The recognition and reporting of vertebral fractures: a powerful tool to reduce the risk of future osteoporotic fractures

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Osteoporosis Canada
Vertebral fracture prevalence:
Mortality rates by number of vertebral fractures:

Number of Vertebral Fractures

- 0
- 1
- 2
- 3
- 4
- 5+

Mortality/1000 Person-years

Kado D. Arch Intern Med 1999; 159: 1215

p for trend < 0.001
Vertebral fractures predict hip fracture:

$$RR = \frac{\text{Prevalent Vertebral Fractures}}{\text{No Prevalent Fracture}}$$

<table>
<thead>
<tr>
<th>Study</th>
<th>Relative Risk</th>
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<tbody>
<tr>
<td>Melton '99</td>
<td>2.3</td>
</tr>
<tr>
<td>Gunnes '98</td>
<td>2.4</td>
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<tr>
<td>Black '99</td>
<td>2.8</td>
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<tr>
<td>Lauritzen '93</td>
<td>3.8</td>
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</tbody>
</table>
Survival Rates after Fracture:

Cooper C. Am J Epidemiol 1993; 137: 1001
All vertebral fractures are clinically important:

Days of pain, or bed rest due to pain, over 3 years

Nevitt M. Arch Intern Med 2000; 160: 77
Radiological fracture recognition (1):

Review of chest radiographs on 934 women aged >60 years, admitted to hospital

On review 132 had 1 or more spinal fractures

Of these: 65 (49%) were reported
23 (17%) were noted in the medical record
25 (19%) were treated

Gehlbach SH et al. Osteoporosis Int 2000;11:577 - 582
Radiological fracture recognition (2):

In a Canadian study of emergency room radiography the following were the chief findings in relation to the thoracic spine:

- Mean age of the population was 75 years,
- 47% were women, and 46% were admitted to the hospital.
- According to the reference radiologist, prevalence of moderate to severe vertebral fractures was 22%.
- Simple agreement was about 88% among reviewers; kappa values were moderate (0.56-0.58).
- Only 55% (12/22) of the vertebral fractures identified were mentioned in the radiology reports.

Role of CT & MRI

CT = Clarify radiographic findings

MRI = Useful for recognizing fracture acuity and incidental disease (e.g. tumours)
Osteoporotic fracturing – the pathological view:
Risk prediction and prevalent fractures:

Vertebral body fractures as a special case:

Vertebral fractures may occur incrementally and not catastrophically.

Mechanism of injury: axial cf. transverse loading (crush)

Vertebral fractures may be associated with a vacuum phenomenon.

Vertebral fractures may only be evident under load-bearing.

The definition of vertebral fractures is subject to debate (and varies by practitioner and country).
Vertebral deformities:

All fractures cause deformities

Not all deformities are due to fracturing
Spinal fracturing:

• Low trauma spinal fractures:

• 60% are asymptomatic

Spinal osteoporosis:

1. Spinal deformities (fractures)

2. Prominent vertical trabeculae (loss of secondary trabeculation)
Genant Grading:
Vertebral fracture assessment using a semiquantitative technique

Normal (Grading 0)

Crush  Biconcavity  Wedge

Gd. 1: <25 % deformity
Gd. 2 25 – 40 % deformity
Gd. 3: >40 % deformity

Genant HK et al. J Bone Miner Res. 1993; 8: 1137-1148
Problematical aspects of the Genant paradigm:

• It proposes a quantitative classification
• It makes unrealistic distinctions between fracture types
• Morphometry cf. radiological “signs” of fracture
• Both projected area (“volume”) and vertical dimensions are invoked
• The reference dimensions are subject to variation and interpretation
• The “grades” overlap
  - Grade 1: 20 – 25%
  - Grade 2: 25 – 40%
  - Grade 3: > 40%
• The classification has suffered mutation or “creep”
Spinal morphometry:
Osteoporotic fractures are nearly always end-plate fractures:

Grade 1 anterior wedge and crush (superior end plate) fracture:
A Grade 2 anterior wedge and superior end-plate fracture:
A Grade 2 anterior wedge and end-plate fracture:
A Grade 3 crush (superior end plate) fracture (arrow)
Glucocorticoid-induced osteoporosis:
Tc-99m MDP bone scan:

Low trauma fractures of the sacrum, sacral ala and coccyx are best recognized by radionuclear bone scans.
Differential diagnosis:
The lower pole of scapula (larger arrow) projected over T 7:
Congenital abnormalities:
Orthogonal views of the lower thoracic spine in a patient with a T 10 “butterfly” (bifid) vertebra:
Cupid’s bow ("notochordal") defects (L3-5):

Dietz GW, Christenson EE.; Vertebrae 1976; 121: 577-579;
Acquired abnormalities:
Scheuermann disease

Juvenile disc disease
Scheuermann disease mimics:

Hereditary progressive arthro-ophthalmopathy (Stickler syndrome)

Acrodysostosis (peripheral dysostosis)
Intervertebral Disc Herniation
Schmorl’s nodes and limbus defects:

Disc herniation into the vertebral body (Schmorl node)

Disc herniation through the secondary ring ossification centre (limbus defect)
Schmorl’s nodes:
Spectrum of Intervertebral Disc Herniation
A limbus defect at the antero-superior margin of L3.
Secondary ossification centres:

Lumbar spine – 5-year old
Disc disease and vertebral remodelling:
Summary:

The old:

- About ten systems varying between subjective and objective; quantitative and qualitative
- Summarised in: Genant H et al. Monograph on vertebral fractures

The new:

- Jiang G. et al. Prevalence SQ (24%) > Qual (11%) > ABQ (7%); BMD α Qual/ABQ OI 2004
- Increasingly, European studies (ISCD) focus on end-plate changes
Inter-observer variability: semiquantitative visual assessment of prevalent fractures

![Graph showing inter-observer variability](chart.png)

- First reading (%)
- Second reading (%)
- % Agree

Experienced obs.
Inexperienced obs.
Incident fracturing: