



# “Clinical Relevance and Detection of Vertebral Fractures”



13th of November 2018  
Prof Willem F Lems,  
Educational Officer ARC ,  
Location Officer Rheumatology VUmc



# Disclosures: Willem F. Lems.



	<b>Company</b>
<b>Speaking Fees/ Advisory Boards</b>	Amgen, Eli Lilly, Merck, UCB, Novartis, Curaphar, Servier, Will Pharma, Abbott, Pfizer, Roche.

# Learning Objectives



- To realise the clinical relevance of detecting vertebral fractures in your patients;
- To know how to diagnose vertebral fractures in your patients;
- And:
- If you have access to Vertebral Fracture Assessment (VFA), to realise that in all patients in which a DXA is indicated, also a VFA is indicated .

# CAPTURE THE FRACTURE<sup>®</sup>



- A global flagship programme by the International Osteoporosis Foundation (IOF)
- Launched in 2012
- Mission: facilitating the implementation of FLS to prevent secondary fractures



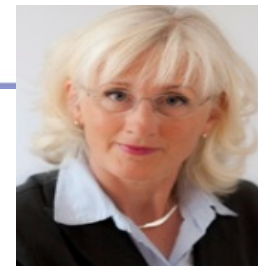
**Prof. Cyrus C. Cooper**  
President, IOF  
University of Southampton  
Medical School, UK



**Prof. Serge Ferrari**  
Chair, CSA  
Geneva University  
Hospital,  
Switzerland



**Prof. Kassim Javaid**  
Co-chair, CTF  
Oxford University,  
UK



**Prof. Kristina Åkesson**  
Co-chair, CTF  
Malmö Skåne Hospital,  
Sweden

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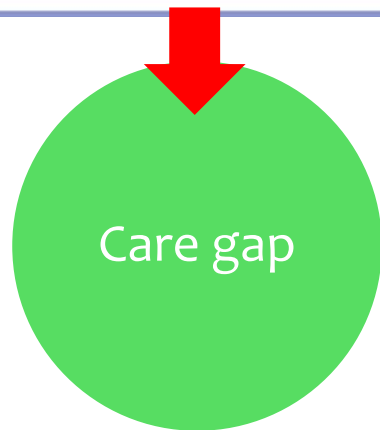
**Prof. Willem Lems**  
VU University  
medical centre,  
The Netherlands

# Why Fracture Liaison Services?



8.9 million fragility Fx/yr  
(1.6 million for hip)

2050: 6.3 million/yr hip  
Fx incidence alone



80% Fx patients not  
screened & treated



Direct cost >110Bn/yr  
by 2025 in the EU, US  
and China

FLS is a clinically and cost-effective model of care to prevent secondary fractures

# KEY AIMS



Be the global voice



Drive national/international policy



Ensure quality



Provide support for FLS implementation, getting started & improving & sustaining

# Ensuring Quality



How do we evaluate the effectiveness of  
an FLS?

→ By creating standards



# BEST PRACTICE FRAMEWORK

## HEALTH CARE QUALITY



### AIM:

1. Set the standard for FLS (13 criteria)
2. Guidance

#### DOWNLOAD THE BPF

Download the Capture the Fracture Best Practice Framework in the following languages:

- Chinese (traditional)
- Chinese (simplified)
- English
- French
- German
- Italian
- Japanese
- Russian
- Slovak
- Spanish
- Polish

Quality improvement

IOF  
CAPTURE *the*  
FRACTURE

**PROTOCOLO ASISTENCIAL DE ENFERMERIA  
para UNIDADES DE FRACTURA**

**Establecimiento de un estándar**

Diversos estudios han demostrado que el modelo de Unidades de Coordinación de Fracturas (Fracture Liaison Services) es el más coste-efectivo para la prevención secundaria de fracturas. Este abordaje sistemático, centrado en la figura de un coordinador de fracturas, puede resultar en un menor número de las mismas, ahorro en costes para el sistema sanitario y mejoras en la calidad de vida de los pacientes.

[www.capturethefracture.org](http://www.capturethefracture.org)

International Osteoporosis  
Foundation

IOF  
CAPTURE *the*  
FRACTURE

**BEST PRACTICE FRAMEWORK  
for FRACTURE LIAISON SERVICES**

**Setting the standard**

Studies have shown that Fracture Liaison Service models are the most cost-effective in preventing secondary fractures. This systematic approach, with a fracture coordinator at its centre, can result in fewer fractures, cost savings for the health system and improvement in the quality of life of patients.

International Osteoporosis  
Foundation

# 13 Criteria and Standards



1. Patient Identification

2. Patient Evaluation

3. Post Fracture Assessment Timing

4. **Vertebral Fracture (VF) ID**

5. Assessment Guidelines

6. Secondary Causes of OP

7. Falls Prevention Services

8. Multifaceted Assessment

9. Medication Initiation

10. Medication Review

11. Communication Strategy

12. Long-term Management

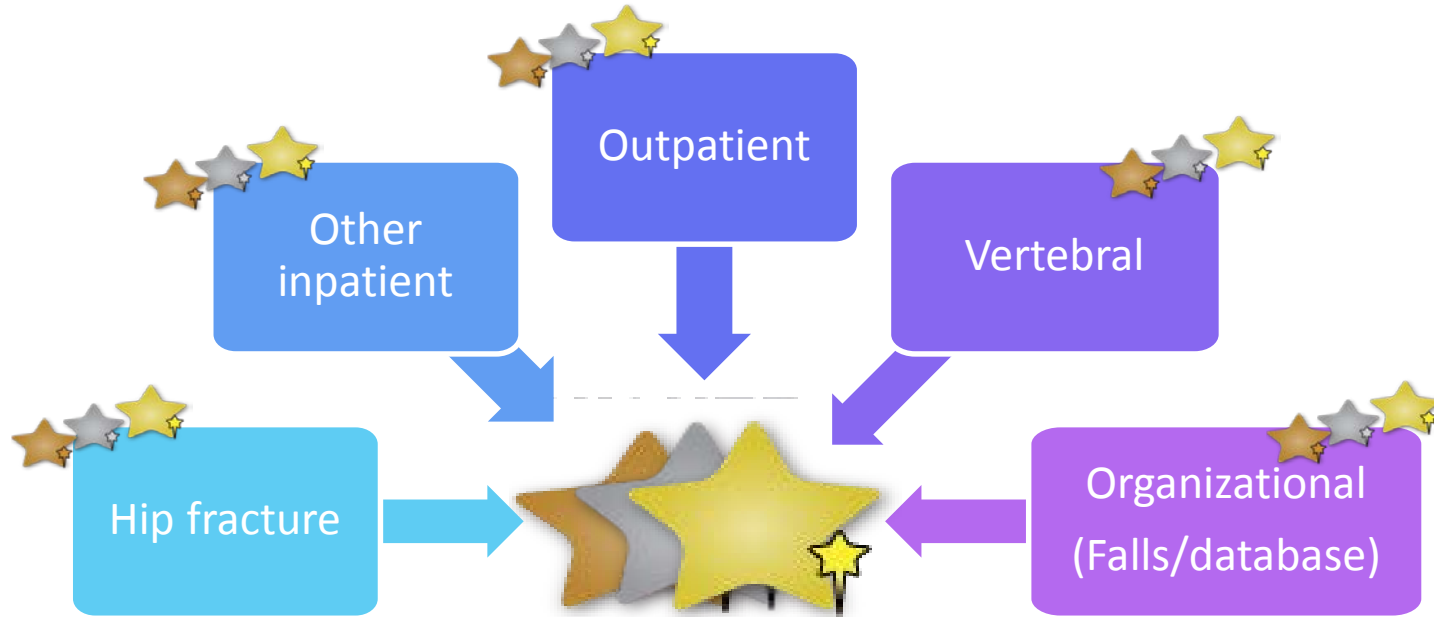
13. Database

## Standard 1 definition:

Fracture patients are identified to enable delivery of secondary fracture prevention

Standard	Bronze	Silver	Gold
Patient Identification	Patients identified, <i>not</i> tracked	Patients identified, <i>are</i> tracked	Patients identified, tracked & <i>independently</i> reviewed

# SCORING: 5 domains



# Best Practice Framework Standards

## 4. Vertebral Fracture Identification

Institution has a system whereby patients with previously unrecognized vertebral fractures are identified and undergo secondary fracture prevention evaluation.

### Level 1

Patients with **clinical vertebral fractures undergo assessment** and/or receive treatment for prevention of secondary fractures.

### Level 2

Patients with **non-vertebral fractures routinely undergo assessment** with lateral vertebral morphometry by DXA (or possibly by plain spine radiology) to assess for vertebral fractures.

### Level 3

Patients **reported by the Institution's Radiologists** to have vertebral fractures on plain X-rays, CT & MRI scans (whether these are serendipitous or not) are identified by the FLS in order that they undergo assessment for treatment for prevention of secondary fractures.

Akesson K, et al Osteo Int 2013

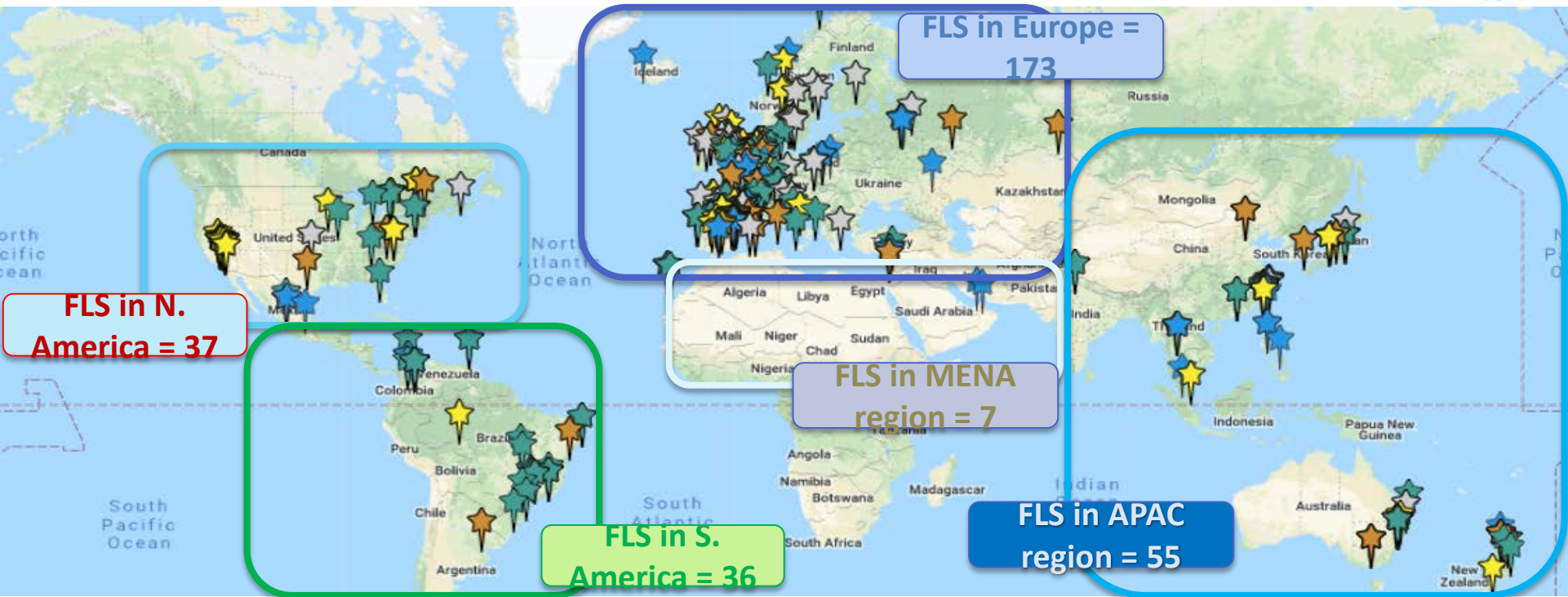


[www.capturethefracture.org](http://www.capturethefracture.org)



International Osteoporosis  
Foundation

# 308 FLS, 39 countries, 6 continents



# The Process



## Step 1

FLS submits online application



## Step 2

FLS marked in green on the map while being reviewed



## Step 3

BPF achievement level assigned

## Step 4

FLS is scored and recognized on the map

<https://youtu.be/gpAAvvukjQw>



**VIDEO!**

# Step 2: FLS marked in green on the map while being reviewed





# Running an FLS?

## Join the Capture the Fracture<sup>®</sup> Programme

### Why join?

- Showcase your achievements
- Learn from the BPF to improve your service
- Get international recognition with a Gold, Silver, or Bronze star
- Be part of a global initiative to prevent secondary fractures



### Who can participate?

- Coordinator-based models of care
- All type of facilities
- At any stage in development
- Any size worldwide





# Steps 3+4: FLS is scored and recognized on the map



## CAPTURE *the* FRACTURE

RECOGNIZED FRACTURE LIAISON SERVICE



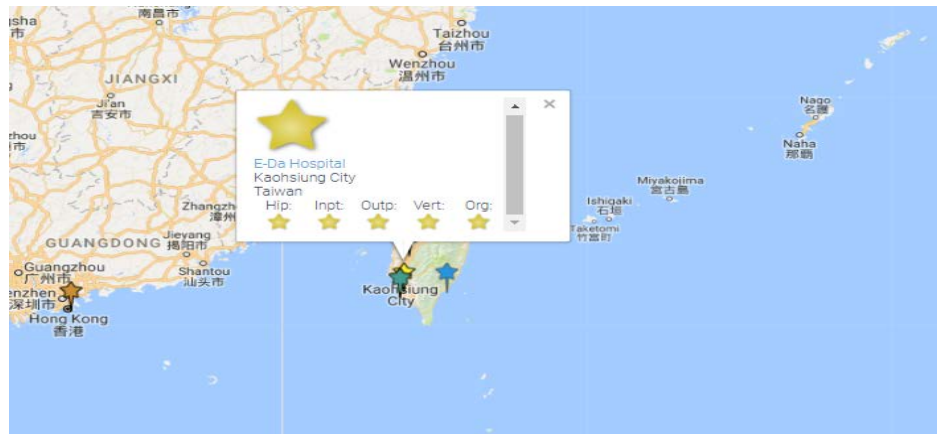
Awarded to:

**E-Da Hospital**  
Kaohsiung City, Taiwan (R.O.C)

for meeting the Gold Level criteria of the Capture the Fracture programme.

  
CYRUS COOPER  
President

  
PHILIPPE HALBOUT  
CEO



# Learning Objectives

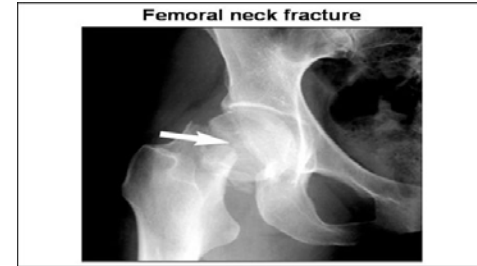
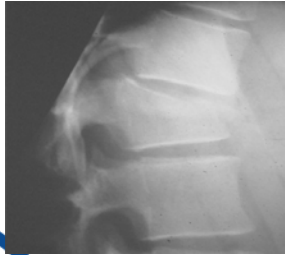


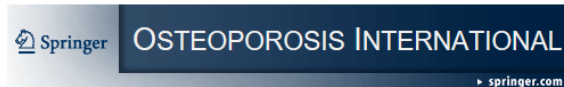
- To realise the clinical relevance of detecting vertebral fractures in your patients;
- To know how to diagnose vertebral fractures in your patients;
- And:
- If you have access to Vertebral Fracture Assessment (VFA), to realise that in all patients in which a DXA is indicated, also a VFA is indicated .



- **3 Clinical Cases;**
- Epidemiology of Vertebral Fractures, why are vertebral fractures so often missed?
- Clinical Relevance of Detecting Vertebral Fractures.
- How to detect Vertebral Fractures easily and reliably in patients at high risk for subsequent fractures? Pitfalls in detecting Vertebral Fractures, Strength/weakness of VFA.
- Discussion on the statement that “in each patient in which a DXA is indicated, also a VFA is indicated”
- Questions.

# Key Question: how to prevent secondary fractures in patients 50 years and over with a recent fracture?





Perspective | Free Access

## Making the first fracture the last fracture: ASBMR task force report on secondary fracture prevention

John A Eisman Earl R Bogoch, Rick Dell, J Timothy Harrington, Ross E McKinney Jr., Alastair McLellan, Paul J Mitchell, Stuart Silverman, Rick Singleton, Ethel Siris, ... [See all authors](#)

First published: 26 July 2012 | <https://doi.org/10.1002/jbmr.1698> | Cited by: 144

[Osteoporos Int.](#) 2013 Aug; 24(8): 2135–2152.

Published online 2013 Apr 16. doi: [10.1007/s00198-013-2348-z](https://doi.org/10.1007/s00198-013-2348-z)

PMCID: PMC3706734

PMID: [23589162](https://pubmed.ncbi.nlm.nih.gov/23589162/)

### Capture the Fracture: a Best Practice Framework and global campaign to break the fragility fracture cycle

[K Åkesson](#), [D Marsh](#), [P. J. Mitchell](#), [A. R. McLellan](#), [J. Stenmark](#), [D. D. Pierroz](#), [C. Kyer](#), [C. Cooper](#),<sup>✉</sup> and IOF Fracture Working Group

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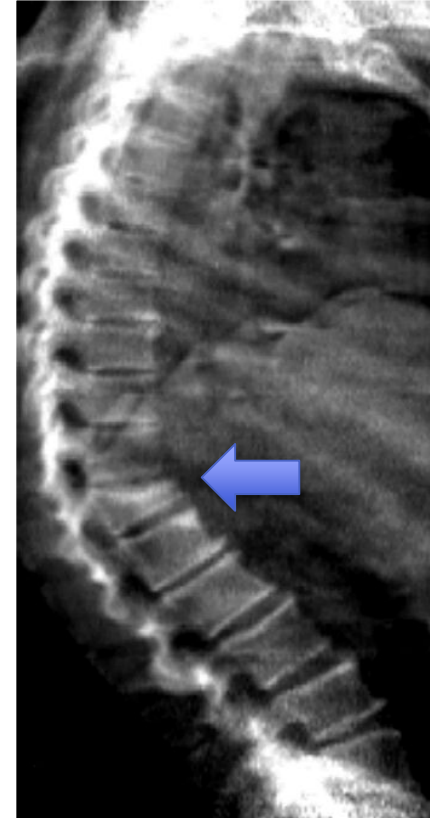
#### Recommendation

### EULAR/EFORT recommendations for management of patients older than 50 years with a fragility fracture and prevention of subsequent fractures

W F Lems<sup>1</sup>, K E Dreinhöfer<sup>2</sup>, H Bischoff-Ferrari<sup>3</sup>, M Blauth<sup>4</sup>, E Czerwinski<sup>5</sup>, JAP da Silva<sup>6</sup>, A Herrera<sup>7</sup>, P Hoffmeyer<sup>8</sup>, T Kvien<sup>9</sup>, G Maalouf<sup>10</sup>, D Marsh<sup>11</sup>, J Puget<sup>\* 12</sup>, W Puhl<sup>13</sup>, G Poor<sup>14</sup>, L Rasch<sup>1</sup>, C Roux<sup>15</sup>, S Schüler<sup>2</sup>, B Serio<sup>16</sup>, U Tarantino<sup>17</sup>, T van Geel<sup>18</sup>, A Woolf<sup>19</sup>, C Wyers<sup>20, 21</sup>, P Geusens<sup>22, 23</sup>

# Case 1: how to prevent secondary fractures in patients 50 years and over with a recent fracture?

A DXA is indicated, but also a VFA??  
(Vertebral Fracture Assessment)



## Case 2: 65-year old lady, with a upper arm fracture (1).



- Traffic accident, BMI 24, no other diseases/drugs
- T score lumbar spine -1.7 and total hip -1.9.
- *It is reasonable to conclude osteopenia, and to suggest a healthy life-style (adequate calcium, vitamin D, exercise), but no start of anti-osteoporotic drug treatment (usually bisphosphonates);*
- 



## Case 2: 65-year old lady, with a upper arm fracture (2).



- Traffic accident, BMI 24, no other diseases/drugs
- T score lumbar spine -1.7 and total hip -1.9.
- *Suppose that 2 vertebral fractures were found: that increases her subsequent fracture risk;*
- *It reasonable to start with anti-osteoporotic drugs, usually a bisphosphonate (in addition to a more healthy life style)*





## Case 3: A 72-year old lady has severe backpain, after lifting a heavy bag

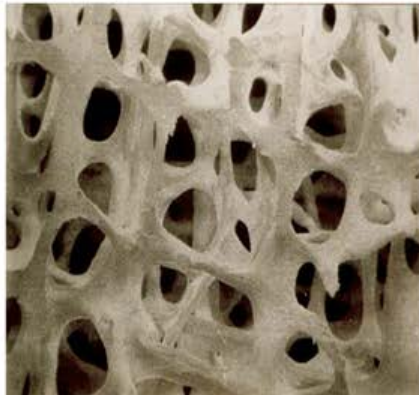


- She has been treated with alendronate for 4 years, her initial DXA showed a hip T-score of -3.1;
- Now a vertebral fracture was diagnosed with 30% height loss;
- Is it a new vertebral (incident) fracture during therapy (failure of therapy?), or is it an old (prevalent) fracture (no failure of therapy)
- *For these cases, it is very helpful when an initial DXA was accompanied by an initial VFA.*

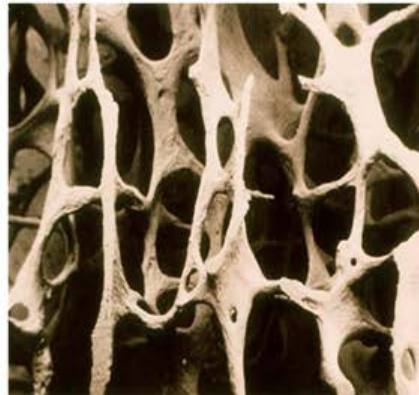


# Definition of osteoporosis

A disease characterized by low bone mass and micro-architectural deterioration of bone tissue leading to reduced bone strength and a consequent increase in fracture risk.



Normal bone



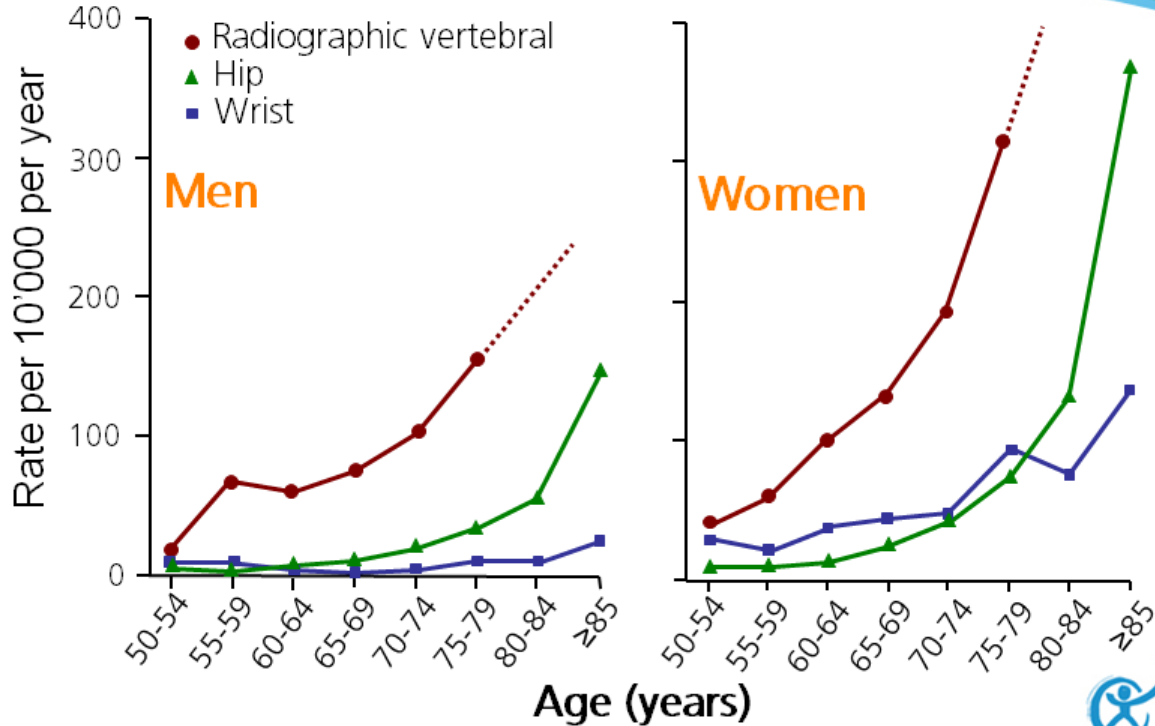
Osteoporosis



- 3 Clinical cases;
- **Epidemiology of Vertebral Fractures, why are vertebral fractures so often missed?**
- Clinical Relevance of Detecting Vertebral Fractures.
- How to detect Vertebral Fractures easily and reliably in patients at high risk for subsequent fractures? Pitfalls in detecting Vertebral Fractures, Strength/weakness of VFA.
- Discussion on the statement that “in each patient in which a DXA is indicated, also a VFA is indicated”
- Questions.



# Age-specific and sex-specific incidence of osteoporotic fractures



Vertebral Fractures are by far the most common fractures!

# Lifetime risk at the age of 50

	Women	Men
Osteoporotic fracture <sup>1,2</sup>	46-53%	21-22%
Hip fracture <sup>2,3</sup>	15-23%	5-11%
Radiographic vertebral fracture <sup>4</sup>	27%	11%
Clinical vertebral fracture <sup>2</sup>	15%	8%
Breast cancer	10-13%	
Prostate cancer		9-11%

NB: variable between countries

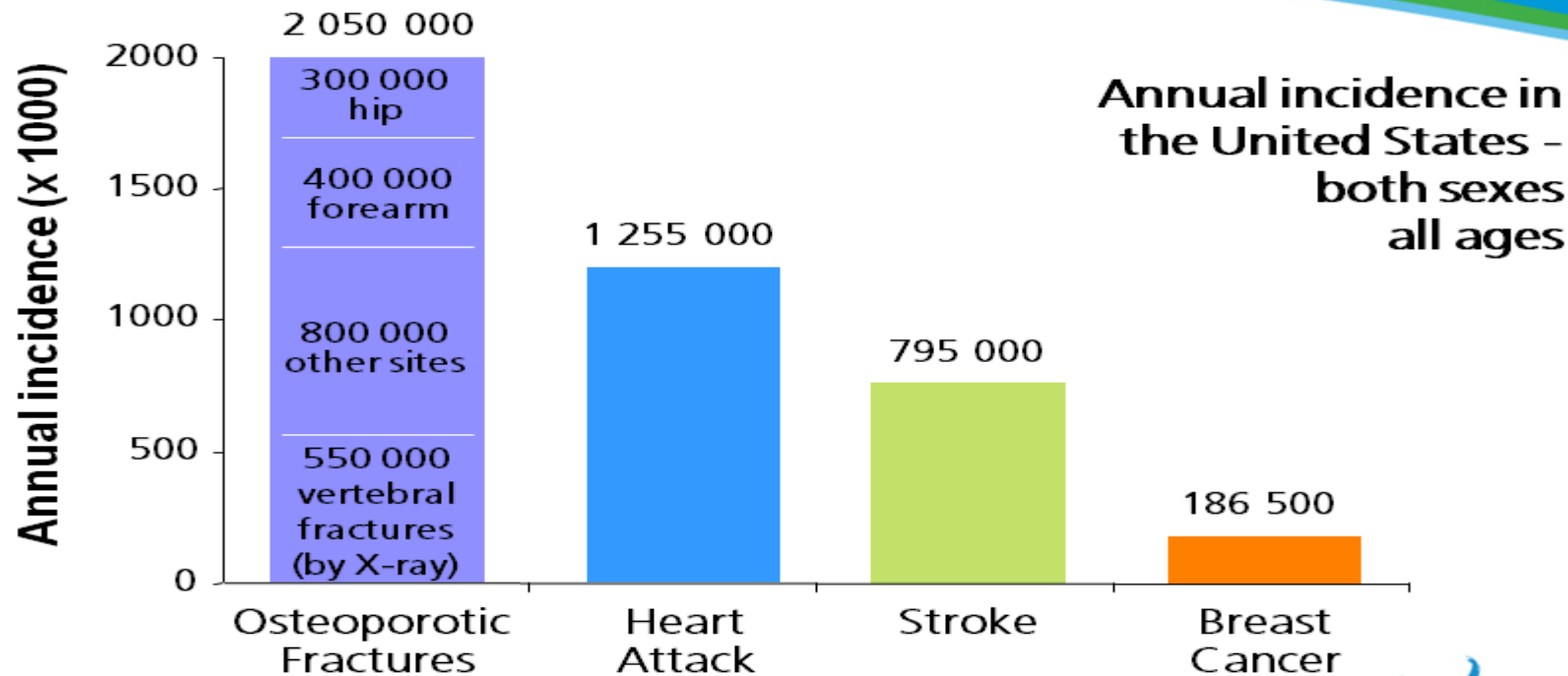
<sup>1</sup>Van Staa TP et al (2001) *Bone* 29: 517

<sup>2</sup>Kanis JA et al (2000) *Osteoporos Int* 11: 669

<sup>3</sup>Samelson EL et al (2007) *J Bone Miner Res* 22: 1449

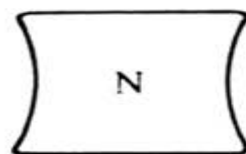
<sup>4</sup>Samelson EL et al (2006) *J Bone Miner Res* 21: 1207

# Comparison of osteoporotic fractures with other common diseases

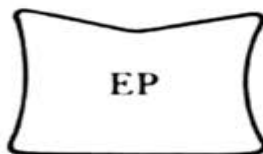


# Vertebral shapes and grading

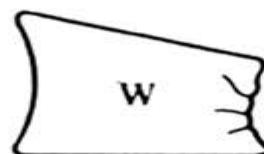
Shape



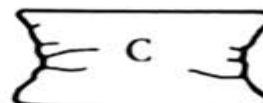
Normal



Endplate



Wedge



Crush

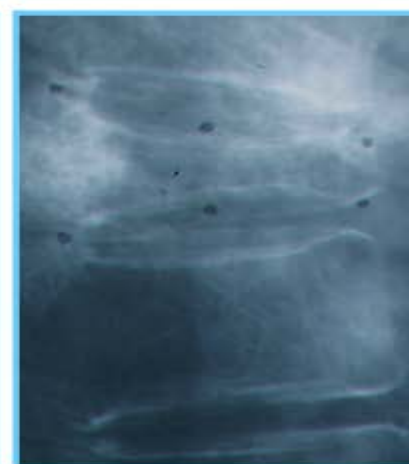
These changes in shape are often combined



Grade 1  
~ 20-25%



Grade 2  
~26-40%



Grade 3  
~40% +

% change  
in shape

The higher the grade of fracture the higher the risk of future fracture

# Semi-quantitative visual grading of vertebral fractures

Grade 0: normal, non fractured vertebra



Grade 1: mild fracture with approximately 20-25% reduction in anterior, middle and posterior relative to the same or adjacent vertebrae.



Grade 2: moderate fracture with approximately 25-40% reduction in anterior, middle and posterior relative to the same or adjacent vertebrae.



Grade 3: severe fracture with approximately >40% reduction in anterior, middle and posterior relative to the same or adjacent vertebrae.





# Why are vertebral fractures so often missed?



- Diagnosing vertebral fractures is more difficult than nonvertebral fractures, because they are often NOT related to trauma;
- Vertebral fractures are often overlooked at radiographs;
- The diagnosis vertebral fracture can be overruled by another diagnosis;
- Missing the clinical relevance of diagnosing vertebral fractures;

# Why are vertebral fractures so often missed?

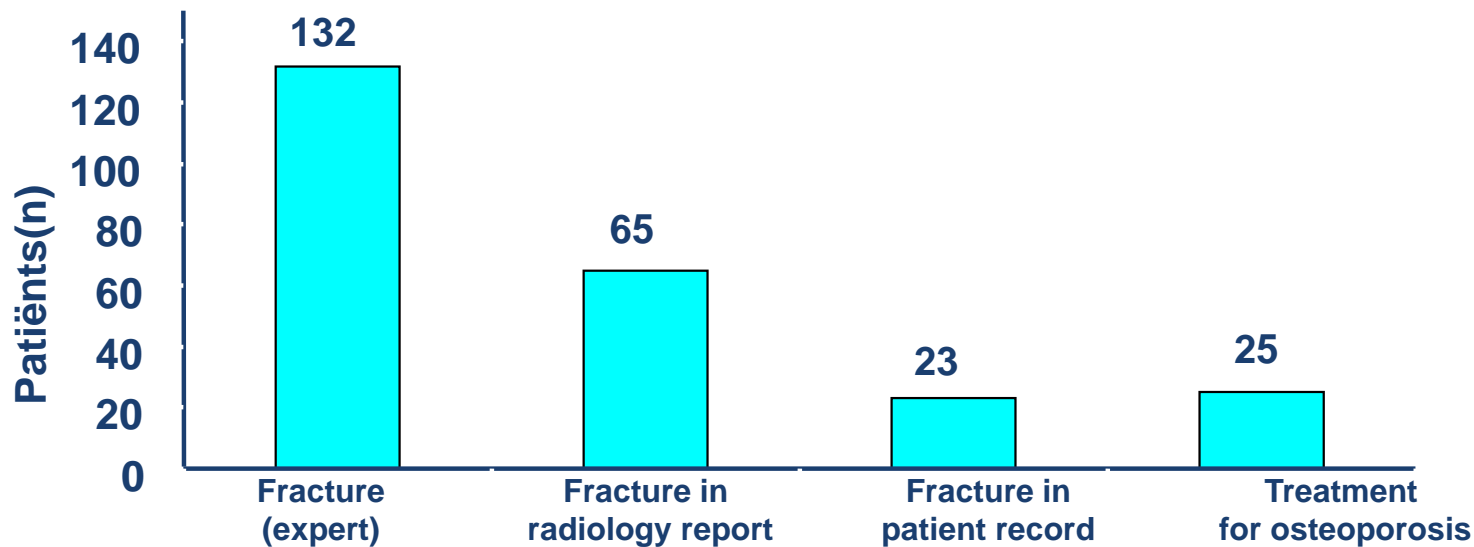


- Diagnosing vertebral fractures is more difficult than nonvertebral fractures, because they are often NOT related to trauma;
- Vertebral fractures are often overlooked at radiographs;
- The diagnosis vertebral fracture can be overruled by another diagnosis;
- Missing the clinical relevance of diagnosing vertebral fractures;
- Only 1/3 are symptomatic (=patients are searching for pain relief by their physician), 2 out of 3 vertebral fractures are regarded as "asymptomatic"



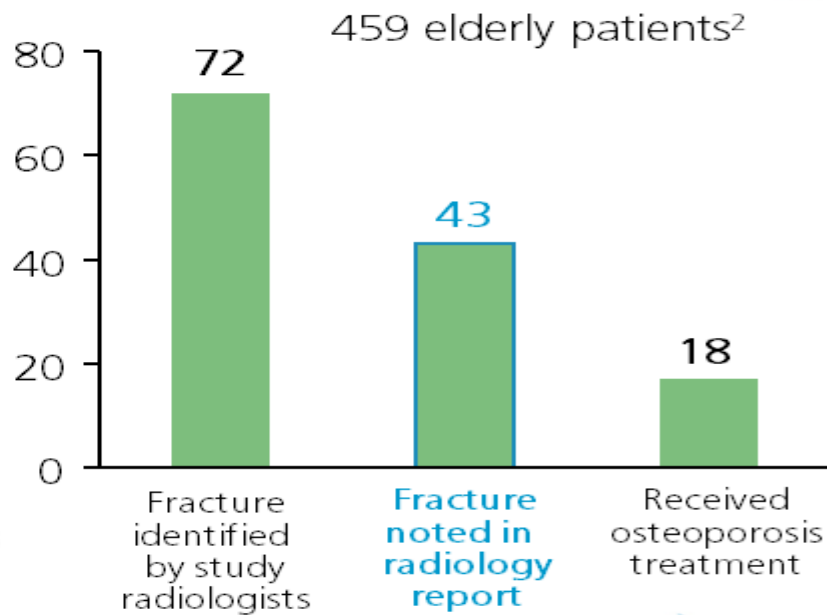
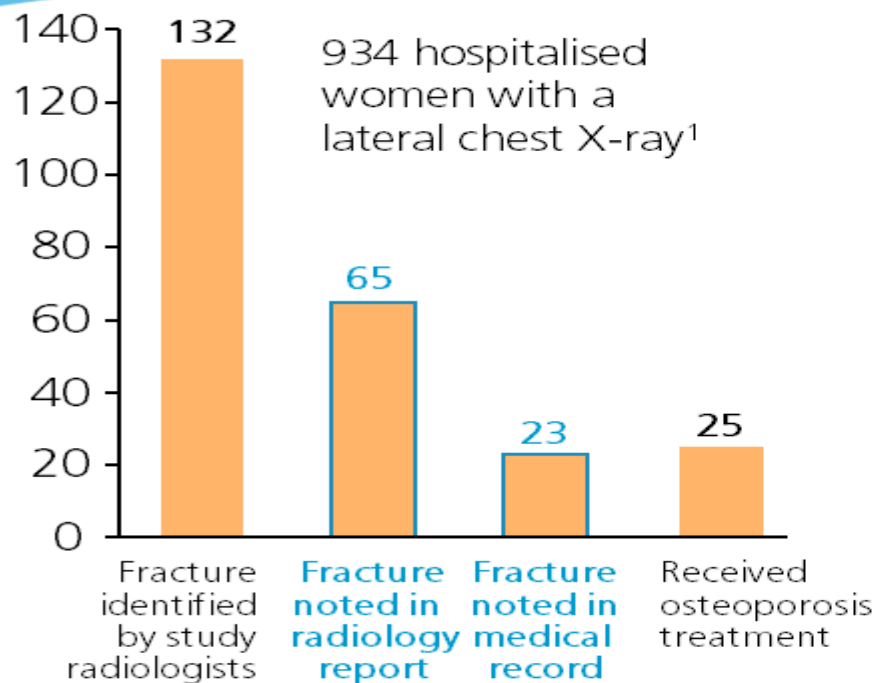
# Vertebral fractures are often not recognized!

**Only 1 out of 5 vertebral fractures are adequately diagnosed and treated!**



n=934 women >60 years old

# Under-diagnosed vertebral fractures



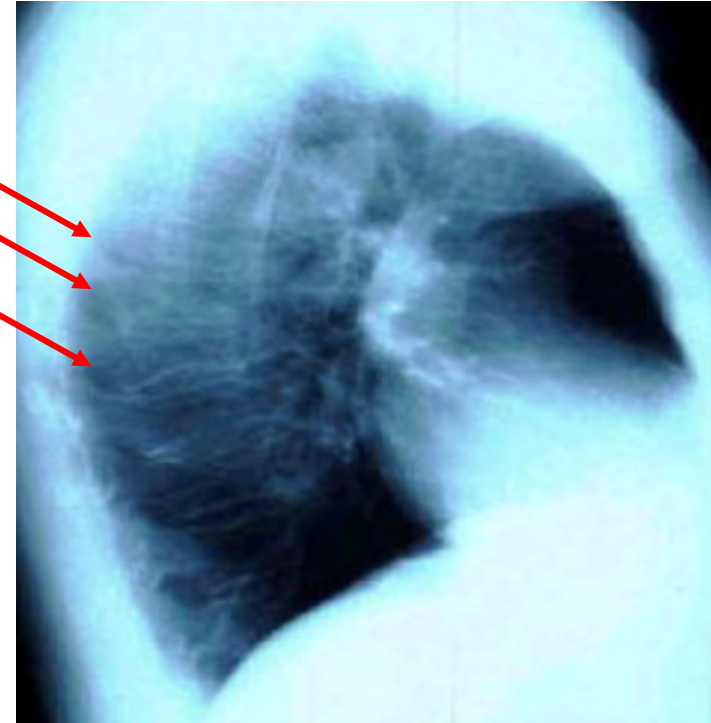
<sup>1</sup>Gehlbach SH et al. (2000) *Osteoporos Int* 11: 577

<sup>2</sup>Majumdar SR et al. (2005) *Arch Intern Med* 165: 905

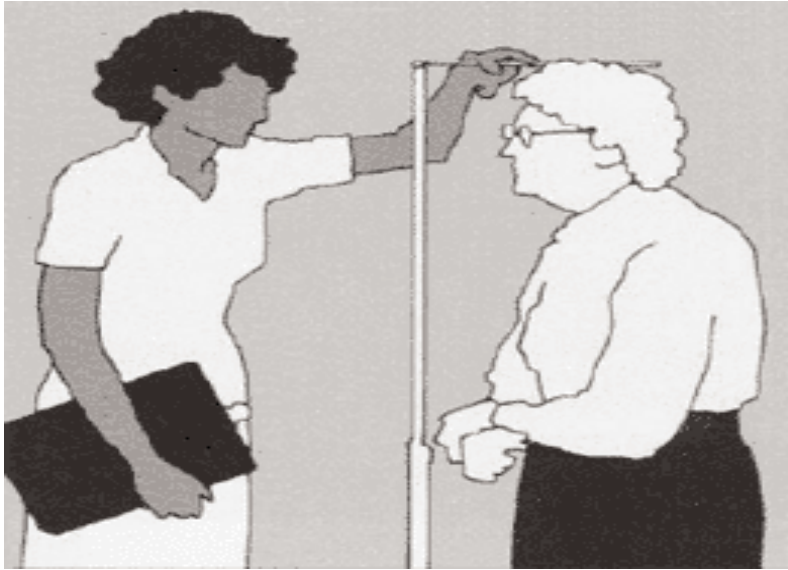
# Why are vertebral fractures so often missed?



- Mrs L., 77 years old
  - Presented with left lower lobe pneumonia
  - Height loss of 4cm
  - Maternal hip fracture
  - Regular use of psychotropic drugs
  - Chest x-ray reveals vertebral Fractures T6-8
  - BMD T score  $-2.8$  SD at hip.



# Is Physical Examination Useful in diagnosing Vertebral Fractures?



- Comparing actual height with height at peak bone age might be very informative!
- 3-5 cm height loss or more might be highly suggestive for vertebral
- (NB Height loss in osteoporotic patients can be up to 10-15 cm!)

# Vertebral versus nonvertebral fractures, clinical characteristics



- Vertebral Fracture:
  - May occur without trauma; during daily activities;
  - Painful in 1 out of 3, majority “asymptomatic”;
  - Gradual;
  - May worsen at same location;
  - Height loss.
- Peripheral Fracture:
  - Nearly always direct after trauma;
  - Severe pain;
  - All or none;
  - Usually not at same location;
  - No deformity .

# Vertebral versus nonvertebral fractures, clinical characteristics



- Vertebral Fracture:
- May occur without trauma; during daily activities;
- Painful in 1 out of 3, majority “asymptomatic”;
- Gradual;
- May worsen at same location;
- Height loss.
- Peripheral Fracture:
- Nearly always direct after trauma;
- Severe pain;
- All or none;
- No deformity .

***Diagnosing a vertebral fracture is more difficult than diagnosing a peripheral fracture!***





# Treatment for Symptomatic Osteoporotic Vertebral Fractures (1)

- Acute Phase:
  - ❖ Bed rest in patients with severe pain
  - ❖ Analgesics such as paracetamol, avoid NSAIDs, morphines.
  - ❖ Eventually low dose paracetamol and low dose tramadol.
  - ❖ Start physical therapy as early as possible



## Treatment for Symptomatic Osteoporotic Vertebral Fractures (2)

- Non-pharmacological prevention of future fractures: adequate supply of calcium and vitamin D. Exercises, and stop smoking/limit alcohol intake
- Start with anti-osteoporotic drugs, usually an oral bisphosphonate (alendronate, risedronate) or zoledronic acid (iv)/denosumab sc . Usually drug-treatment for 5 years (or more)

Suppose, your (elderly) patient has back pain and a vertebral deformity.  
Can you list 4 categories of differential diagnosis and some clues or characteristics of the other 4 listed in the differential diagnosis?



- ❖ Osteoporotic Fracture
- ❖ .....
- ❖ .....
- ❖ .....
- ❖ .....

Suppose, your (elderly) patient has back pain and a vertebral deformity.  
Can you list 4 categories of differential diagnosis and some clues or characteristics of the other 4 listed in the differential diagnosis?



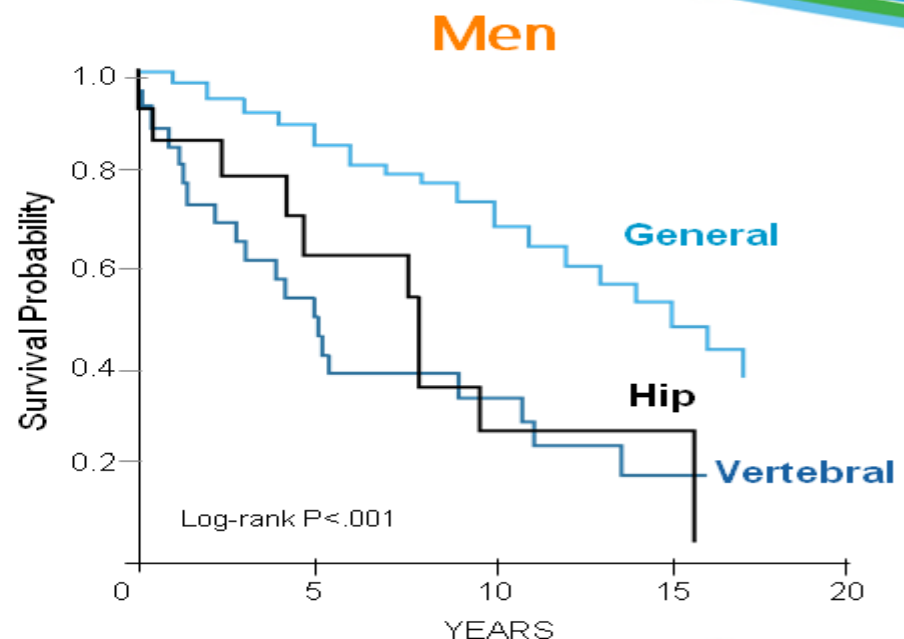
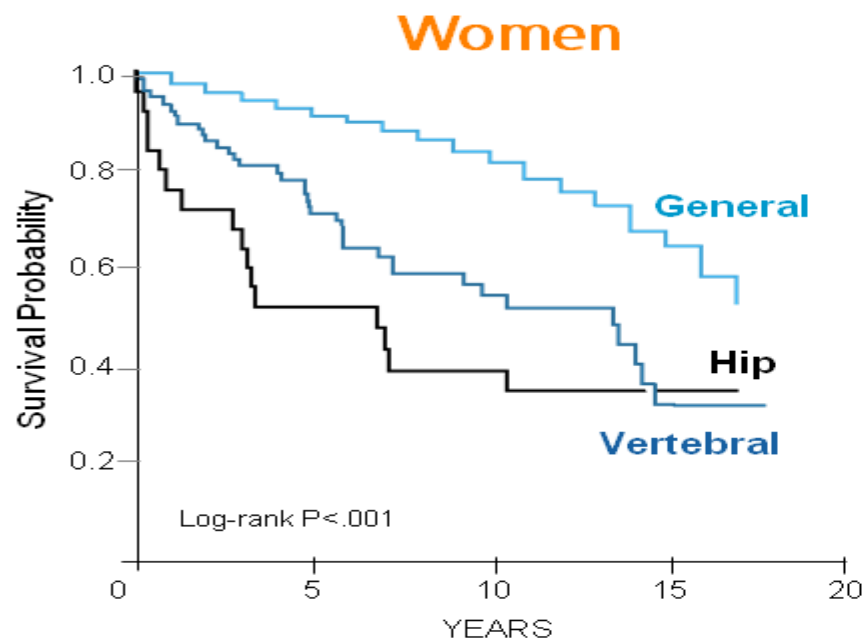
- ❖ Osteoporotic Fracture
- ❖ Non-specific musculoskeletal back pain
- ❖ Cancer: Multiple myeloma or Metastasis
- ❖ Infection: Osteomyelitis
- ❖ Inflammatory Back Pain (Spondyloarthritis)



- 3 Clinical Cases;
- Epidemiology of Vertebral Fractures, why are vertebral fractures so often missed?
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# Similar mortality in patients with vertebral fractures and in those with hip fractures

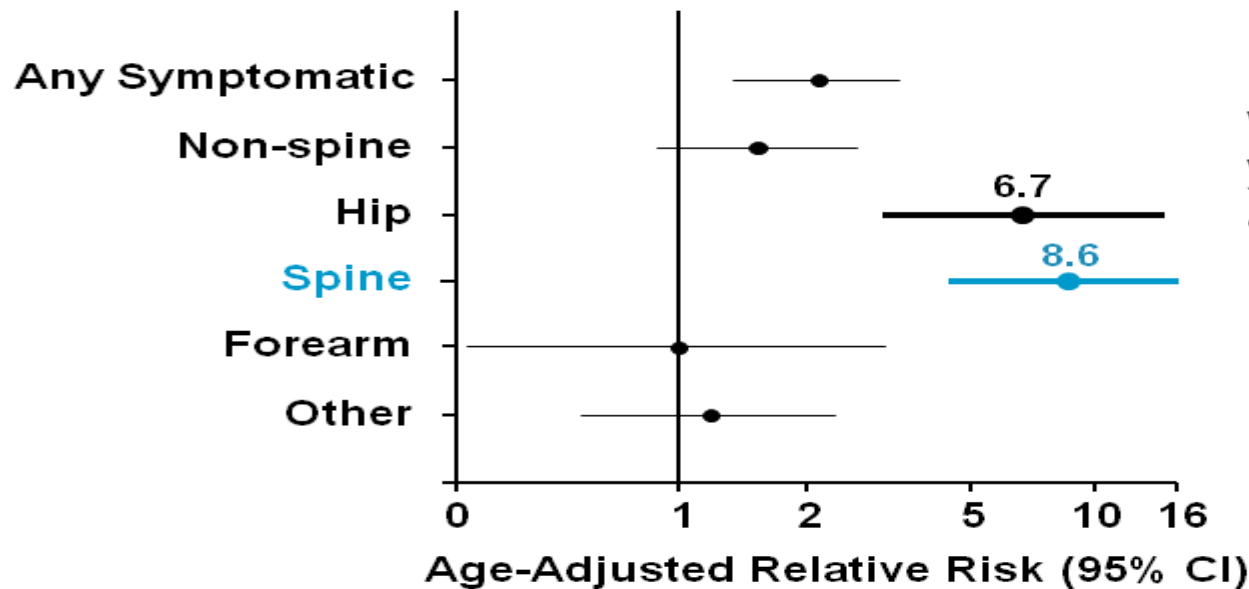


Adapted from Bliuc D et al. (2009) JAMA 301(5): 513



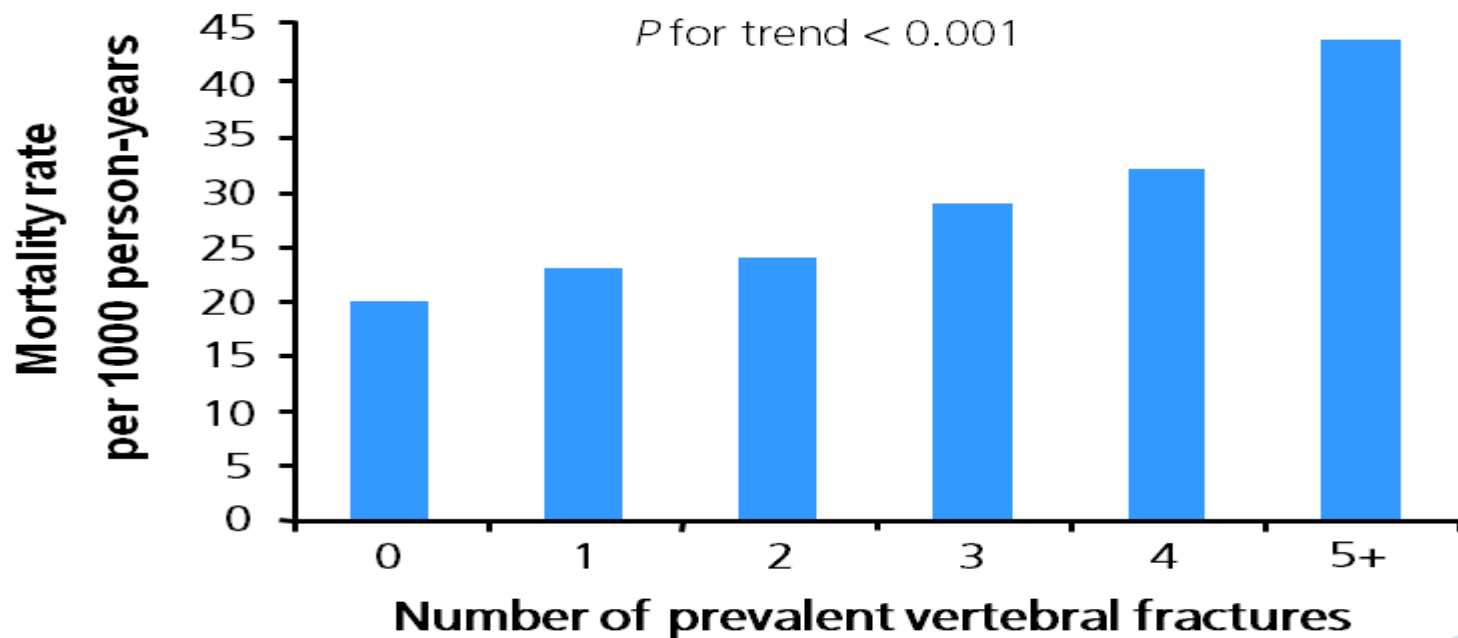
# Relative risk of death following clinical osteoporotic fractures

## Fracture Intervention Trial (FIT)\*



\*6459 postmenopausal women ages 55-81 years followed for an average of 3.8 years

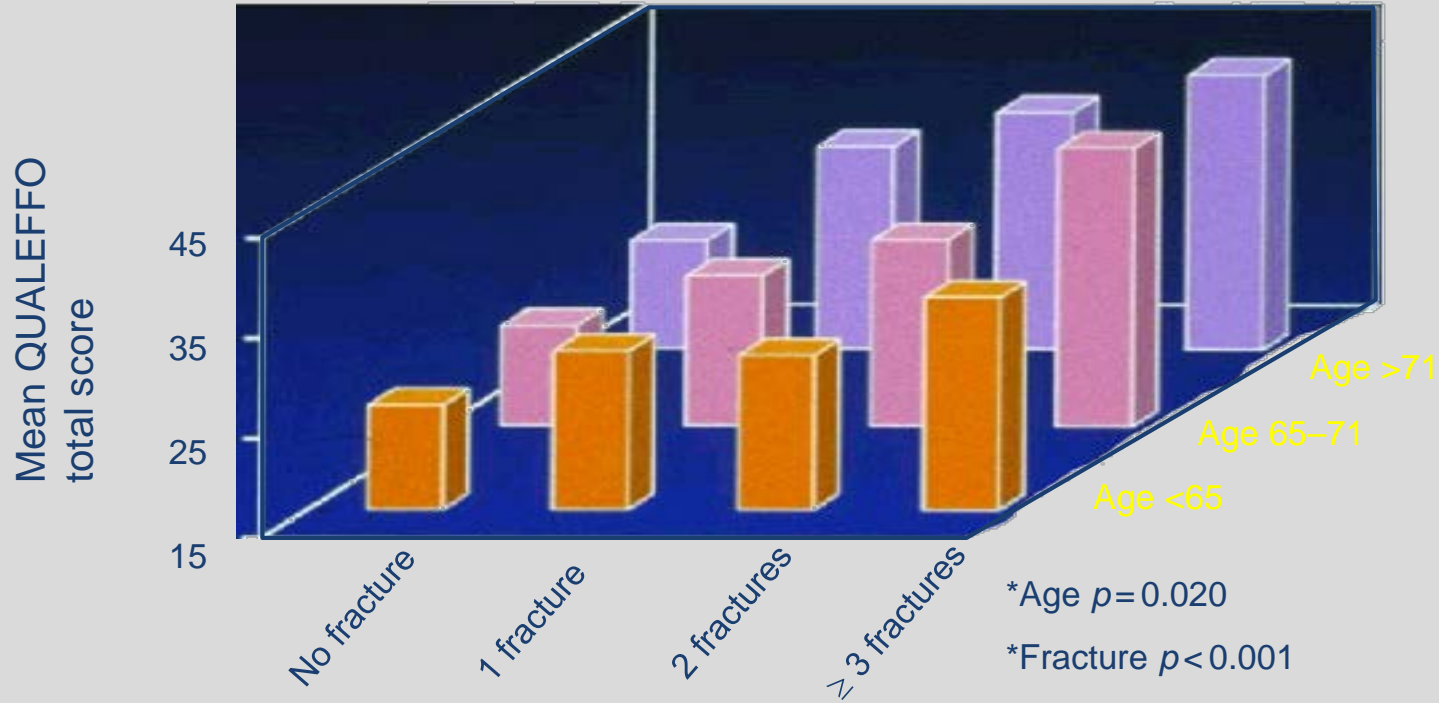
# Mortality rate increases with the number of prevalent vertebral fractures







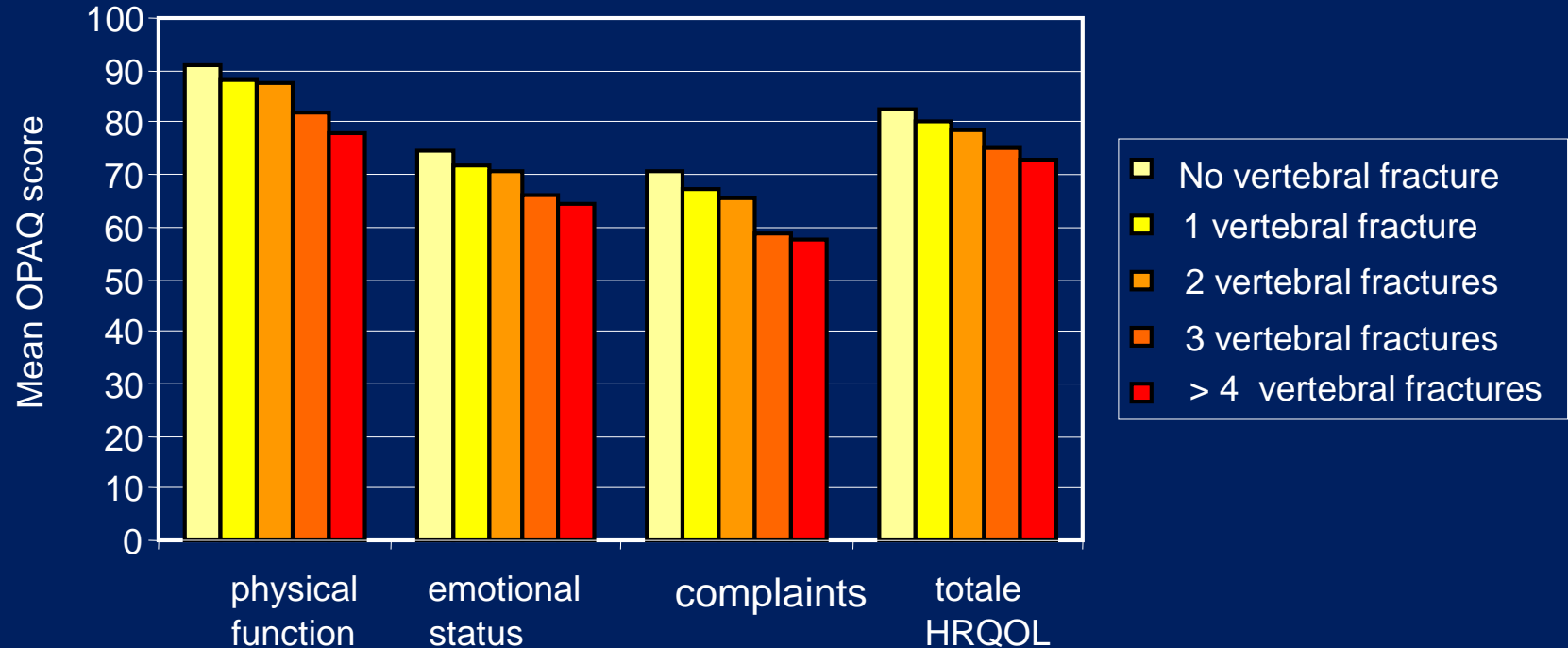
# Quality of life decreases with age and with number of vertebral fractures



Oleksik, Lips et al,

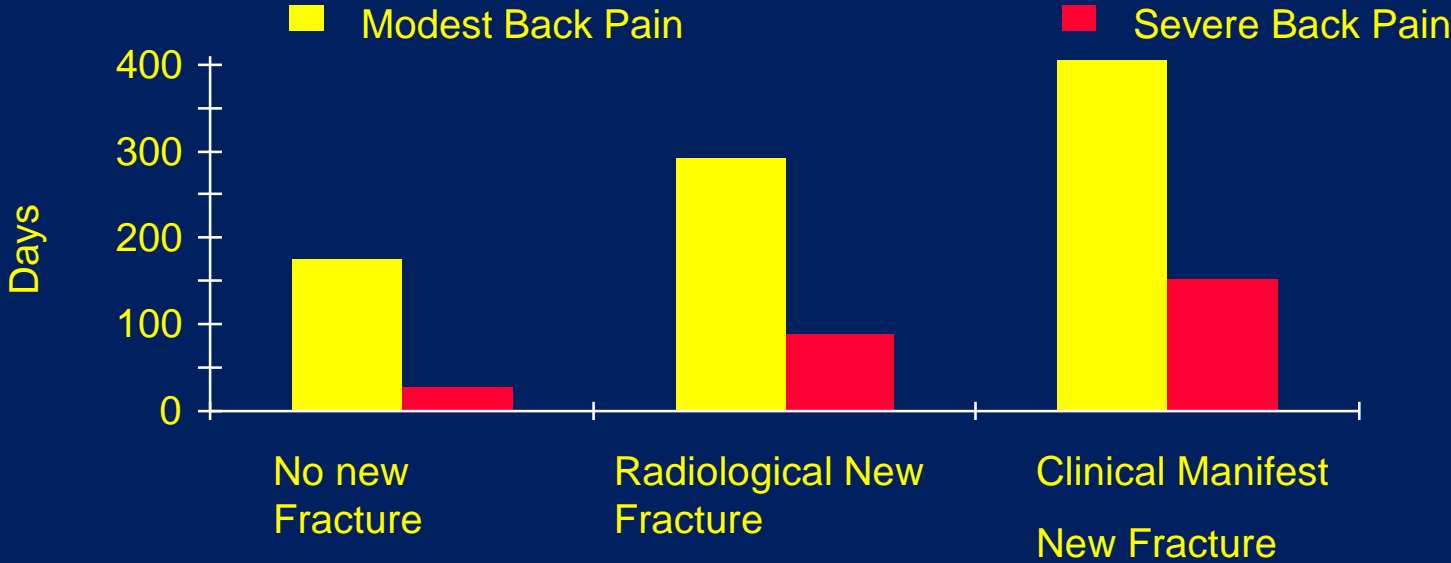
J Bone Miner Res 15:1384–92 (2000)

# Prevalent Vertebral Fractures reduce “Health-Related Quality Of Life” (HRQOL)

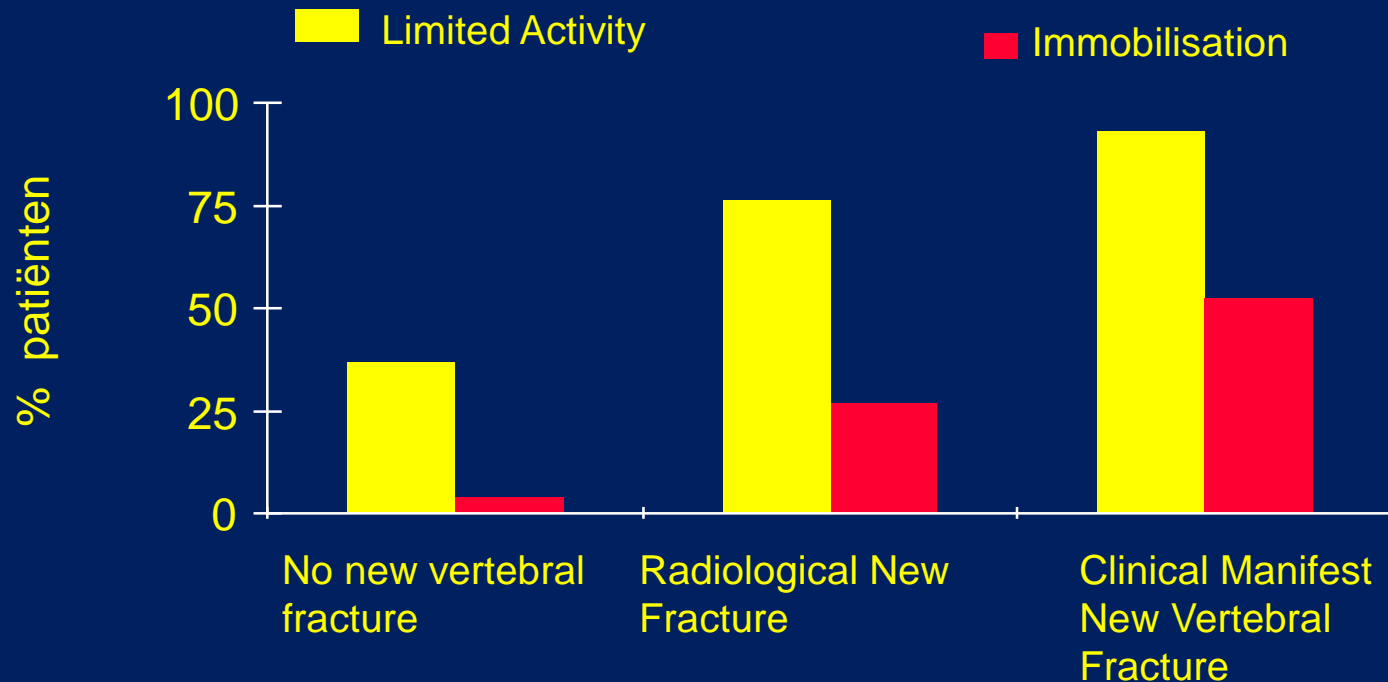




# Days with Back Pain, SOF-study. N=9700, 4 years observation



# Days with Limited Activity, SOF-study, n=9700, 4 years observation



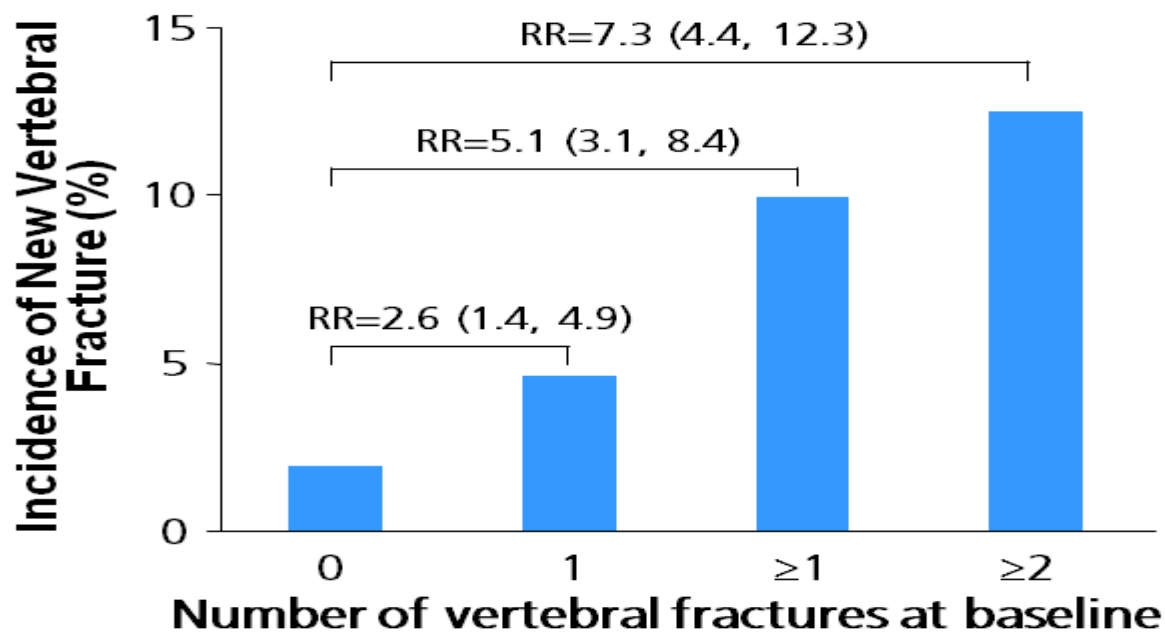
# Consequences of vertebral fractures

- Kyphosis
- Loss of height
- Bulging abdomen
- Acute and chronic back pain
- Breathing difficulties
- Depression
- Reflux and other GI symptoms
- Difficulty with activity of daily living (bending, rising, dressing, climbing stairs)
- Need to use a walking aid



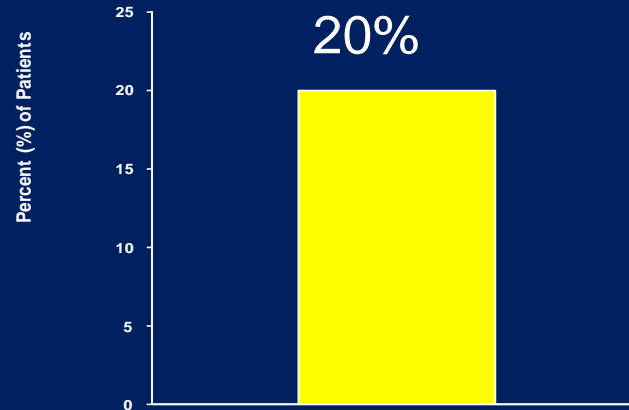
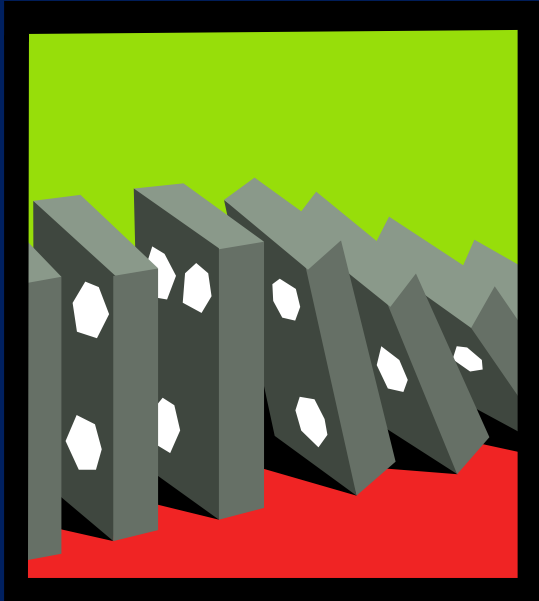
**REDUCED INDEPENDENCE  
AND QUALITY OF LIFE**

# Prior vertebral fracture increases the risk of subsequent vertebral fracture



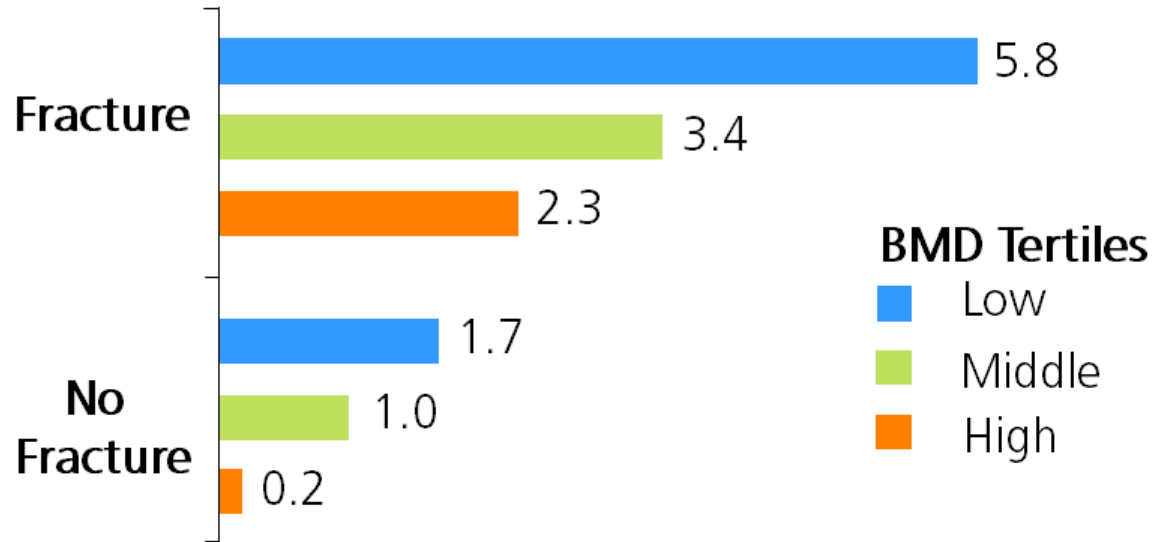
# Deterioration of bone strength

1 in 5 postmenopausal women who have an incident vertebral fracture, fracture again within a year



# Prior fracture increases the risk for future vertebral fracture, independent of BMD

Risk of vertebral fractures (% per year)

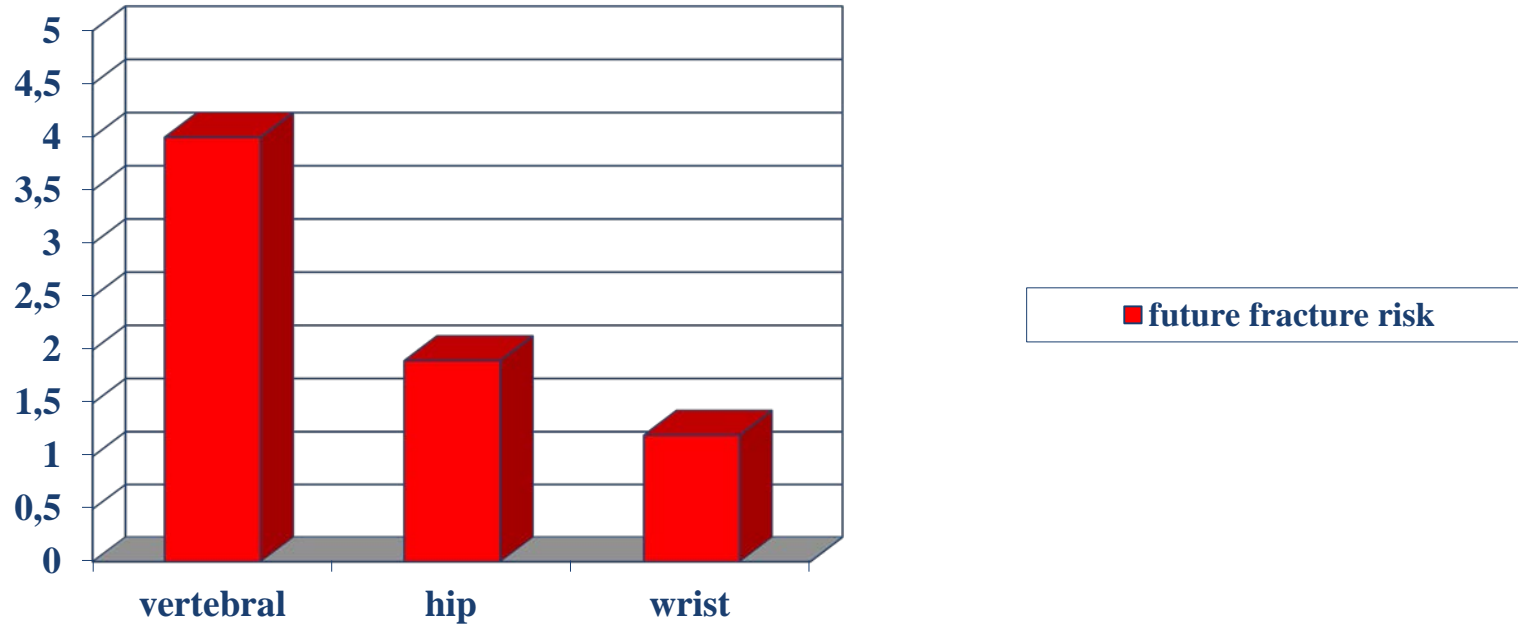


Adapted from Ross et al. (1991) *Ann Int Med* 114(11): 919



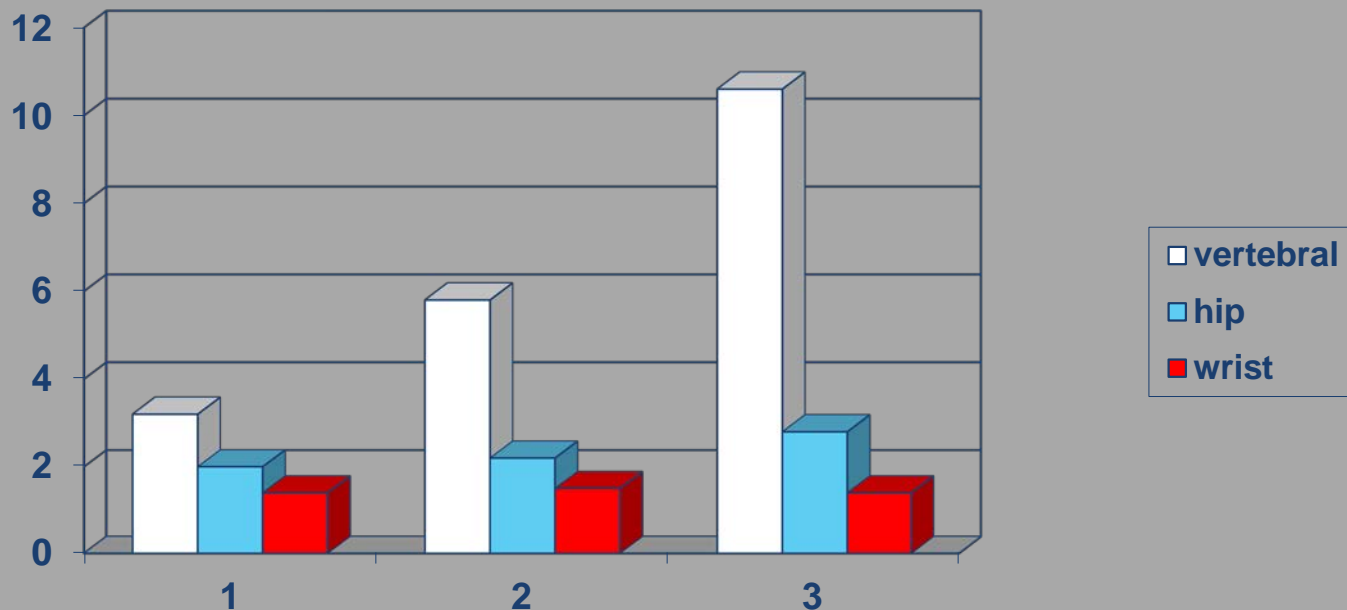


# Relative Risk for Future Fractures in patients with a prevalent vertebral deformity (corrected for age and BMD)



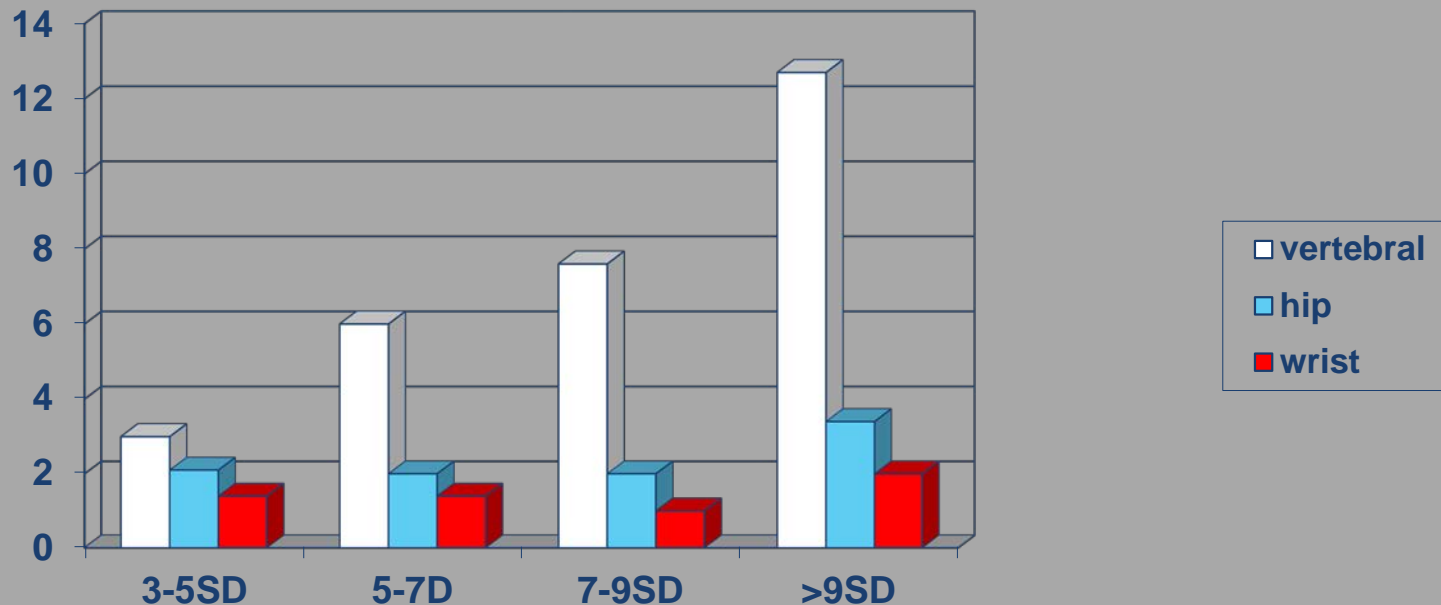


## Relative Risk for Subsequent Fractures, related to Number of Prevalent Vertebral fractures

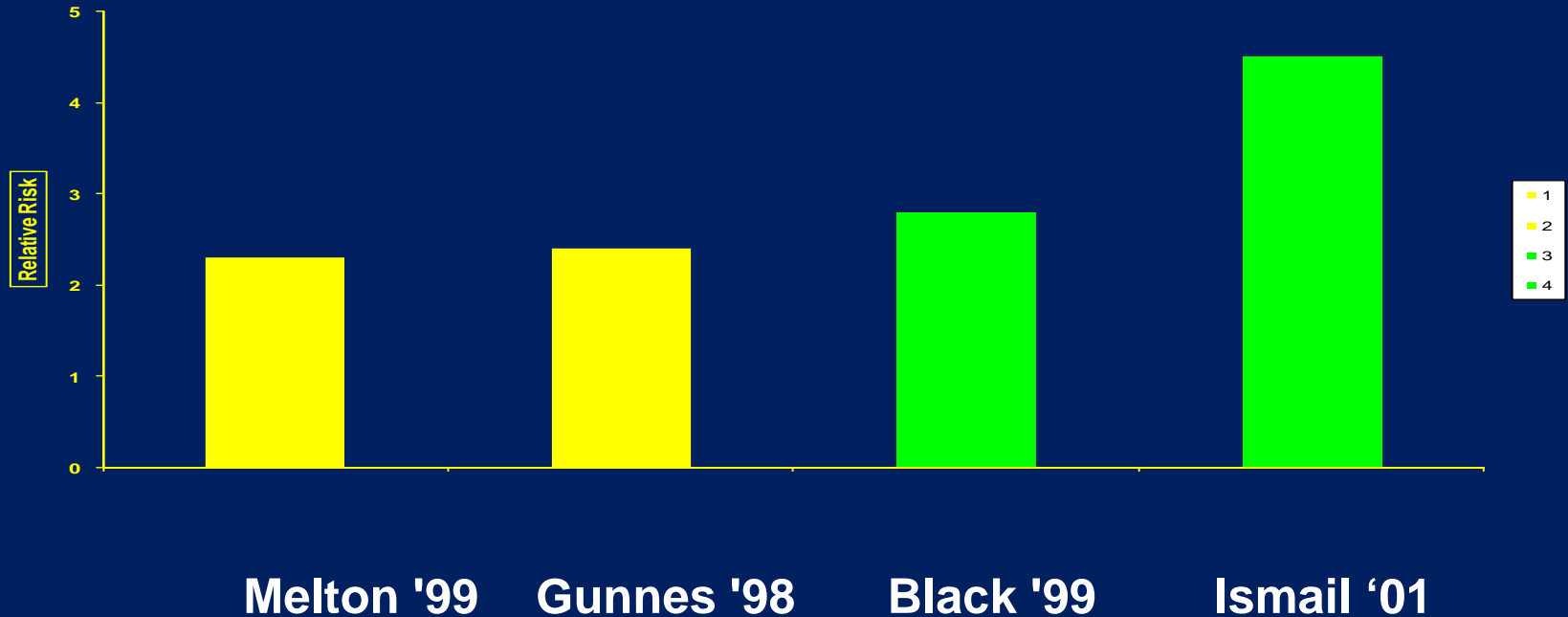




## Relative Risk for subsequent Vertebral fractures, related to Severity of Prevalent Vertebral Fractures



# Vertebral fractures increase the risk for hip fractures over 3-4 years



- clinically diagnosed vertebral fracture
- radiologically diagnosed vertebral fracture

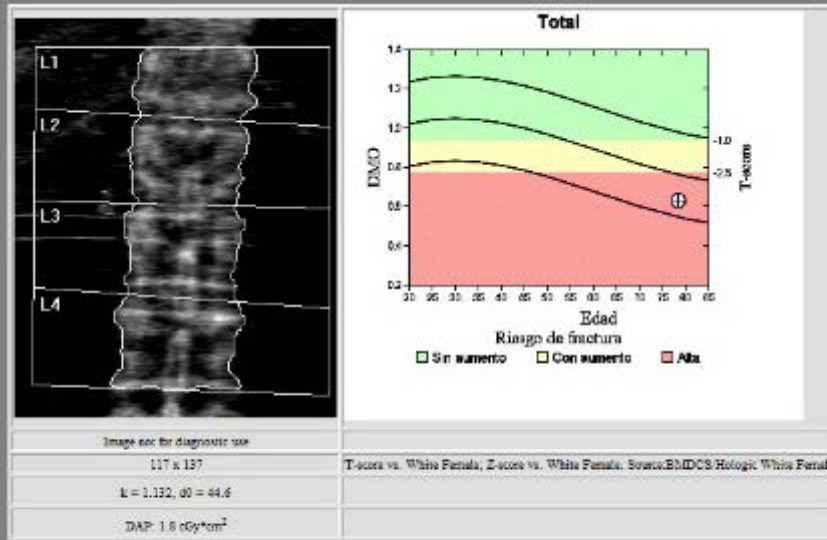
Melton et al. Osteoporosis Int 1999; 10: 214-222.  
Gunnes et al. Acta Orthop Scand 1999; 69: 508-512.  
Black et al. JBMR 1999; 14: 821-828.  
Ismail et al. Osteoporosis Int 2001; 12: 85-90.



- 3 Clinical Cases
- Epidemiology of Vertebral Fractures, why are vertebral fractures so often missed?
- Clinical Relevance of Detecting Vertebral Fractures.
- **How to detect Vertebral Fractures easily and reliably in patients at high risk for subsequent fractures? Pitfalls in detecting Vertebral Fractures, Strength/weakness of VFA.**
- Discussion on the statement that “in each patient in which a DXA is indicated, also a VFA is indicated”
- Questions.



# Dual-energy X-ray Absorptiometry (DXA)



## T-score

- $> -1$ : normal
- $-1, -2.5$ : osteopenia
- $< -2.5$ : osteoporosis

### Resumen de resultados:

Region	Area[cm <sup>2</sup> ]	BMC[g]	BMD[g/cm <sup>2</sup> ]	T-score	PR (Peak Reference)	Z-score	AM (Age Matched)
L1	12.83	8.19	0.638	-3.2	64	-0.9	87
L2	14.87	9.24	0.621	-3.7	60	-1.1	83
L3	15.95	10.40	0.652	-3.9	60	-1.2	83
L4	16.60	10.15	0.611	-4.1	58	-1.3	81
<b>Total</b>	<b>60.25</b>	<b>37.98</b>	<b>0.630</b>	<b>-3.8</b>	<b>60</b>	<b>-1.2</b>	<b>83</b>

CV de DMO Total 1.0%, ACF = 1.028, BCF = 0.959, TH = 6.764

Fracture Risk: High, WHO Classification: Osteoporosis

## Examples of SQ vertebral fractures



Grade 0  
Normal

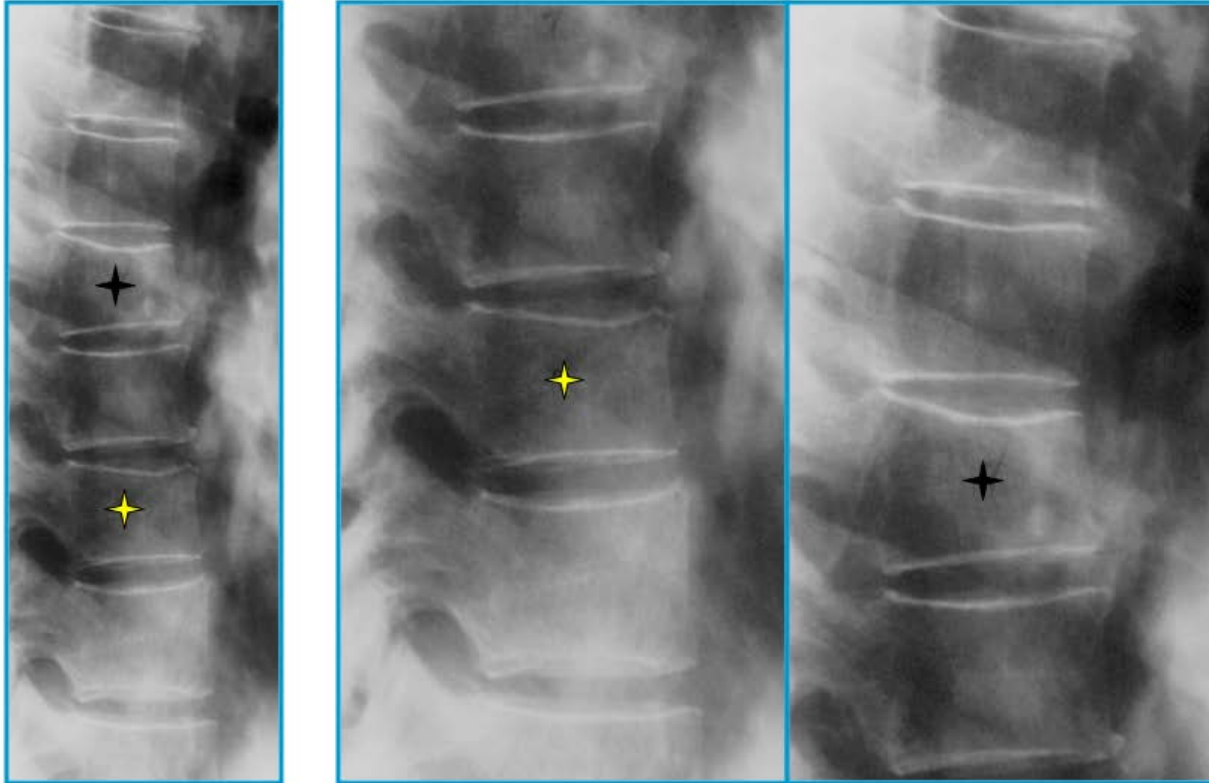
Grade 1  
Mild

Grade 2  
Moderate

Grade 3  
Severe

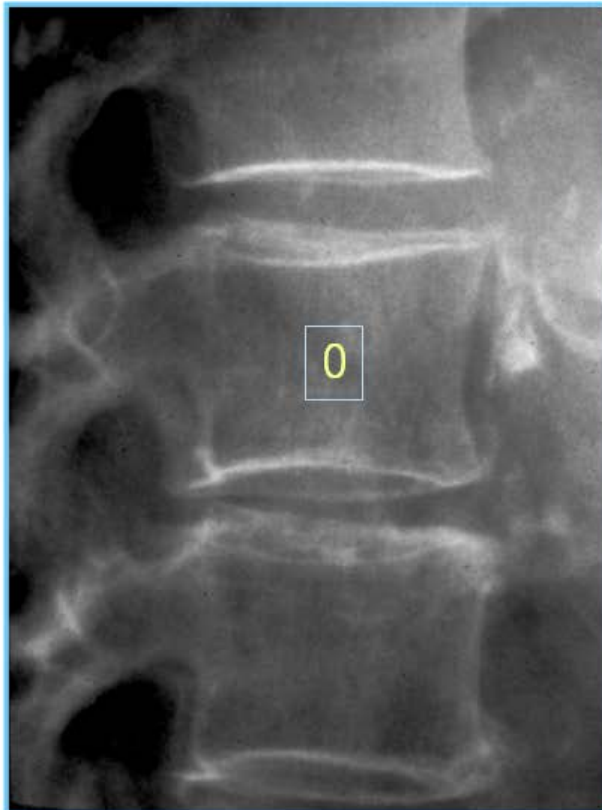
# SQ mild fractures

Loss of contiguity and parallelism of adjacent endplates

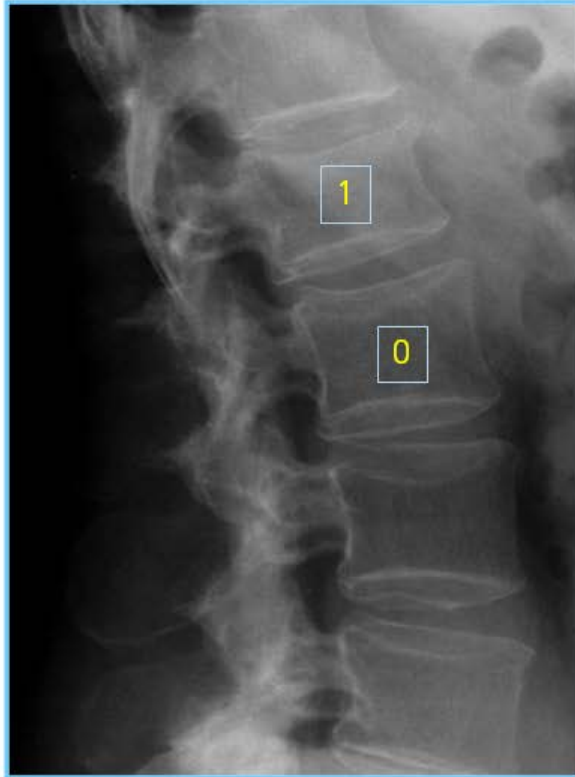




# SQ incident moderate fracture

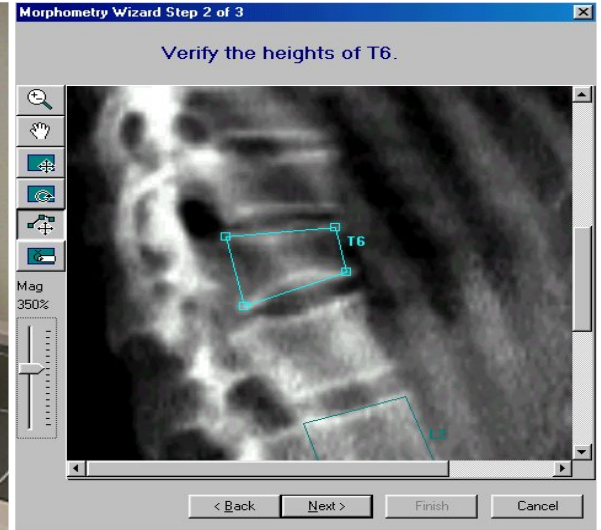


# SQ incident severe & moderate fractures





# Modern DXA-machines are capable to detect Vertebral Fractures (VertebralFracture Assessment)

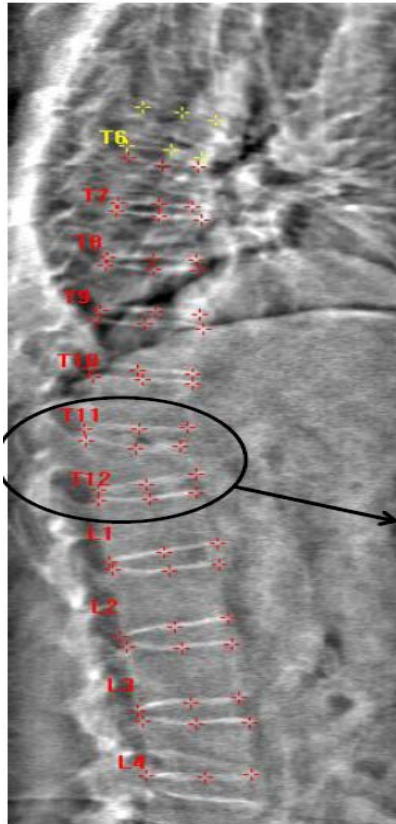


# Vertebral Fracture Assessment (VFA)

## Definition

- Use of fan beam densitometry to image the lateral and AP thoraco-lumbar spine for prevalent and incident vertebral fractures

# New Technique: Vertebral Fracture Assessment (VFA) with a DXA machine



Vertebral Assessment						
Label	Height (mm)			Percent Deformation		
	Post	Mid	Ant	Wedge	Biconcave	Crush
T6	19.5	19.0	19.1	1.6%	2.2%	0.0%
T7	22.6	18.7	19.8	12.5%	17.3%	0.0%
T8	23.1	20.7	19.4	16.0%	10.5%	0.0%
T9	22.4	20.9	21.9	1.9%	6.5%	0.0%
T10	24.3	22.7	22.9	5.7%	6.7%	0.0%
T11	25.7	23.9	21.7	15.7%	7.2%	0.0%
T12	25.0	18.1	15.1	39.4%	27.3%	0.0%
L1	30.6	26.6	26.3	14.2%	13.2%	0.0%
L2	32.8	27.5	26.0	20.8%	16.2%	0.0%
L3	31.6	27.0	26.3	16.7%	14.6%	0.0%
L4	26.6	26.4	25.9	2.6%	0.6%	0.0%



How does VFA compare to standard lateral spine radiography?

# Comparison of X-ray and VFA

	<b>X-ray</b>	<b>VFA</b>
<b>Radiation dose</b>	600 $\mu$ Sv	3 - 40 $\mu$ Sv
<b>Access</b>	Separate visit	Point of service
<b>Cost</b>	Higher (\$92 *)	Lower (\$45 *)
<b>Obliquity</b>	Common in LS	Less parallax effect
<b>Resolution</b>	Higher	Lower
<b>Visualization</b>	Superior above T7	May be superior in LS

\* Medicare reimbursement; Sv = Sievert, LS = Lumbar Spine

# Limitations of VFA

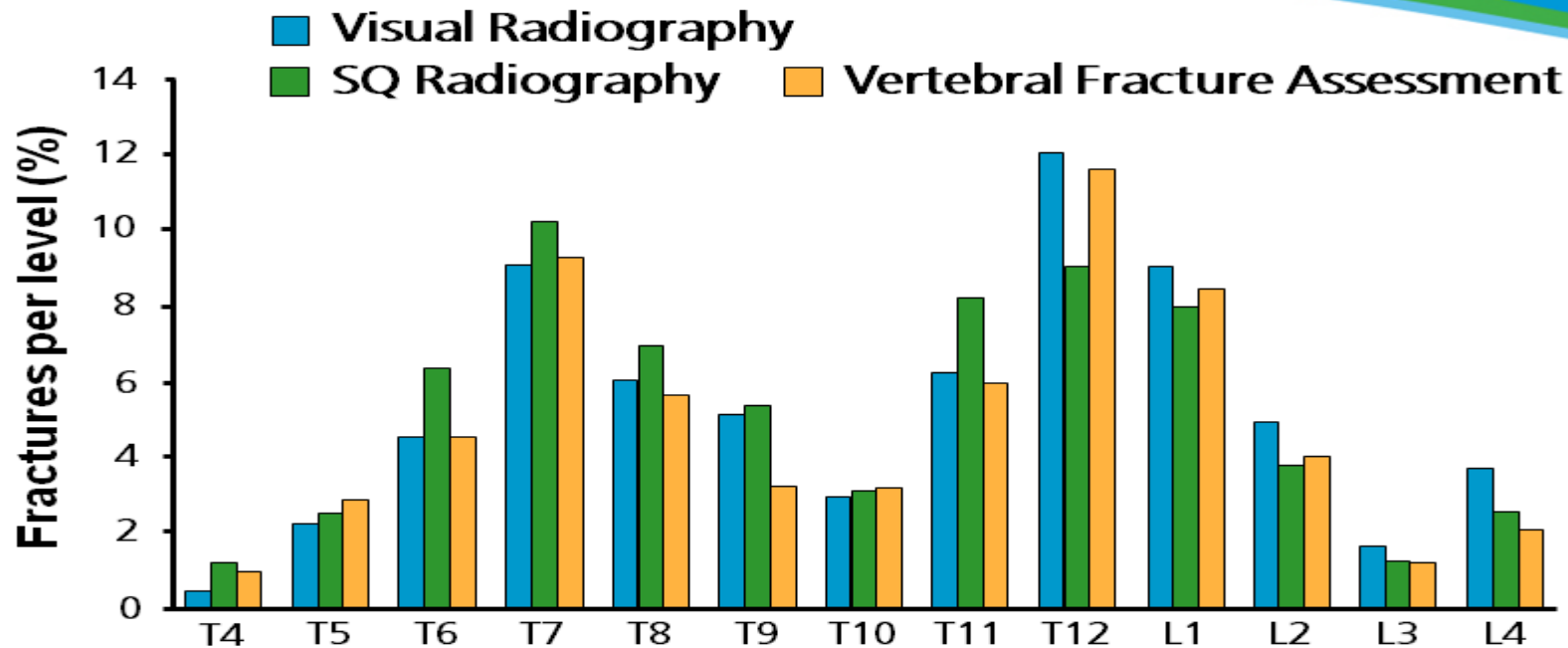
- **Lower resolution than X-ray**
  - Can be more difficult to differentiate etiologies for vertebral deformities other than fracture
- **Poor visualization above T7**
  - T7 and below - 97% visualized<sup>1</sup>
  - T6 - 70%<sup>2</sup>
  - T5 - 60%<sup>2</sup>
  - T4 - 43%<sup>2</sup>

<sup>1</sup>Rea JA et al. (1998) *Osteoporos Int* 8(2):177

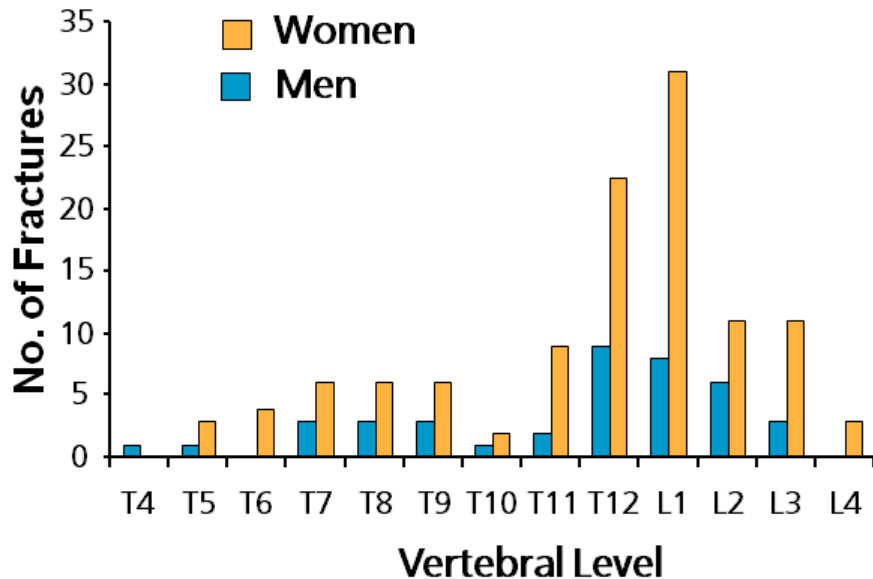
<sup>2</sup>Ferrar L et al. (2000) *J Bone Miner Res* 15(3): 575



# Prevalence of vertebral fractures on VFA and spine radiographs



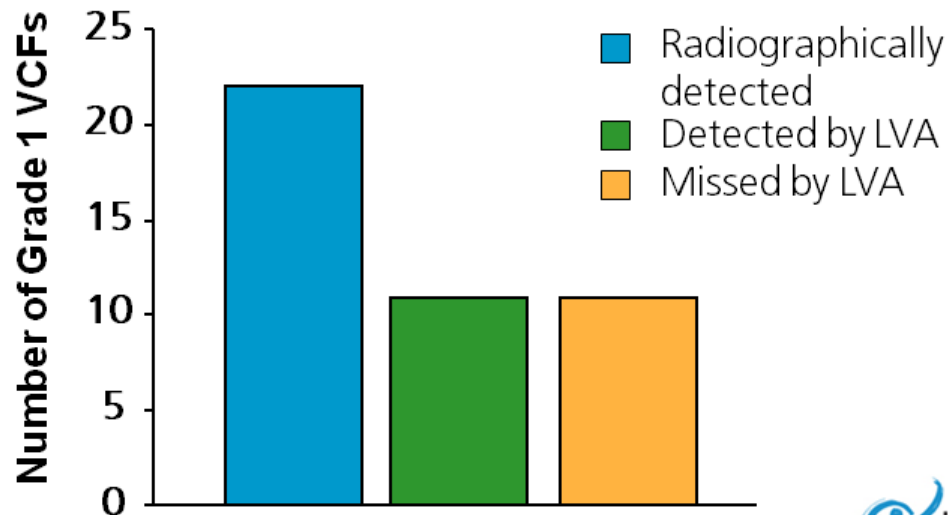
# Incident T4 to T6 fractures are not common



Incident fractures:  
6.3 years,  
Rotterdam study  
240 new fractures  
in 176 of 3469  
persons

# Grade 1 fractures: more difficult to identify

Of 22 grade 1 compression fractures present in evaluable vertebral bodies, 11 (50%) were detected by LVA (VFA)



# Accuracy of VFA vs. standard radiography (per vertebra analyses)

	Sensitivity	Specificity
Fracture Grades 1-3	53% - 70%	94% - 99%
Fracture Grades 2-3	57% - 95%	96% - 99%

- Those patients with unevaluable vertebrae on VFA or moderate to severe scoliosis excluded

*Binkley N et al. (2005) Osteoporos Int 16: 1513; Fuerst T et. al. (2009) Osteoporos Int 20: 1199*

*Damiano J et al. (2006) 9(1): 66; Hospers IC et al. Radiology 251(3): 822*

*Rea JA et al. (2000) Osteoporos Int 11: 660*

*Schousboe JT et al. (2006) Osteoporos Int 17: 281*

*Chapurlat RD et al. (2006) Osteoporosis Int 17:1189*

# Improved VFA technology

## All but one of the studies comparing VFA and standard radiography used older technology

Hospers, IC et al. (2009) *Radiology* 251(3): 822-828

- Agreement between VFA vs Genant SQ radiography (grades 1-3): kappa = 0.83
- Agreement between VFA vs qualitative radiography (grades 1-3): kappa = 0.82

A



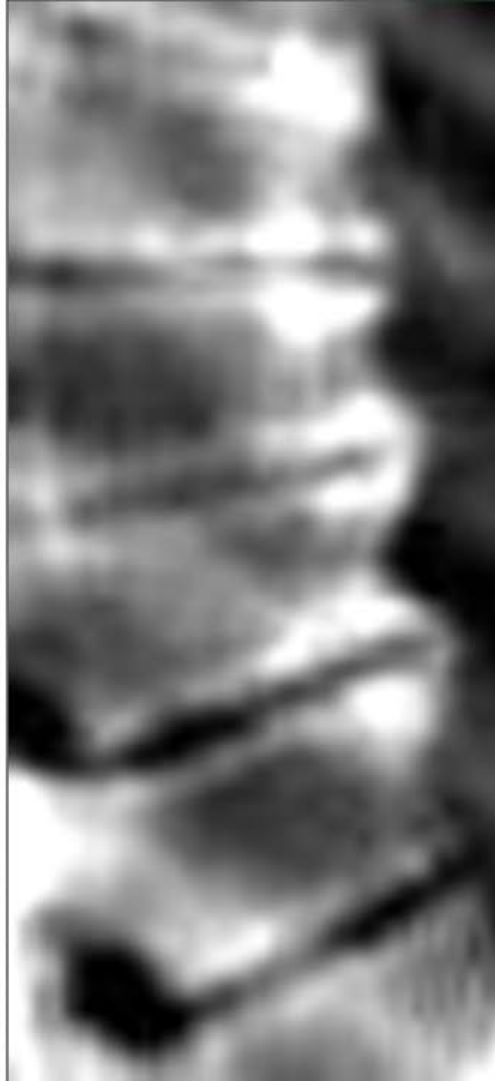
B



Changes in VFA  
technology:  
newer (A) vs.  
older (B)

# Vertebral deformities that are not osteoporotic fractures

- Normal anatomic variants
- Congenital anomaly
- Degenerative disease – disc space narrowing
- Infection – TB, osteomyelitis
- Paget's disease
- Scheuermann's disease (+/- Schmorl's Nodes)
- Malignancy
- Short vertebral height without any endplate depression or cortical break?



Degenerative remodeling and hypertrophy causing elongation and wedging of vertebra – mimics fracture



# Non-fracture abnormality

## Schmorl's nodes

Here associated with vertebral fractures



Schmorl's nodes are herniations of the intervertebral disc through the vertebral end-plate

“in every patient that is visiting an FLS in which a DXA is made, also a VFA should be done” , how to **interpret** the VFA? (1)



“Since the specificity of VFA is very high, a completely normal VFA more or less rules out a vertebral fracture”.



## “in every patient that is visiting an FLS in which a DXA is made, also a VFA should be done” , how to **interpret** the VFA? (2)



- In Clinical Trials, a height loss of 20% is regarded as a vertebral fracture;
- In Clinical Practice: because of the low sensitivity, the threshold for starting anti-osteoporotic treatment based on VFA is higher, e.g one severe deformity (>40% height loss), or 2 or more moderate deformities (25-40% height loss);
- When there is doubt about the presence or absence of a vertebral fracture in a patient in which that influences starting with anti-osteoporotic treatment or not, conventional Xrays of the spine should be performed.



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- **Discussion on the statement that “in each patient in which a DXA is indicated, also a VFA is indicated”**
- Questions.



## Effect of implementation of guidelines on assessment and diagnosis of vertebral fractures in patients older than 50 years with a recent non-vertebral fracture

R. Y. van der Velde<sup>1,2</sup> · S. P. G. Bours<sup>3</sup> · C. E. Wyers<sup>1,2</sup> · W. F. Lens<sup>4</sup> · P. P. M. M. Geusens<sup>3,5</sup> · J. P. W. van den Bergh<sup>1,2,5</sup>

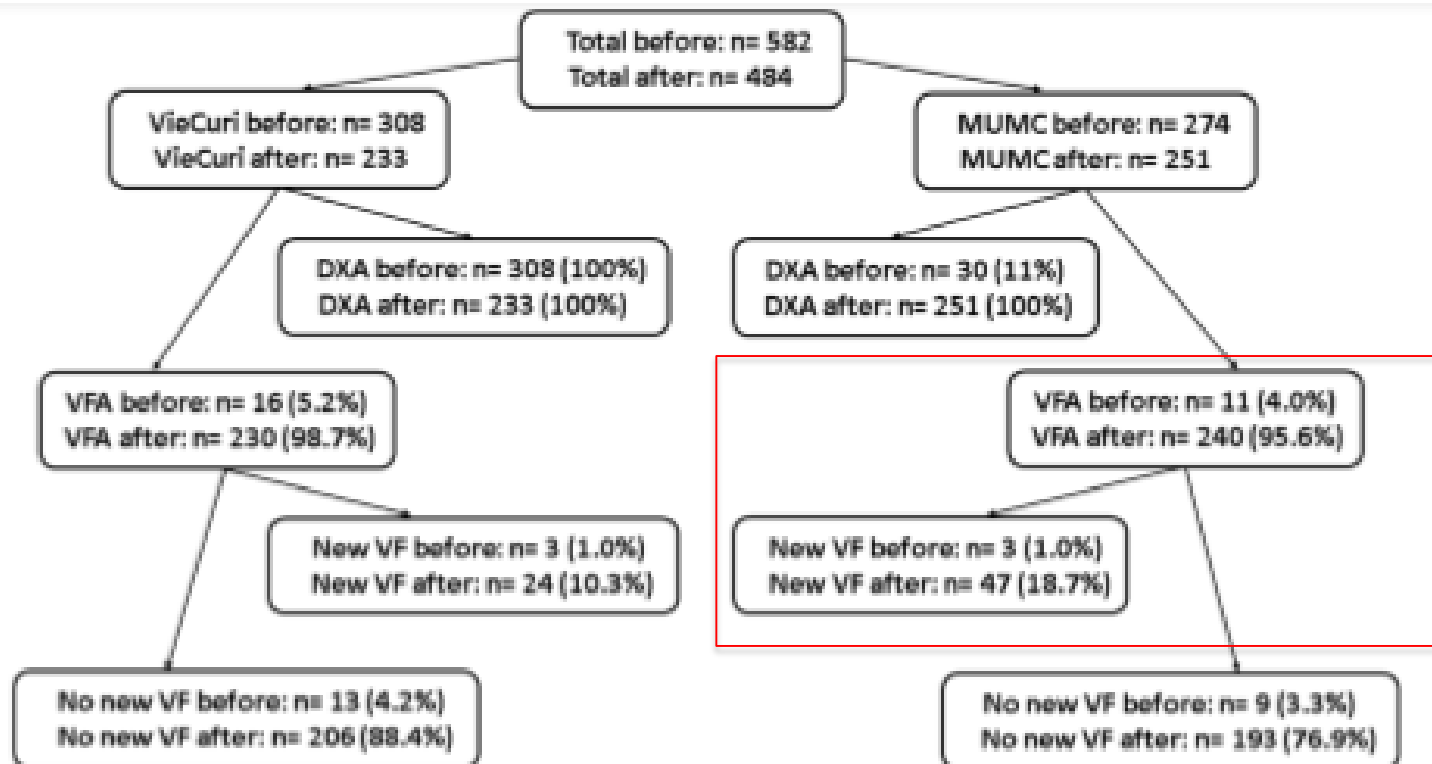
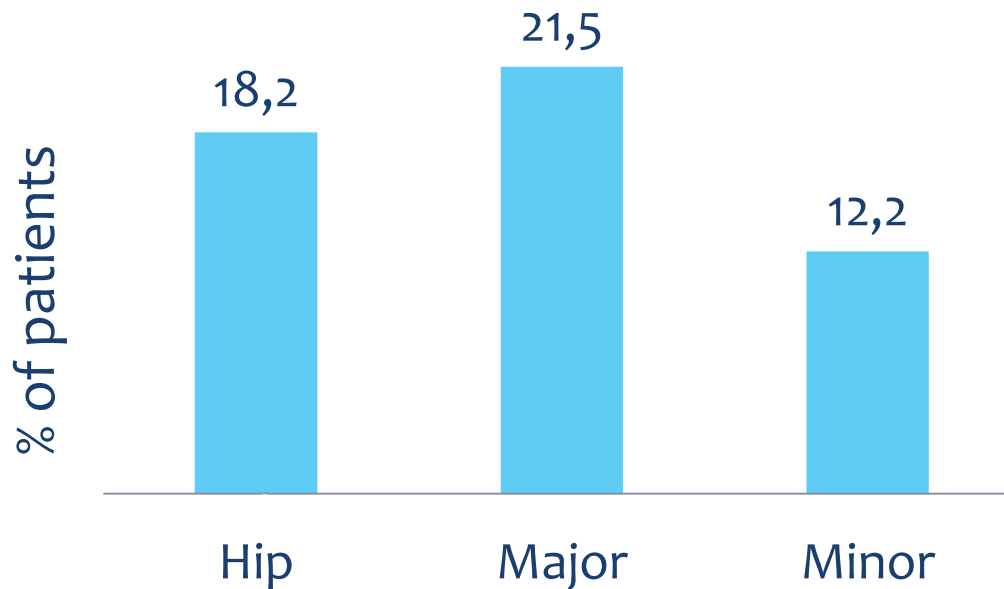
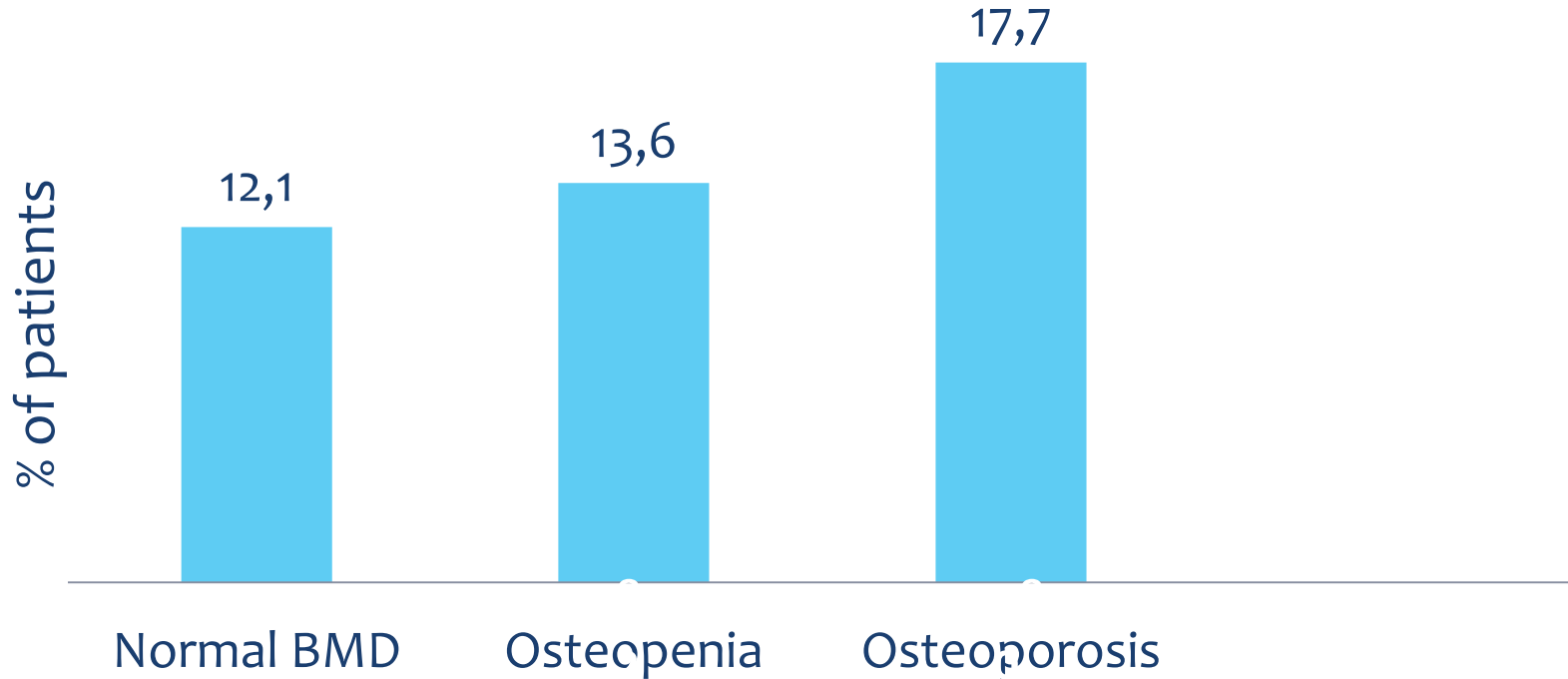


Figure 4 Percentage of patients with  $\geq 1$  newly diagnosed vertebral fracture according to baseline fracture (only patients after implementation of VFA)

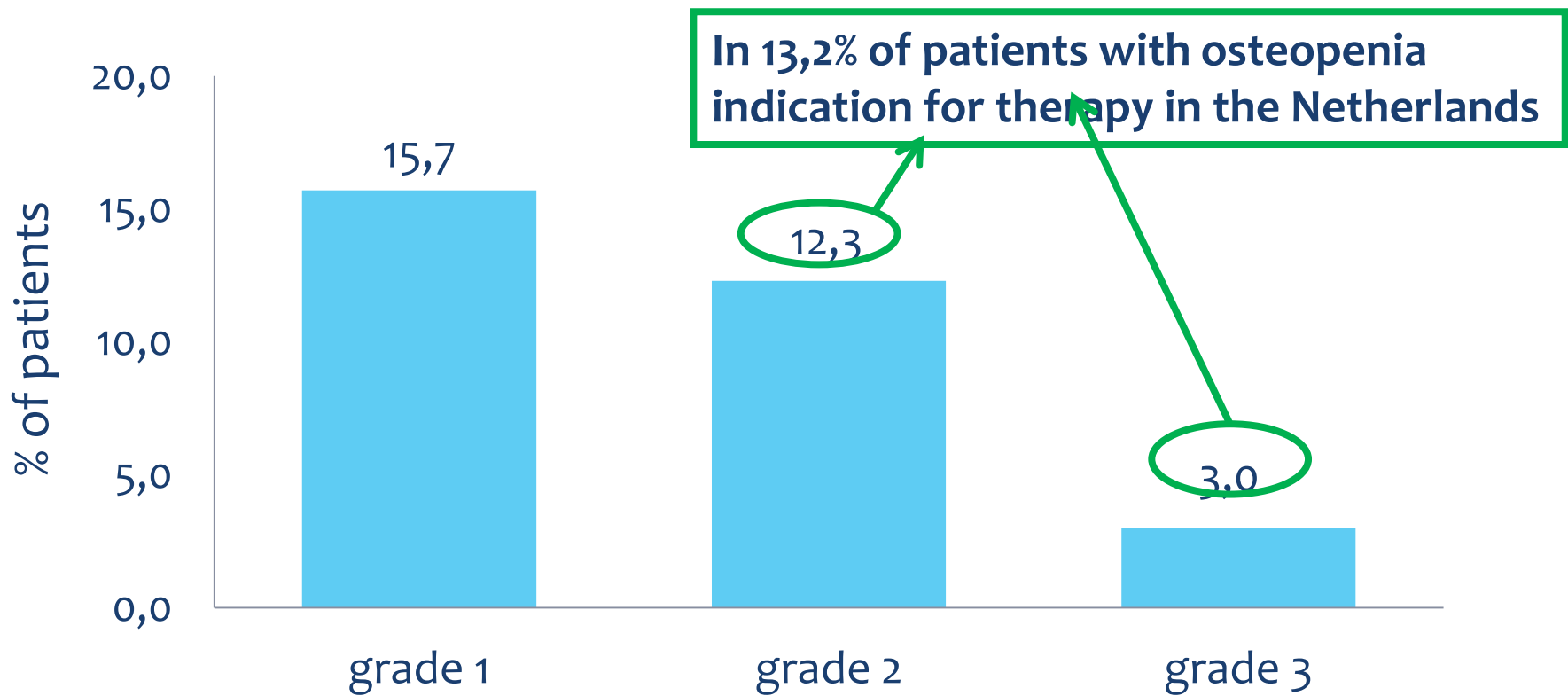


**Figure 2** Percentage of patients with  $\geq 1$  newly diagnosed vertebral fracture ( $\geq$  grade 2) according to BMD





# Figure 3 Clinical implication in patients with osteopenia





## Pre-Summary

- **Worldwide, a substantial percentage of vertebral fractures are not diagnosed by radiologists or clinicians<sup>1</sup>**
- **It is likely that this contributes to unnecessary pain and suffering and to the under treatment of osteoporosis**
- **Identification of patients with a vertebral fracture is important because the presence of prevalent fracture greatly increases the risk of future fracture**
- **Recent widespread approval of effective treatments for patients with osteoporotic vertebral fractures**



<sup>1</sup> Delmas PD et al. (2005) JBMR 20: 557-563

## **“In each patient in which a DXA is indicated, also a VFA is indicated”**



- Diagnosing one or more vertebral fractures in a patient with osteopenia increases the subsequent fracture risk, and that may be crucial for starting anti-osteoporotic treatment or not;
- Having a baseline VFA, offers the opportunity to discriminate between incident fractures and prevalent fractures. This is clinically relevant, since incident fractures might indicate treatment failure, while prevalent fractures do not.



# Learning Points Vertebral Fractures

---

- Recognize the signs and symptoms of an vertebral fracture;
  - Be aware of the high prevalence of vertebral fractures and its risk factors;
  - Diagnose a vertebral fracture efficiently;
  - Know about symptomatic treatment options in the acute phase;
  - Realise that prevention of subsequent fractures is crucial.
- 
- Vertebral fracture with VFA can be diagnosed in patients in which which a DXA is indicated and performed.

# Thank you



THANK YOU



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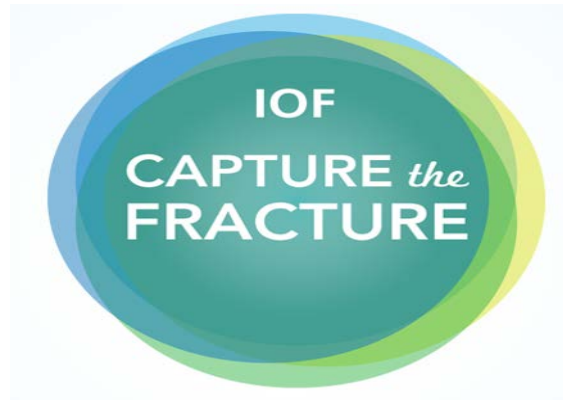


Inspired by **patients.**  
Driven by **science.**



On behalf of IOF and CTF SteerCo, we thank you for  
your participation in this webinar

If you have any additional questions or comments  
please email [mfujita@iofbonehealth.org](mailto:mfujita@iofbonehealth.org)





“In patients visiting an FLS, not only a DXA is indicated, but also a VFA (vertebral fracture assessment)”.

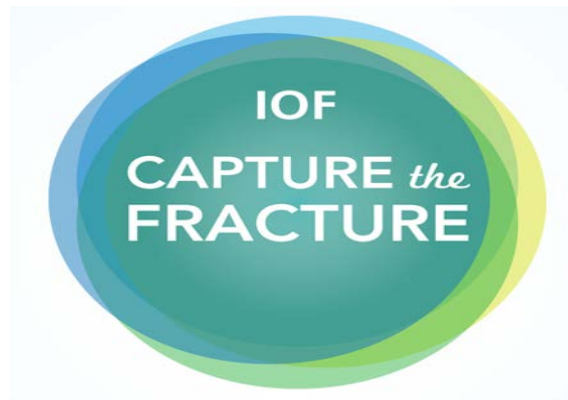


Thank you for your attention!

You can ask your questions Now!,  
or later at [wf.lems@vumc.nl](mailto:wf.lems@vumc.nl)



# Q & A





## Q1: Is there an standardized way to report VFA findings that you could recommend to us?



- *Good question. Unfortunately, radiologists often report either "some height loss", or only "height loss". I strongly advocate that radiologists also quantify and report the amount of height loss: Th8 has a height loss of 22% and TH10 of 41%, that really helps clinicians. In this example, the fracture of Th8 is mild according to Genant, but the fracture of Th10 is severe, and can be an indication for treatment (in a patient with BMD in osteopenic range)*

## Q2: in your opinion: What are the issues behind DXA+VFA reimbursement?



- *That differs from country to country. Although I am not an expert in costs, costs are certainly an issue. In US there is the so-called crisis in osteoporosis: underdiagnosis and undertreatment. The reimbursement for DXA is going down to only around 35 dollar; I can understand that also performing VFA and reporting VFA for 35 dollar can be limited. This is one of the reasons for crisis in osteoporosis in US.*
- *In many other countries, among them the Netherlands, the reimbursement is above 100 Euro, it is more easy to perform both a DXA and VFA. Additionally, performing a VFA is also incorporated in our Dutch recommendations: only performing a DXA is suboptimal diagnostics.,*

**Q3: The more VFA we perform, the higher number of osteopenic patients with vertebral fractures: How do you consider the best way to spread the need (among physicians) of performing more VFA tests in Osteopenic& Osteoporotic patients?**



- *Key question. My answer is very clear: in all individuals in which there is an indication for a DXA, because of an earlier fracture, or in patients with risk factors, or in prednisone users, always do a VFA in addition to DXA.*

## Q4: How does an FLS improve diagnosis, management and treatment of VF patients?



- *Excellent question. I suppose that in all your patients with a recent fracture at FLS, a DXA is performed. My statement that you should also perform a VFA in these patients. If not available, you should buy not a new machine, but only some additional software, which is not very costly. The two most important advantages are that:*
- *- you can diagnosis vertebral fractures in patients with osteopenia (which differs from no indication for treatment because of osteopenia to start anti-osteoporotic treatment because of vertebral fractures). In my lecture, I showed in Maastricht that occurs in 13.2% of their FLS patients*
- *-you can later in the course of the disease differentiate between a new incident (treatment failure?) and an already existing prevalent fracture (=no treatment failure), when you find a vertebral fracture, because you have a baseline value.*

## Q5:)If you do not have access to DXA due to resource limitation, nor VFA. What do you recommend? CT and MRI?



- A good question, in fact two questions.
- *-One answer is conventional radiographs. Conventional radiographs are gold standard for detecting vertebral fractures, and thus even better than VFA. However, they are limited by the higher costs and the radioactivity. In patients in which you know their length at peak bone loss, you can measure their actual length: if it is 3-5 cm or more it is highly likely that the patient has vertebral fractures. CT and MRI are very expensive, we only use that when there is doubt whether it is an osteoporotic fracture or another disease eg a malignancy.*
- *-If you do not have access to DXA, you have clinical risk factors like age and BMI, and the best you can do in that situation is a FRAX score without BMD.*