Vertebral Fracture Assessment- VFA

Calling a Fracture a Fracture
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
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)
Why?
Increased morbidity and mortality

Vertebral fractures are associated with an 8-fold increase in age-adjusted mortality

Fracture risk by BMD and previous fracture

Why?

Ross et al., 1991
"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
Identification of vertebral fracture in imaging services
Opportunities for the identification of VFx

1. Patient presents with symptoms that suggest vertebral fracture
   - Clinically appropriate spine imaging obtained (radiograph, MRI or CT)

2. Patient has investigation for another indication
   - Lateral spine is evaluated routinely by reporting clinician in all imaging that includes the thoracic and/or lumbar spine

3. Patient attends for axial DXA
   - Where indicated, VFA is performed at time of DXA

Vertebral fracture identified

Reporting clinician records 'vertebral fracture' with appropriate signposting for further assessment

FLS case-finding or via referring clinician

Assessment to consider differential diagnosis, quantify fracture risk and investigate for underlying cause of osteoporosis

Implement management plan to control symptoms and reduce the risk of further fracture

Patient details added to FLS Database

Depending on local pathways, implementation within FLS or osteoporosis clinic

Royal Osteoporosis Society
Better bone health for everybody
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
Audit of CT CAP spine reporting

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

<table>
<thead>
<tr>
<th>standards</th>
<th>Audit</th>
<th>reports</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comment on the spine in report</td>
<td></td>
<td>161 (83.4%)</td>
</tr>
<tr>
<td>Scans in which VF identified</td>
<td>26 (13.5%)</td>
<td>15 (9.3%)</td>
</tr>
<tr>
<td>Scans with correct terminology</td>
<td></td>
<td>7 (46.6%)</td>
</tr>
<tr>
<td>Reports with VF recommending further assessment</td>
<td></td>
<td>0</td>
</tr>
</tbody>
</table>
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
Interrogate

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

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

<table>
<thead>
<tr>
<th>Level</th>
<th>BMD</th>
<th>Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>L1</td>
<td>0.703</td>
<td>9.11</td>
</tr>
<tr>
<td>L2</td>
<td>0.670</td>
<td>11.16</td>
</tr>
<tr>
<td>L3</td>
<td>0.745</td>
<td>12.05</td>
</tr>
<tr>
<td>L4</td>
<td>0.759</td>
<td>12.66</td>
</tr>
</tbody>
</table>
**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
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
**Action**

**Non reporting practitioners**

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

**Reporting practitioners**

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

²The 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.
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
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
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
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.
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
### LVA Morphometry

<table>
<thead>
<tr>
<th>Region</th>
<th>Avg. HL</th>
<th>A/P Ratio</th>
<th>A/P Ratio</th>
<th>Z-score</th>
<th>Z-score</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(mm)</td>
<td>(%)</td>
<td>(mm)</td>
<td>(%)</td>
<td>(%)</td>
</tr>
<tr>
<td>T4</td>
<td>1.30</td>
<td>-2.8</td>
<td>100</td>
<td>0.9</td>
<td></td>
</tr>
<tr>
<td>T5</td>
<td>1.31</td>
<td>-2.8</td>
<td>89</td>
<td>-0.7</td>
<td></td>
</tr>
<tr>
<td>T6</td>
<td>1.27</td>
<td>-3.4</td>
<td>71</td>
<td>-2.9</td>
<td></td>
</tr>
<tr>
<td>T7</td>
<td>1.15</td>
<td>-4.7</td>
<td>88</td>
<td>-0.1</td>
<td></td>
</tr>
<tr>
<td>T8</td>
<td>1.65</td>
<td>-1.0</td>
<td>113</td>
<td>3.5</td>
<td></td>
</tr>
<tr>
<td>T9</td>
<td>1.39</td>
<td>-3.2</td>
<td>86</td>
<td>-1.0</td>
<td></td>
</tr>
<tr>
<td>T10</td>
<td>1.40</td>
<td>-3.8</td>
<td>73</td>
<td>-3.2</td>
<td></td>
</tr>
<tr>
<td>T11</td>
<td>1.24</td>
<td>-5.3</td>
<td>81</td>
<td>-1.8</td>
<td></td>
</tr>
<tr>
<td>T12</td>
<td>1.53</td>
<td>-4.2</td>
<td>68</td>
<td>-4.0</td>
<td></td>
</tr>
<tr>
<td>L1</td>
<td>1.78</td>
<td>-3.4</td>
<td>81</td>
<td>-2.2</td>
<td></td>
</tr>
<tr>
<td>L2</td>
<td>2.56</td>
<td>0.0</td>
<td>106</td>
<td>1.2</td>
<td></td>
</tr>
<tr>
<td>L3</td>
<td>2.55</td>
<td>-0.2</td>
<td>115</td>
<td>2.1</td>
<td></td>
</tr>
<tr>
<td>L4</td>
<td>2.63</td>
<td>0.2</td>
<td>105</td>
<td>0.0</td>
<td></td>
</tr>
</tbody>
</table>

**Comments:**

1. Reference based on L2, L3, and L4
2. The precision (AIDO) is 1 mm for heights and 0.05 for ratios.
VFA case studies: calling a fracture a fracture

Case 1
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
VFA 4 fractures identified
VFA 4 fractures identified
Plain film- Scheurmann’s disease
No fractures
VFA case studies:
calling a fracture
a fracture

Case 3
VFA 1 fracture identified
VFA 1 fracture identified
Plain film- Schmorl’s node
No fractures
VFA case studies: calling a fracture a fracture

Case 4
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