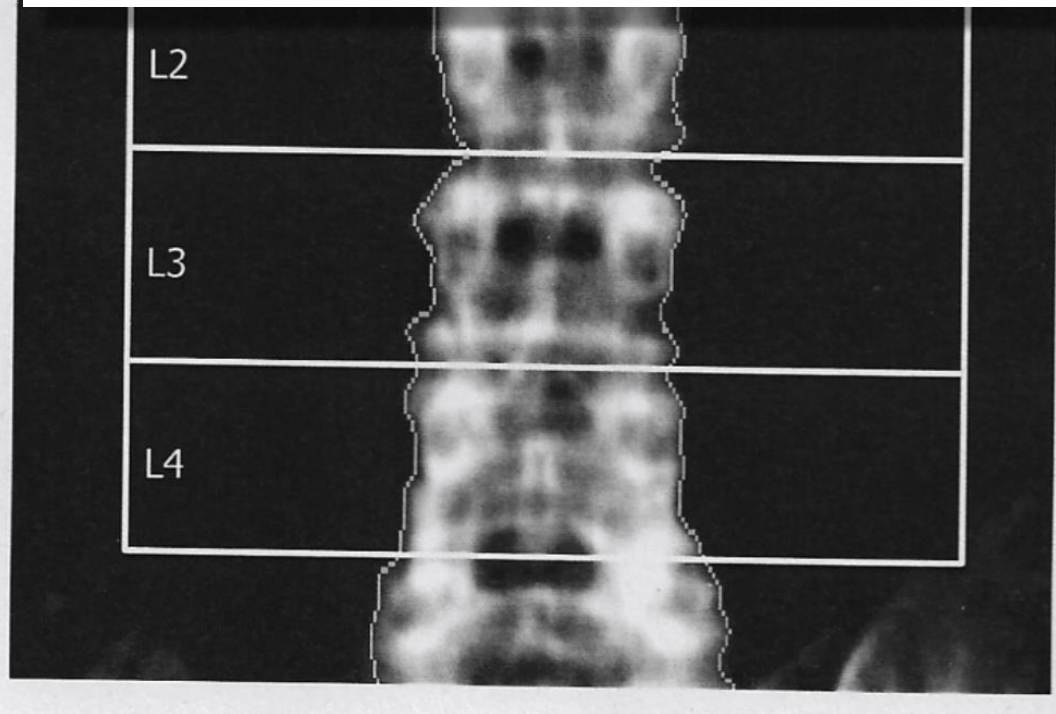| Region	BMD g/cm2	T-score
L1-4	0.992	-1.6
L1		-0.5
L2		-2.4
L3		-2.2
L4		-1.3

Spine 5

AP Spine Bone Density

Vertebrae will be excluded from analysis where:

1. There is a focal abnormality, regardless of the magnitude of impact on BMD. Examples include vertebral fracture, degenerative changes, vertebroplasty and implantable devices such as orthopaedic implants, stents, grafts etc. (illustrated by Figures 2 to 4).
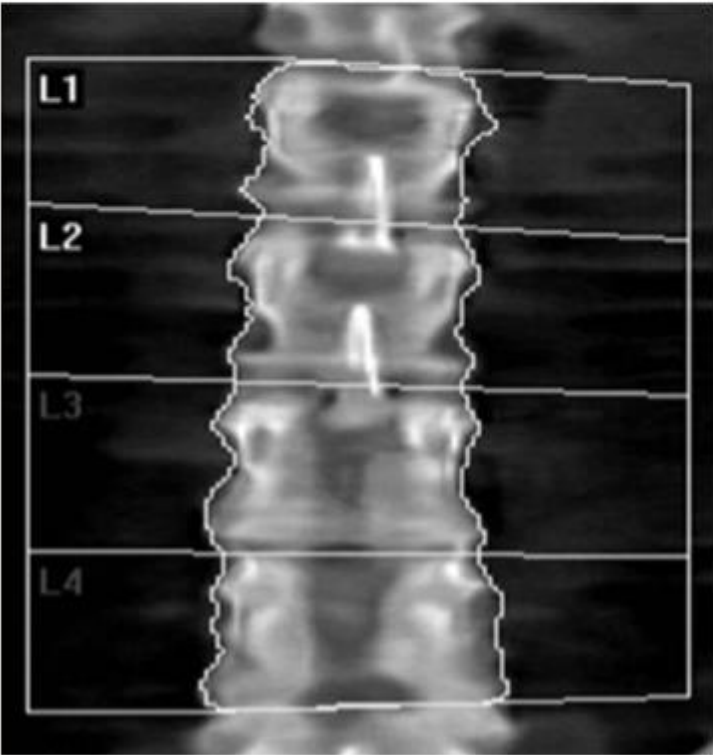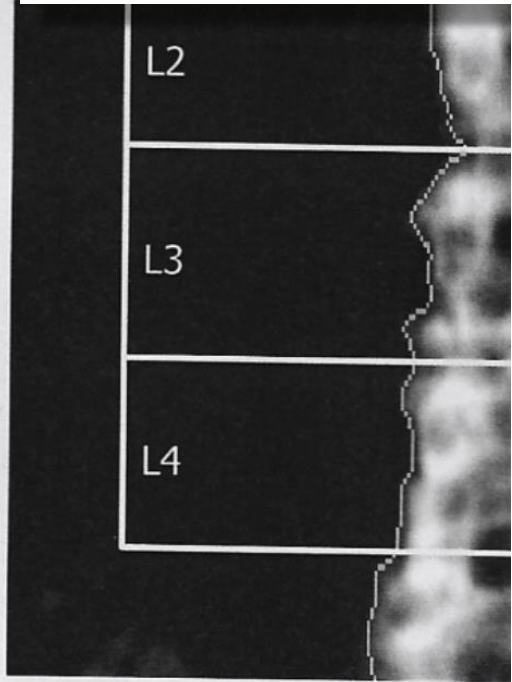
Region	BMD g/cm2	T-score
L2		-2.4
L3		-2.2
L4		-1.3

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Spine 5

Vertebrae will be ex[cluded]

AP Spine

1. There is a focal a[rea of increased BMD due to]
   fracture, degener[...]
   stents, grafts etc

2. The result differs by > 1SD from adjacent
   vertebra(e) *and* there is a visible abnormality
   to inform which vertebra(e) to exclude[10]
   (illustrated in Figure 5).

[g]/cm2 | T-score

[B]MD. Examples include vertebral
such as orthopaedic implants,

	T-score
	-2.4
	-2.2
	-1.3

T-score	
L1	-1.4
L2	-1.3
L3	-2.5
L4	-2.6

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Spine 5

AP Spine

Vertebrae will be exc

1. There is a focal a fracture, degene stents, grafts etc

2. The res vertebra to inforr (illustra

3. There is an artefact overlying the vertebra(e) or in the soft tissue adjacent to the vertebra(e) affecting the validity of the measurement in accordance with the manufacturer's user manual (ilustrated in Figure 6).
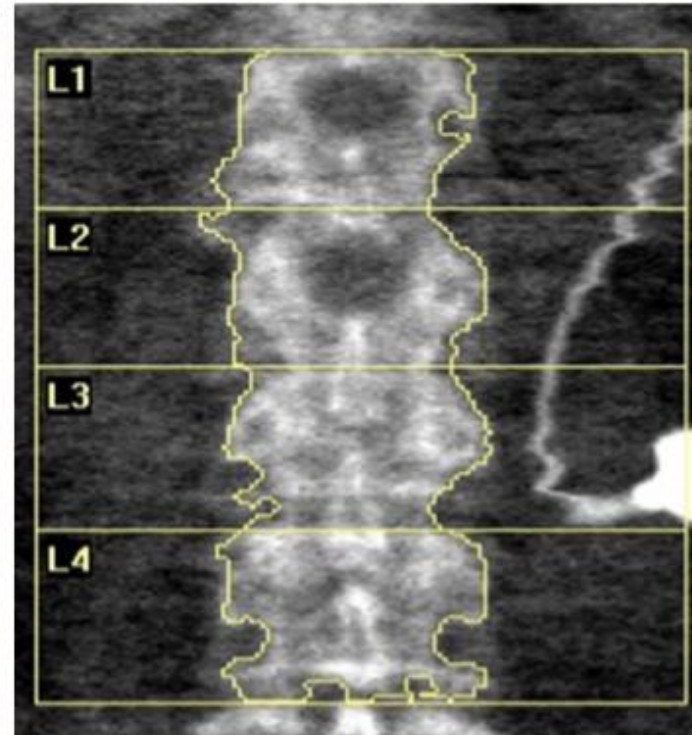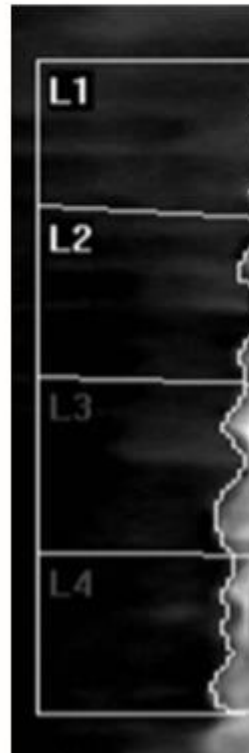
score

include vertebral
aedic implants,

2.4

2.2

1.3
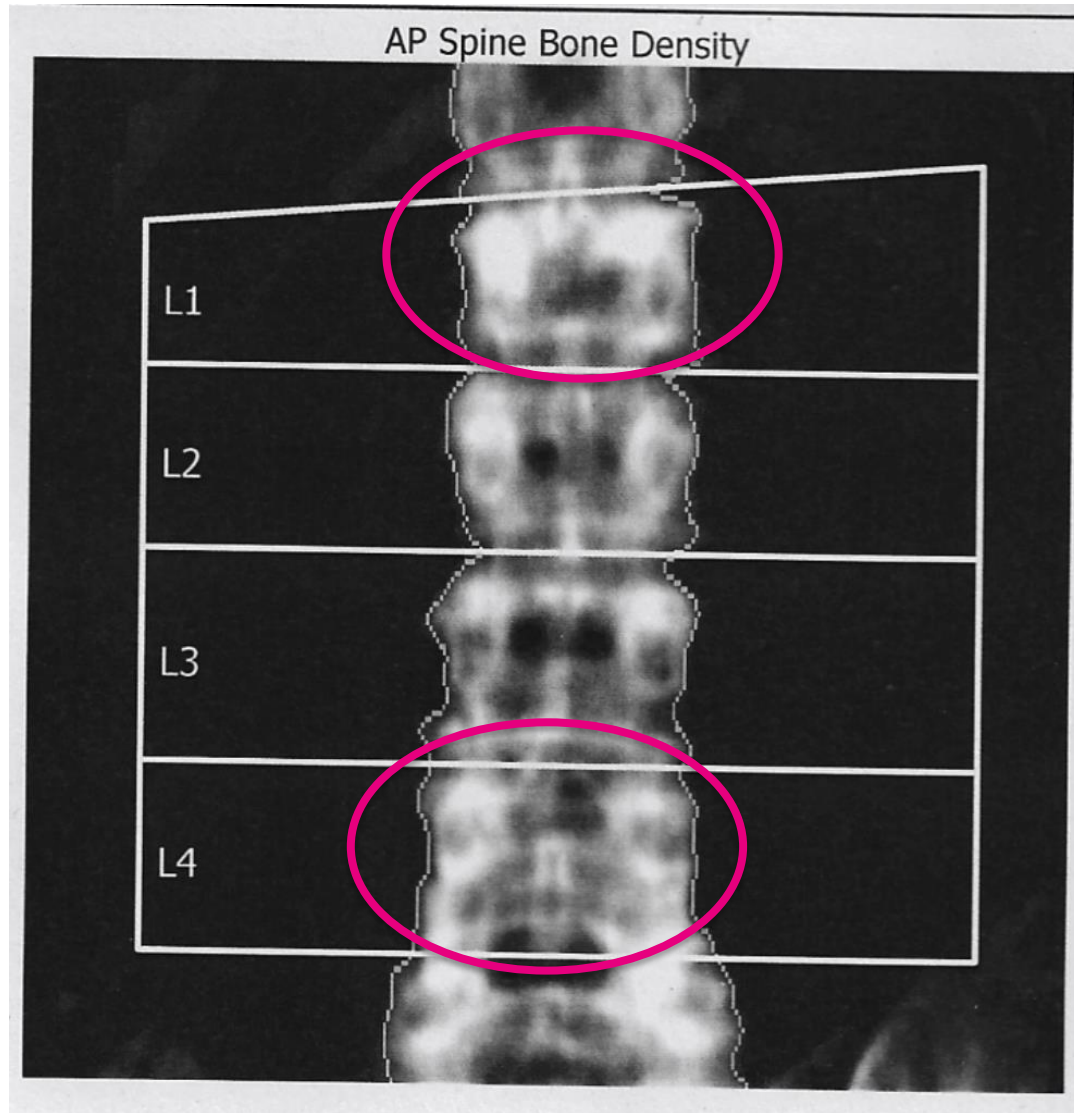
Figure 6: DXA image showing soft tissue artefact from gastric band adjacent to L1 to 3

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Spine 5

AP Spine Bone Density

Region	BMD g/cm2	T-score
L1-4	0.992	-1.6
L1		-0.5
L2		-2.4
L3		-2.2
L4		-1.3

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Spine 5

AP Spine Bone Density
(L1)
L2
L3
(L4)

Region	BMD g/cm2	T-score	Z-score
L1-4	0.992	-1.6	0.1
L2–3	0.926	-2.3	-0.6

Error effect inclusion of degenerative change

Increased BMD

Increased precision error

Decreased reliability

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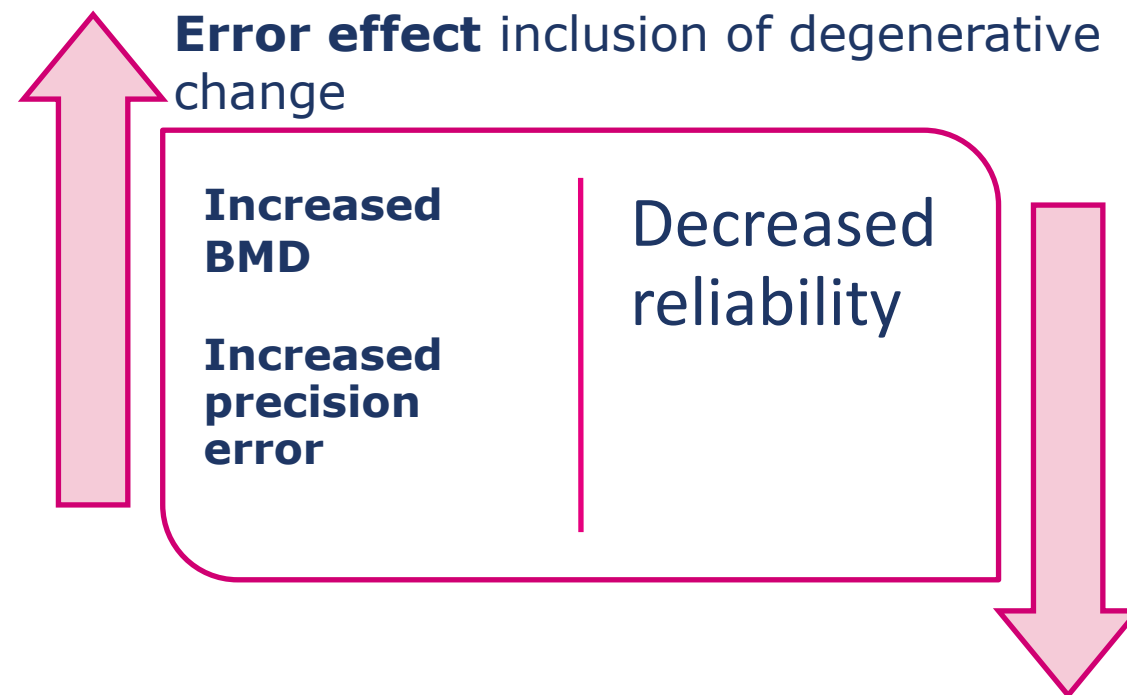
Femur 1

Left Femur Bone Density
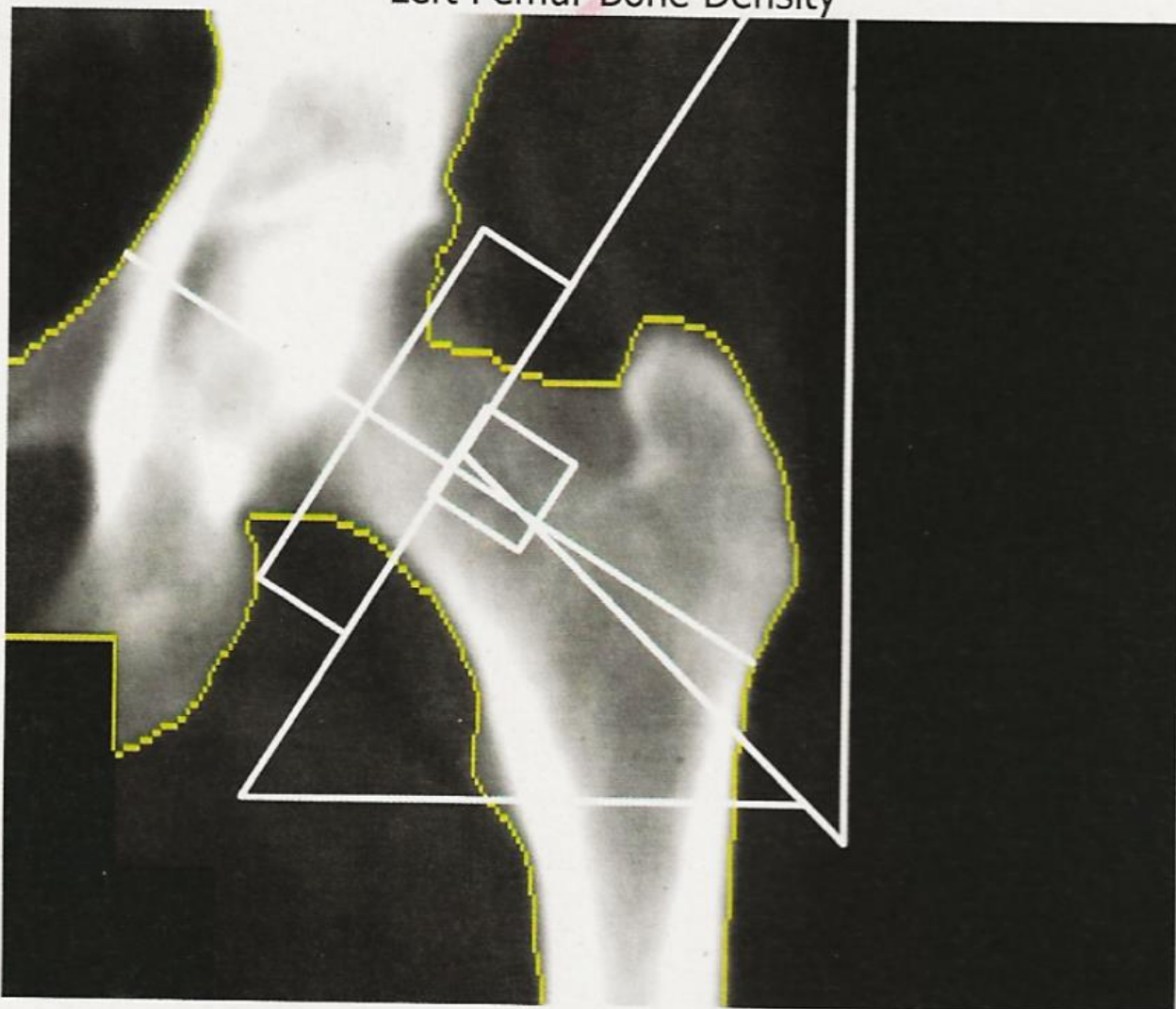
Region	BMD g/cm2	T-score
Total	0.992	-1.6
NOF	0.819	-1.6

Femur 1

Left Femur Bone Density

Left Femur Bone Density
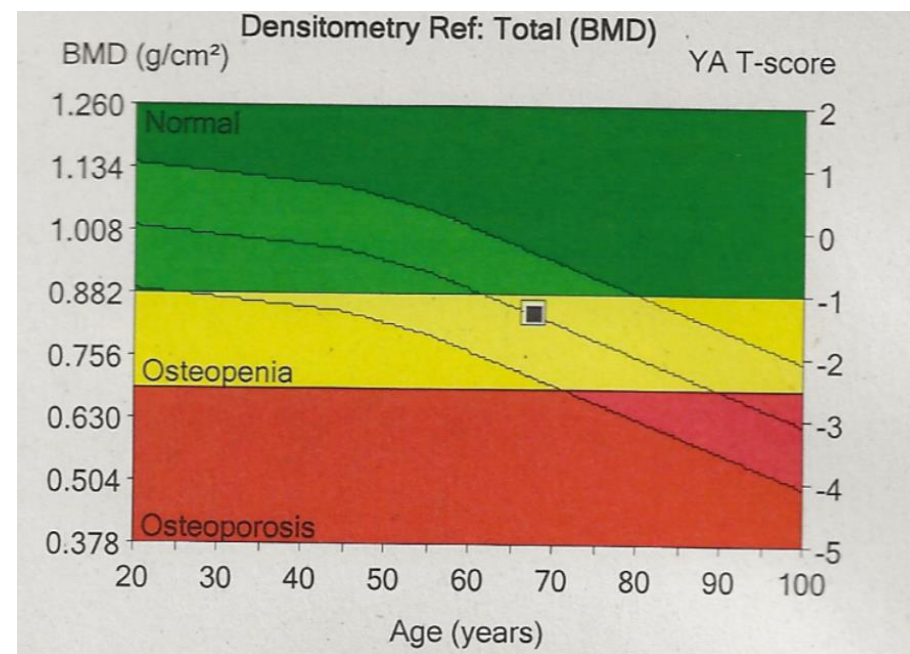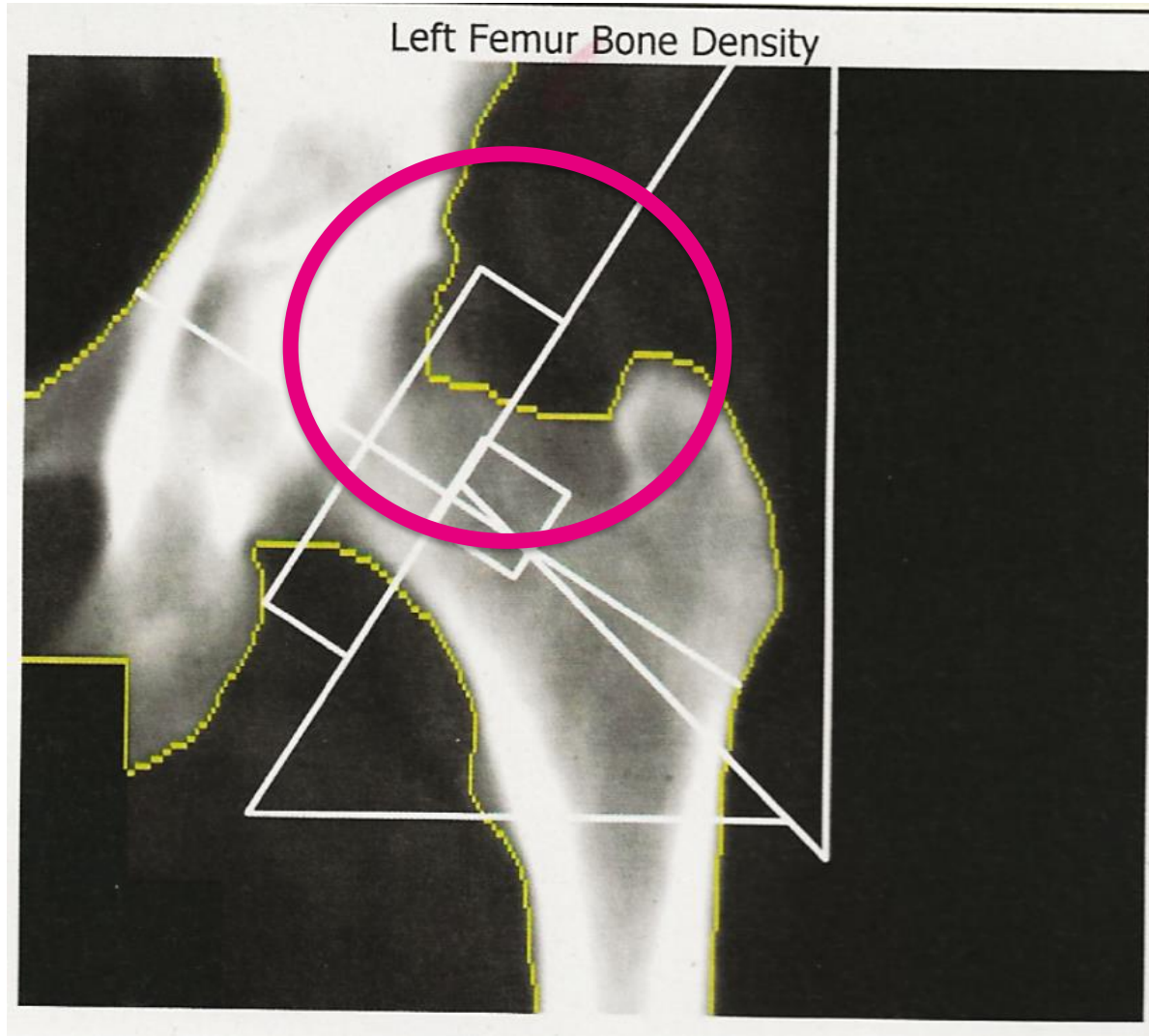
FN box measuring bone as ST and incorrect place

Femur 1

Left Femur Bone Density
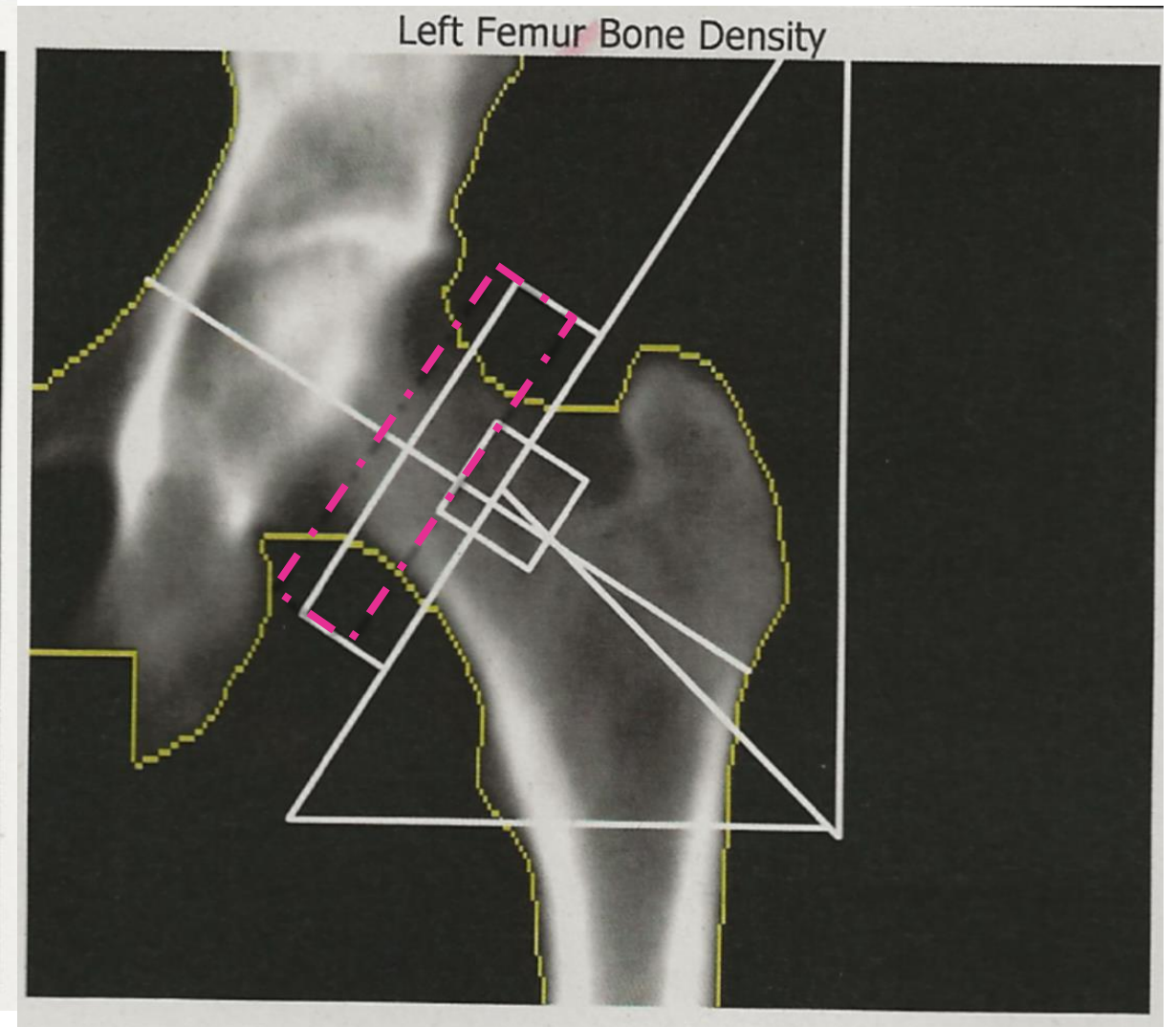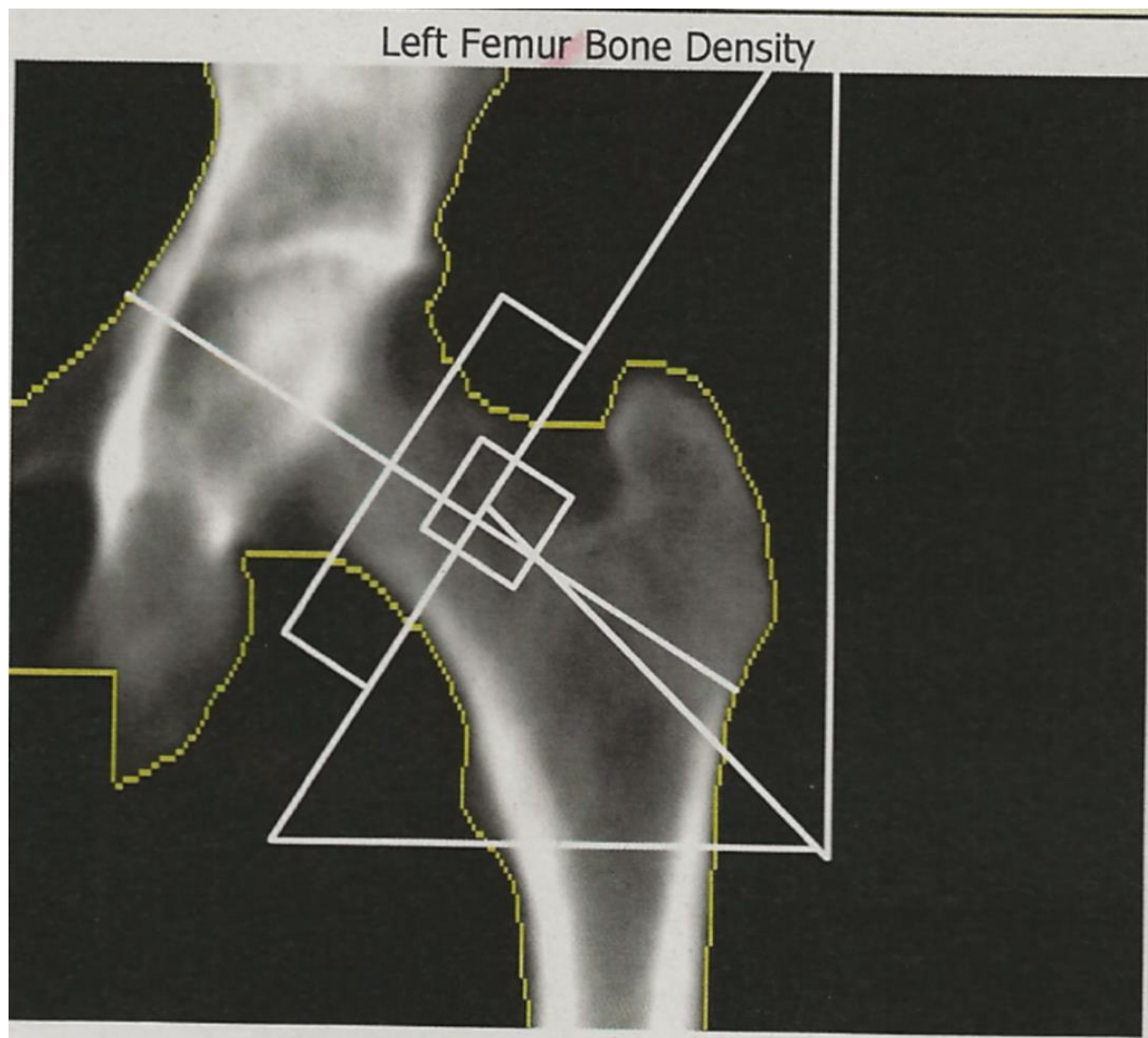
Region	BMD g/cm2	T-score
Total Incorrectly placed	0.846	-1.3
Total Corrected	0.851	-1.2
NOF Incorrectly placed	0.819	-1.6
NOF Corrected	0.783	-1.8

Error effect poor bone map & incorrect FN box placement

Increases NOF BMD	Decreases Total BMD

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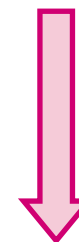
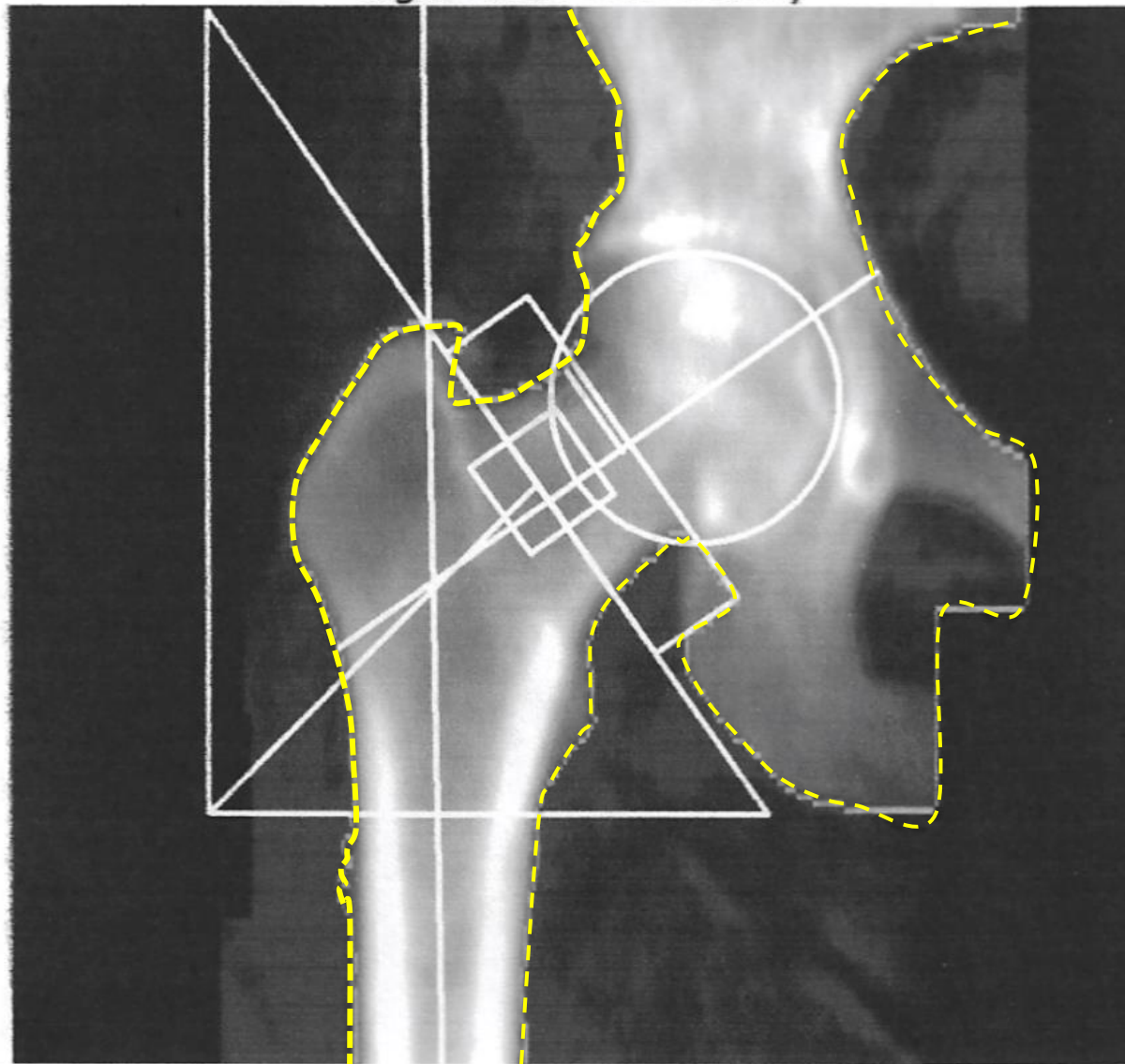# Femur 1

Effect on fracture risk assessment using FRAX
Risk factors:
female, ages 67 years with fragility fracture

Region	BMD g/cm2	T-score	FRAX major osteoporotic fracture	FRAX hip fracture
NOF Incorrectly placed	0.819	-1.6	14.3%	2.1%
NOF Corrected	0.783	-1.8	15.8%	2.7%

Femur 2

Right Femur Bone Density

Region	BMD g/cm2	T-score
Total	1.174	1.3
NOF	1.108	0.5

Femur 2

Right Femur Bone Density
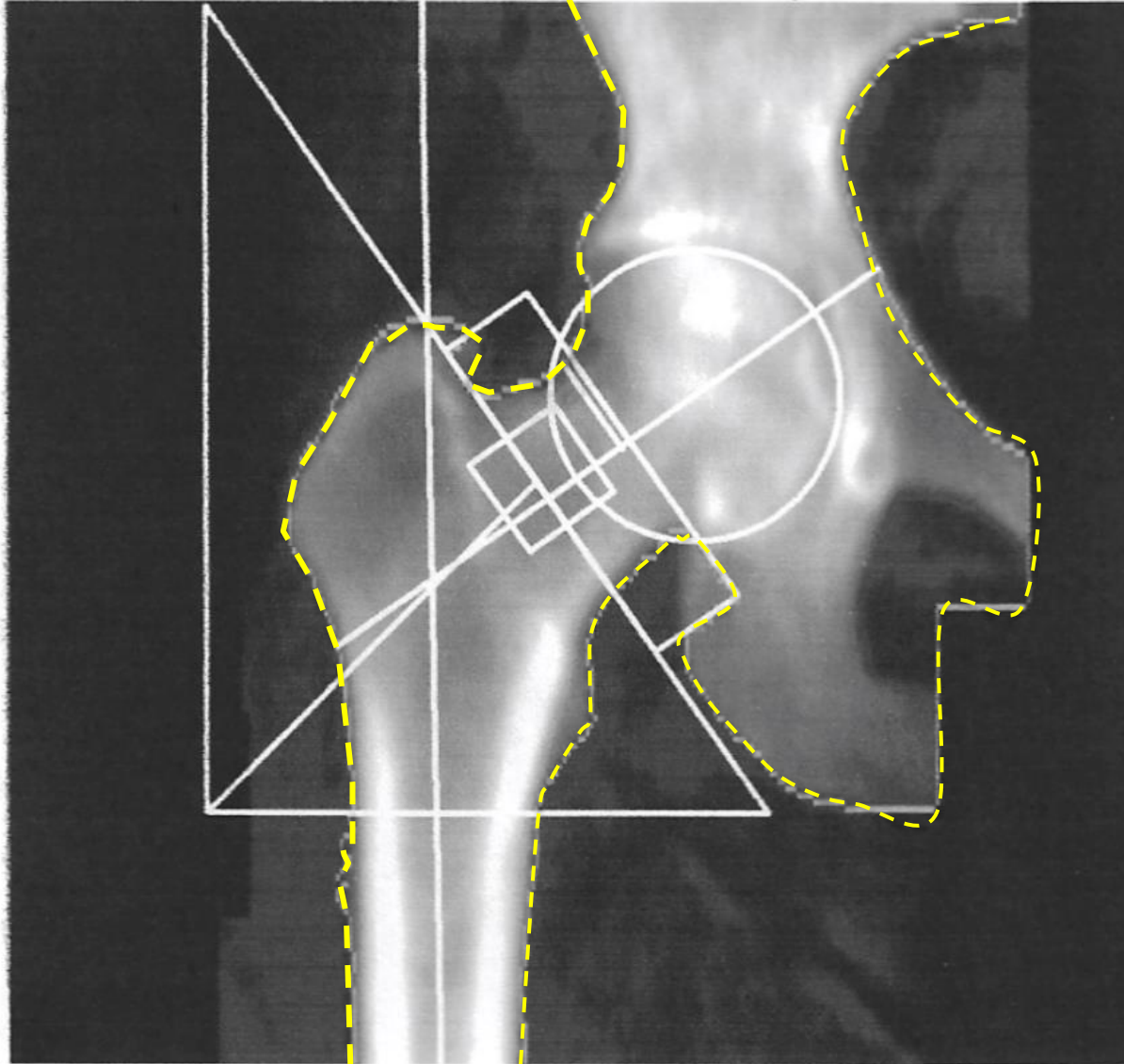
Right Femur Bone Density
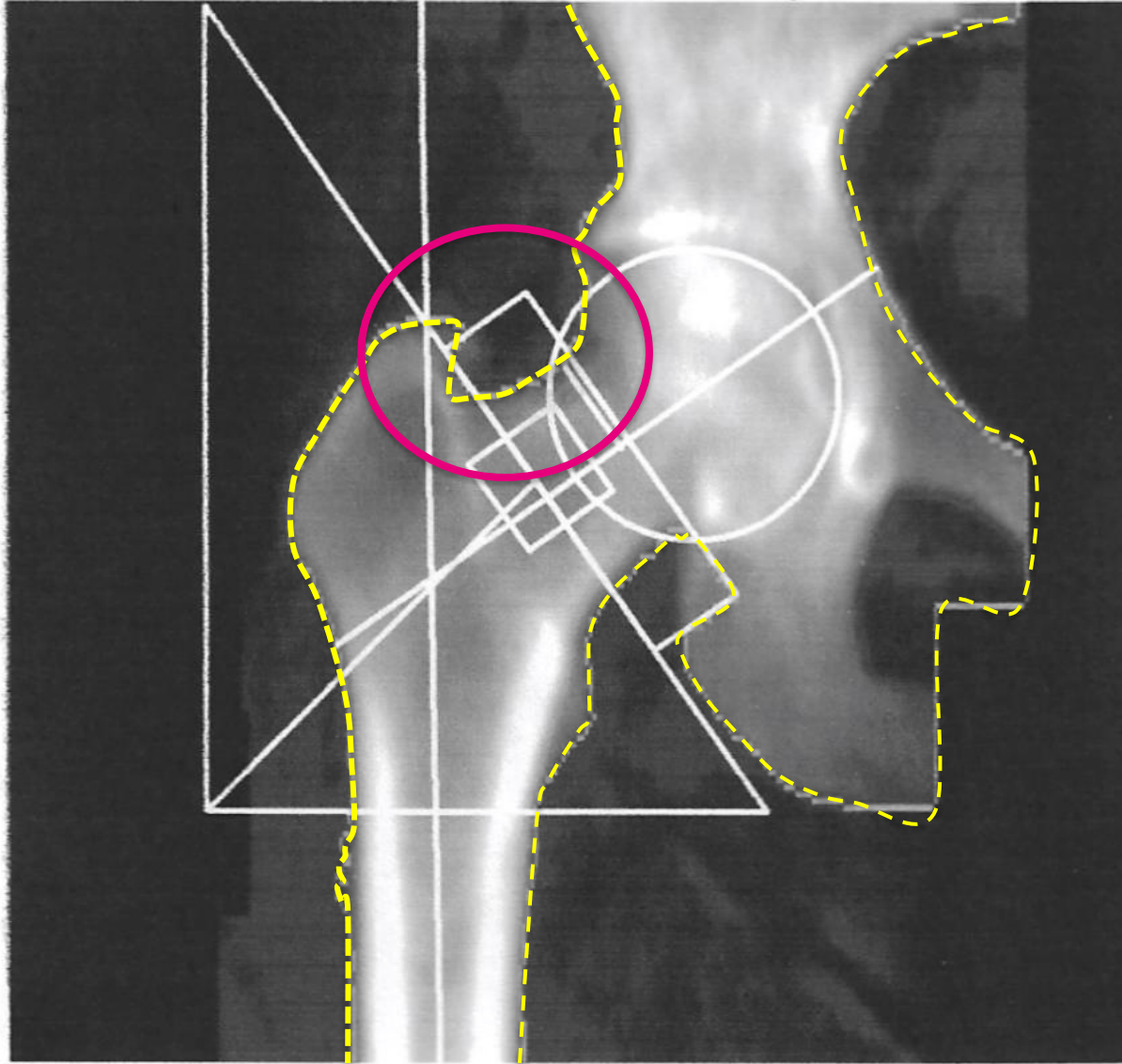
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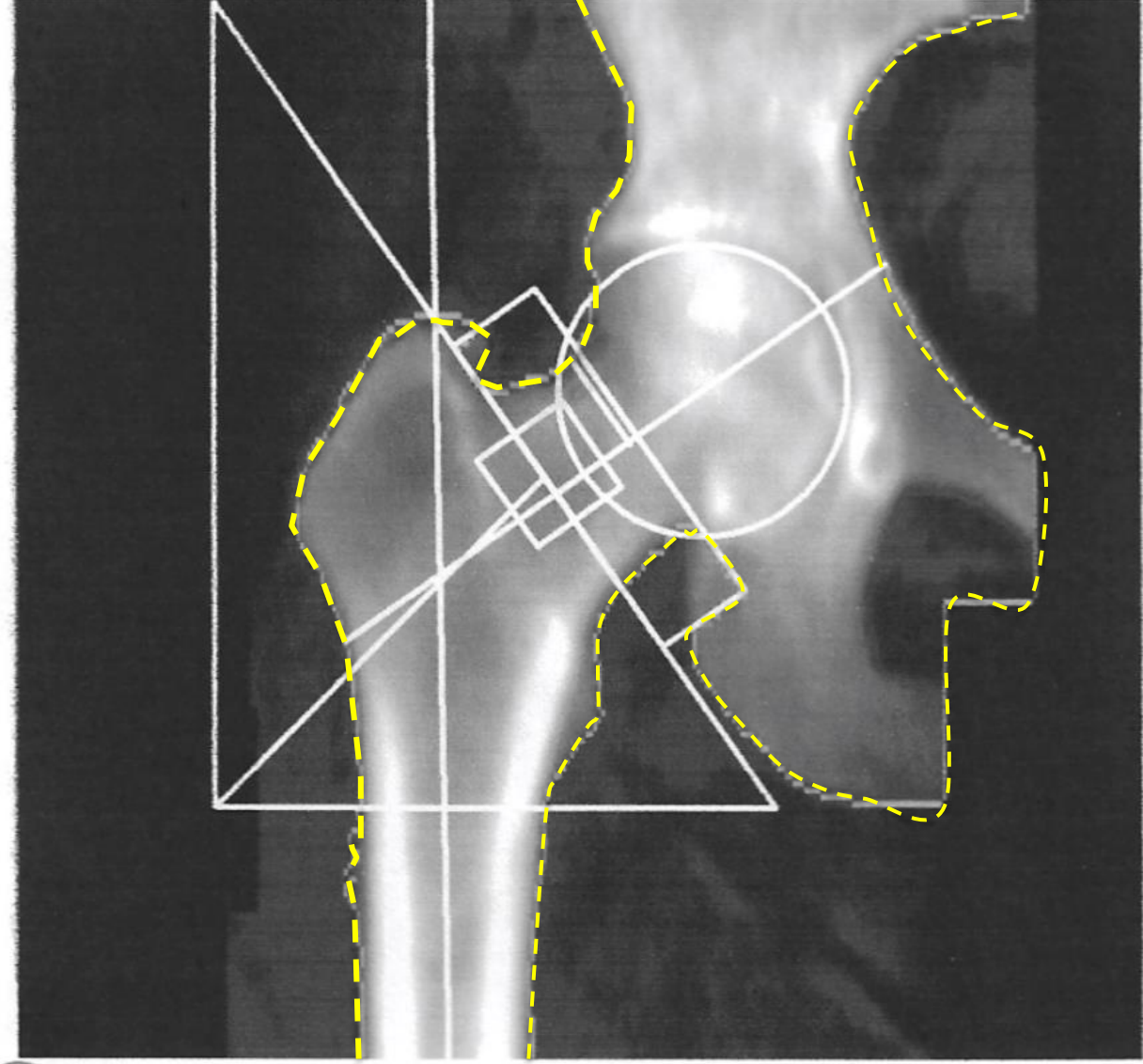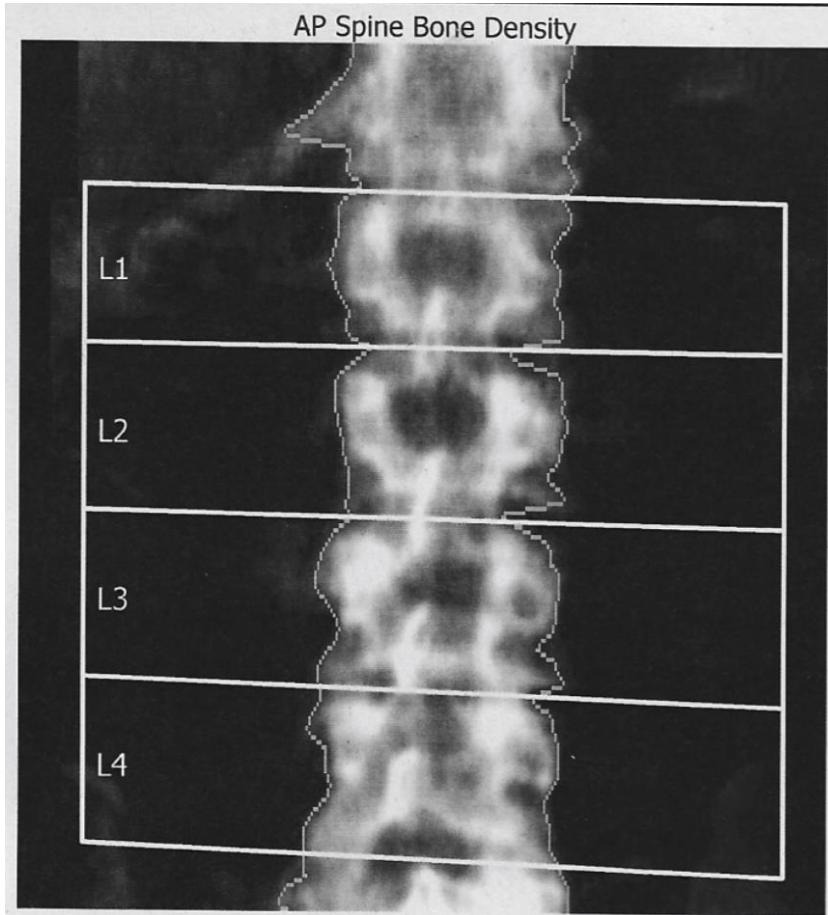
Femur 2

Right Femur Bone Density

Error effect: poor bone map deleting greater trochanter
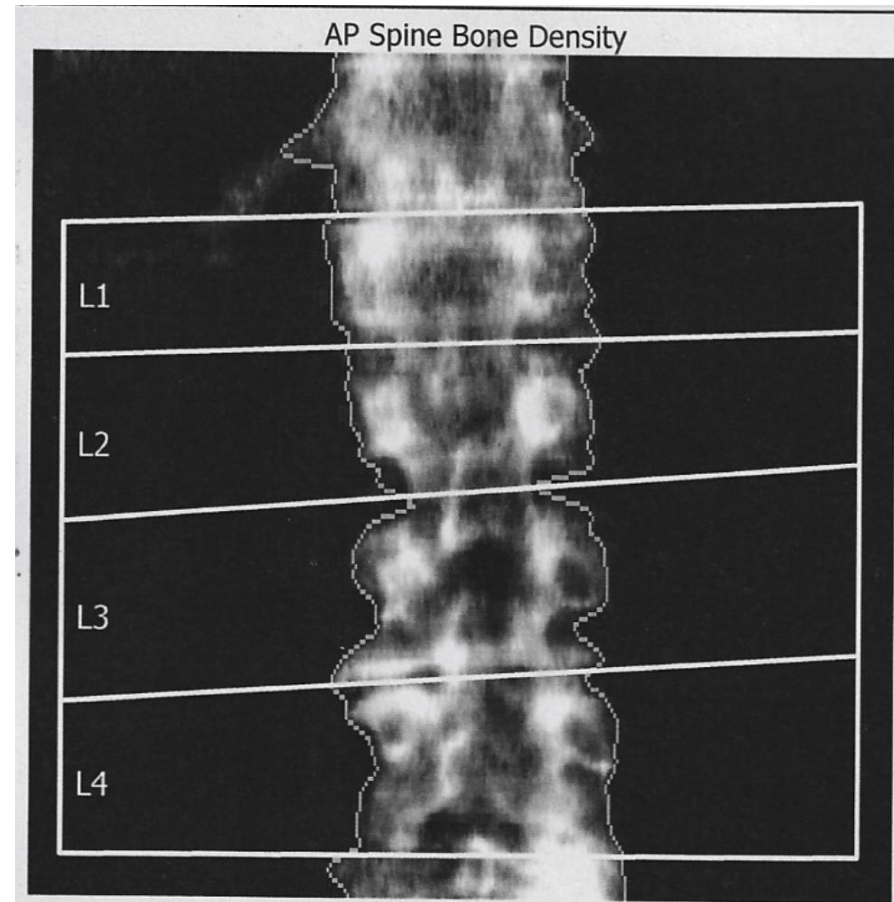
Incorrect total hip measurement

?? Effect on BMD
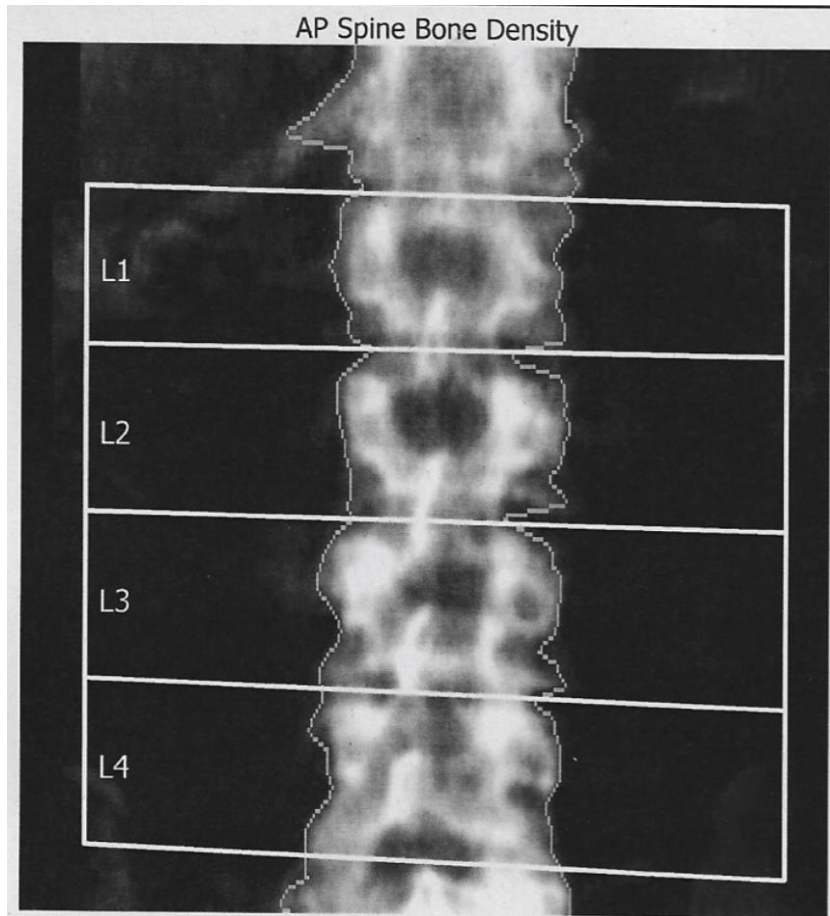
Decreased reliability of NOF measurement

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Follow up case 1

Region	BMD g/cm2	T-score	Z-score
L1-4	1.026	-1.6	-1.5

Region	BMD g/cm2	T-score	Z-score	% change
L1-4	0.959	-2.2	-2	-6.5 %

Follow up case 1

Region	BMD g/cm2	T-score	Z-score
L1-4	1.026	-1.6	-1.5

Region	BMD g/cm2	T-score	Z-score	% change
L1-4	0.959	-2.2	-2	-6.5 %

Follow up case 1

AP Spine Bone Density
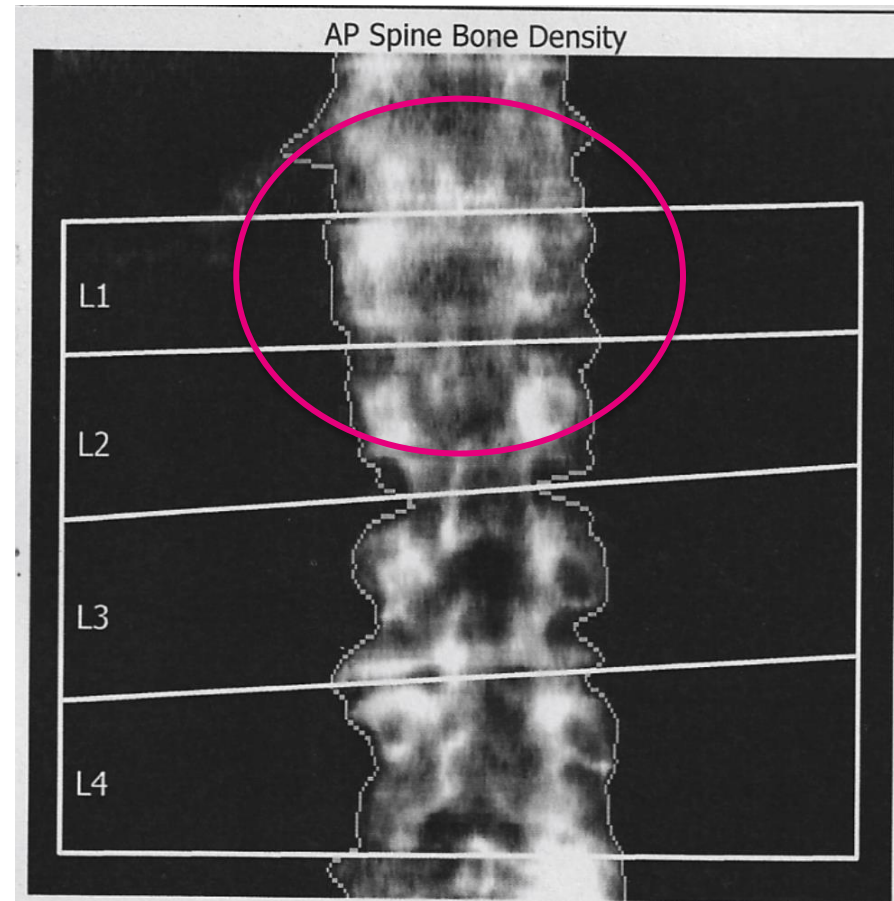
Region	BMD g/cm2	T-score	Z-score	% change
L1-4	0.959	-2.2	-2	-6.5 %
L2-4	0.963	-2.3	-2.1	-9.2 %

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Reliable or not reliable???

Left Femur Bone Density

Left Femur Bone Density

Image not for diagnosis

Image not for diagnosis
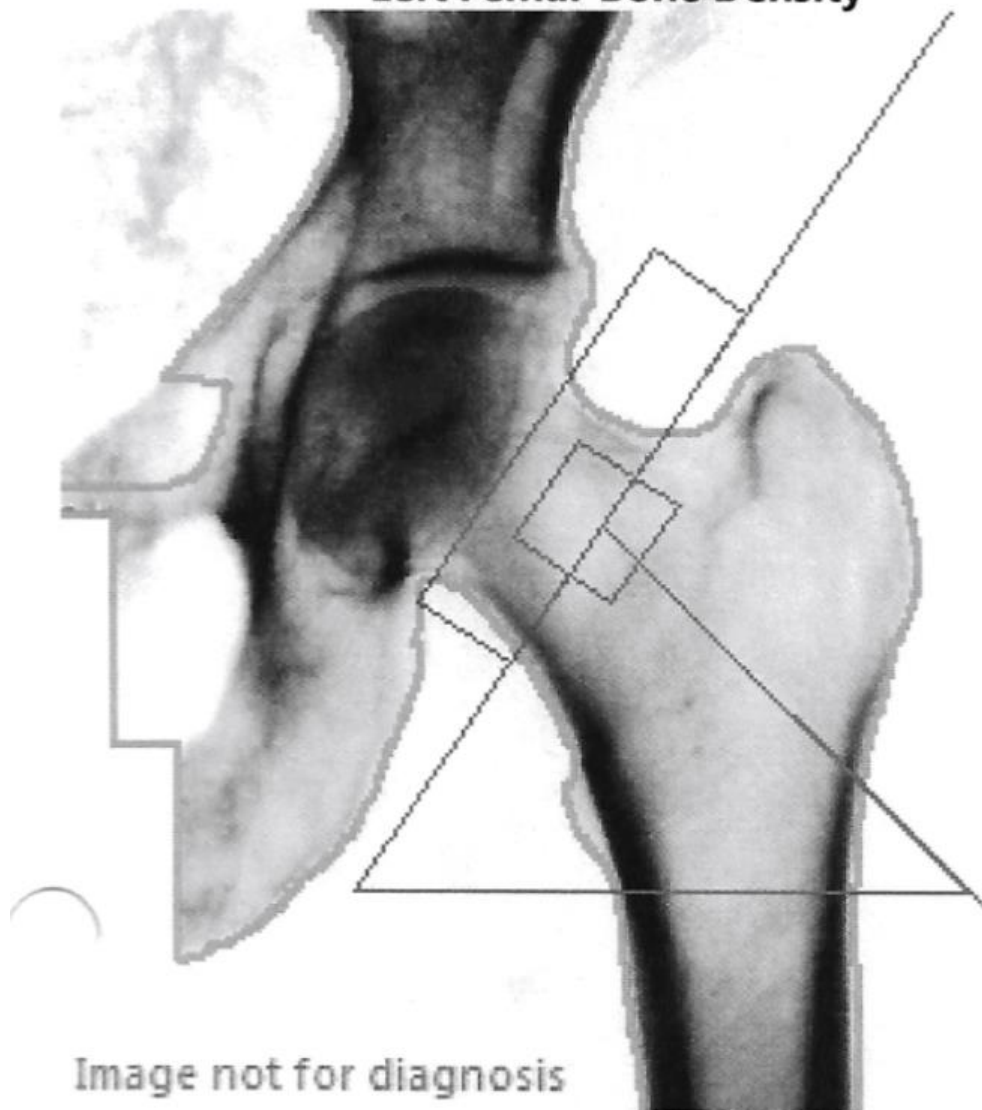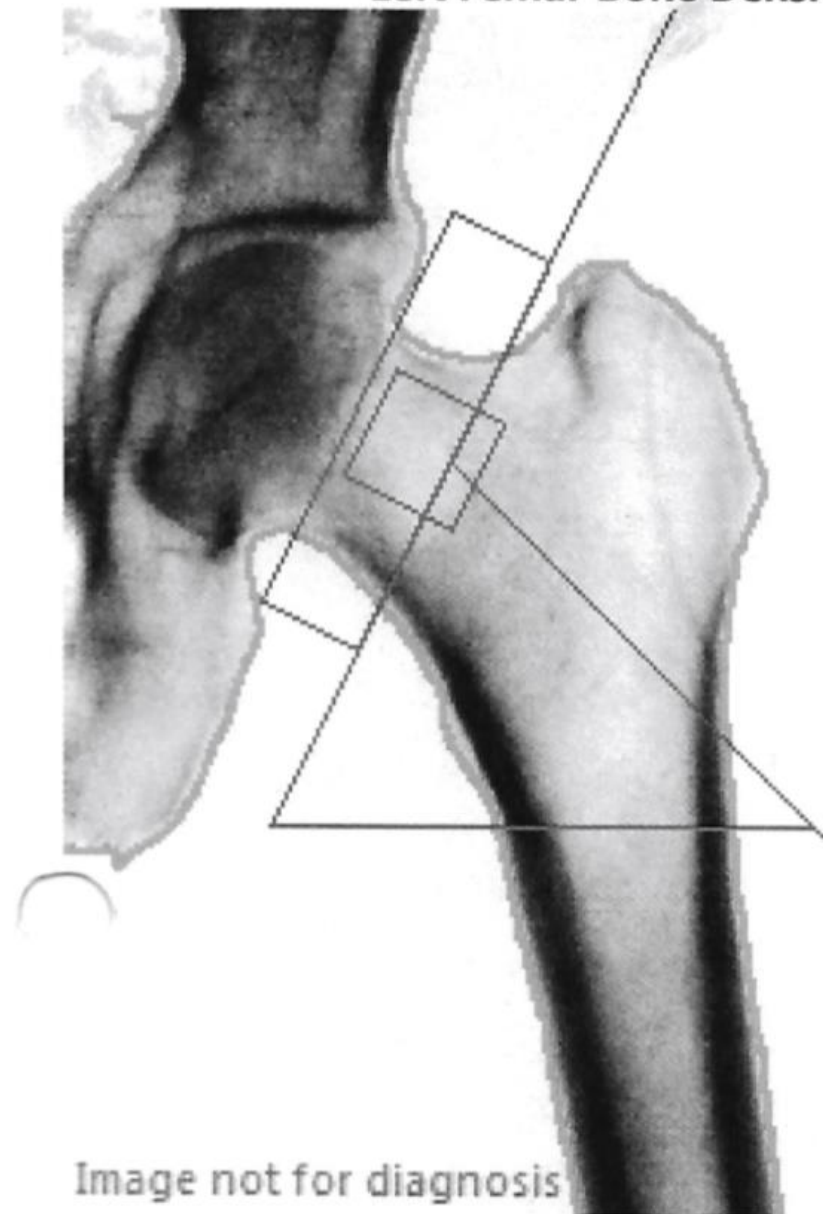
- Rate of change 1.1% in 3 years

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Left Femur Bone Density Trend
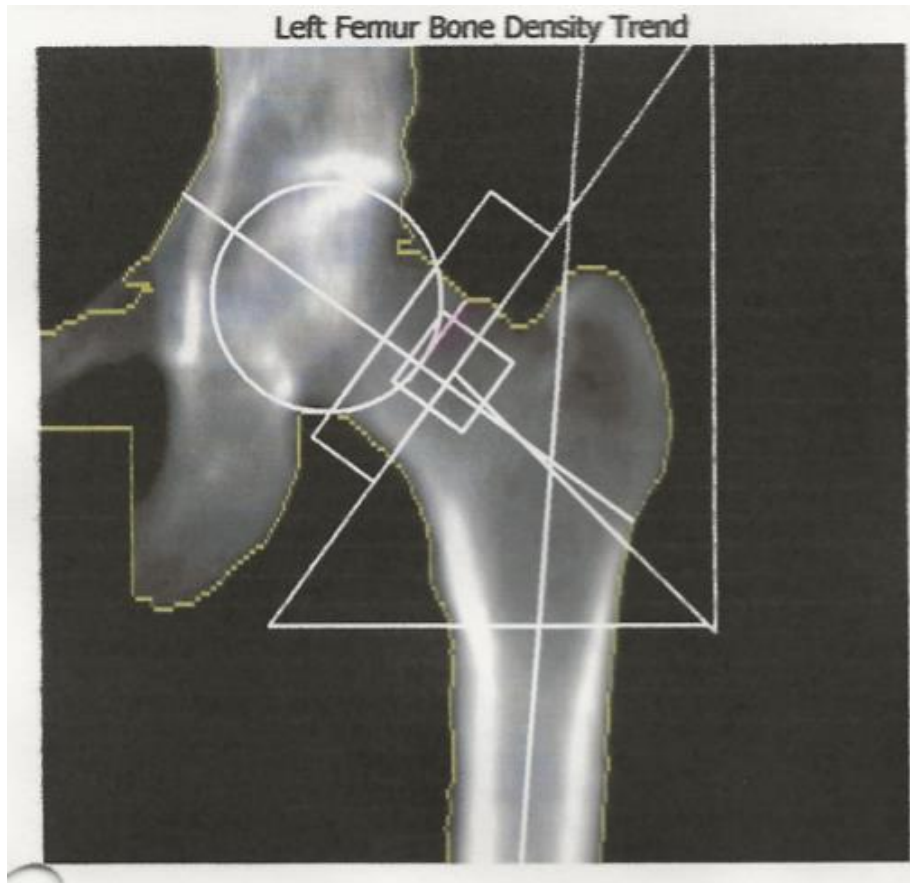
- Rate of change 13.9% in 2 years
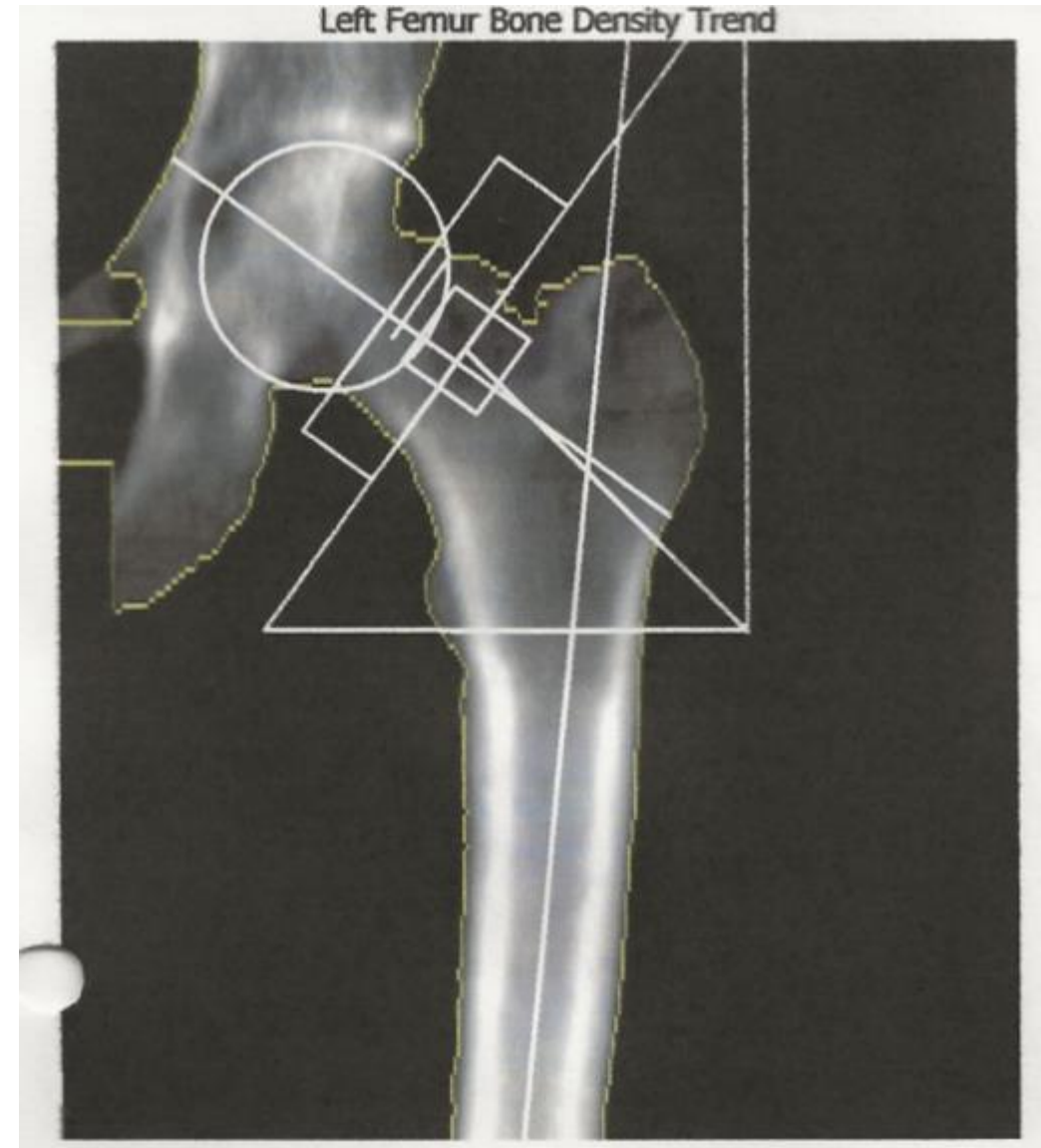
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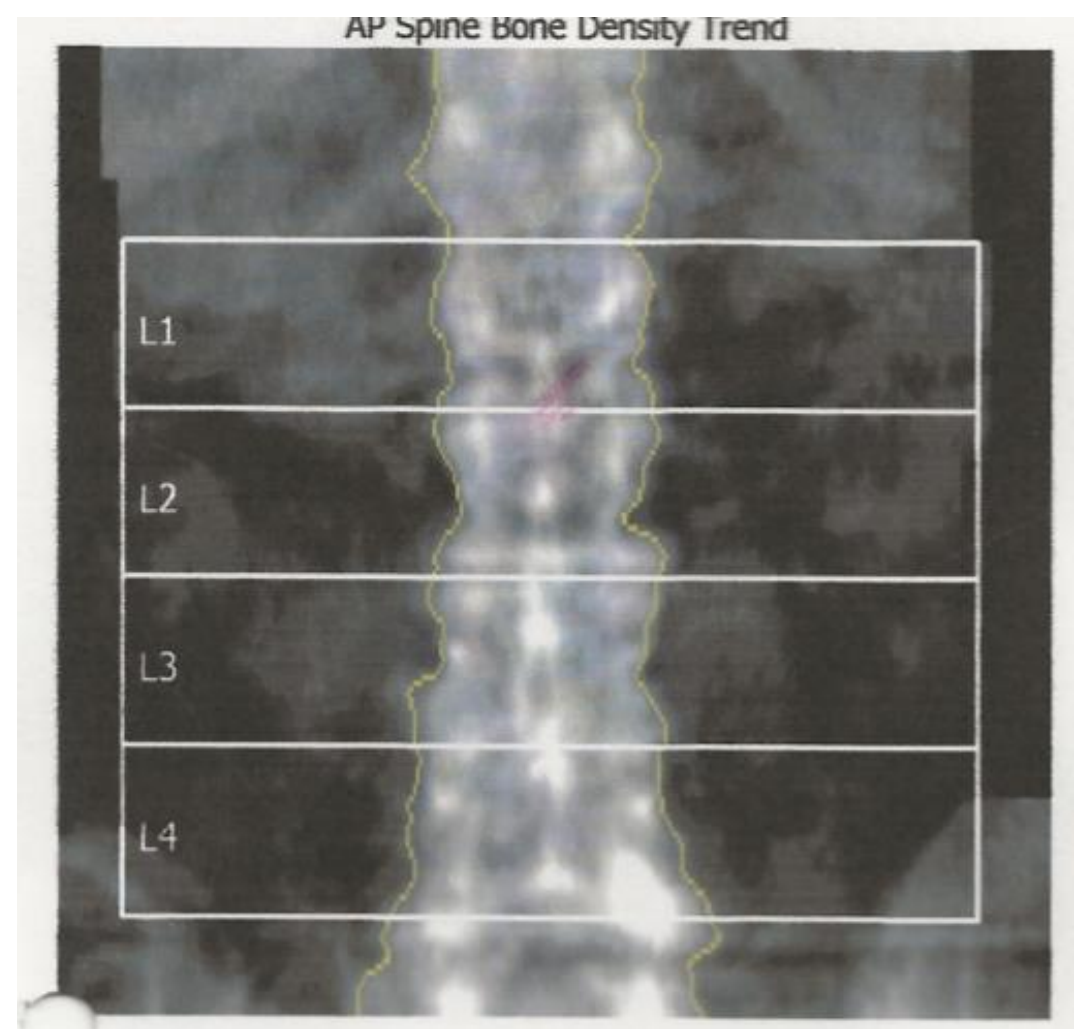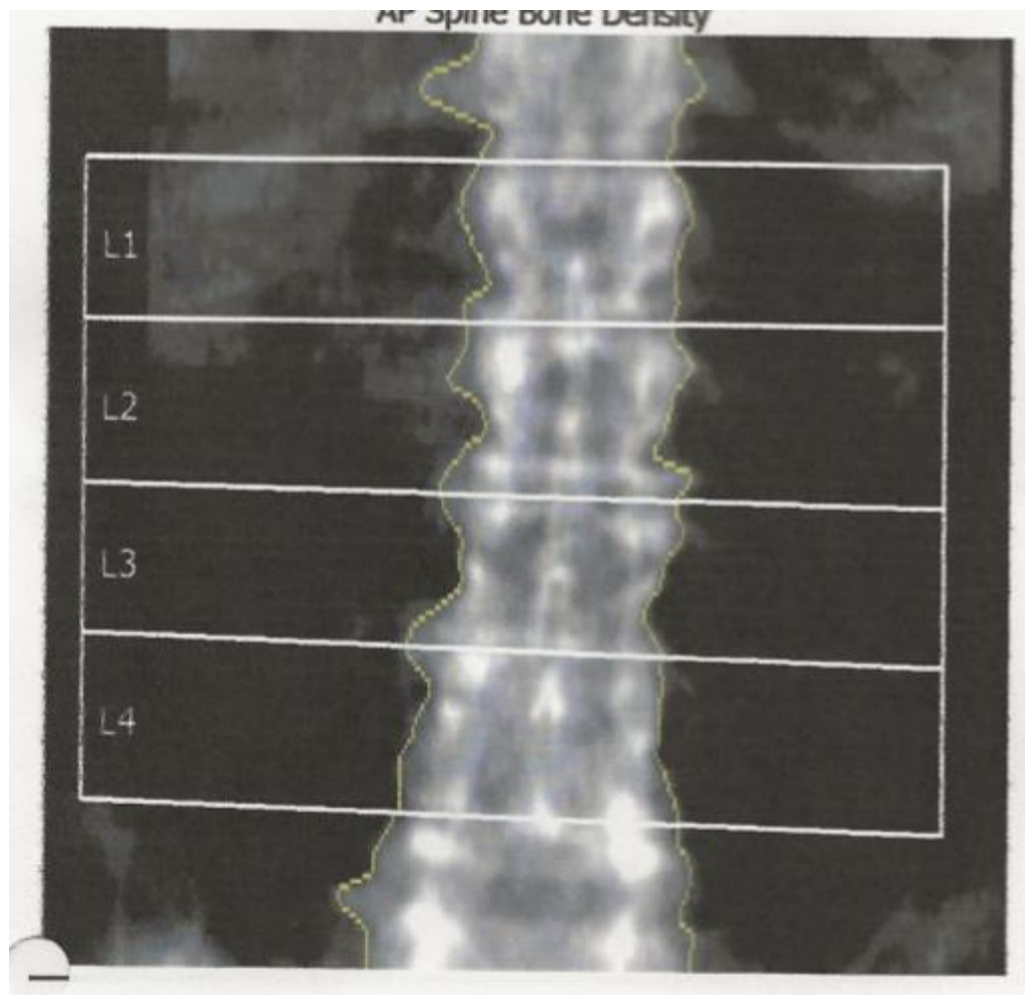
- Rate of change 12.5% in 11 years
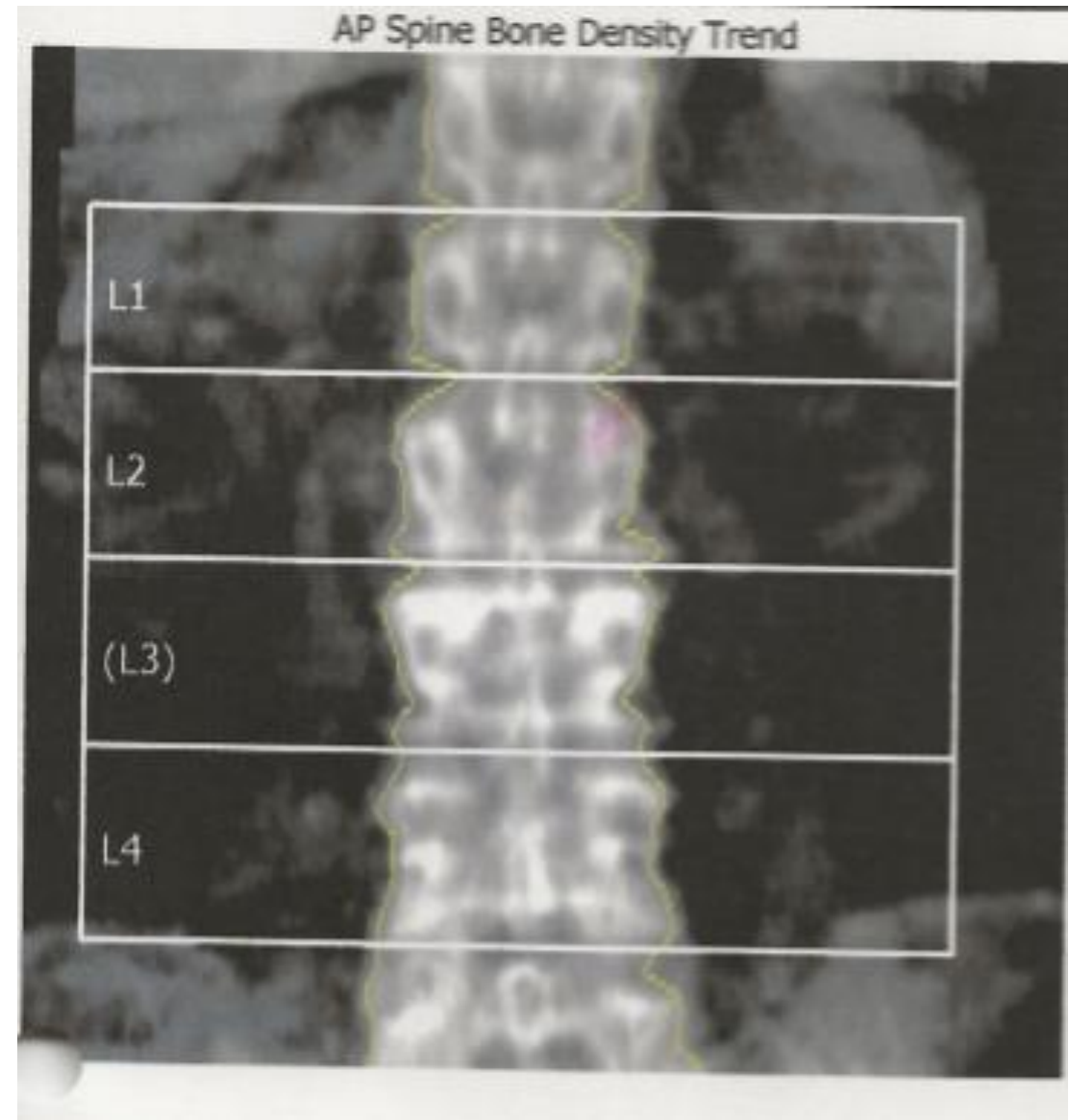
- Rate of change 2% in 2 years

Questions & discussion