Osteoporosis Assessment Using DXA and Instant Vertebral Assessment

Clay County Hospital
Working Together For A Healthier Community

HOLOGIC
Osteoporosis
The Silent Thief
The Facts About Osteoporosis

• 1 in 2 women will develop osteoporosis
• 60,000 deaths annually due to complications from osteoporosis
• This is more than breast and cervical cancers combined
  – 40,000 from breast cancer
  – 4,000 from cervical cancer
The Osteoporosis Epidemic

• Every 3 minutes someone has a fracture due to osteoporosis
• 30 million American women at risk
• 300,000 hip fractures per year
  – 20% mortality within 1 year
  – 50% never regain independence
What is Osteoporosis?

- Osteoporosis is a systemic skeletal disease characterized by low bone mass and micro architectural deterioration, with a consequent increase in bone fragility with susceptibility to fracture.*
- How is osteoporosis measured?
  - Bone density T-score $\geq 2.5$ SD below young normal mean†

Who is at Risk?

- Early menopause, surgical menopause
- Low body weight compared to height
- Diet - low intake of milk products and lack of vitamin D
- Life-style factors: cigarette smoking, caffeine, alcohol abuse, lack of exercise
- Drugs and diseases, corticoseroid treatment, hyperthyroidism, anorexia nervosa, amenorrhoea, arthritis
- Genetic factors (family history, race)
Assessing Risk Through BMD Measurement

Osteoporosis

Low Bone Mass

Osteopenia

Normal

-2.5  -1.0

Treatment  Maintenance/Prevention  Monitor

Know Your T-Score!
Normal and Osteoporotic Bone Architecture

Normal Bone

![Normal Bone](image1)

Osteoporotic Bone

![Osteoporotic Bone](image2)

Reproduced from *J Bone Miner Res* 1986;1:15-21 with permission of the American Society for Bone and Mineral Research. © 1986 by Massachusetts Medical Society. All rights reserved.
Bone Metabolism

• Bone is made up of:
  – Trabecular (spongy)
  – Cortical (compact)

Osteoporotic  Healthy
Bone Metabolism

THE LIVING SKELETON

• SKELETAL LIFE AT THE CELLULAR LEVEL
  Consists of Two Processes:
  • bone resorption *(osteoclasts)*
  • bone formation *(osteoblasts)*
• Bone remodeling continues throughout life even after the cessation of growth

• The skeleton reaches peak bone mass between age 25 and 40 depending on the site in the body
Bisphosphonates

- **Alendronate (Fosomax™ Merck)**
  - One weekly dose
  - Slows bone resorption/fracture reduction
  - GI problems/ not absorbed well
  - Generic, 2/08

- **Risedronate (Actonel™ P&G)**
  - One weekly dose
  - Slows bone resorption/fracture reduction
  - GI problems/ not absorbed well
Bisphosphonates (cont.)

- Ibandronate (Boniva™ Roche)
  - One Monthly dose (New Quarterly Dose)
  - Slows bone resorption/fracture reduction
  - GI problems/ not absorbed well

- Zoledronic Acid (Reclast™ Novartis)
  - Once a year infusion
  - Slows bone resorption/fracture reduction of all clinical sites
  - Approved for postmenopausal women only at this time
Therapies for Osteoporosis

- Estrogen
  - Maintenance drug
  - Reduces risk of cardio-vascular problems / stroke
  - Controversy - Women’s Health Initiative
- Raloxifene (Evista™ Lilly)
  - SERM – designer Estrogen
  - Reduced fracture risk
  - Maintenance drug
Therapies for Osteoporosis

- **Teriparatide (Forteo™ Lilly)**
  - Injectable pen that requires refrigeration
  - Synthetic parathyroid hormone
  - Yearly treatment (10K / year)
  - Stimulates bone growth

- **Calcitonin™ (Sandoz)**
  - Well tolerated
  - Low turnover only
Central vs. Peripheral Measurements

Central Sites
- Spine
- Hip

Peripheral Sites
- Forearm
- Phalanges
- Heel
Types Of Densitometry Instrumentation

1. Dual Energy X-ray Absorptiometry (DXA)
   - central or peripheral sites (pDXA)

2. Single Energy X-ray Absorptiometry (SXA)
   - peripheral sites only - low usage

3. Quantitative Ultrasound (QUS)
   - peripheral sites only

4. Quantitative Computed Tomography (QCT)
   - Central sites or peripheral sites - low usage
Central vs. Peripheral BMD Measurements

• Hip and spine the “Gold Standard” for Diagnosis
• Hip and spine the “Gold Standard” for Monitoring of BMD changes
• Peripheral measurements useful for risk assessment, but not preferred
• Peripheral measurements NOT RECOMMENDED for Monitoring of BMD changes
• BMD and Vertebral Assessment (IVA) is the standard of care
DXA: The Gold Standard

- Detects early bone loss and monitors therapeutic effectiveness
- Measures axial skeletal sites where early bone loss occurs
- High precision (<1.0%)
- Low patient dose
- High-resolution imaging
Sahara Heel Ultrasound

- Radiation-free
- Dry technology
- Light weight, portable (22 lbs.)
- Rapid assessment (<10 sec)
- Utility:
  - Risk assessment w/o DXA
  - Screening for DXA
  - Ideal for smaller practices
Hologic DXA: True Linear Fan-beam Scanning
Hologic DXA: True Linear Fan-beam Scanning

One Pass Technology
– Single sweep scanning
– CT based acquisition geometry
– Digital image processing for all scan modes
– Continuous calibration
– Anthropomorphic spine phantom
**W.H.O. Classification**  
World Health Organization

T-scores are used to decide whether a patient has reduced BMD consistent with osteoporosis and osteopenia.

<table>
<thead>
<tr>
<th>T-score</th>
<th>Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>T &lt; -1.0 SD</td>
<td>Normal</td>
</tr>
<tr>
<td>-1.0 SD &lt; T &lt; -2.5 SD</td>
<td>Osteopenic</td>
</tr>
<tr>
<td>T &lt; -2.5 SD</td>
<td>Osteoporotic</td>
</tr>
</tbody>
</table>

*For every SD of decline, fracture risk increases 2-3x!*  
—World Health Organization (W.H.O.)
BMD Test Results

- **BMD** = g/cm\(^2\) of bone mineral

- Z-scores normalize a patient’s BMD by assessing the amount of bone loss compared to the expected loss for age-matched peers.

- T-scores indicate the amount of bone loss, by quantifying the difference between a patient’s BMD at his/her current age, and the peak bone mass for young normals.
Hologic
The Gold Standard in Osteoporosis Assessment
BMD and Vertebral Fracture Assessment
Why Aren’t Vertebral Fractures Commonly Considered in Osteoporosis Assessment?

- Most fractures are asymptomatic
  - <1% of back pain episodes due to Vertebral Fracture (Ettinger, 1996)
- Height loss is difficult to assess
- Radiographs are infrequently ordered
  - Not available at point of care
  - High radiation dose (800 mRem typical)
  - Difficult to identify appropriate candidates
- Only 20 - 25% of Vfx are recognized clinically (Ensrud 1999)
Why is Vertebral Fracture Assessment Necessary?

- Combined BMD/Fracture Assessment is the standard of care
- 20 - 25% of postmenopausal women have fractures
- 30% of women needing treatment are missed without IVA
- New ISCD Training and Clinical Guidelines
- New WHO Guidelines Require FX Information
Clinical Relevance of BMD and IVA

- Knowledge of the presence of a fracture is a strong indicator of risk
- Often impossible to know that fractures are occurring until it’s too late
- The presence of vertebral fracture, combined with BMD, provides superior prediction of fracture risk
- Very low radiation dose (1% of conventional radiographs)
- Captures entire spine in one 10-second scan
Industry Momentum

- Approved drugs are now available for prevention and treatment of osteoporosis
- At least 45 companies are currently developing additional therapies
- Increased attention to women's health
- Increased focus on “graying of America”
- Increased focus on disease prevention

A woman is at least 3X more likely to comply with hormonal therapy if she has knowledge about her bone mass.
—Silverman, Greenwald et. al Ob/Gyn V89, 1997 3(321-325).
Integration of Vertebral Fracture and BMD Improves Risk Assessment

- Risk increases 75x with multiple vertebral fractures and low BMD
- Risk increases 25x with 1 vertebral fracture and low BMD

### BMD Levels
- Low BMD
- Med BMD
- Hi BMD

### Fracture Counts
- No Fx
- 1 Fx
- > 1 Fx
Vertebral Fracture: The key factor in patient evaluation
IVA Opportunity
Clinical Importance is Accepted

- **Prevalence:** 20 - 25% of postmenopausal women have fractures
- **Mis-classification:** 30% of women needing treatment are missed without IVA
- **High Re-fracture Rate:** 20% will re-fracture within one year
- **Effective Therapies Exist:** Treatment reduces fracture risk in these women by 50% in the first year!
- **Value in Patient Counseling:** Showing the patient a fracture has great value
- **Standard of Care:** IVA / BMD assessment is the established standard of care
Case Study: BMD and IVA

- AP spine T-score = -1.0 (osteopenia)
- L2 wedge deformity subsequent to baseline IVA evaluation
- Fracture indicates increased risk, need for more aggressive therapy

70 year-old female
Clinical Implications

- If this woman’s doctor had been able to identify her first fracture ...

- Perhaps the rest of her fractures could have been prevented
Instant Vertebral Assessment and Abdominal Aortic Calcifications
DXA with IVA HD

- Point of Care Assessment:
  - BMD
  - VFA
  - Aortic Calcification
AAC and *Discovery*

- **Improves Patient Health**
  - Doubles clinical utility of IVA (Osteoporosis and Cardiovascular)
  - Performed on target population (> age 55)
  - Allows intervention before being symptomatic

- **Improves Practice ROI**
  - Significant risk factor for further evaluation
  - Stress test >> Carotid ultrasound >> CT Calc Scoring >> CT Angio
  - AAC > 20x more likely +CA score by CT
Abdominal Aortic Calcification
New Links to Fracture Risk

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Links between cardiovascular disease and osteoporosis in postmenopausal women: serum lipids or atherosclerosis per se?

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Abstract
Introduction and hypothesis Epidemiological observations suggest links between osteoporosis and risk of acute cardiovascular events and vice versa. Whether the two clinical conditions are linked by common pathogenic factors or atherosclerosis per se remains incompletely understood. We investigated whether serum lipids and polymorphism in the ApoE gene modifying serum lipids could be a biological linkage.

Methods This was an observational study including 1176 lipid components were independent contributors to the variation in spine or hip BMD. When comparing the women with or without vertebral fractures, serum triglycerides showed significant differences. This finding was however not applicable to hip or wrist fractures. After adjustment for age, severe AC score (≥6) and/or manifest cardiovascular disease increased the risk of hip but not vertebral or wrist fractures.

Conclusion The contribution of serum lipids to the modulators of BMD does not seem to be direct but rather indirect via promotion of atherosclerosis, which in turn can affect
Abdominal Aortic Calcification
New Links to Fracture Risk
Moderate/Severe AAC
3X Risk for Hip Fracture

Relative risk

Low AAC          Moderate/Severe AAC

0    0.5    1    1.5    2    2.5    3
AAC Case Study 3

- 76 Year Old Caucasian Female, Weight 135 lbs., Current Height 66”, 1” Height Loss Since Age 25
- Previous Non-Vertebral FX
- T-Score
  - -1.4 Neck
  - -1.2 Total Hip
  - -0.1 Spine L1-L4

Severe AAC
(AAC = 6 on 8 point Scale)
Osteoporosis Can Be Prevented!