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What to look for on DXA for Vertebral Fractures

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Nuclear Medicine Clinical Team Manager
- Swansea Bay University Health Board -

19/09/2019

WOAG Educational Meeting: Vertebral Fractures

Vertebral Fractures

- Account for significant morbidity and mortality
- So common that they are often overlooked as ‘incidental’ findings
- Readily available golden opportunity to identify patients requiring bone protecting medication
- Identification makes a real contribution to reducing incidence of hip fractures
- Natural progression can be halted by early identification
- Represent a huge financial burden on NHS

What Makes Vertebral Fractures Different?

- Most do not present acutely
- Many go undiagnosed (50-70%, ref. NICE TA161)
- Incremental process
- Often arise in absence of specific trauma
- Highly predictive of skeletal ‘fragility’
- Potentially the most important fractures to identify
- Account for chronic pain and morbidity
- Must be actively ‘looked for’ → **(Think fracture!)**

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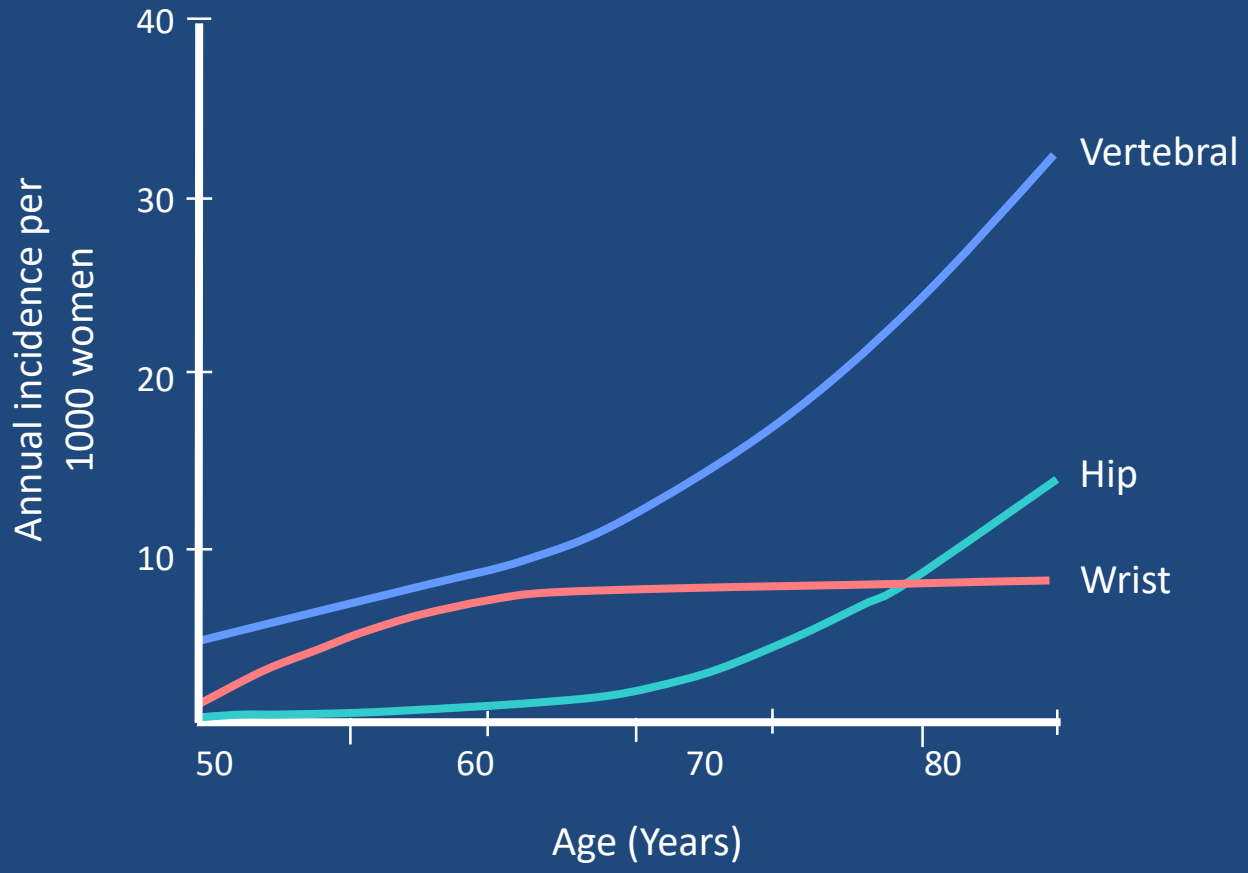
Vertebral Fractures Substantially Increase the Risk of New Fragility Fractures

A woman with one vertebral fracture has a 4.4 times increased risk of another vertebral fracture and 2.3 times increased risk of hip fracture *(NICE TA161)*

One woman in five will suffer from another vertebral fracture within a year
(Lindsay et al., JAMA, 2001)

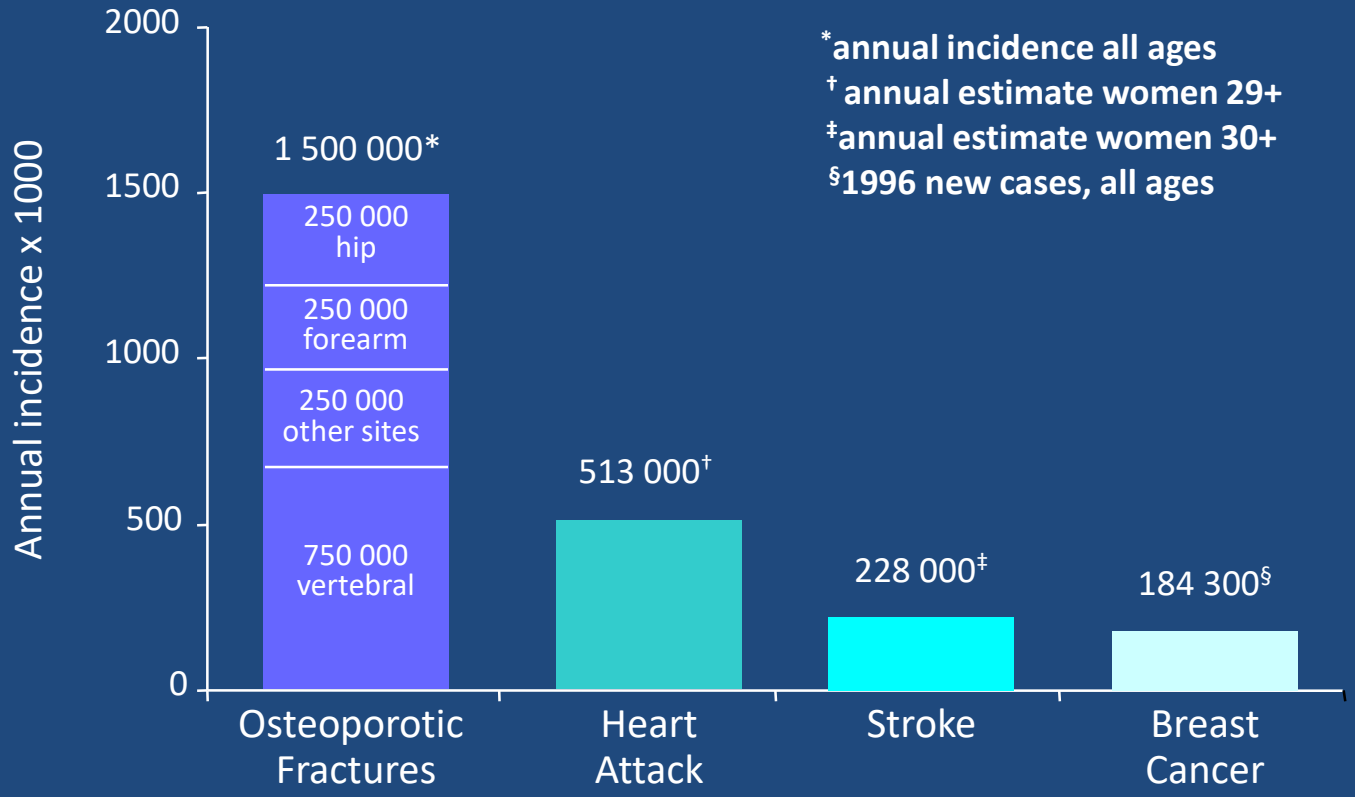
Women with low BMD and one fracture have a 25x risk of a women with normal BMD and no fracture

Incidence Rates for Vertebral, Wrist and Hip Fractures in Women after Age 50



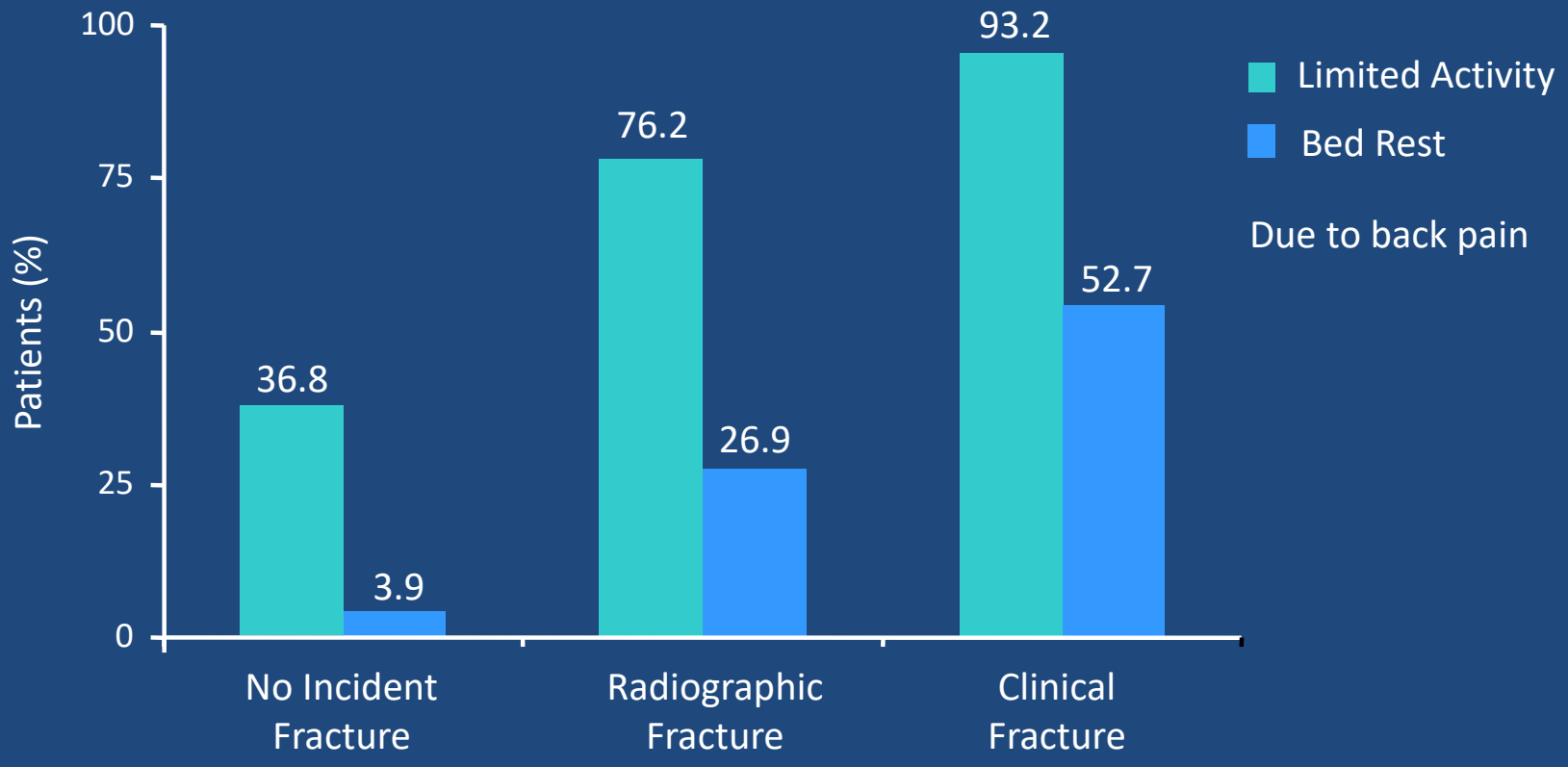
Wasnich RD, Primer on the Metabolic Bone Diseases and Disorders of Mineral Metabolism. 4th edition, 1999

Osteoporotic Fractures in Women: Comparison with Other Diseases



Riggs BL, Melton LJ. Bone 1995
Heart and Stroke Facts, 1996, American Heart Association
Cancer Facts & Figures, 1996, American Cancer Society

All Types of Vertebral Fractures are Associated With Morbidity

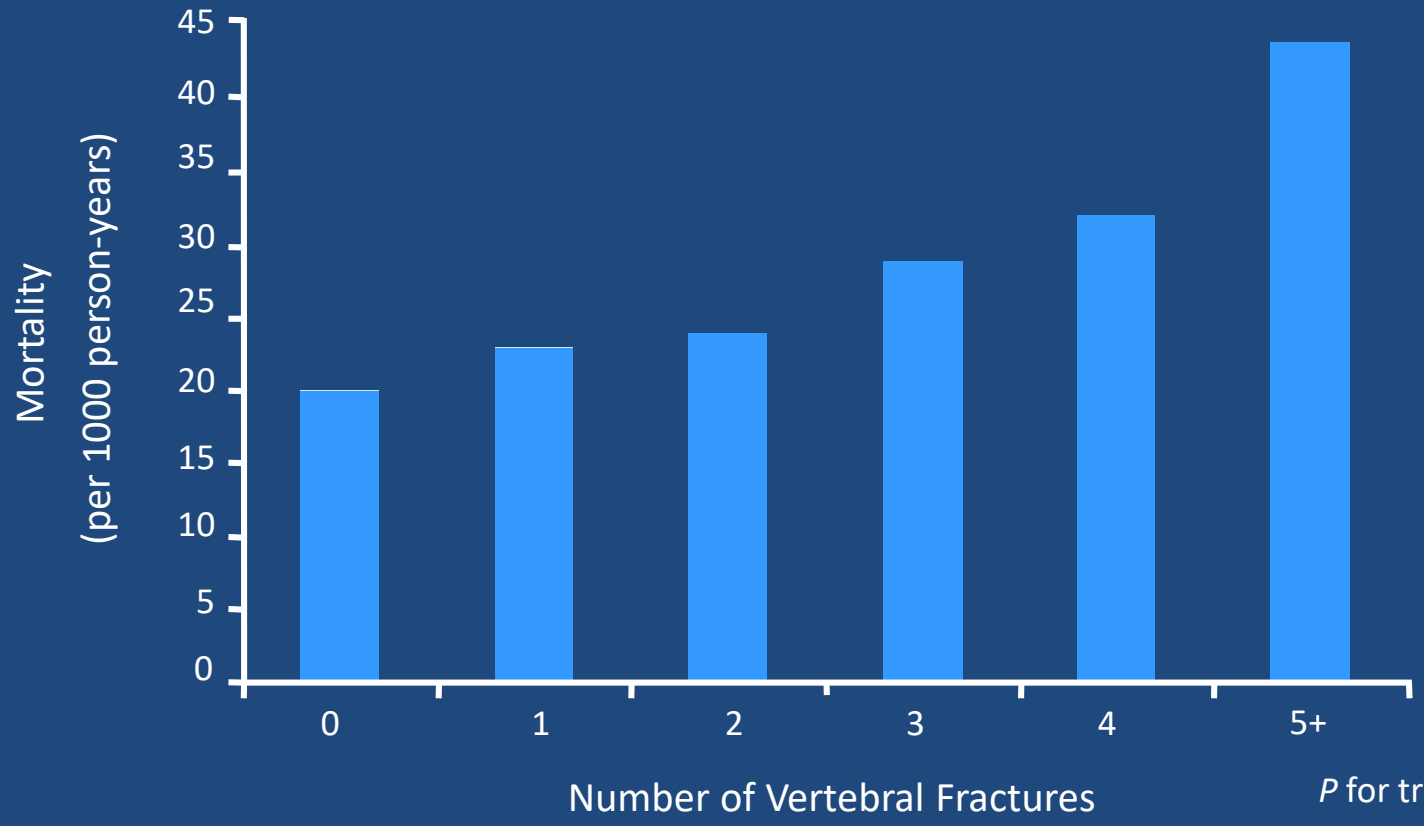


Nevitt MC et al., Arch Intern Med.2000, 160:77

NICE TA161

Vertebral fractures are associated with a 4.4% increased mortality (UK specific data)

Mortality Rates by Number of Prevalent Vertebral Fractures



P for trend < 0.001

Kado DM et al., Arch Intern Med 1999,159:1215

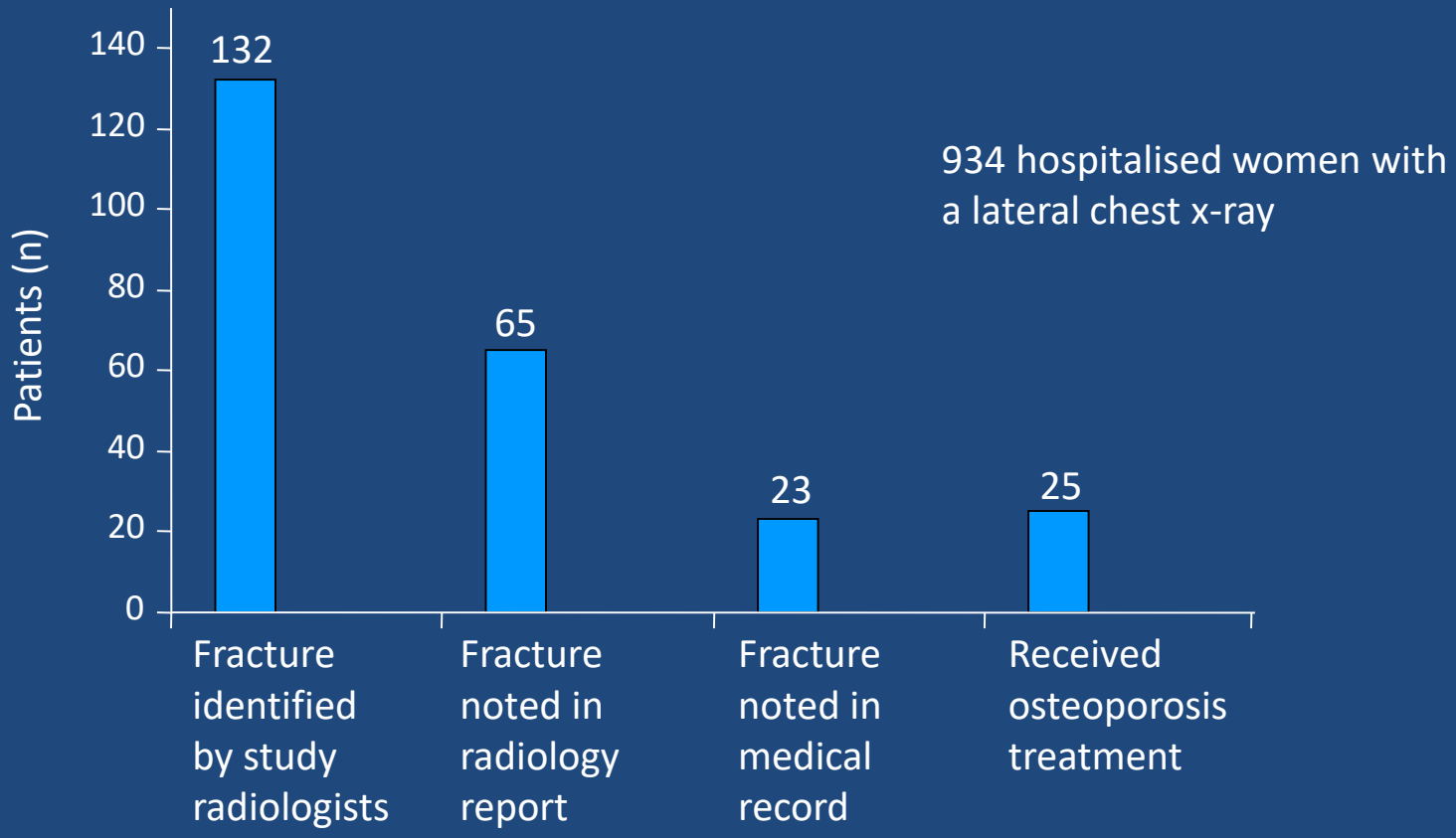
Vertebral Fracture Morbidity

- Chronic pain from multiple ‘incremental’ fractures
- Exaggerated kyphosis
- Cause reduced mobility, leading to further bone loss
- Impact on respiratory reserve, especially in COPD patients
- Significant increase in GP visits

Vertebral Fracture In Summary

- Are the most common osteoporotic fractures
- Are associated with excess mortality
- Are associated with significant morbidity, even if they do not come to clinical attention
- Increase the risk of subsequent vertebral fracture(s) by 5 fold and of other fragility fractures (including hip) by 2 fold
- Highly predictive of future fracture risk due to the relative absence of trauma in their causation

A Retrospective Study Suggests that Vertebral Fractures are Underdiagnosed



Gehlbach et al.,Osteoporos Int 2000, 11:577

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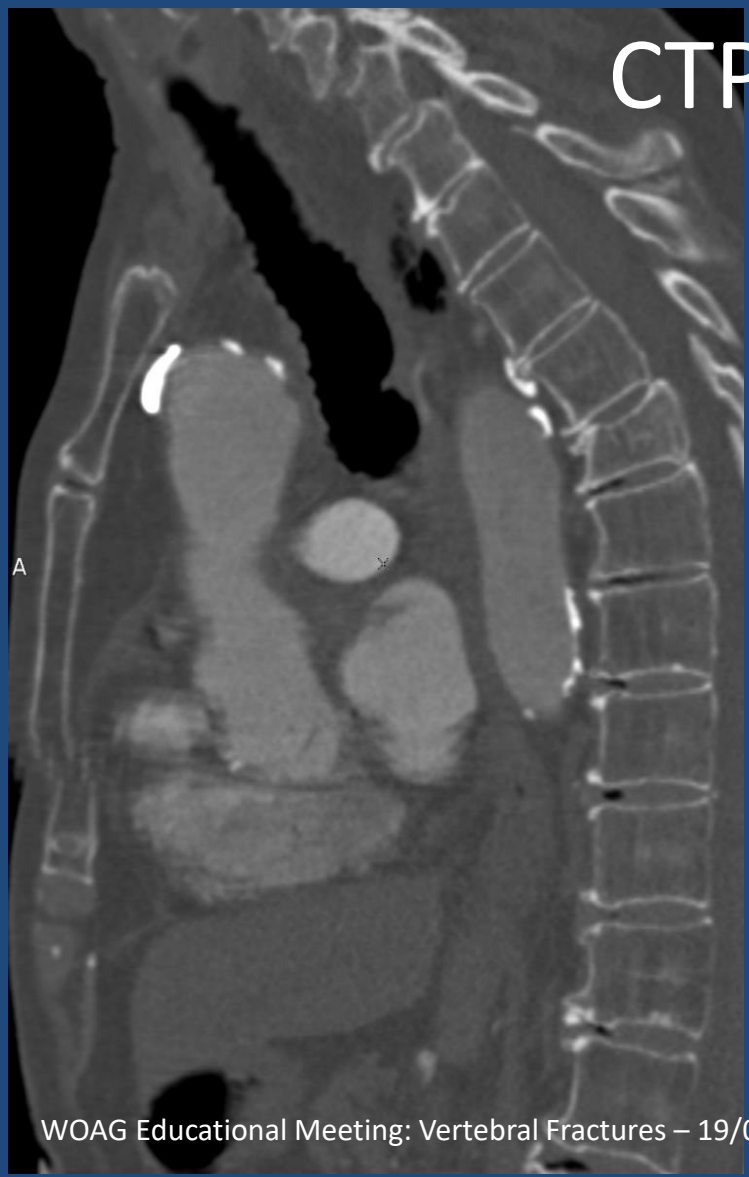
Unreported Vertebral Fractures on

WB CT

CTPA



What about DXA??

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Identification of Vertebral Fractures in DXA

Think

- Is there a vertebral fracture
- Is this patient at risk of vertebral fractures?

Interrogate

- Patient questionnaire
- DXA scan image AND data

Act

- Flag
- report

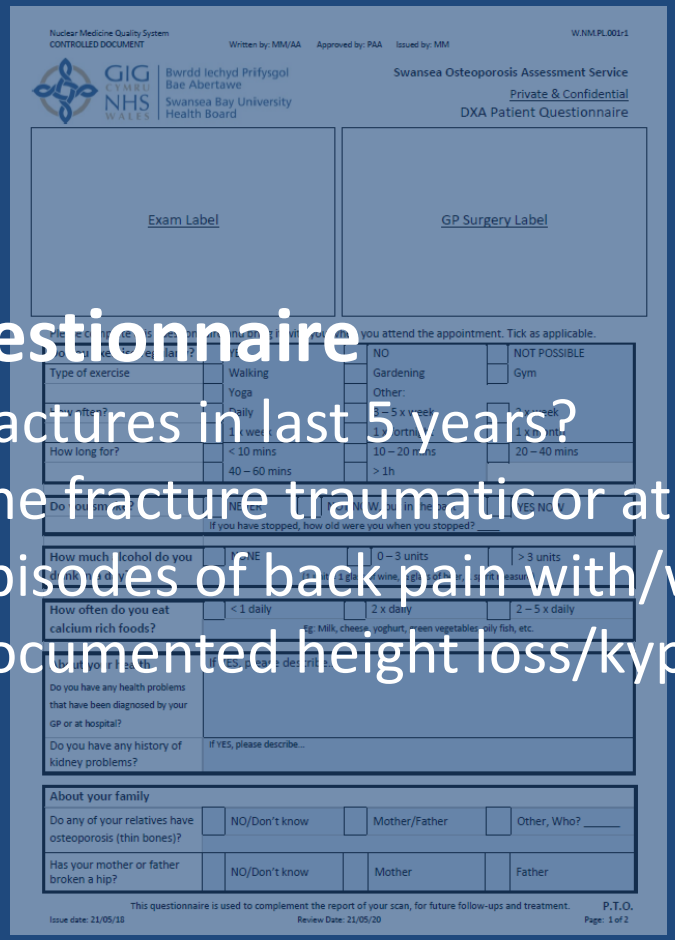
Interrogate

Referral

Patient questionnaire

- Any fractures in last 5 years?
- Was the fracture traumatic or atraumatic?
- Any episodes of back pain with/without radiation
- Any documented height loss/kyphosis

PACS



Nuclear Medicine Quality System — CONTROLLED DOCUMENT — W.NM.PL.001:1

Written by: MM/AA — Approved by: PAA — Issued by: MM

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Swansea Osteoporosis Assessment Service

Private & Confidential

DXA Patient Questionnaire

Exam Label

GP Surgery Label

Please tick the box that applies to you when you attend the appointment. Tick as applicable.

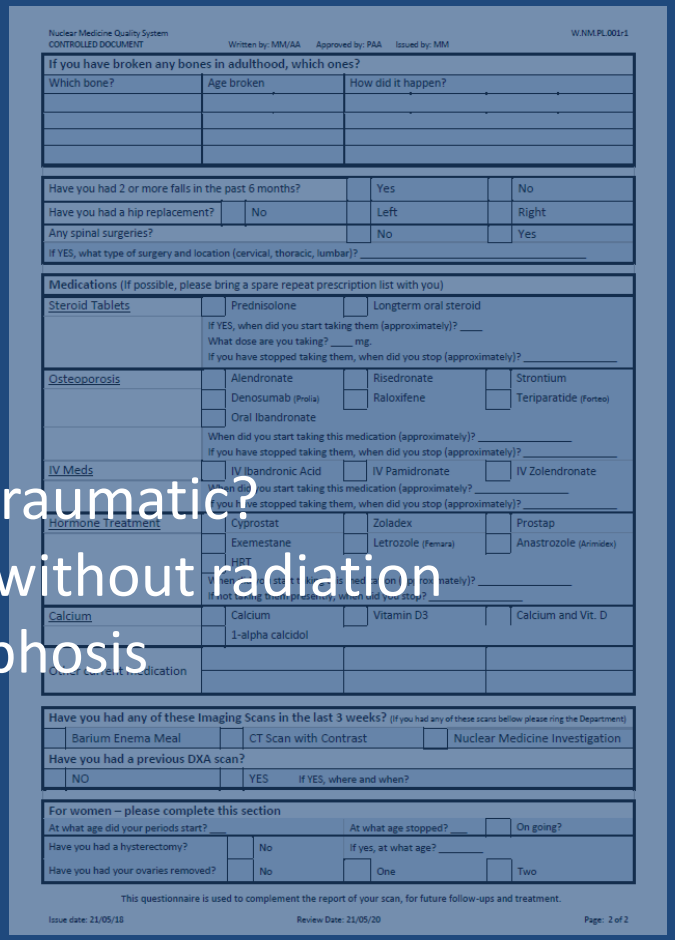
Do you exercise regularly?	YES		NO		NOT POSSIBLE
Type of exercise		Walking		Gardening	Gym
		Yoga		Other:	
How often?		Daily		1 – 5 x week	
		1 x week		1 x fortnight	1 x month
How long for?		< 10 mins		10 – 20 mins	20 – 40 mins
		40 – 60 mins		> 1h	
Do you smoke?	YES		NO		
	If you have stopped, how old were you when you stopped? ___				
How much alcohol do you drink?	NONE		0 – 3 units		> 3 units
	(e.g. glass of wine, pint of beer, measure of spirits)				
How often do you eat calcium rich foods?	< 1 daily		2 x daily		2 – 5 x daily
	(eg: Milk, cheese, yoghurt, green vegetables, oily fish, etc.				
Do you have any health problems that have been diagnosed by your GP or at hospital?	If YES, please describe...				
Do you have any history of kidney problems?	If YES, please describe...				

About your family

Do any of your relatives have osteoporosis (thin bones)?	NO/Don't know		Mother/Father		Other, Who? _____
Has your mother or father broken a hip?	NO/Don't know		Mother		Father

This questionnaire is used to complement the report of your scan, for future follow-ups and treatment. P.T.O.

Issue date: 21/05/18 — Review Date: 21/05/20 — Page: 1 of 2



Nuclear Medicine Quality System — CONTROLLED DOCUMENT — W.NM.PL.001:1

Written by: MM/AA — Approved by: PAA — Issued by: MM

If you have broken any bones in adulthood, which ones?

Which bone?	Age broken	How did it happen?

Have you had 2 or more falls in the past 6 months?		Yes		No	
Have you had a hip replacement?	No		Left		Right
Any spinal surgeries?		No		Yes	
If YES, what type of surgery and location (cervical, thoracic, lumbar)? _____					

Medications (If possible, please bring a spare repeat prescription list with you)

Steroid Tablets		Prednisolone		Longterm oral steroid	
	If YES, when did you start taking them (approximately)? ___ What dose are you taking? ___ mg. If you have stopped taking them, when did you stop (approximately)? _____				
Osteoporosis		Alendronate		Risedronate	Strontium
		Denosumab (Prolia)		Raloxifene	Teriparatide (Forteo)
		Oral Ibandronate			
	When did you start taking this medication (approximately)? _____ If you have stopped taking them, when did you stop (approximately)? _____				
IV Meds		IV Ibandronic Acid		IV Pamidronate	IV Zolendronate
	When did you start taking this medication (approximately)? _____ If you have stopped taking them, when did you stop (approximately)? _____				
Hormone Treatment		Cyprostat		Zoladex	Prostap
		Exemestane		Letrozole (Femara)	Anastrozole (Arimidex)
		HRT			
	When did you start taking this medication (approximately)? _____ If not taking HRT, have you ever taken it? If YES, when did you stop (approximately)? _____				
Calcium		Calcium		Vitamin D3	Calcium and Vit. D
		1-alpha calcidol			
Other relevant medication					

Have you had any of these Imaging Scans in the last 3 weeks? (If you had any of these scans bellow please ring the Department)

Barium Enema Meal | CT Scan with Contrast | Nuclear Medicine Investigation

Have you had a previous DXA scan?

NO | YES — If YES, where and when?

For women – please complete this section

At what age did your periods start? ___		At what age stopped? ___	On going?
Have you had a hysterectomy?	No	If yes, at what age? _____	
Have you had your ovaries removed?	No	One	Two

This questionnaire is used to complement the report of your scan, for future follow-ups and treatment.

Issue date: 21/05/18 — Review Date: 21/05/20 — Page: 2 of 2

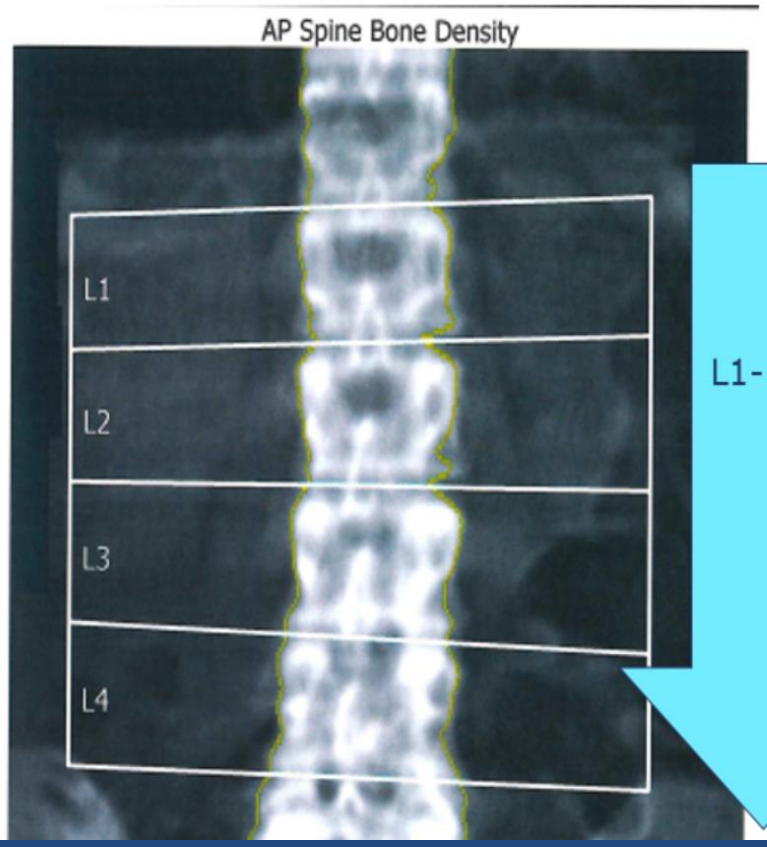
Interrogate

DXA images and data

- Appearances of vertebral height loss??
- Any unexplained reduction in vertebral area?
- Any previous imaging?

Interrogate

NORMAL geometry and BMD distribution

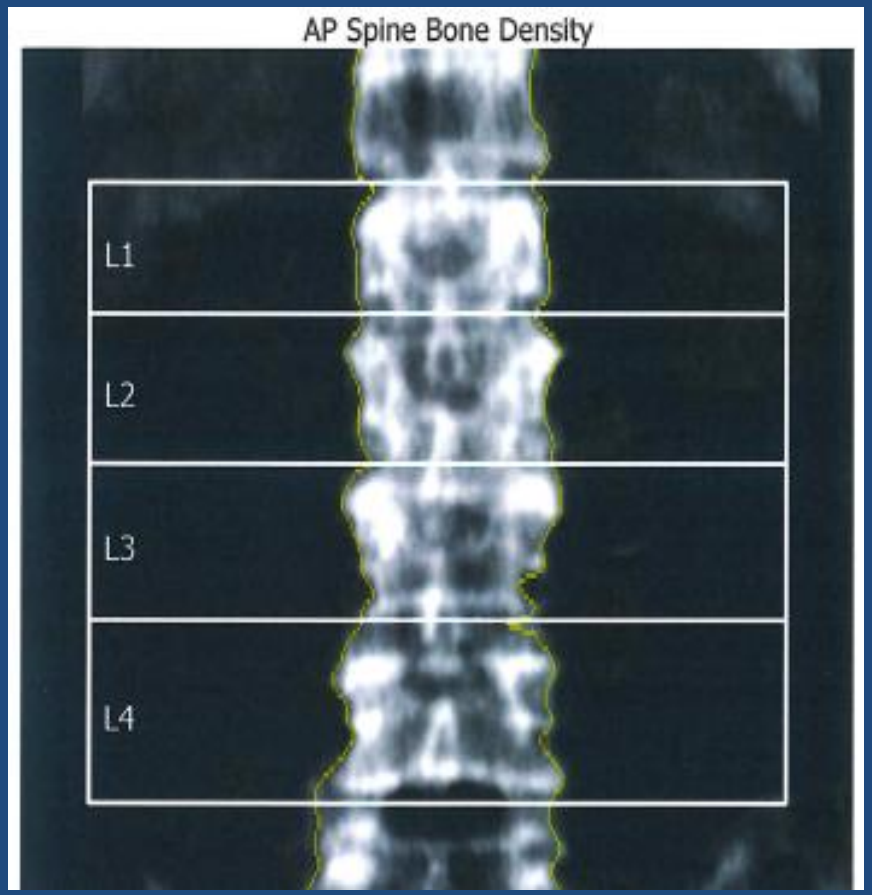


L1- L4

BMD & Area

	BMD (g/cm 2)	AREA (cm2)
L1	0.568	10.03
L2	0.639	10.77
L3	0.761	12.51
L4	0.765	12.72

Interrogate



	BMD	Area
L1	0.703	9.11
L2	0.670	11.16
L3	0.745	12.05
L4	0.759	12.66

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Case Study 1

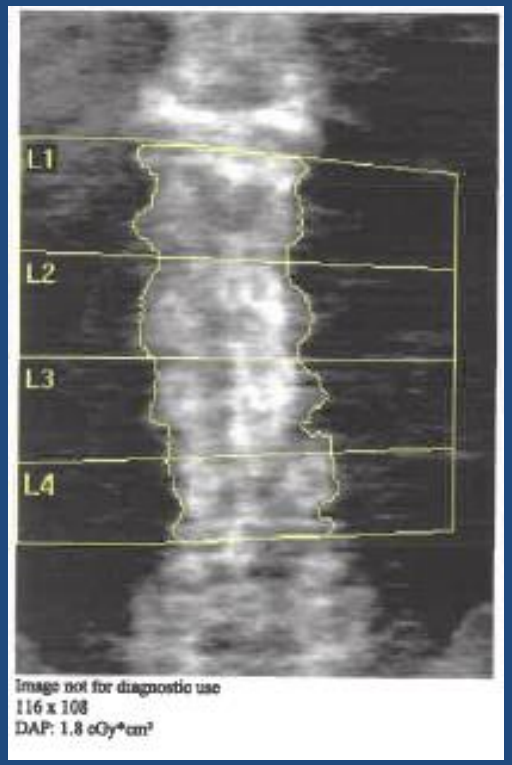


Image not for diagnostic use
116 x 108
DAP: 1.8 cGy*cm²

Vertebral Fractures?

- 85 year old
- ♀ patient

- *"Was started on Alendronic acid and calcium/vitamin D in 2014 after a fragility fracture. Since then, has been found to have osteoporotic vertebral fractures thoracic and lumbar – 2016 & 2018 ? Would benefit from alternative treatments"*

DXA Results Summary:

Region	Area (cm²)	BMC (g)	BMD (g/cm²)	T - score	Z - score
L1	11.97	11.24	0.939	-0.5	2.1
L2	10.83	11.56	1.068	0.4	3.2
L3	11.12	12.48	1.122	0.3	3.3
L4	9.40	9.51	1.012	-0.4	2.6
Total	43.32	44.79	1.034	-0.1	2.7

Total BMD CV 1.0%
WHO Classification: Normal
Fracture Risk: Not Increased

fRight Hip 11.01.2019


Image not for diagnostic use
91 x 100 NECK: 49 x 15
DAP: 1.6 cGy*cm²

fLeft Hip 11.01.2019


Image not for diagnostic use
88 x 104 NECK: 49 x 15
DAP: 1.4 cGy*cm²

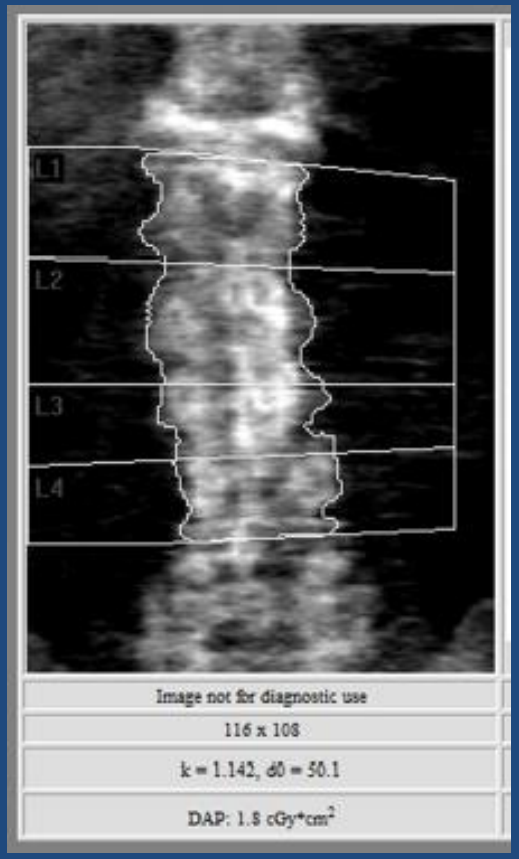
DXA Results Summary:

Region	Area (cm²)	BMC (g)	BMD (g/cm²)	T - score	Z - score
Neck					
Left	4.78	2.73	0.572	-2.5	-0.0
Right	5.17	3.05	0.589	-2.3	0.2
Mean	4.98	2.89	0.580	-2.4	0.1
[Diff.]	0.40	0.32	0.017	0.2	0.2
Total					
Left	32.03	24.00	0.749	-1.6	0.7
Right	30.08	21.41	0.712	-1.9	0.4
Mean	31.05	22.70	0.731	-1.7	0.6
[Diff.]	1.95	2.59	0.037	0.3	0.3

Total BMD CV 1.0%
WHO Classification on Bolded Results: Osteopenia

DXA – 11/01/2019

Case Study 1

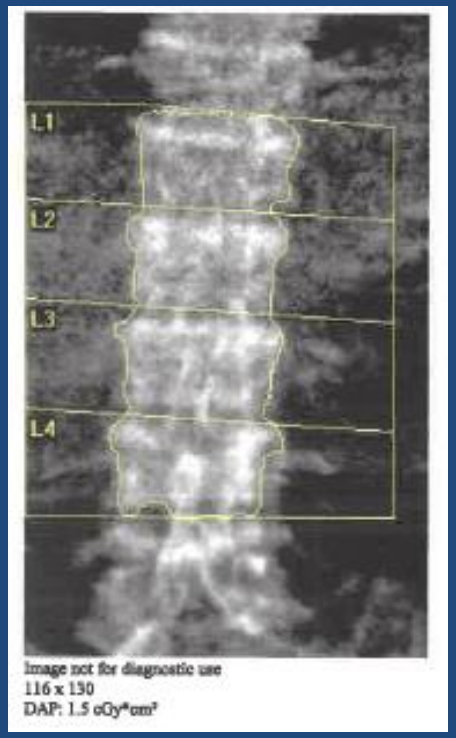


DXA – 11/01/2019

CTPA – 06/06/2016

X-ray – 03/06/2016

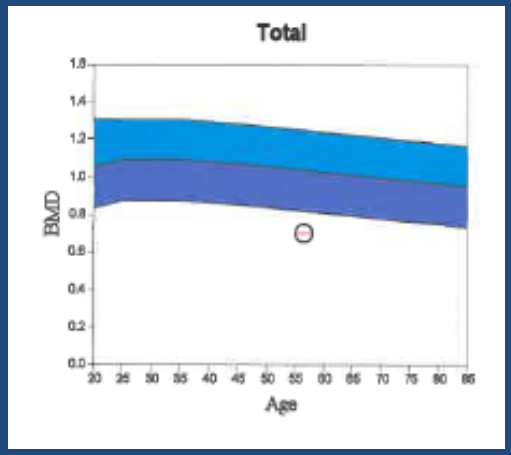
Case Study 2



DXA Results Summary:

Region	Area (cm²)	BMC (g)	BMD (g/cm²)	T-score	Z-score
L1	14.22	9.44	0.664	-3.7	-3.2
L2	14.42	10.20	0.707	-3.5	-3.0
L3	15.98	11.12	0.696	-3.7	-3.2
L4	14.21	9.88	0.695	-3.6	-3.0
Total	58.84	40.64	0.691	-3.6	-3.1

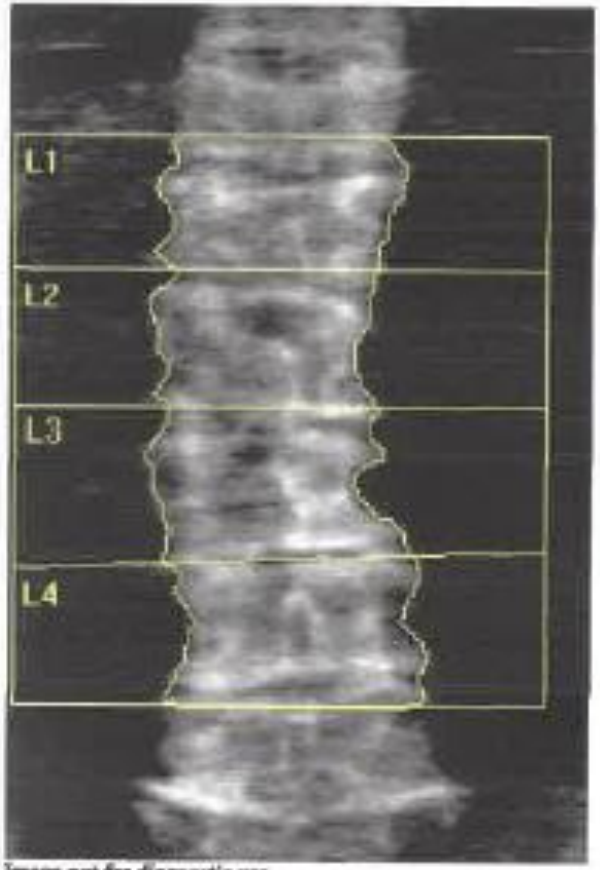
Total BMD CV 1.0%
WHO Classification: Osteoporosis
Fracture Risk: High



DXA – 24/01/2019

- 56 years old
- ♂ patient
- *"Gentleman presenting with a 2-3 month history of issues with worsening back pain, pointing to the lower thoracic region. Recent imaging shown multiple old rib fractures as well as wedging of the vertebrae in the lower thoracic region as well as the lumbar region. Denies any significant trauma, only reporting falling out of bed 4 weeks ago... I wonder if he is osteoporotic."*

Case Study 3



Vertebral Fractures?

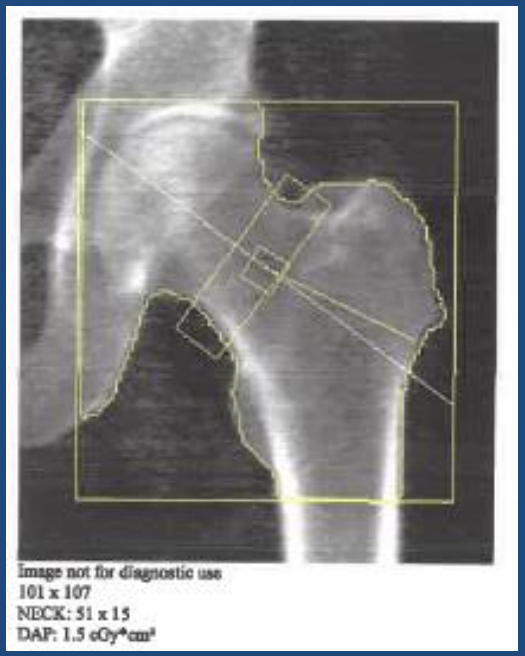
- 83 year old
- ♀ patient

- *"H/o falls & hip # as well as distal radial #. No bone protection meds. Osteopenia in 2009."*

DXA Results Summary:

Region	Area (cm²)	BMC (g)	BMD (g/cm²)	T-score	Z-score
L1	14.38	13.56	0.943	-0.4	2.0
L2	13.56	11.60	0.856	-1.6	1.2
L3	16.24	15.97	0.984	-0.9	2.0
L4	16.98	17.02	1.002	-0.5	2.5
Total	61.16	58.14	0.951	-0.9	1.9

Total BMD CV 1.0%
WHO Classification: Normal
Fracture Risk: Not Increased



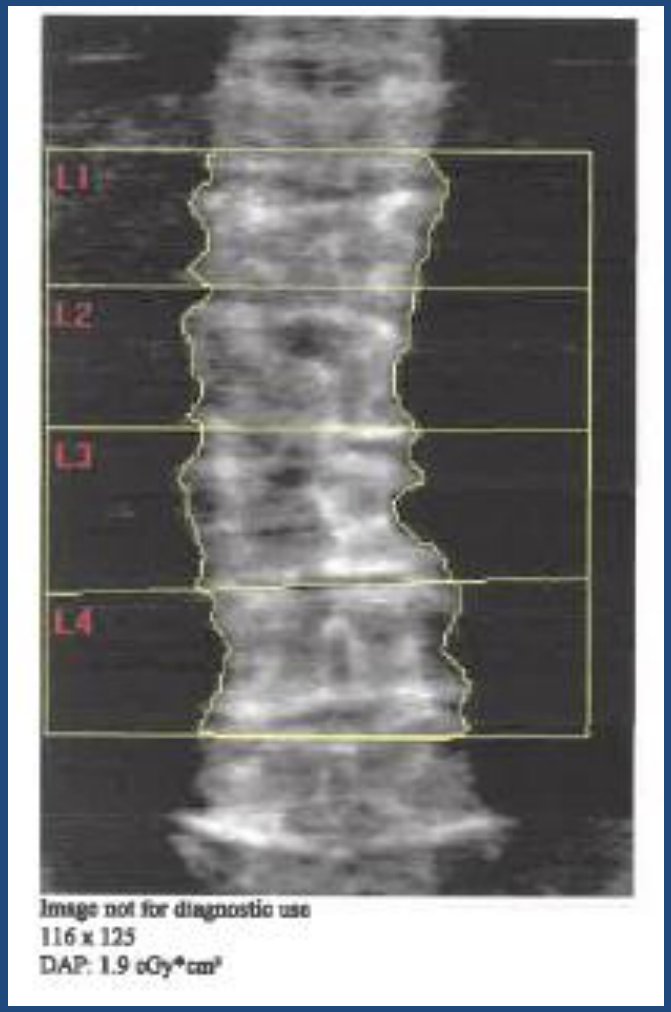
DXA Results Summary:

Region	Area (cm²)	BMC (g)	BMD (g/cm²)	T-score	Z-score
Neck	6.14	3.24	0.528	-2.9	-0.4
Total	40.15	25.61	0.638	-2.5	-0.3

Total BMD CV 1.0%
WHO Classification: Osteoporosis

DXA – 29/11/2018

Case Study 3



DXA – 29/11/2018

Lumbar Spine X-ray Report (10/11/2018):

"There is an old wedge fracture of L1 (grade II). This appears to be slightly worse when compared with the images of 27/07/2018. This a mild compression fracture of the superior endplate of T12 (grade I). There are severe degenerative changes with multilevel disc narrowing. There is a scoliosis concave to the left with vertebral torsion. There is generalised osteopenia."

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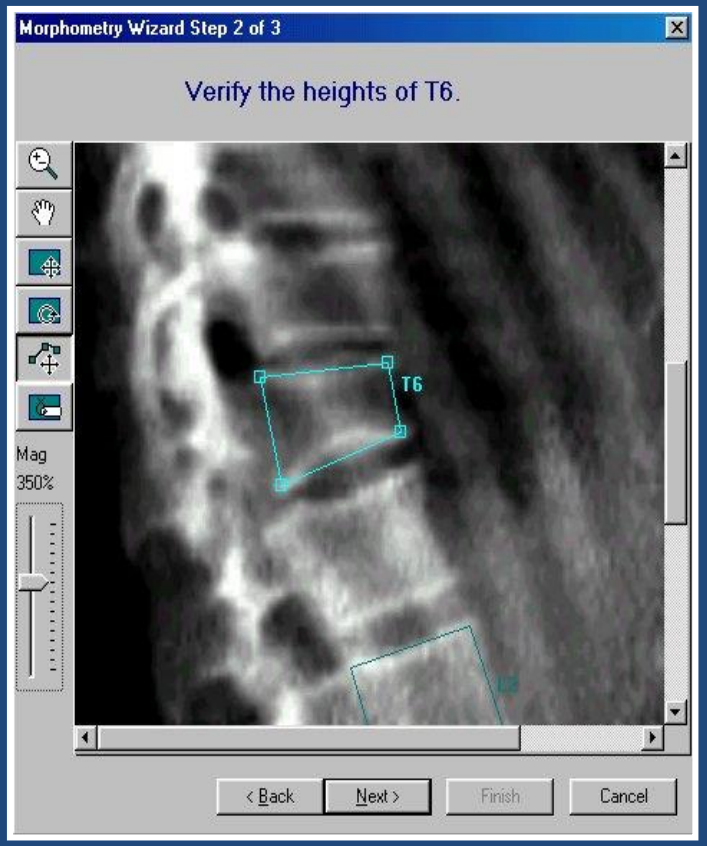
Combining BMD & Vertebral Fracture Assessment: An Approach to Improve the Diagnosis Rate of Vertebral Fractures

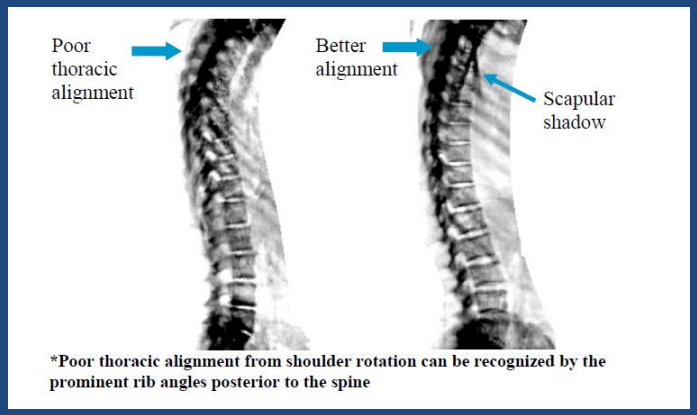
- Improves risk assessment
- Identification of occult fractures
- Identification of scoliosis
- Identification of artefacts

Vertebral Fracture Assessment

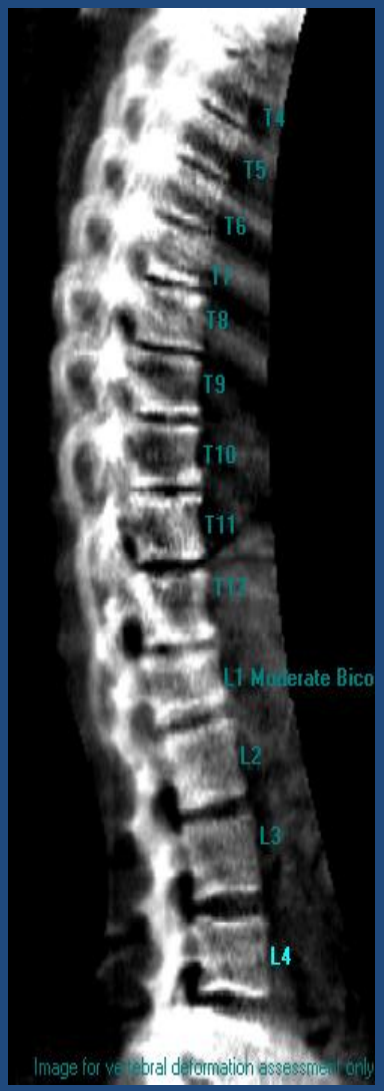


VFA

- Should include part of L5 to top of T4
- Lateral – should be seen as rectangular boxes with only one edge.
- L5 should usually sit between the iliac crests
- L4 is frequently bisected by the iliac crests
- Thoracic vertebrae shorter, square and have rib articulations.



*Poor thoracic alignment from shoulder rotation can be recognized by the prominent rib angles posterior to the spine



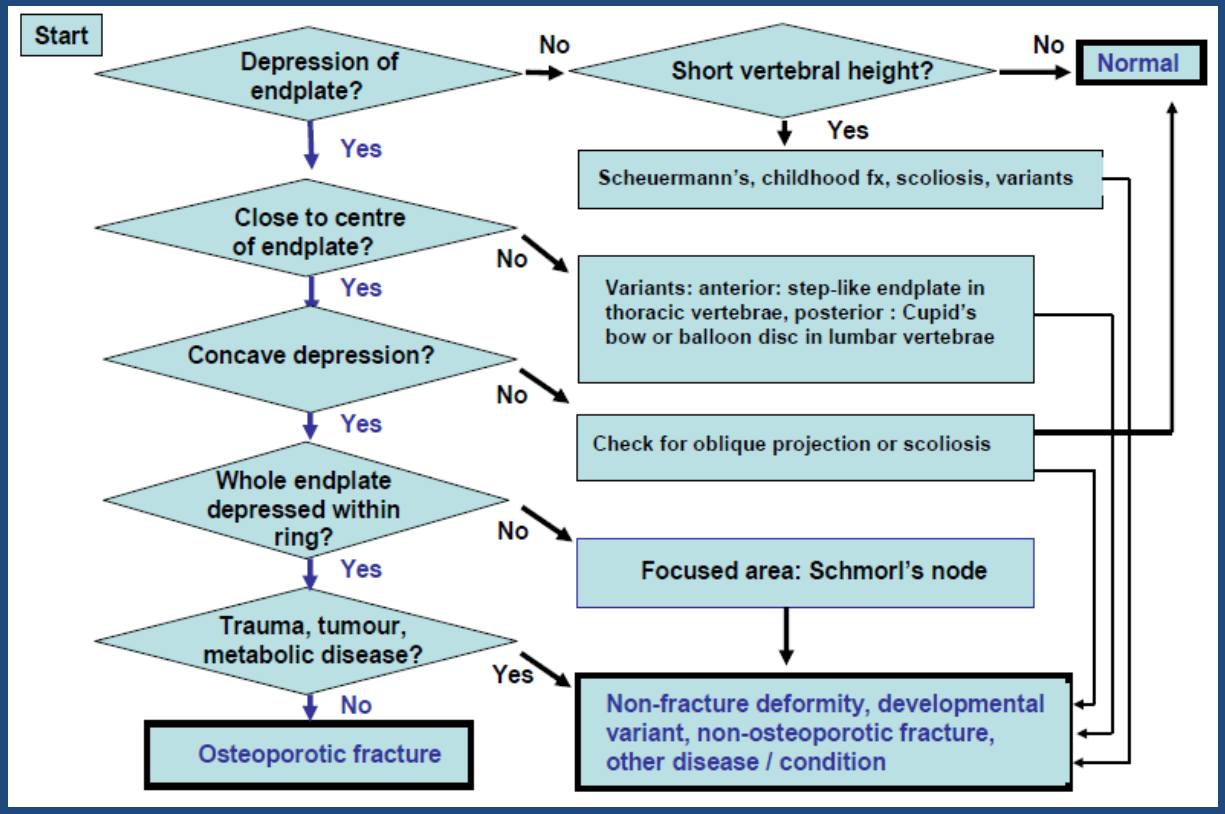
Schousboe et al, IOF, Vertebral Fract Init 2011

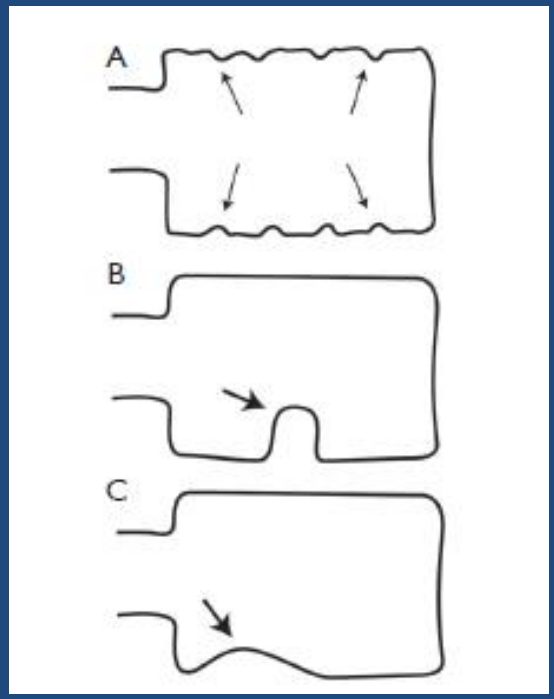
VFA Interpretation

Ultimately, the Question is:
Are The Vertebral Bodies Normal or Abnormal?

- **Normal**
- **Abnormal**
  - Definite vertebral fracture
  - Equivocal vertebral fracture
  - Other vertebral abnormalities

Algorithm-based Qualitative Assessment for Differential Diagnosis of Vertebral Fractures





Schematic diagram showing endplate impressions caused by (A) Scheuermann's disease; (B) Schmorl's node and (C) Cupid's bow deformity.

Jiang et al.,Osteoporos Int 2004, 15(11):887-96

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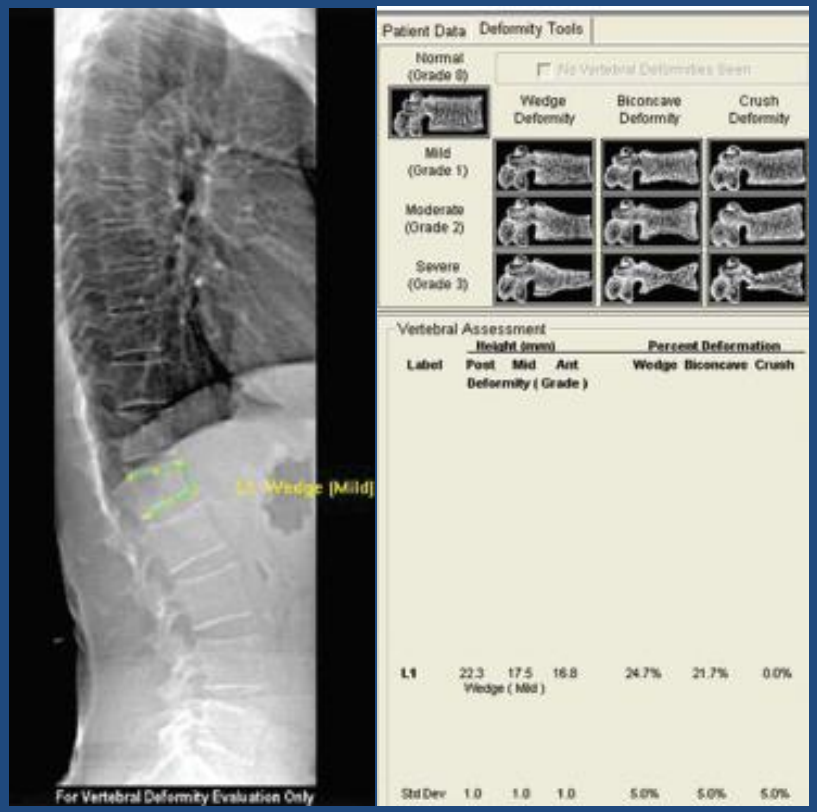
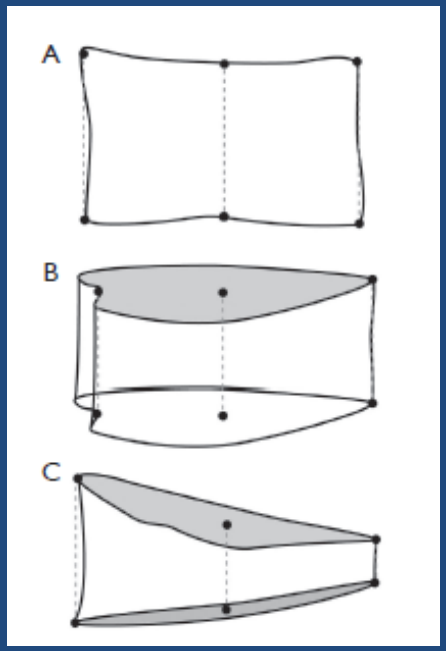
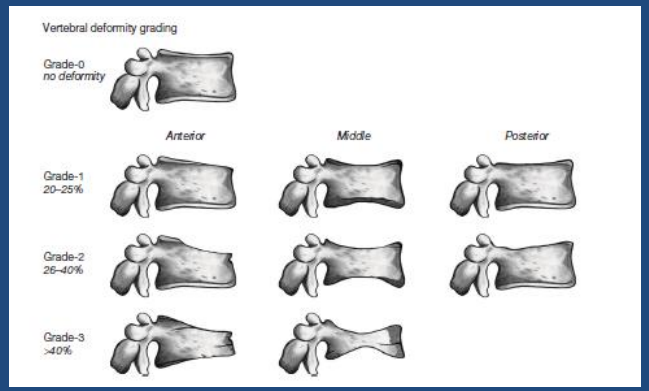
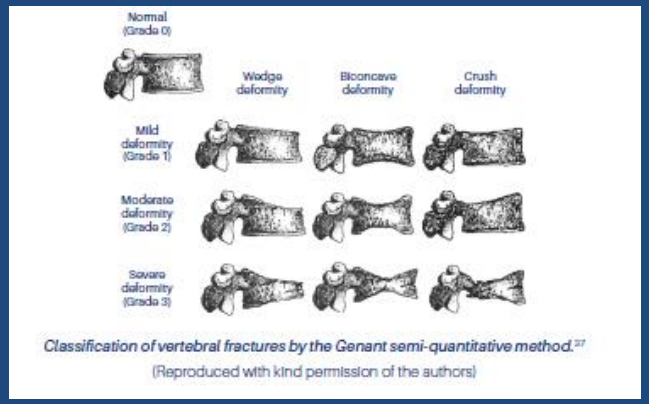
Assessment of Vertebral Fractures for Differential Diagnosis





Schematic diagram showing examples of reference point placement for quantitative morphometry





Action

Non reporting practitioners

- Flag suspicion of vertebral fracture to the reporting clinician

Reporting practitioners

- Report suspicion of vertebral fracture
- Confirm vertebral fracture - request VFA/plain film or indicate this must be done in report

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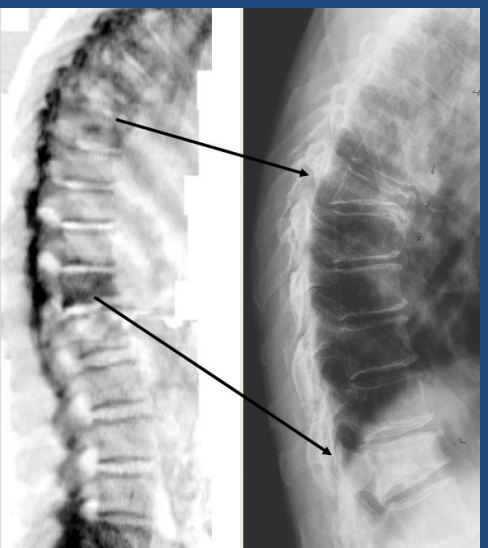
Comparison Between Vertebral Fracture Assessment (VFA) and Lateral Spine Radiography



VFA	Lateral Spine x-ray
Image acquisition at the same time as DXA for BMD	Higher spatial resolution & less noise
Lower cost	Evaluation of more vertebrae
Lower radiation exposure (≈3-40 mSv)	Higher cost
Poor performance on upper thoracic spine	Higher radiation exposure (600 mSv)
Lower inter-observer variability and reliability	Higher inter-observer variability and reliability

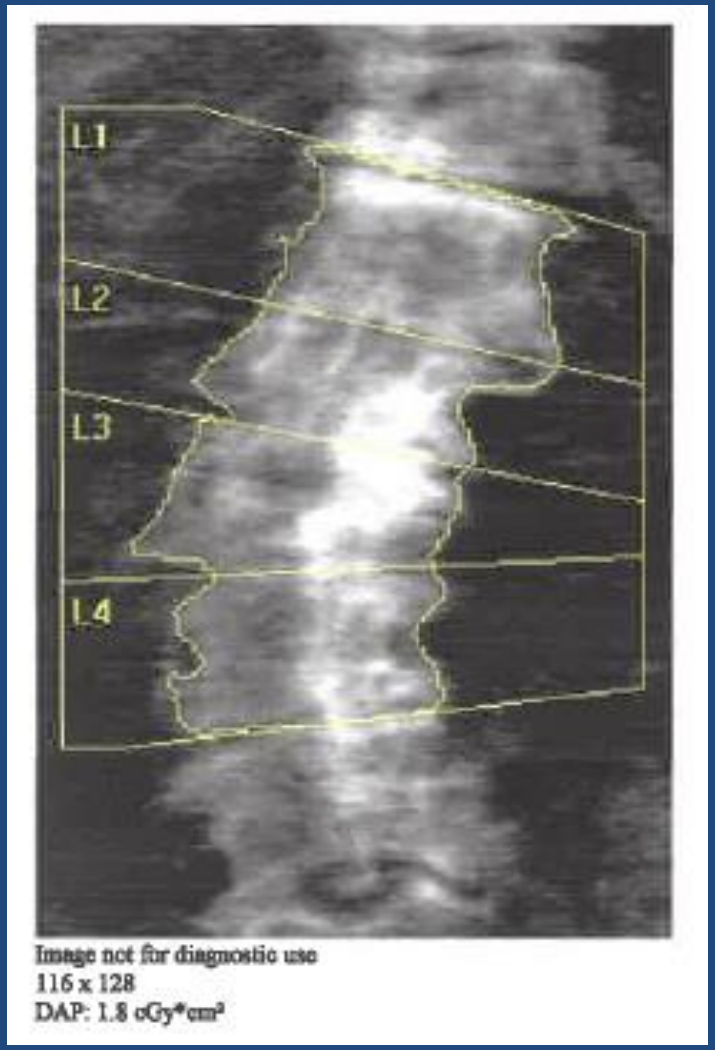
Action

Indications for VFA:

- T-score < -1.0 SD + 1 or more:
  - Woman aged > 70 or man >80
  - Historical height loss > 4 cm
  - Self reported but undocumented prior vertebral fracture
  - Glucocorticoid therapy >5 mg BD > 3 mo
  - Appearances on DXA suggestive of vertebral fracture

ISCD 2015

Case Study 4



DXA – 20/05/2019

Vertebral Fractures?

- 88 year old
- 141cm
- 56kg
- ♀ patient

- *"X-ray lumbar spine showed severe osteoporosis; not on any treatment; no h/o #."*

DXA Results Summary:

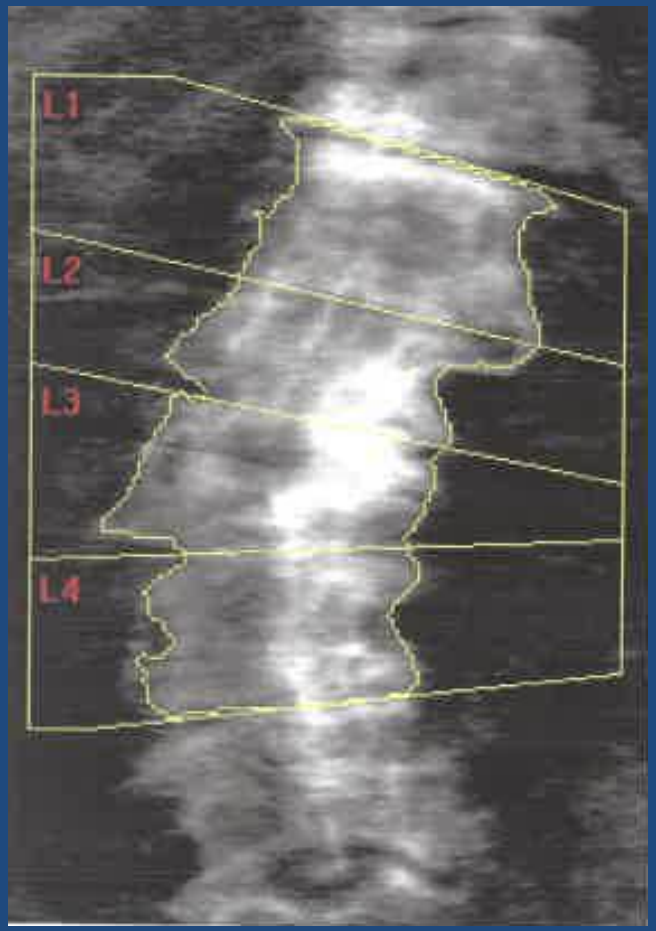
Region	Area (cm²)	BMC (g)	BMD (g/cm²)	T-score	Z-score
L1	16.78	18.24	1.087	0.9	3.4
L2	13.09	16.16	1.235	1.9	4.7
L3	14.90	17.26	1.159	0.7	3.7
L4	15.23	13.66	0.896	-1.5	1.6
Total	**60.00**	**65.31**	**1.089**	**0.4**	**3.3**

Total BMD CV 1.0%
WHO Classification: Normal
Fracture Risk: Not Increased

GIG CYMRU NHS WALES
Bwrdd Iechyd Prifysgol Bae Abertawe
Swansea Bay University Health Board

Royal Osteoporosis Society
Better bone health for everybody

Case Study 4



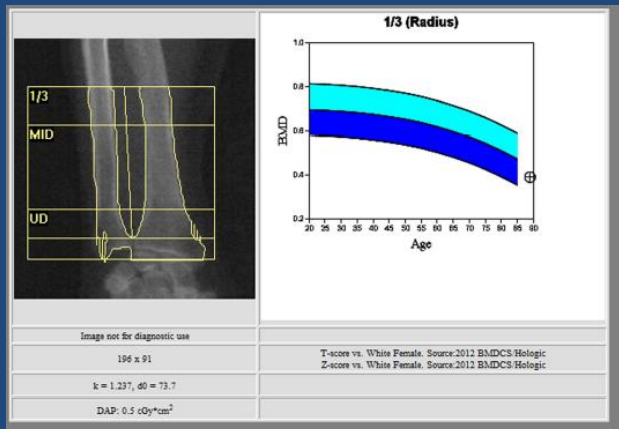


Image not for diagnostic use

196 x 91

k = 1.237, d0 = 73.7

DAP: 0.5 cGy*cm²

T-score vs. White Female, Source:2012 BMDCS/Hologic
Z-score vs. White Female, Source:2012 BMDCS/Hologic

Results Summary:

Region	Area[cm²]	BMC[(g)]	BMD[g/cm²]	T-score	PR (Peak Reference)	Z-score	AM (Age Matched)
1/3	2.83	1.10	0.390	-5.1	56		
MID	6.47	2.48	0.383	-4.1	63		
UD	3.79	1.02	0.268	-3.0	61		
Total	13.09	4.60	0.351	-4.2	61		

Total BMD CV 1.0%, ACF = 1.039, BCF = 1.000

Fracture Risk: High; WHO Classification: Osteoporosis

DXA – 20/05/2019

Case Study 4 - VFA

DXA – 20/05/2019

Vertebral Fractures?

- 88 year old
- 141cm
- 56kg
- ♀ patient

- *"X-ray lumbar spine showed severe osteoporosis; not on any treatment; no h/o #."*

GIG CYMRU NHS WALES | Bwrdd Iechyd Prifysgol Bae Abertawe | Swansea Bay University Health Board

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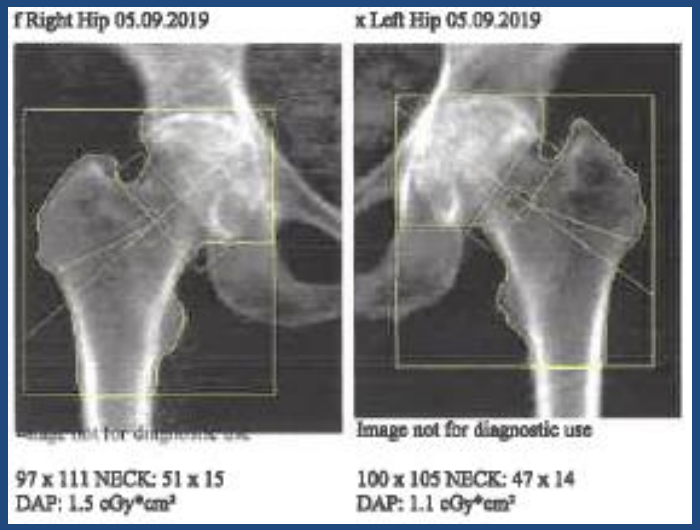
Case Study 5



DXA Results Summary:

Region	Area (cm²)	BMC (g)	BMD (g/cm²)	T-score	Z-score
Neck					
Left	5.54	3.31	0.598	-2.3	-0.1
Right	5.70	3.43	0.601	-2.2	-0.1
Mean	5.62	3.37	0.600	-2.2	-0.1
|Diff.|	0.16	0.12	0.003	0.0	0.0
Total					
Left	40.45	26.51	0.655	-2.3	-0.5
Right	41.99	29.57	0.704	-1.9	-0.1
Mean	41.22	28.04	0.680	-2.1	-0.3
|Diff.|	1.55	3.06	0.049	0.4	0.4

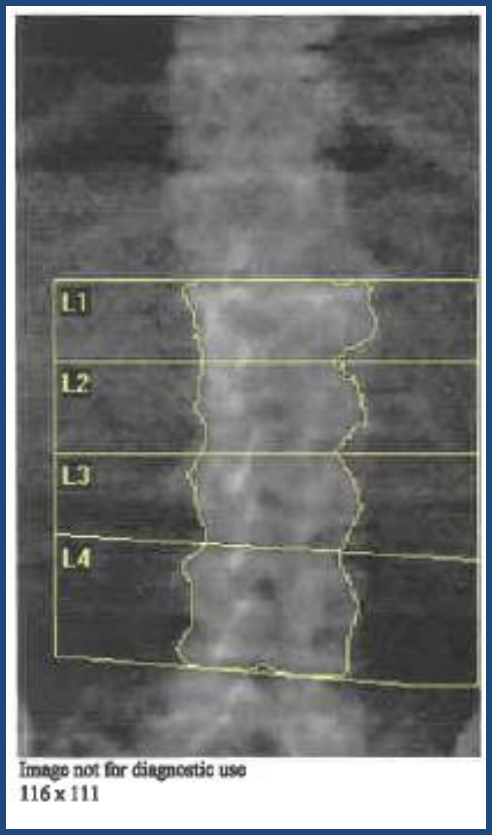
Total BMD CV 1.0%
WHO Classification on Bolded Results: Osteopenia

DXA – 05/09/2019

- 76 year old
- 146cm
- 55.3kg
- ♀ patient

- *"For monitoring change in BMD. Last scan June 2016. Repeat scan suggested for 3 years time."*

Lumbar spine previously excluded



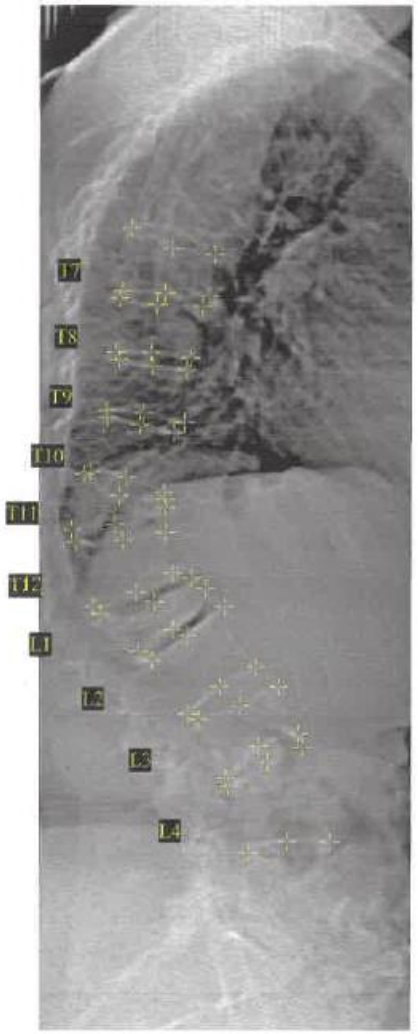
DXA – 25/03/2010

DXA Results Summary:

Region	Area (cm²)	BMC (g)	BMD (g/cm²)	T-score	Z-score
L1	10.45	9.05	0.866	-0.5	1.2
L2	10.56	7.32	0.693	-3.0	-1.2
L3	11.13	7.86	0.707	-3.4	-1.4
L4	15.06	11.87	0.788	-3.0	-0.9
Total	47.20	36.10	0.765	-2.6	-0.6

Total BMD CV 1.0%
WHO Classification: Osteoporosis
Fracture Risk: High

Case Study 5



Scan Information:

Scan Date:	05.09.2019 - A0905191A
Scan Type:	f SE Lateral Image
Analysis:	05 September 2019 15:13
Operator:	TS
Model:	Horizon A (200232)
Comment:	

Vertebral Assessment:

Label	Height (mm) Post	Mid	Ant	Deformity (Grade)	Percent Deformation Wedge	Biconcave	Crush
T7	24.8	18.0	16.4	Wedge (Moderate)	34.1%	27.3%	0.0%
T8	21.0	18.4	20.7	Normal	1.5%	12.4%	0.0%
T9	20.6	18.4	20.4	Normal	0.9%	10.6%	0.0%
T10	22.3	21.3	23.6	Normal	0.0%	4.1%	5.7%
T11	22.1	11.2	3.2	Wedge (Severe)	85.3%	49.6%	0.0%
T12	26.4	20.8	16.2	Wedge (Moderate)	38.5%	21.0%	0.0%
L1	20.9	13.0	7.0	Wedge (Severe)	66.2%	37.6%	0.0%
L2	25.0	23.4	26.5	Normal	0.0%	6.4%	5.9%
L3	25.4	17.7	19.7	Biconcave (Moderate)	22.4%	30.6%	0.0%
L4	27.2	31.6	38.3	Crush (Moderate)	0.0%	-16.2%	28.9%
Std Dev	1.0	1.0	1.0		5.0%	5.0%	5.0%

Physician's Comment:

HOLOGIC®

Case Study 6

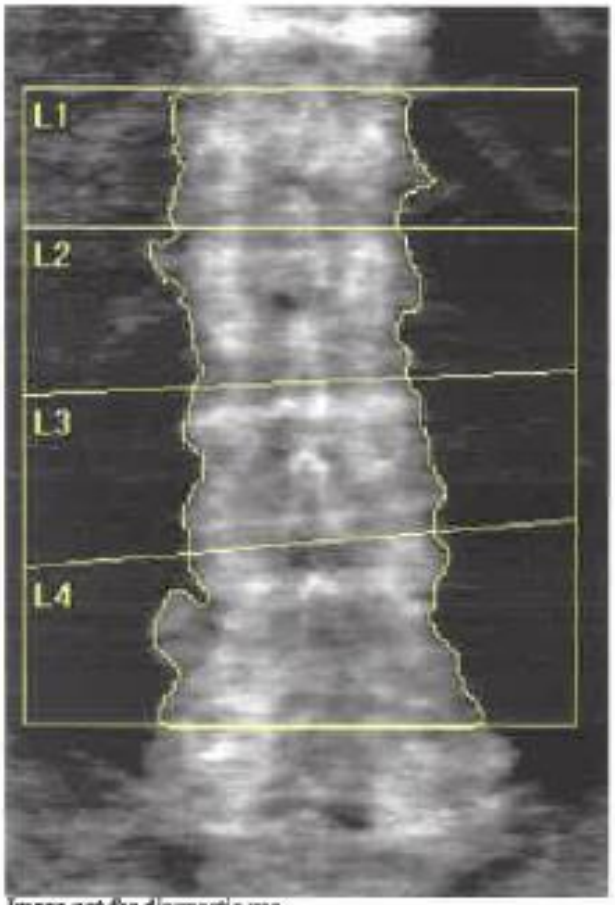


Image not for diagnostic use
116 x 134
DAP: 1.9 cGy*cm²

Vertebral Fractures?

- 69 year old
- 154cm
- 70.8 kg
- ♀ patient

- *"Routine monitoring post autologous stem cell transplantation for MM."*

DXA Results Summary:

Region	Area (cm²)	BMC (g)	BMD (g/cm²)	T - score	Z - score
L1	14.49	16.59	1.145	1.4	3.3
L2	16.26	18.88	1.161	1.2	3.3
L3	17.23	20.55	1.193	1.0	3.2
L4	23.32	25.76	1.105	0.4	2.6
Total	**71.29**	**81.78**	**1.147**	**0.9**	**3.0**

Total BMD CV 1.0%
WHO Classification: Normal
Fracture Risk: Not Increased

DXA – 16/08/2019

Case Study 6

f Right Hip 16.08.2019

103 x 103 NECK: 49 x 15
DAP: 1.3 cGy*cm²

f Left Hip 16.08.2019

103 x 99 NECK: 49 x 15
DAP: 1.2 cGy*cm²

DXA Results Summary:

Region	Area (cm²)	BMC (g)	BMD (g/cm²)	T - score	Z - score
Neck					
Left	5.00	3.81	0.761	-0.8	1.0
Right	5.34	4.01	0.752	-0.9	0.9
Mean	5.17	3.91	0.757	-0.8	1.0
|Diff.|	0.34	0.21	0.009	0.1	0.1
Total					
Left	33.58	31.97	0.952	0.1	1.6
Right	35.62	34.53	0.969	0.2	1.7
Mean	34.60	33.25	0.961	0.2	1.6
|Diff.|	2.03	2.55	0.017	0.1	0.1

Total BMD CV 1.0%
WHO Classification on Bolded Results: Normal

DXA – 16/08/2019

Scan Information:

Scan Date: 16.08.2019 - A08161915
Scan Type: f SE Lateral Image
Analysis: 16 August 2019 14:45
Operator: LH
Model: Horizon A (200232)
Comment:

Vertebral Assessment:

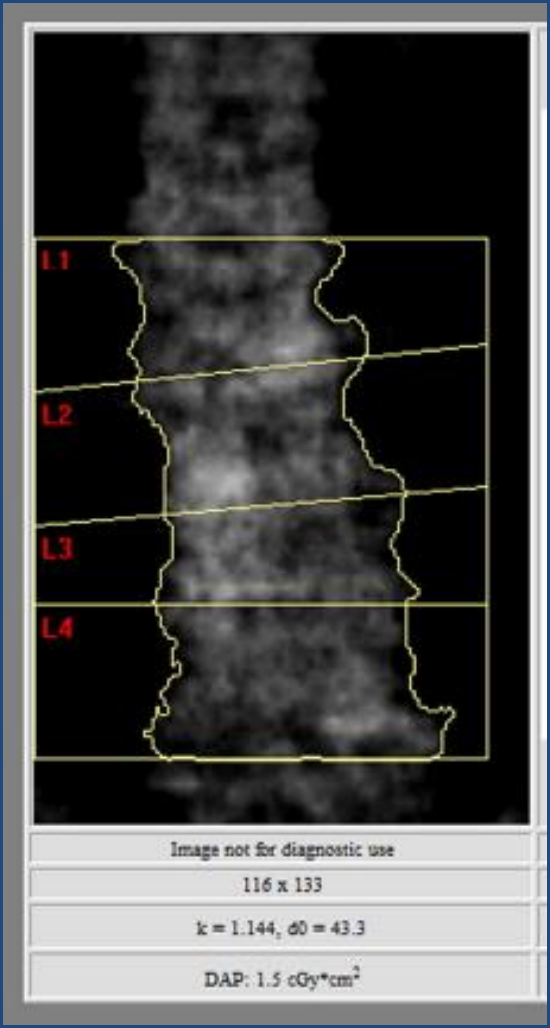
Label	Height (mm) Post	Mid	Ant	Percent Deformation Wedge	Biconcave	Crush	Deformity (Grade)
T8	19.8	16.5	16.5	16.4%	16.7%	0.0%	Normal
T9	19.2	18.9	18.1	5.9%	2.0%	0.0%	Normal
T10	23.3	17.5	21.2	9.1%	24.8%	0.0%	Biconcave (Mild)
T11	22.8	20.9	16.2	28.9%	8.2%	0.0%	Wedge (Moderate)
T12	18.8	15.7	14.3	24.0%	16.2%	0.0%	Wedge (Mild)
L1	23.5	16.5	20.0	14.8%	29.7%	0.0%	Biconcave (Moderate)
L2	28.0	21.0	27.2	2.9%	25.1%	0.0%	Biconcave (Moderate)
L3	25.4	22.6	26.6	0.0%	11.1%	4.4%	Normal
L4	27.3	23.3	24.0	12.1%	14.9%	0.0%	Normal
Std Dev	1.0	1.0	1.0	5.0%	5.0%	5.0%	

Physician's Comment:

HOLOGIC

WOAG Educational Meeting: Vertebral Fractures – 19/09/2019

Case Study 7

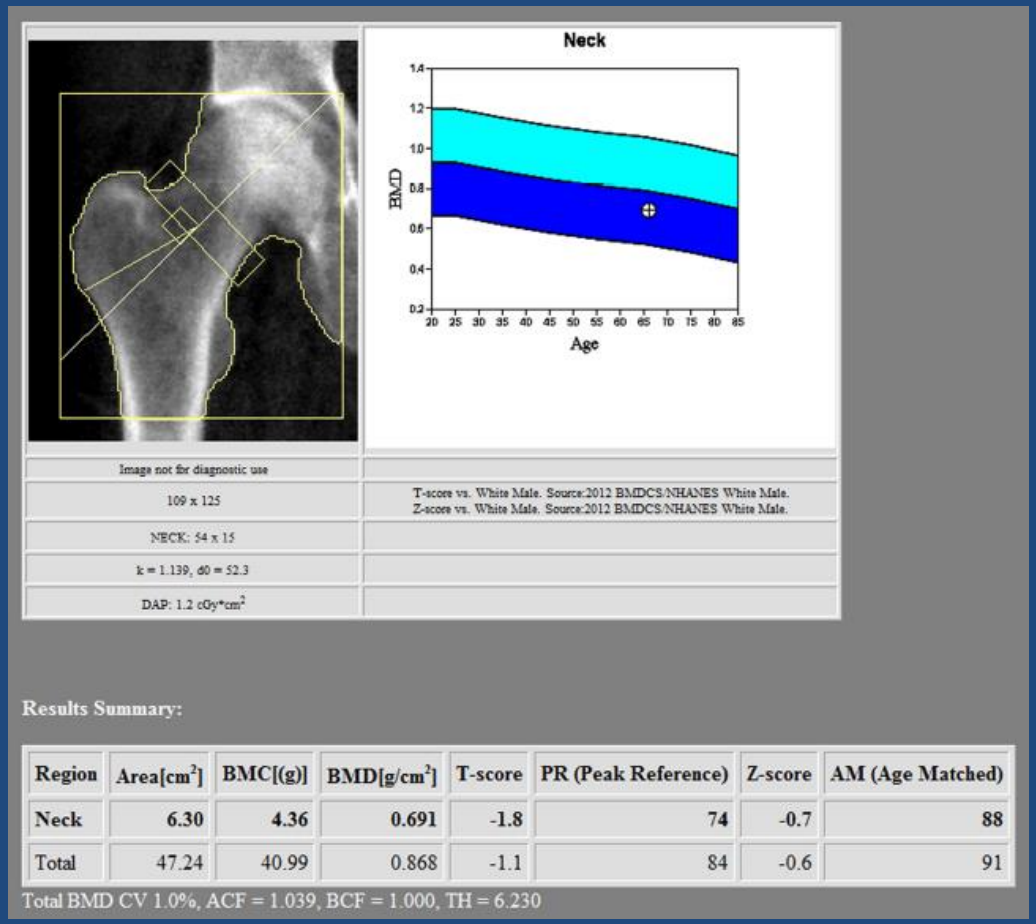


- 66 year old
- 177cm
- 98.5 kg
- ♂ patient

- *"On long-term corticosteroid therapy. On residronate for 17 years. Now stopped. Needs alternative therapy or drug holiday?"*

DXA – 07/02/2019

Case Study 7



Results Summary:

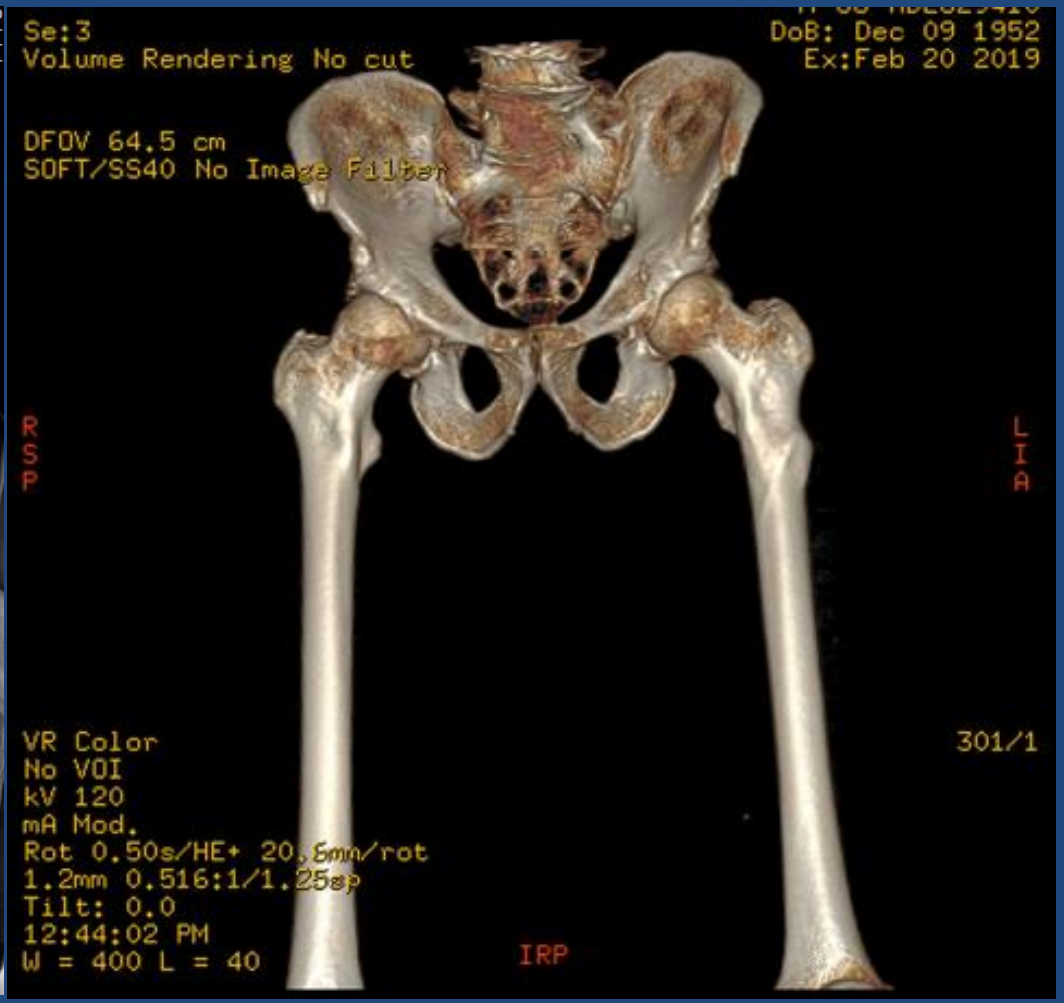
Region	Area[cm²]	BMC[(g)]	BMD[g/cm²]	T-score	PR (Peak Reference)	Z-score	AM (Age Matched)
Neck	6.30	4.36	0.691	-1.8	74	-0.7	88
Total	47.24	40.99	0.868	-1.1	84	-0.6	91

Total BMD CV 1.0%, ACF = 1.039, BCF = 1.000, TH = 6.230

DXA – 07/02/2019

Case Study 7

X-ray – 13/02/2019



CT – 20/02/2019

Bone Mineral Density accounts for 70% of bone strength*

*JAMA, 2001; 285 : 785-795

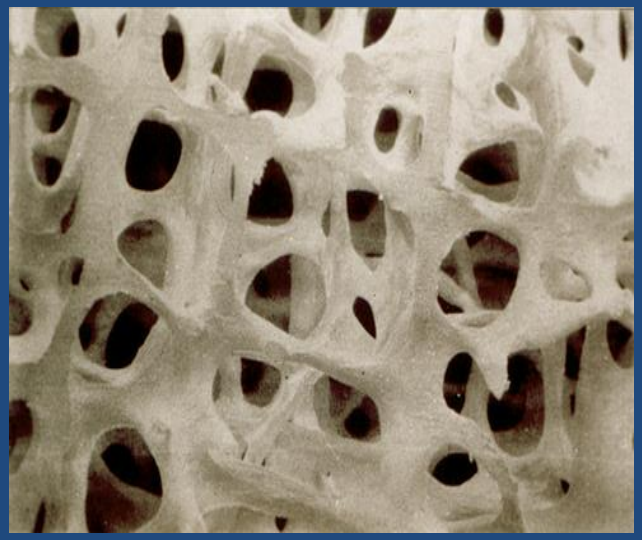
Think

- Vertebral Fracture
- Hip Fracture
- Bone Quality

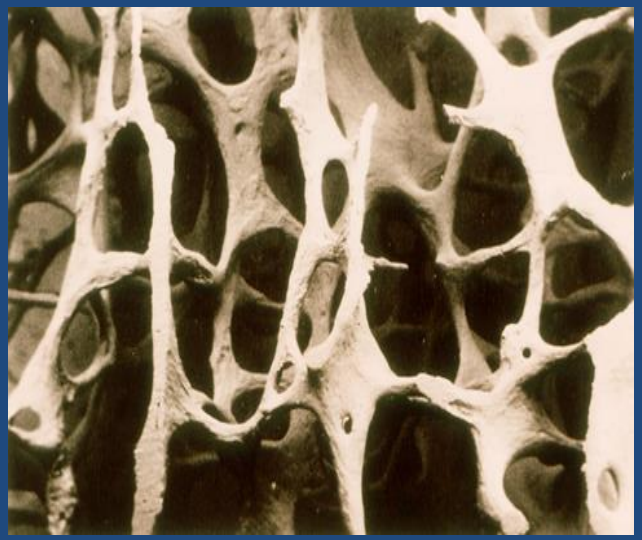
New Definition of Osteoporosis

Osteoporosis is defined as a skeletal disorder characterized by compromised bone strength predisposing a person to an increased risk of fracture. Bone strength primarily reflects the integration of bone density and bone quality.

NIH Consensus Conference 2001



Normal bone



Osteoporotic Bone

Journal of Clinical Densitometry: Assessment of Skeletal Health, vol. 12, no. 2, 170–176, 2009

1094-6950/09/12:170–176/$36.00
DOI: 10.1016/j.jocd.2008.11.006

Original Article

Evaluation of the Potential Use of Trabecular Bone Score to Complement Bone Mineral Density in the Diagnosis of Osteoporosis: A Preliminary Spine BMD–Matched, Case-Control Study

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