Vertebral Fracture Assessment- VFA

Calling a Fracture a Fracture

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21 May 2019

VFA: Calling a fracture a fracture

- Recap:

  - Why are vertebral fracture an important finding?
  - Identification of fractures in imaging
  - Identification of fractures in DXA
  - VFA

- VFA Case studies

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Why?

- Most common osteoporotic fracture

  - Prevalence studies suggest that 12% of women aged 50–79 have vertebral fractures

- Strongly predict future fracture

 risk- RR for NOF# 2.8

- Under-diagnosed (70% undiagnosed)

Black et al., JBMR 1999; Melton et al., OI 1999; Lindsay et al., JAMA 2001

O'Neill TW, Felsenberg D, Varlow J, Cooper C, Kanis JA, Silman J. The prevalence of vertebral deformity in European men and women: the European Vertebral Osteoporosis Study. J Bone Miner Res. 1996;11:1010-18

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Why?

Increased morbidity and mortality
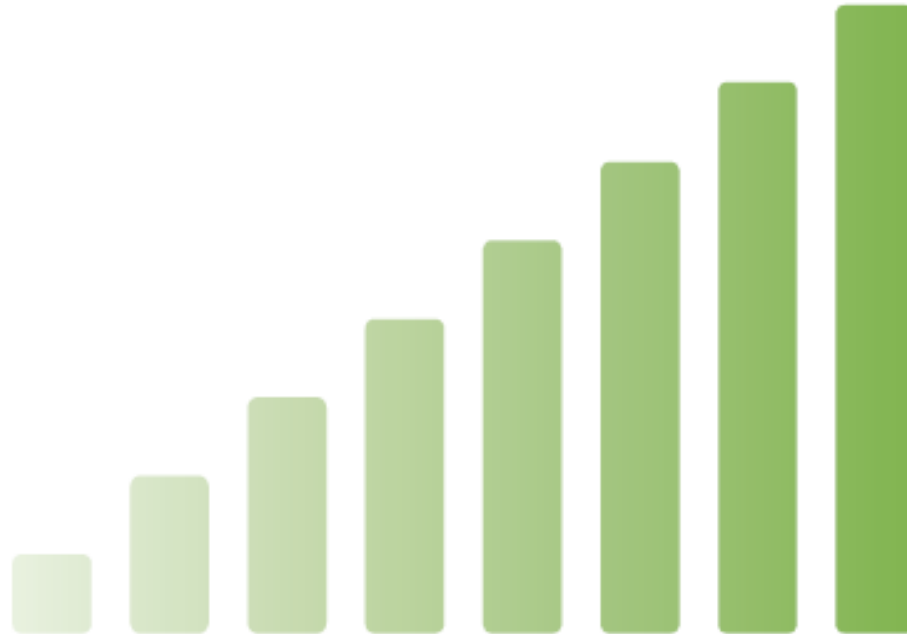
Vertebral fractures are associated with an **8-fold** increase in age-adjusted mortality [19-21]

19 Cauley JA, Risk of mortality following clinical fractures. Osteoporosis Int. 2000;11:556-61.
20 Kado DM, Vertebral fractures and mortality in older women: a prospective study. Arch Intern Med. 1999;159(11):1215-20.
21 Jalava T, et al. Association between vertebral fracture and increased mortality in osteoporotic patients. J Bone Miner Res. 2003;18(7):1254-60.

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Why?

Fracture risk by BMD and previous fracture
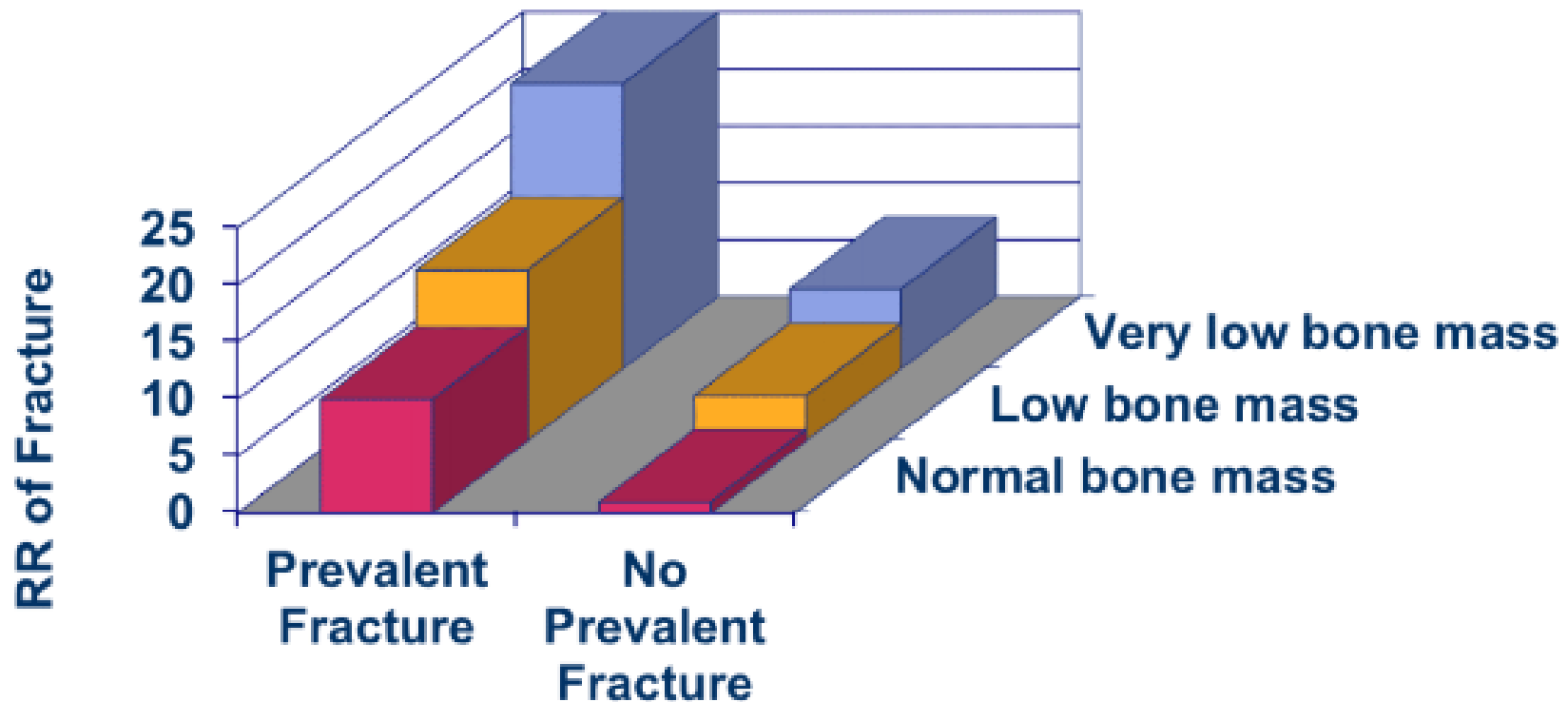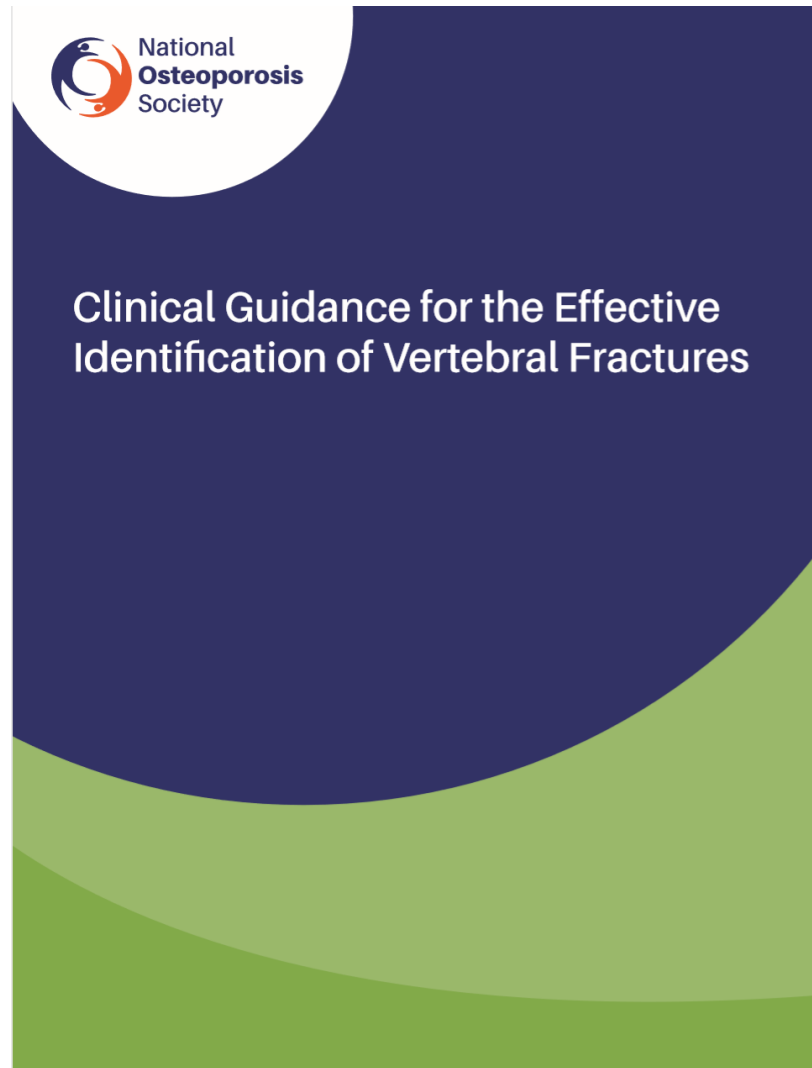

Ross et al., 1991

Why?

"It's a sad thing, but I really do believe that if the fracture I suffered in my spine had been spotted earlier than it was, I would have been spared a great deal of pain and suffering.

Believe me when I say, living with these fractures is a nightmare that never goes away."

Christine Sharp

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Identification of vertebral fracture in imaging services

Opportunities for the identification of VFx
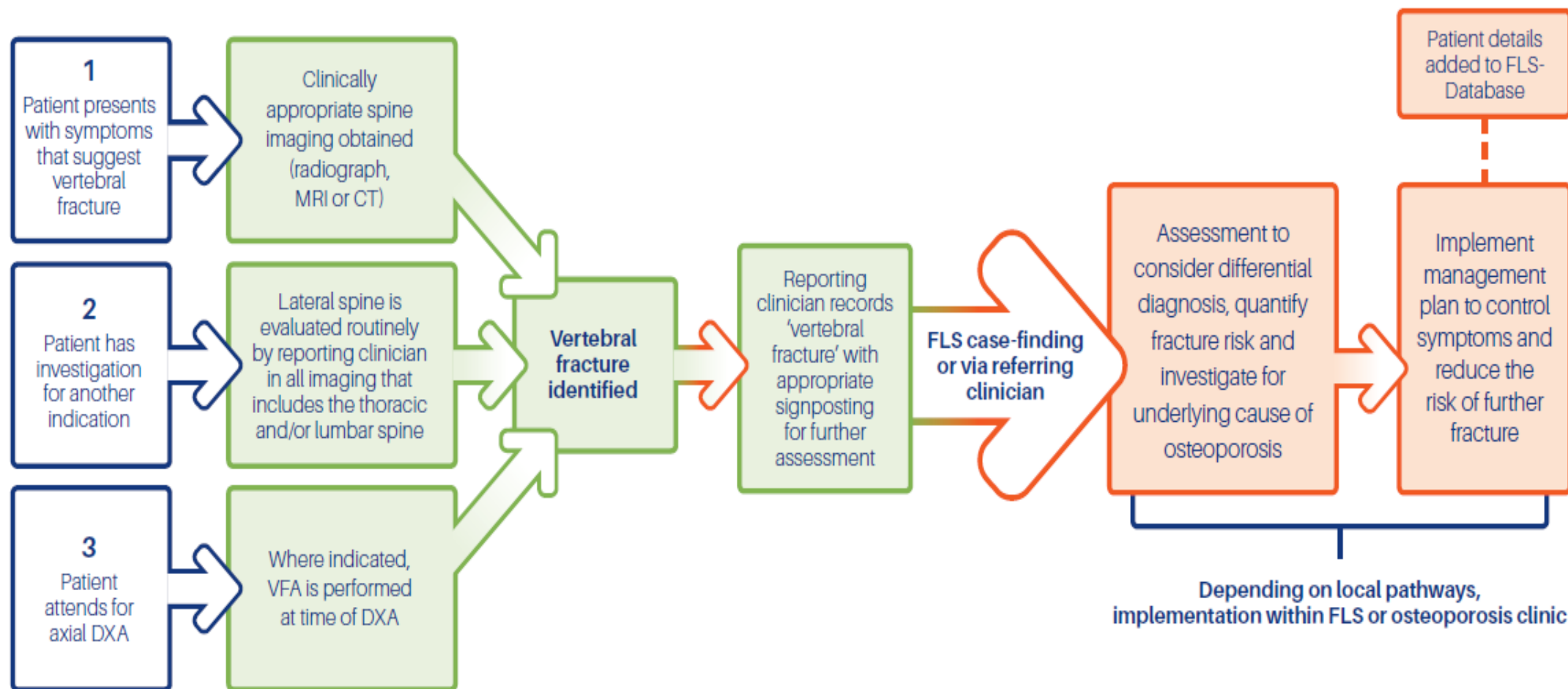
The Guidance

- **Seek** vertebral fractures apparent on any imaging that includes the thoracic and/or lumbar spine

- **Report** vertebral fractures clearly and unambiguously

- **Alert** the referring clinician to the need for further assessment of fracture risk, via FLS where available

seek

report

alert

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Audit of CT CAP spine reporting

- Results of pilot 193 CT CAP men and women >50years

standards	Audit	reports
Comment on the spine in report		161 (83.4%)
Scans in which VF identified	26 (13.5%)	15 (9.3%)
Scans with correct terminology		7 (46.6%)
Reports with VF recommending further assessment		0

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Identification of VFx 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

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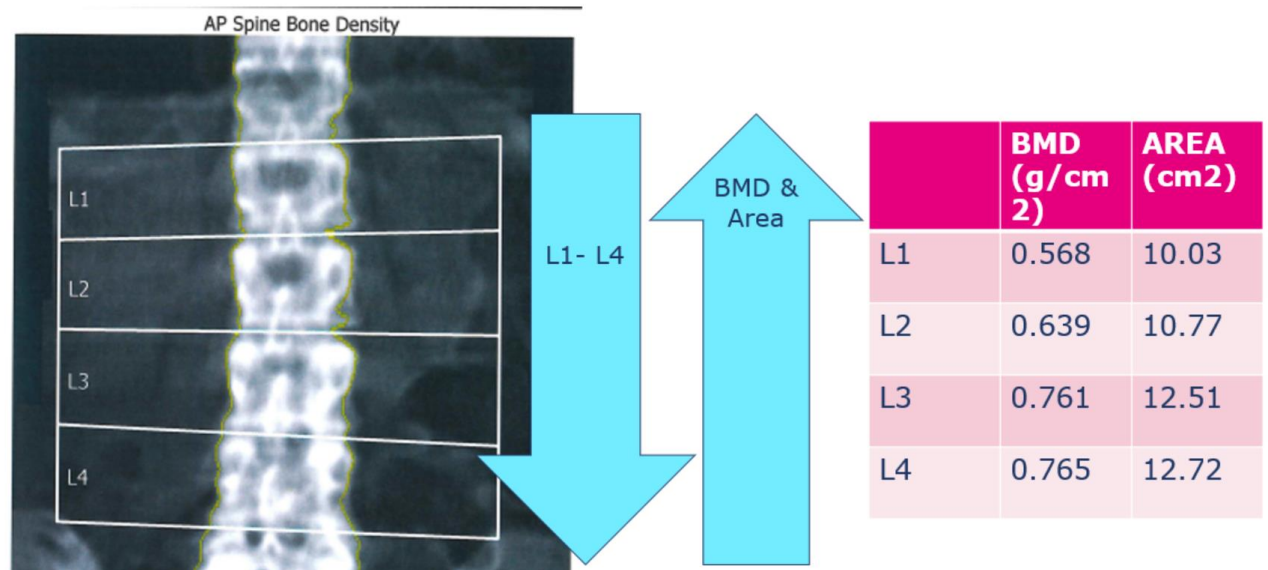Better bone health for everybody

Interrogate

- **Patient questionnaire**
  - Any fractures in last 5 years?
  - Any episodes of back pain with/without radiation
  - Any documented height loss/kyphosis

Healthy Bones Service Level 2
Derriford Hospital
Telephone 01752 439469

Plymouth Hospitals **NHS**
NHS Trust

HEALTHY BONES: DXA Scan Questionnaire
(Please complete and bring with you on the day of your appointment).   HBQ2012.v1.2

Surname.. First Name(s)..

Date of Birth   .... Hospital or NHS No ....

Scan information:
1) Have you had a Bone Density (DXA) scan before?   Yes ☐   No ☐   Unsure ☐
If yes: Where and when? _____

2) Have you undergone Spine or Hip Surgery?   Yes ☐   No ☐   Unsure ☐
If yes: What was it? _____

3) Have you had a scan or test requiring an
injection or *drink* In the last 4 weeks?   Yes ☐   No ☐   Unsure ☐
If yes: What was it? _____

Medical history:
a) Do you drink **3 or more** units of alcohol (1 unit = 1 small glass of wine or ½ pint regular strength beer/cider):
   Every day? ☐   Weekly? ☐   Monthly? ☐   Never Drink ☐

b) Have either of your parents ever broken/fractured a hip?   Yes ☐   No ☐   Unsure ☐

c) Have you ever been prescribed Steroids (tablets/prednisolone)   Yes ☐   No ☐   Unsure ☐
If yes please tell us when and for how long: _____

d) Have you broken or fractured a bone in your adult life?   Yes ☐   No ☐   Unsure ☐
If yes: which bone/s?_____ How did this happen?_____

e) Have you been diagnosed with or
 are you being treated for any long term medical conditions?   Yes ☐   No ☐   Unsure ☐
If yes please tell us what?_____

f) Have you ever been diagnosed with Rheumatoid arthritis   Yes ☐   No ☐   Unsure ☐

g) Are you a current smoker?   Yes ☐   No ☐   Unsure ☐

FEMALE PATIENTS ONLY(PLEASE CIRCLE)
Is there any possibility that you are pregnant?   Y/N
Are you going through/been through
 the menopause?   Y/N
Have you taken HRT?   Y/N
Have you had a hysterectomy?   Y/N
Signature............................Date...............

ALL PATIENTS:
Please list your current regular medications here:

Have you ever taken Strontium Ranelate/Protelos? Y/N
Continue overleaf if there is not enough room.

RADIOGRAPHER USE ONLY
Comments: LMP date.............

If your weight is more than 160kG
please contact the department for advice.

Height	Weight	kgs
cms		

ID Checked by .... Scanned by ....date:.............

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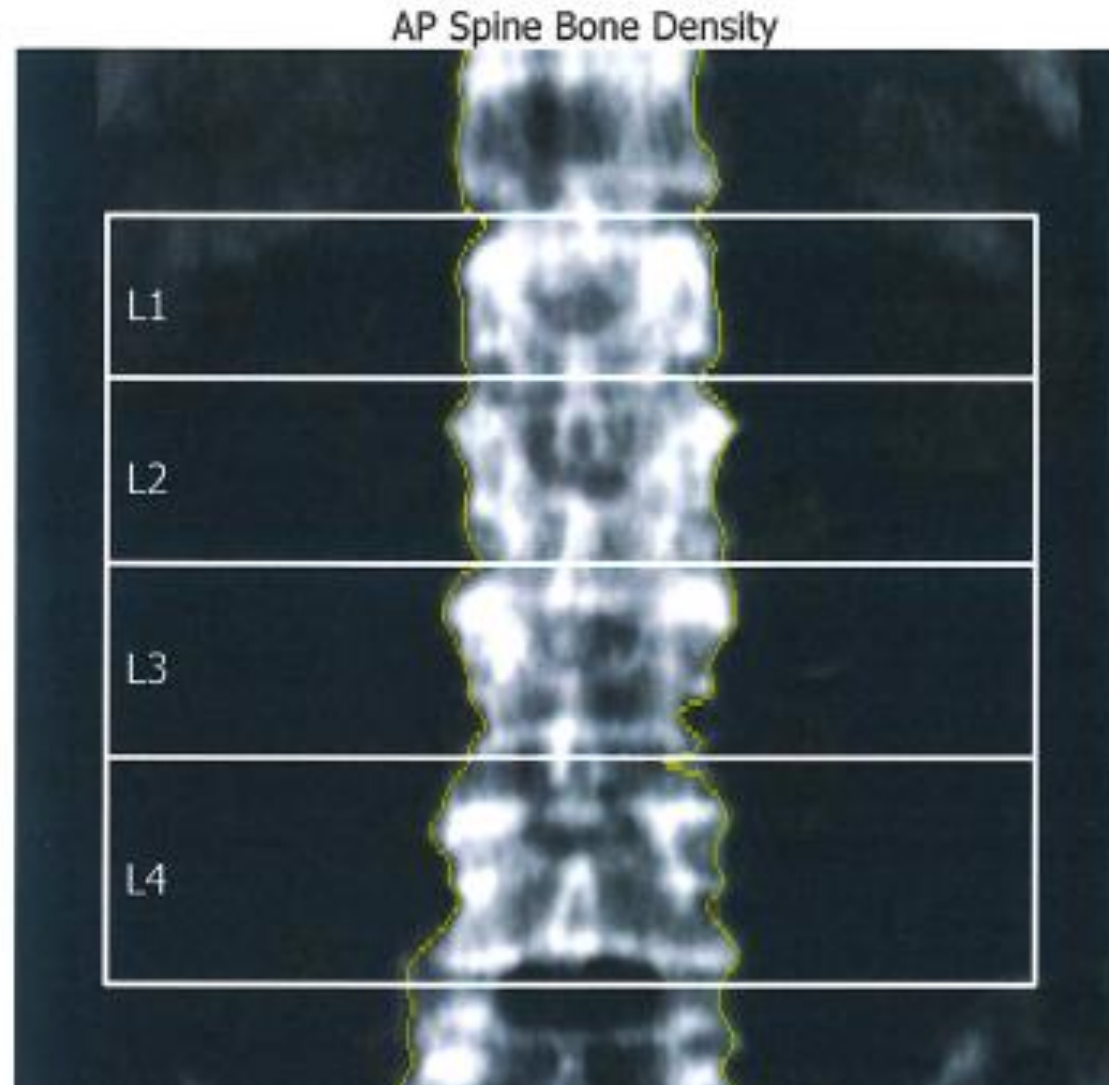Better bone health for everybody

Interrogate

- **DXA images and data**
  - Appearances of vertebral height loss??
  - Any unexplained reduction in vertebral area?
  - Any previous imaging?

NORMAL geometry and BMD distribution

AP Spine Bone Density

L1
L2
L3
L4

L1- L4

BMD & Area

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

Interrogate

AP Spine Bone Density

	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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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/pain film or indicate this must be done in report

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Action

Non reportin...

- Flag ...g clinician

Report...

- Report ...
- Confirm ...dicate this must...

Action

Non reporting

1. A radiology report should be ==actionable and prompt appropriate care for the patient.== It should answer the clinical question and include a tentative or differential diagnosis when an abnormality is seen and relevant negative observations if pertinent.[1]

Rep

2. The wording of the report should be unambiguous and should take into account the professional background of the referrer. ==Further investigations or specialist referral should be suggested within the report when they contribute to patient management.==

- Re

- Confirm ... dicate this must

VFA

- Clinical risk profiles have limited predictive ability

- High index of suspicion required to justify spine radiographs

  - Radiation dose

  - Cost

  - Patient inconvenience

- VFA can be obtained at same time as BMD measurement

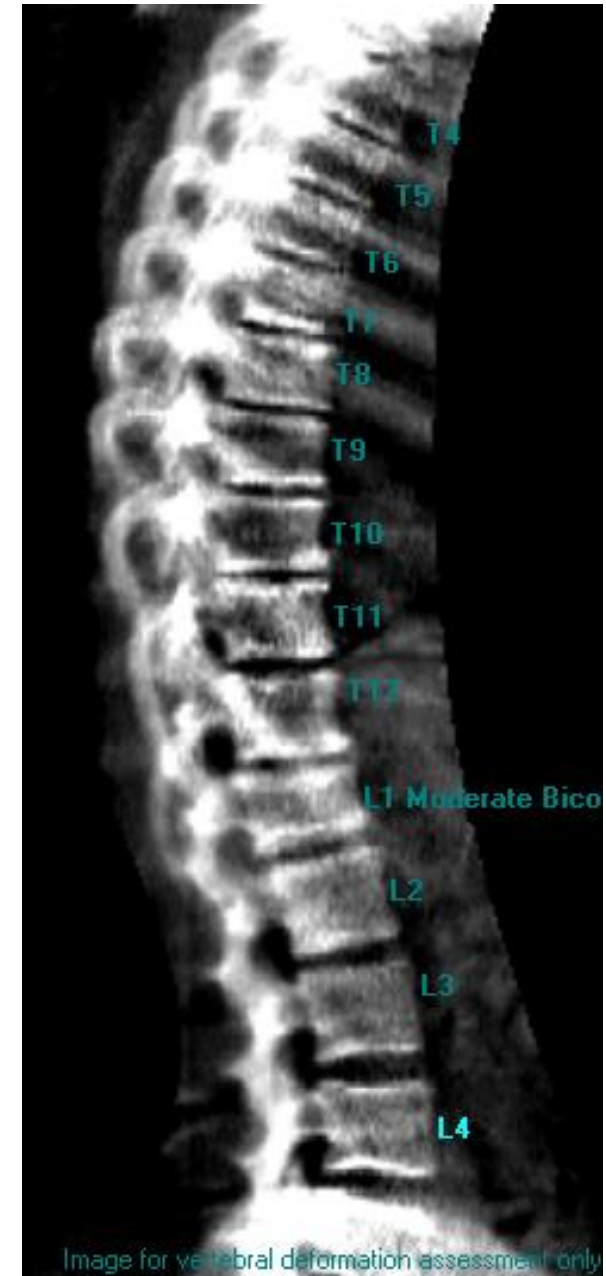- Presence of fracture may access anabolic treatments

VFA

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

ISCD 2015

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VFA

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  - 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

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.

Image for vertebral deformation assessment only

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VFA Quantitative Morphometry

Advantages

- Objective

- Reproducible

- Widely used in clinical trials

- Allows for variability in shape and size

Disadvantages

- Time-consuming

- Does not differentiate cause of a deformity:

  - Vertebral fracture

  - Non-fracture deformity
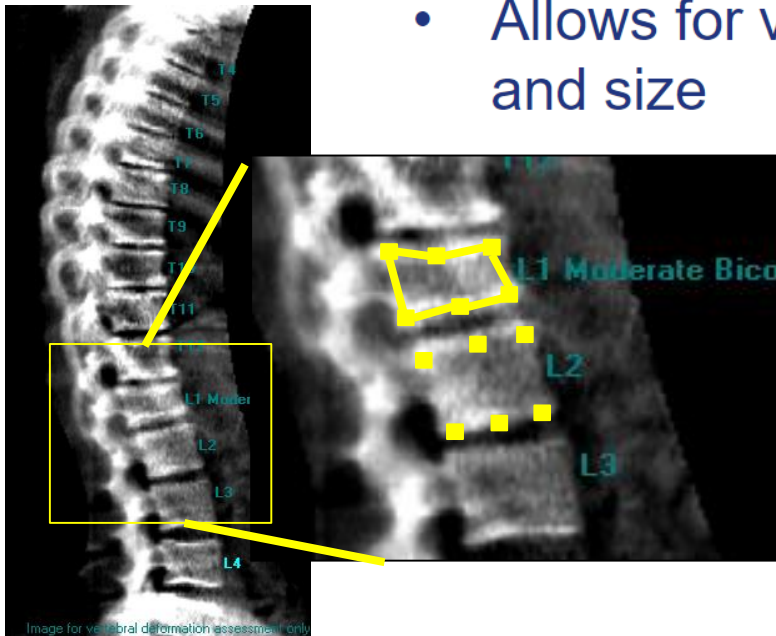
Image for vertebral deformation assessment only

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Patient:	####	
Birth Date:	####	####
Height / Weight:	####	####
Sex / Ethnic:	####	####
Facility ID:		
Referring Physician:	Dr Bleksley	
Measured:	#### (13.60)	####
Analyzed:	#### (13.60)	####

LVA Morphometry

Region [1]	Avg. Ht. [2] (cm)	Z-score	A/P Ratio [2] (%)	Z-score
T4	1.30	-2.8	100	0.9
T5	1.31	-2.8	89	-0.7
← T6	1.27	-3.4	71	-2.9
← T7	1.15	-4.4	88	-0.1
T8	1.65	-1.0	113	3.5
← T9	1.39	-3.2	86	-1.0
← T10	1.40	-3.8	73	-3.2
← T11	1.24	-5.3	81	-1.8
← T12	1.53	-4.2	68	-4.0
← L1	1.78	-3.4	81	-2.2
L2	2.56	0.0	106	1.2
L3	2.55	-0.2	115	2.1
L4	2.63	0.2	105	0.0

← Moderate Compression
← Severe Compression

COMMENTS:

1 - Reference based on L2, L3, and L4
2 - The precision (±1SD) is 1mm for heights and 0.05 for ratios

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VFA case studies: calling a fracture a fracture

Case 1

T7

T8
T9

T10

T11

T12
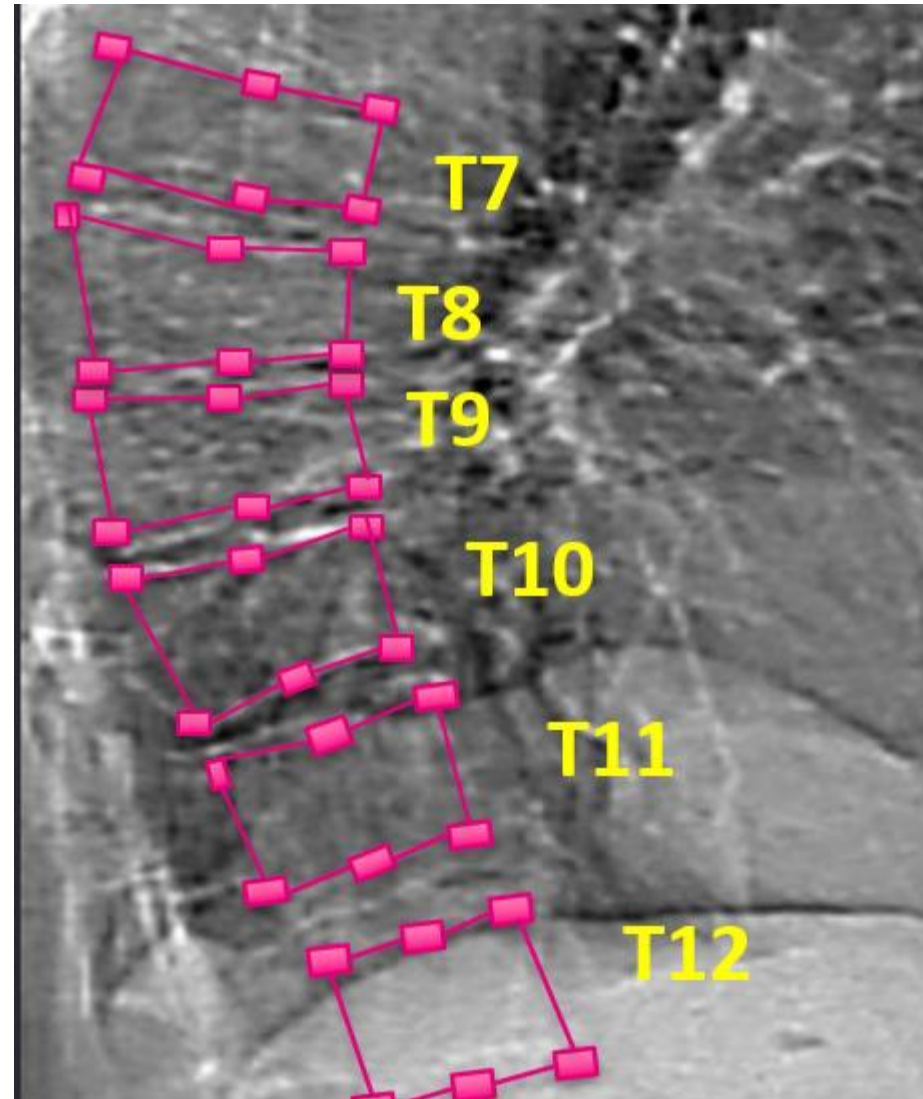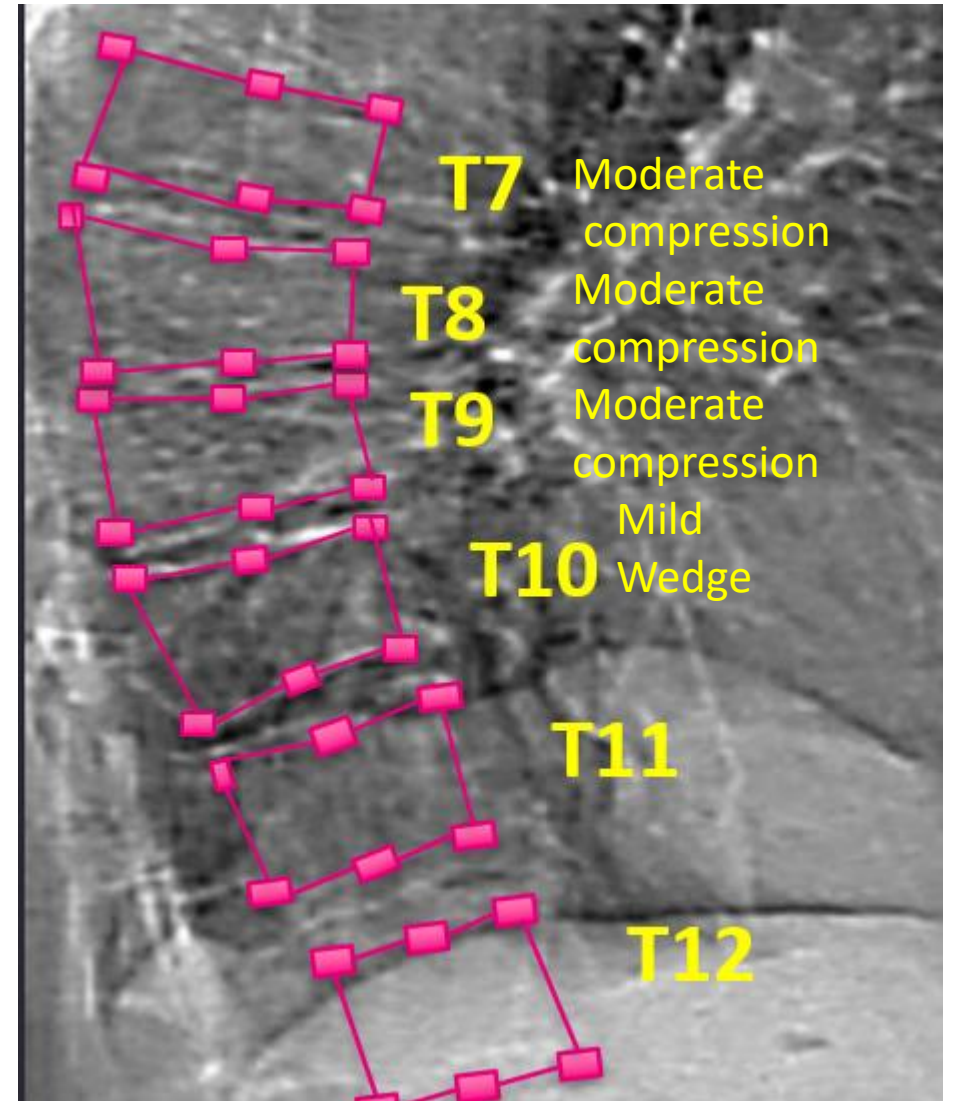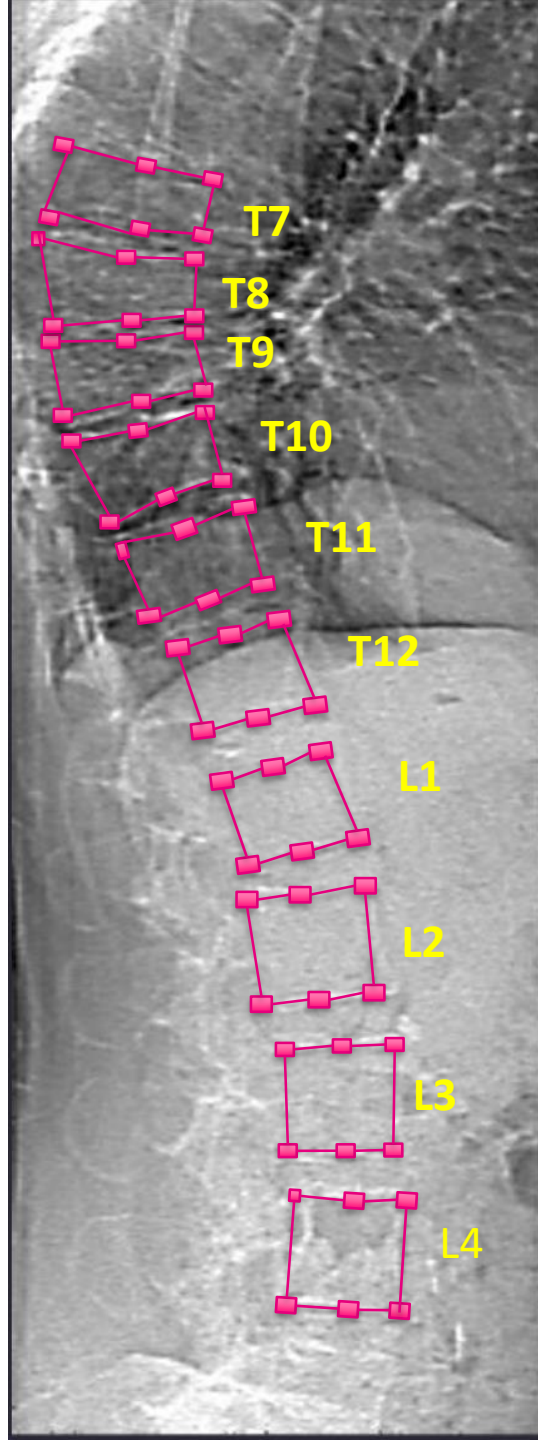
L1

L2

L3

L4
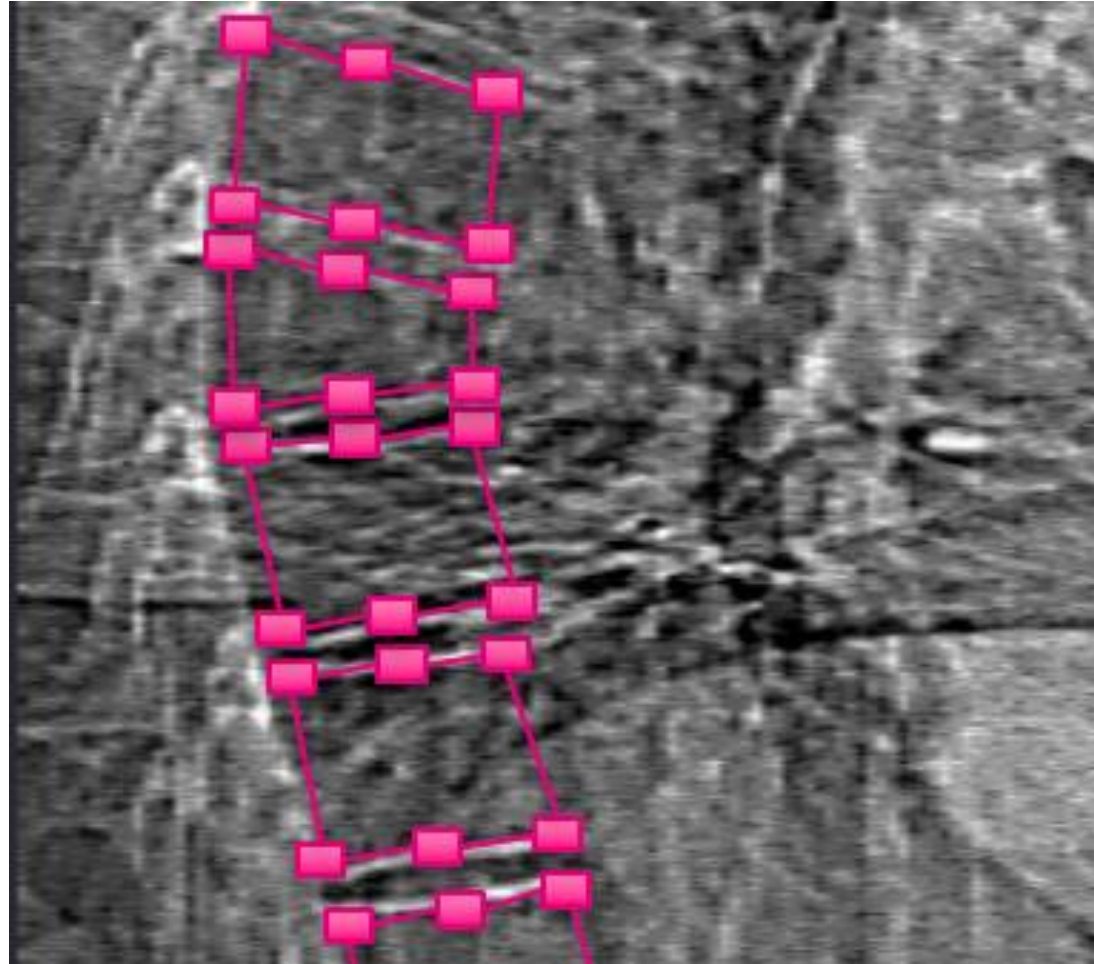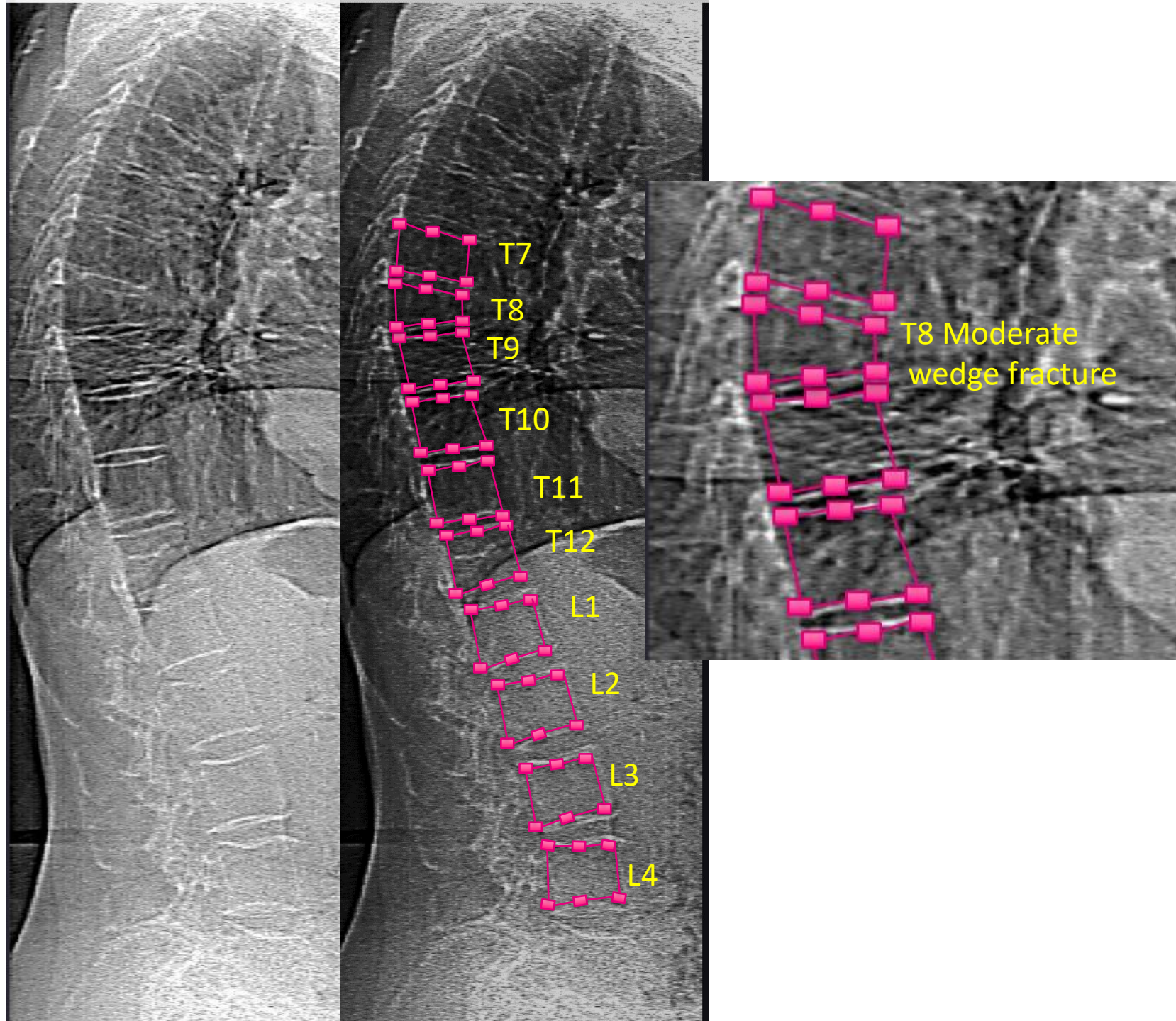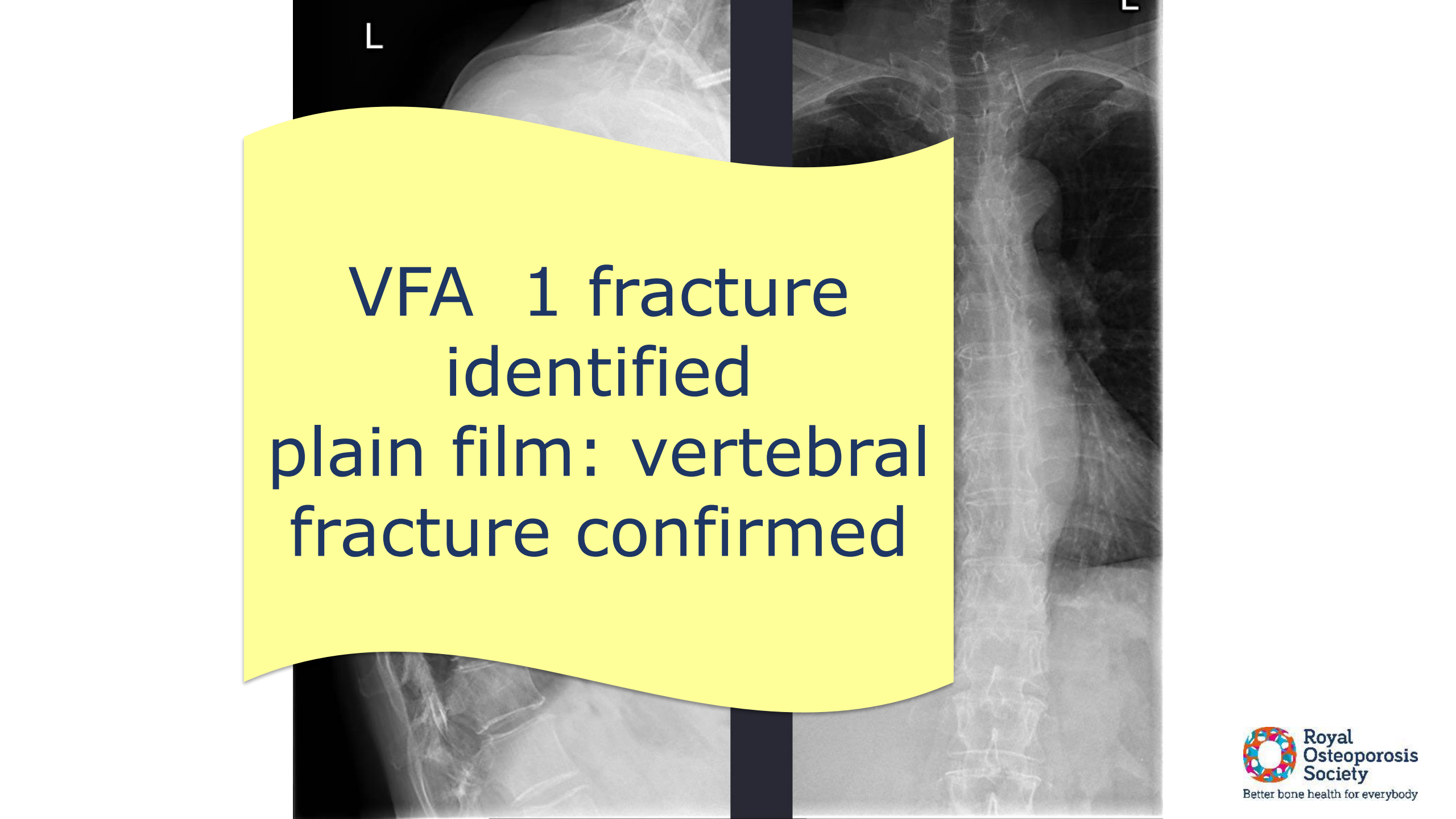
T8 Moderate wedge fracture

VFA 1 fracture identified
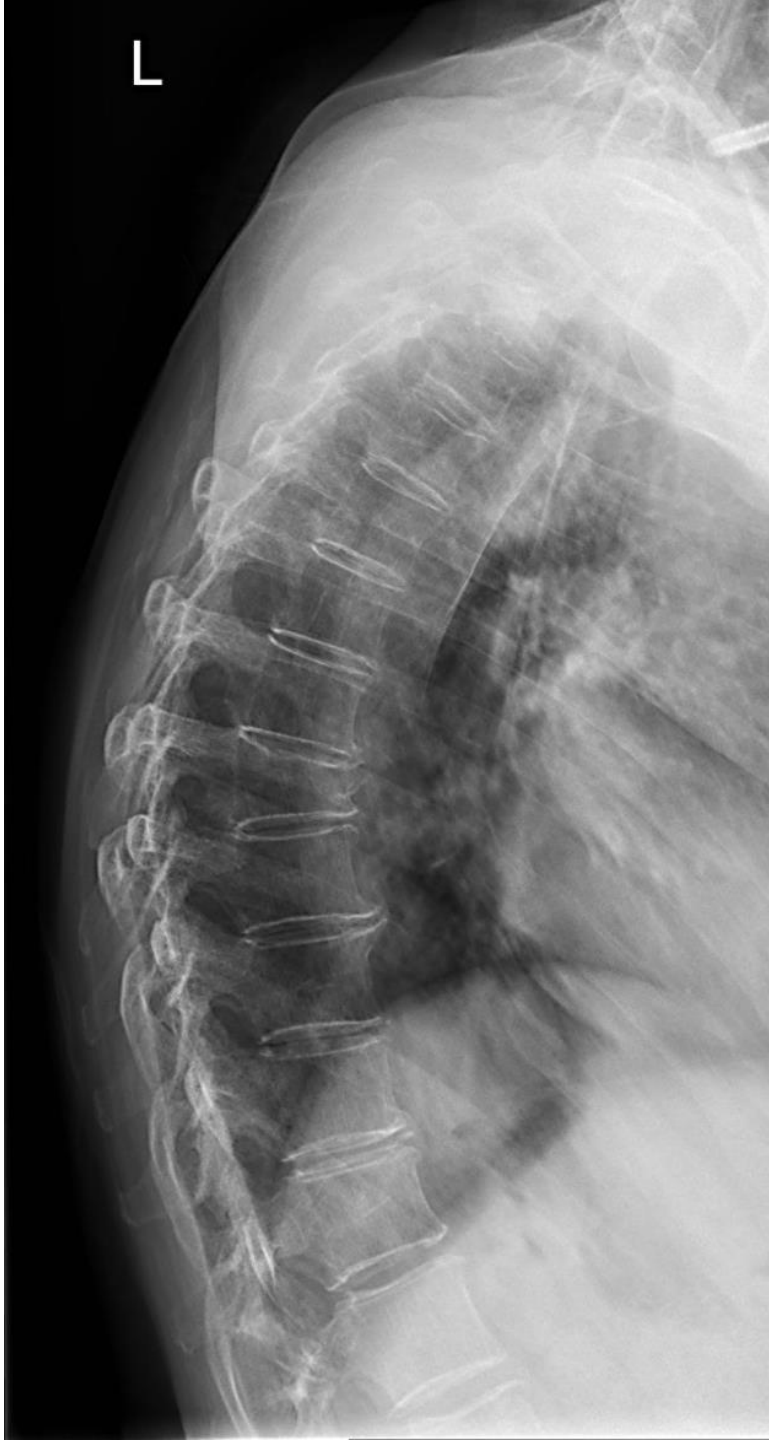
VFA 1 fracture identified
plain film: vertebral fracture confirmed

VFA case studies: calling a fracture a fracture

Case 2

T7
T8
T9
T10
T11
T12
L1
L2
L3
L4

T7   Moderate
       compression
T8   Moderate
       compression
T9   Moderate
       compression
T10   Mild
       Wedge
T11
T12

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VFA 4 fractures identified

T7 — Moderate compression
T8 — Moderate compression
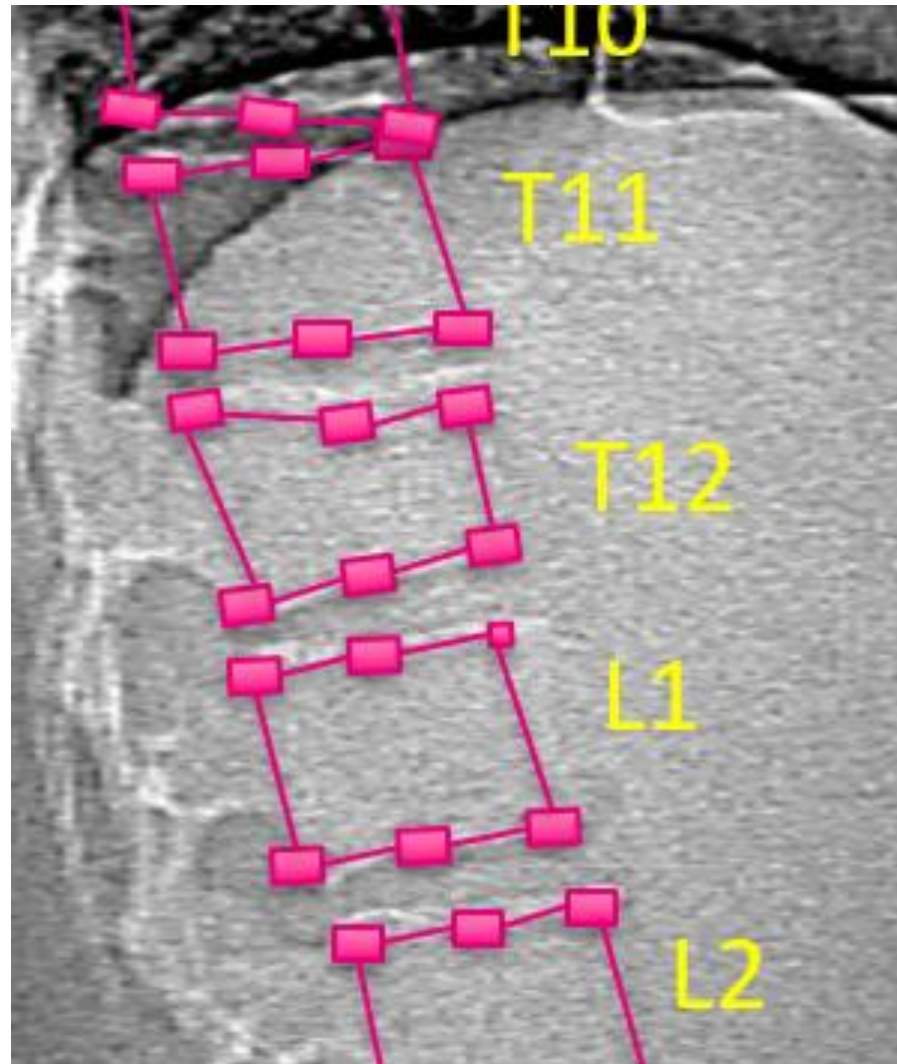T9 — Moderate compression
T10 — Mild Wedge
T11
T12

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VFA 4 fractures identified

Plain film- Scheurmann's disease

No fractures

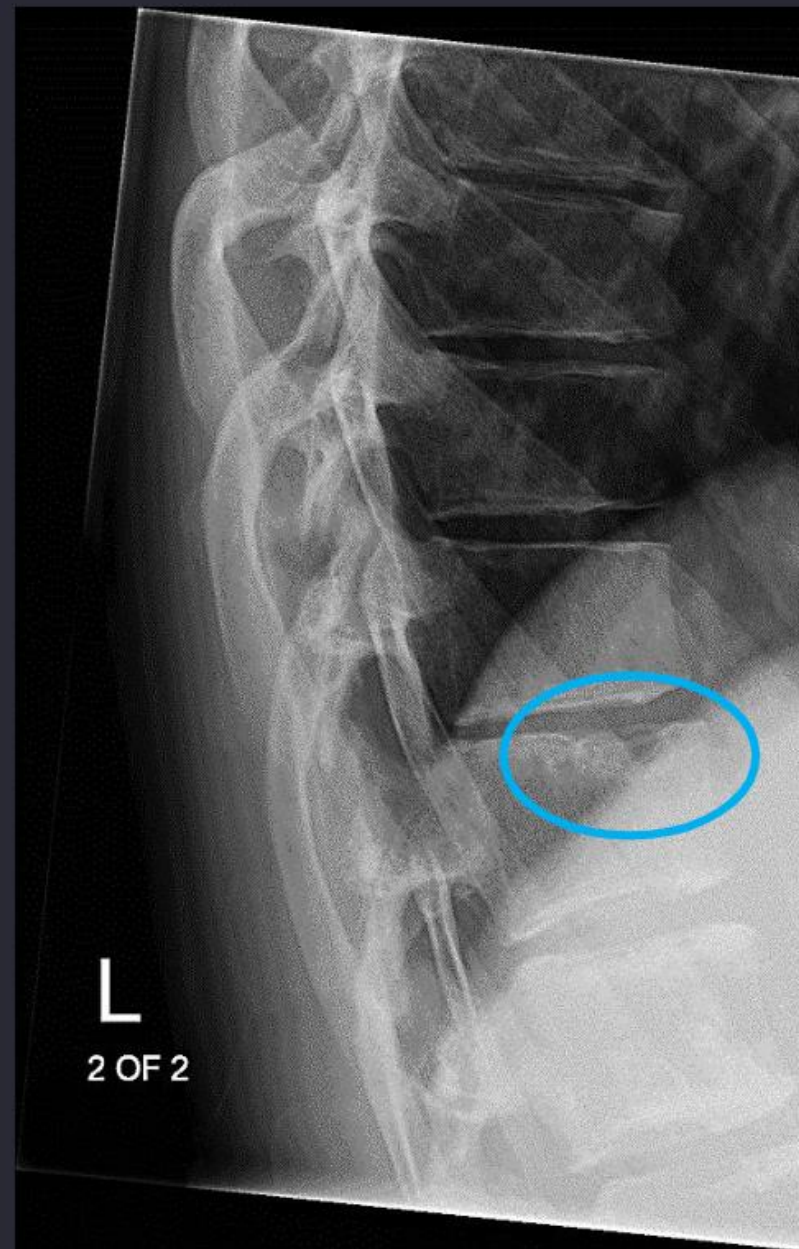**VFA case studies: calling a fracture a fracture**

Case 3
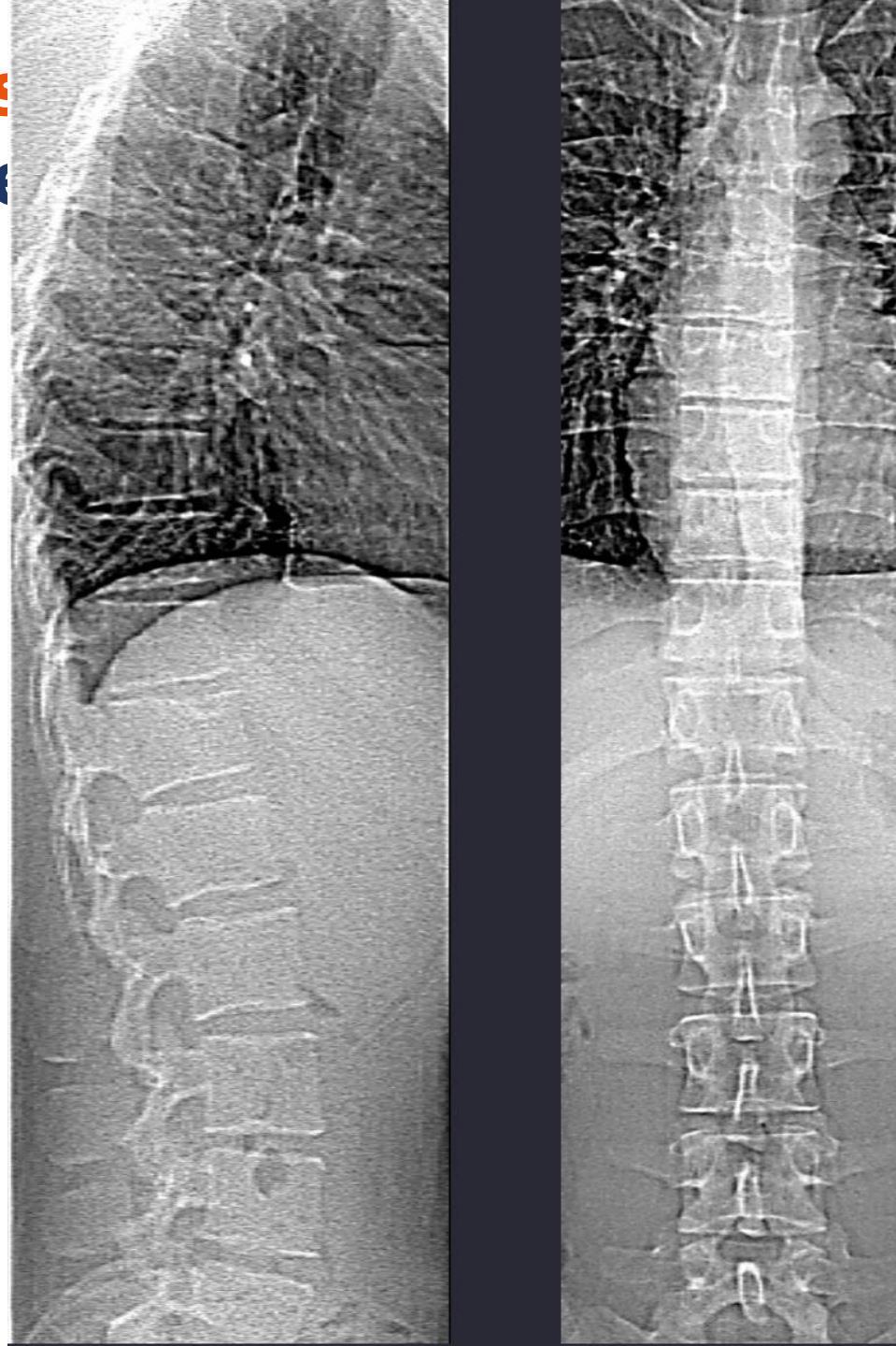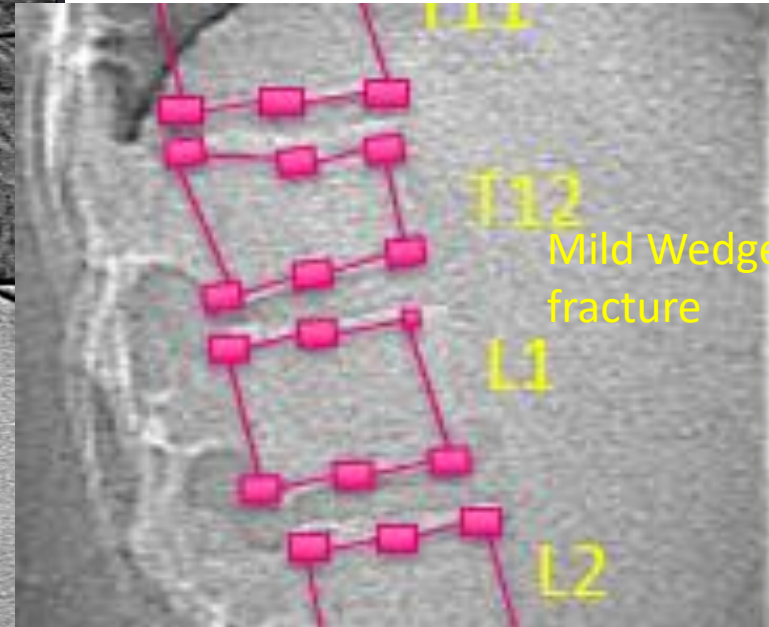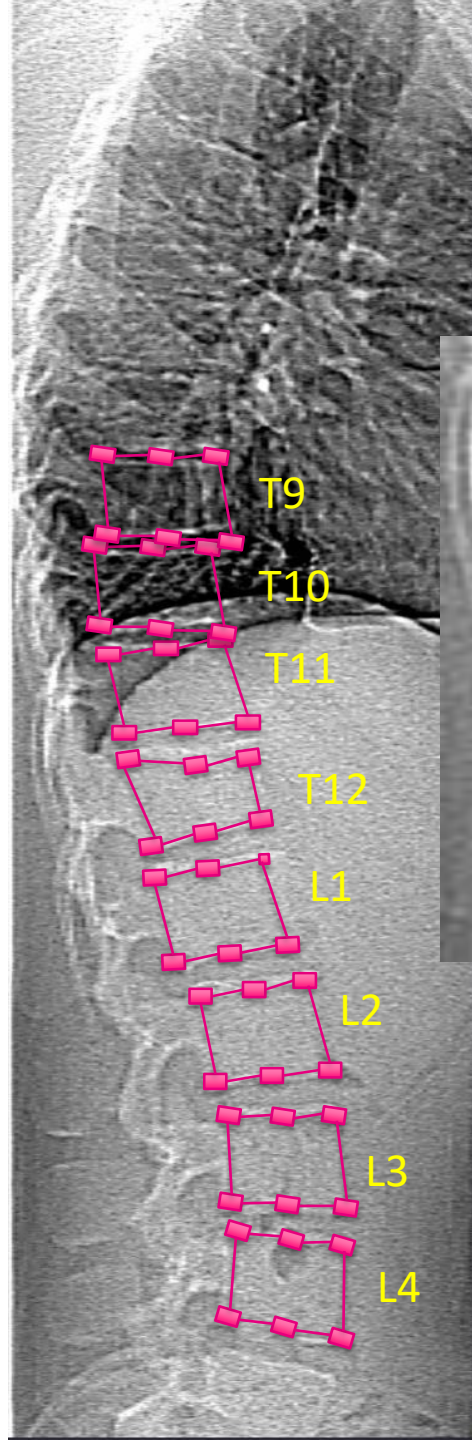
T9

T10

T11

T12

L1

L2

L3

L4

T11

T12

Mild Wedge fracture

L1

L2

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VFA 1 fracture identified

Coned view

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VFA 1 fracture identified

Plain film- Schmorl's node

No fractures

Coned view

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VFA case studies: calling a fracture a fracture

Case 4

Mild Wedge fracture

Moderate biconcave fracture

Mild biconcave fracture

Mild biconcave fracure
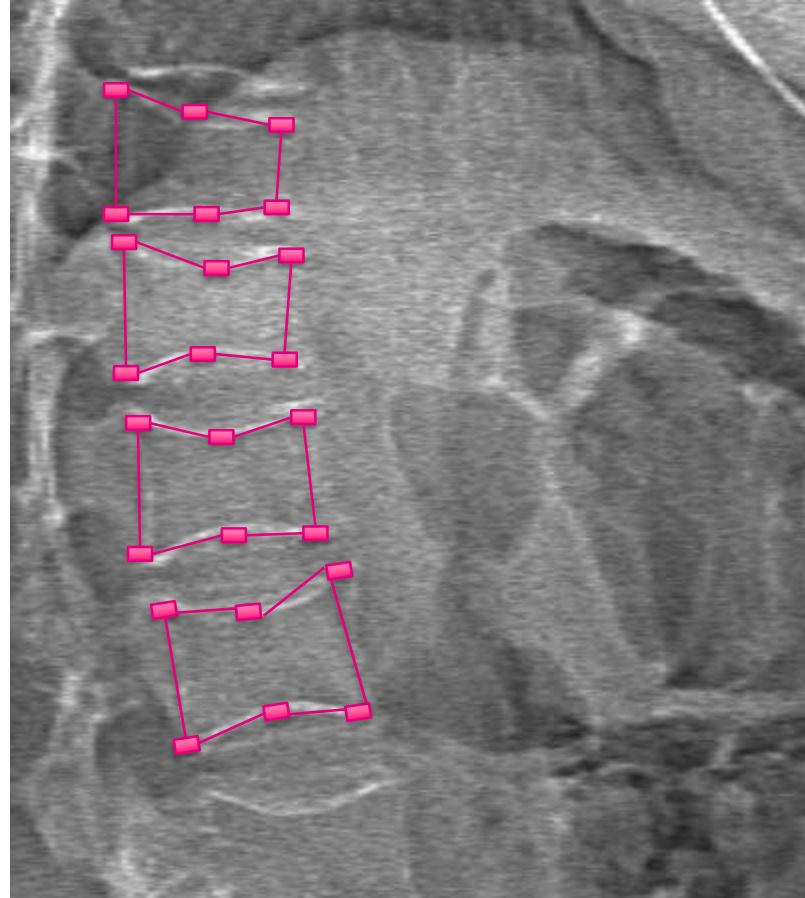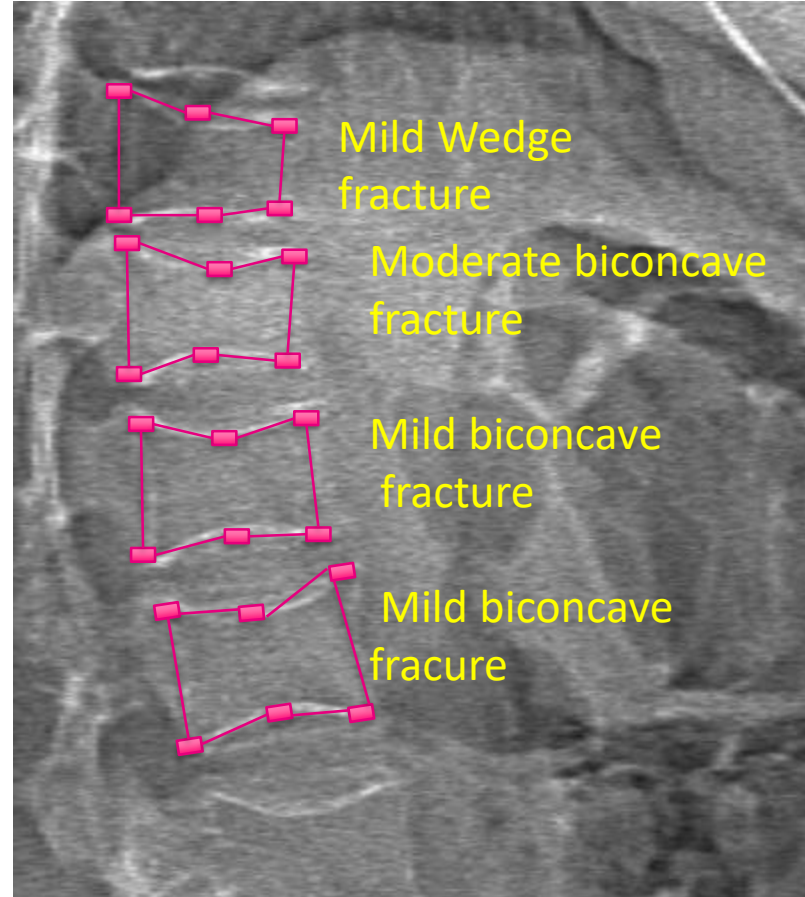
VFA 9 fractures identified

VFA 9 fractures identified

Plain film- osteomalacia

No fractures

VFA case studies:
calling a fracture a fracture

Summary:
  - VFA cannot differentiate between mild/grade 1 fractures and non-fracture deformities

VFA – indications for further imaging

- **ISCD recommends that further imaging not routinely required to confirm VFX detected on VFA**

- **Rationale for further imaging**

  - Confirm fracture, clues about level of trauma

  - Differentiate non-fracture deformities

    - Scheuermann's, degenerative change

  - Examine for other pathology causing fracture

    - Paget's, malignancy

- **Healthcare governance implications**

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