



Osteoporosis Assessment Using DXA and Instant Vertebral Assessment

Clay County Hospital

Working Together For A Healthier Community **BJC** HealthCareSM



Osteoporosis The Silent Thief

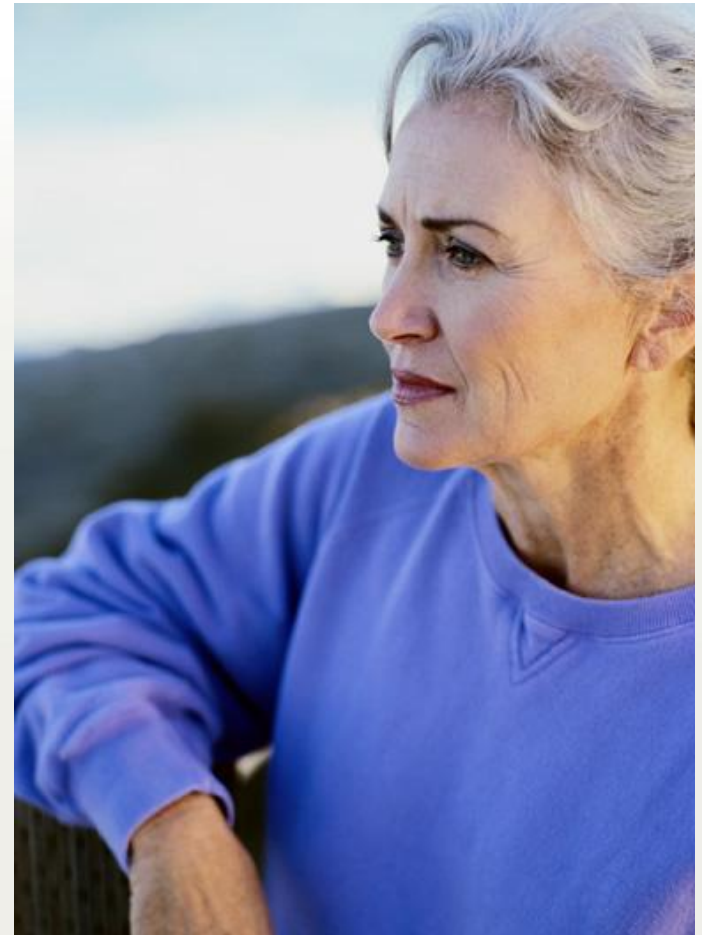
The Facts About Osteoporosis

- 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



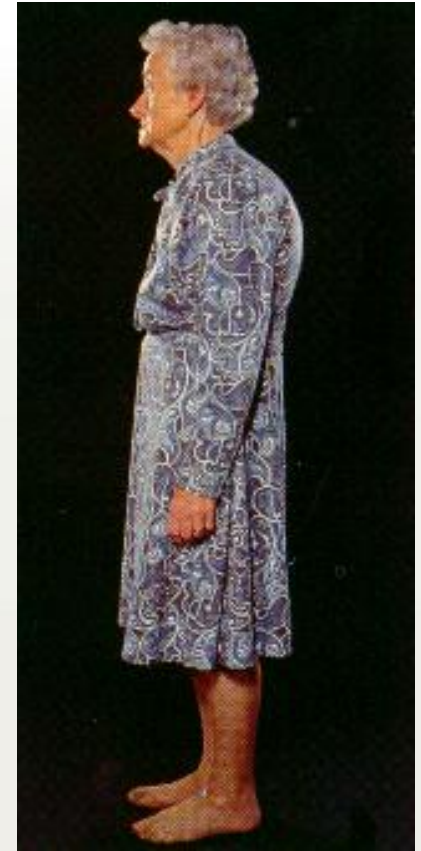
The Osteoporosis Epidemic

- 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 ≥ 2.5 SD below young normal mean†



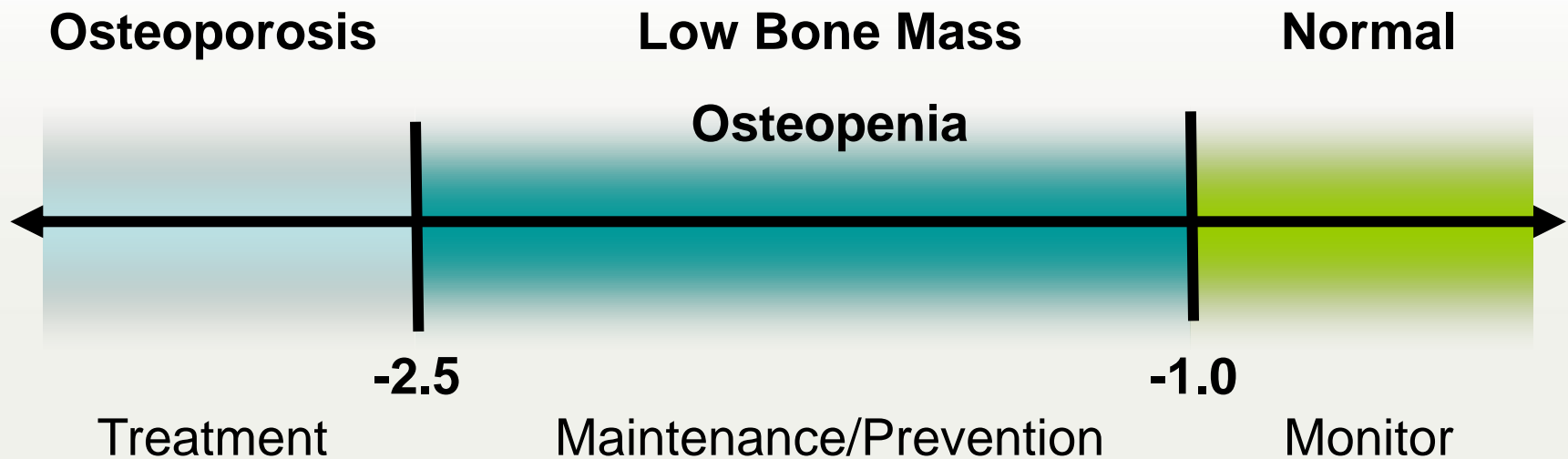
*Consensus Development Conference: Diagnosis, prophylaxis, and treatment of osteoporosis, *Am J Med* 1993;94:646.

† Kanis JA et al, *J Bone Miner Res* 1994;9:1137.

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, corticosteroid treatment, hyperthyroidism, anorexia nervosa, amenorrhoea, arthritis
- Genetic factors (family history, race)

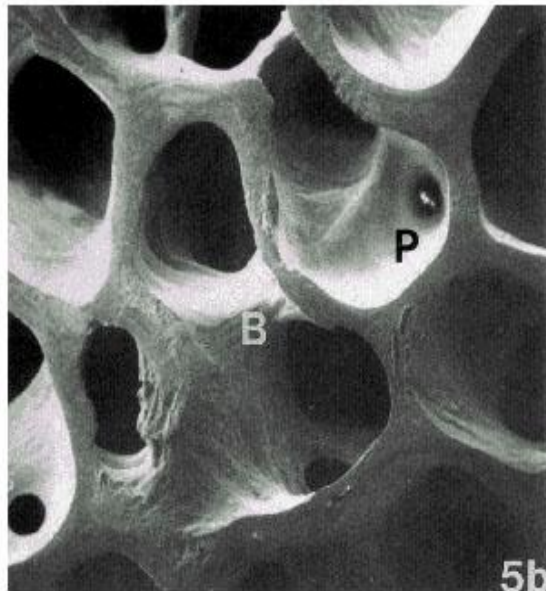
Assessing Risk Through BMD Measurement



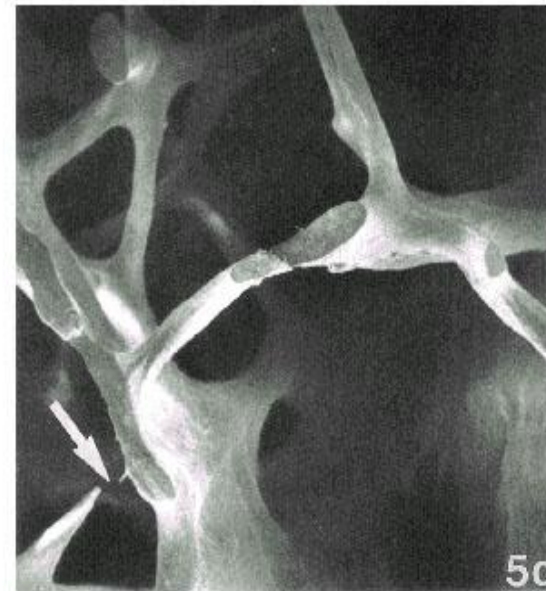
Know Your T-Score!

Normal and Osteoporotic Bone Architecture

Normal Bone



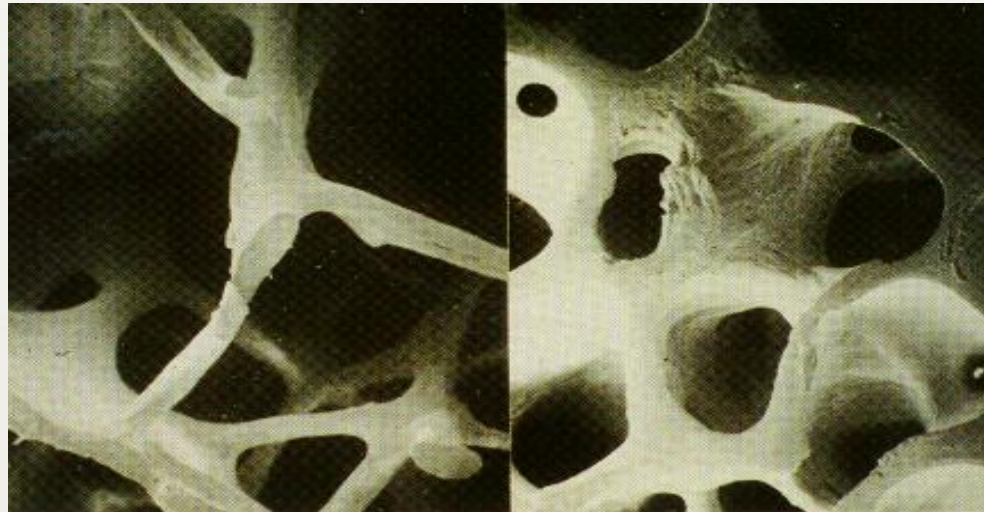
Osteoporotic Bone



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

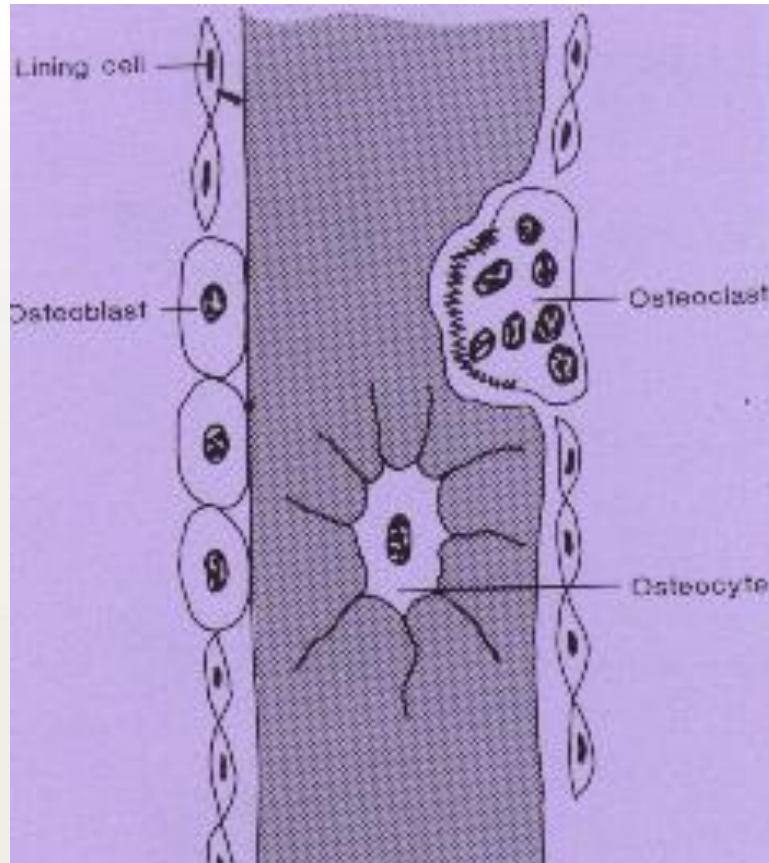
- Bone is made up of:
 - Trabecular (spongy)
 - Cortical (compact)



Osteoporotic

Healthy

Bone Metabolism



- SKELETAL LIFE AT THE CELLULAR LEVEL

Consists of Two Processes:

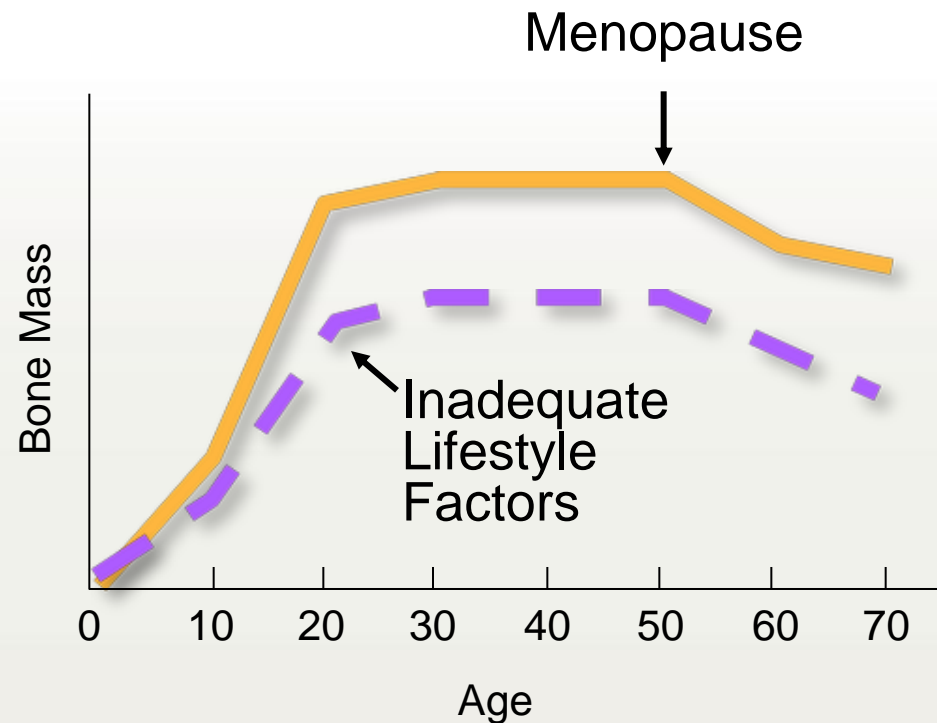
- bone resorption
(*osteoclasts*)
- bone formation
(*osteoblasts*)

THE LIVING SKELETON

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Peak Bone Mass

- 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



Therapies for Osteoporosis

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



Therapies for Osteoporosis

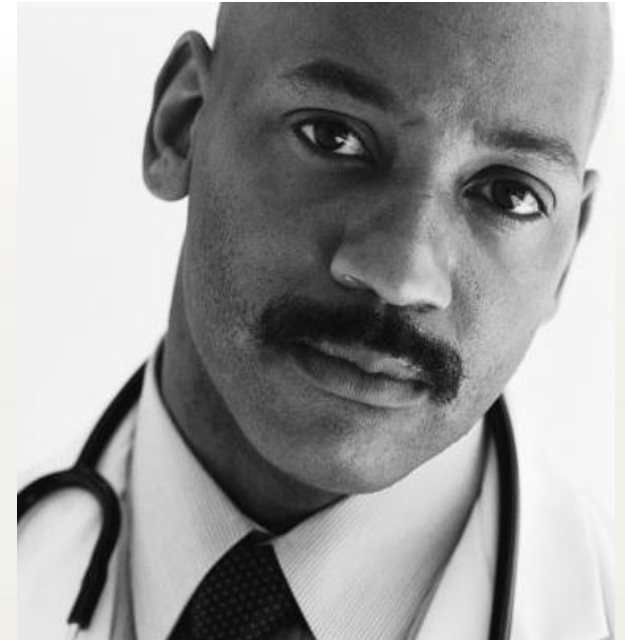
Bisphosphonates (cont.)

- 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

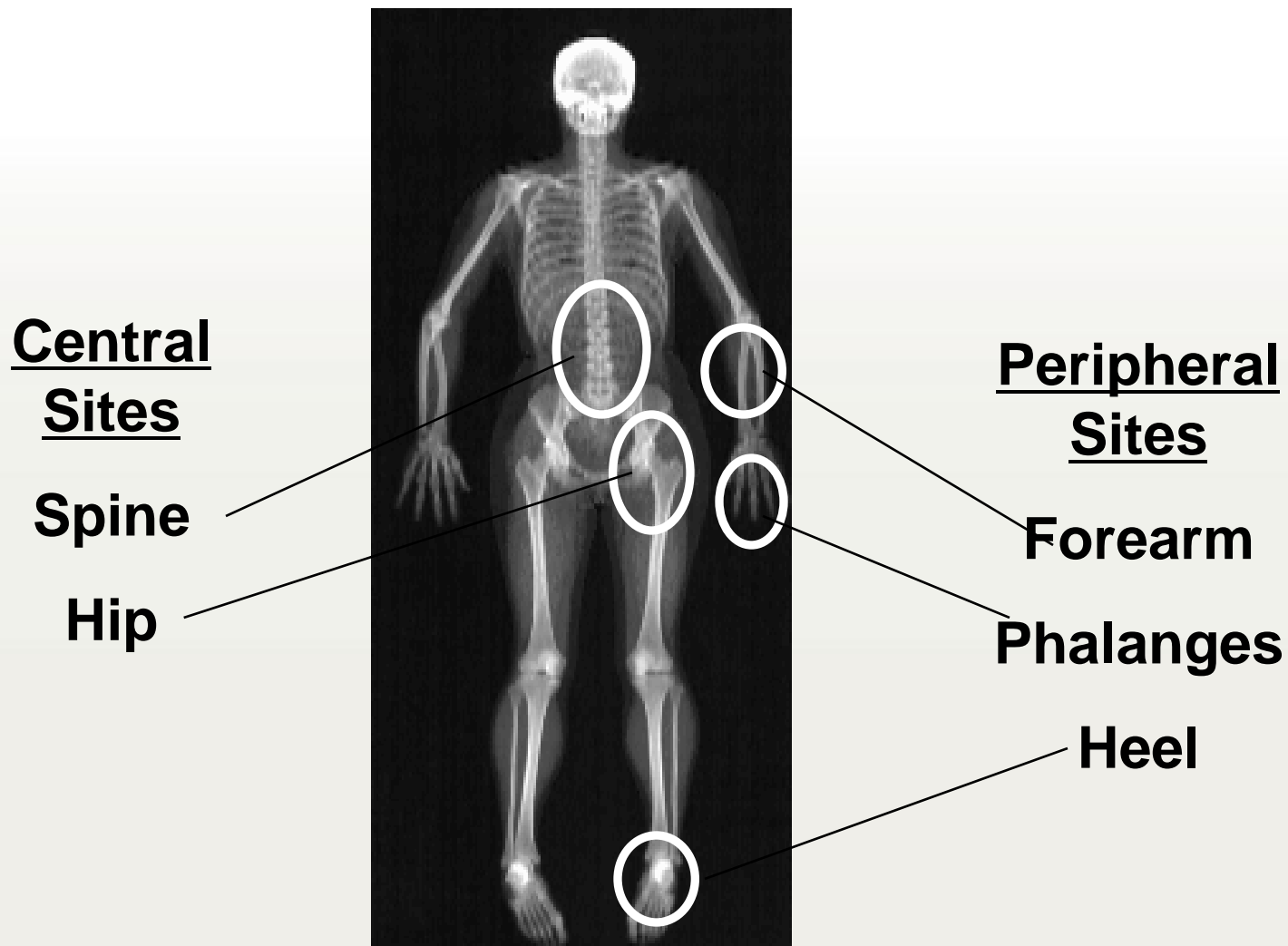
- Teriparatide (Forteo™ Lilly)
 - Injectable pen that requires refrigeration
 - Synthetic parathyroid hormone
 - Yearly treatment (10K / year)
 - Stimulates bone growth
- Calcitonin™ (Sandoz)
 - Well tolerated
 - Low turnover only





Osteoporosis Assessment Technology Overview

Central vs. Peripheral Measurements



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

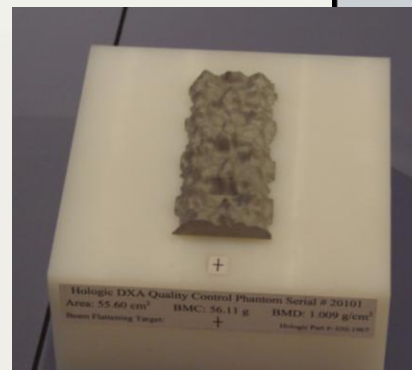
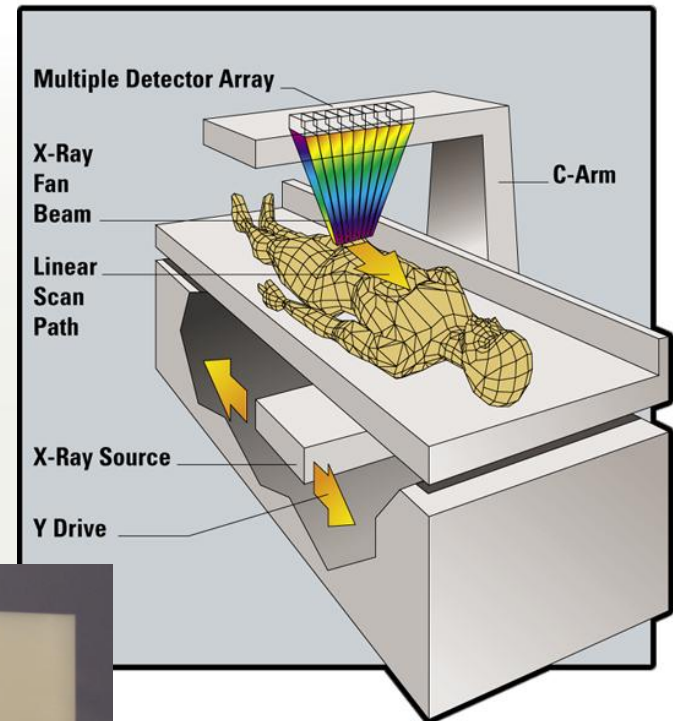


Hologic DXA: True Linear Fan-beam Scanning

One Pass Technology

- Single sweep scanning
- CT based acquisition geometry
- Digital image processing for all scan modes
- Continuous calibration
- Anthropomorphic spine phantom

FAN BEAM Multiple Detectors



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.

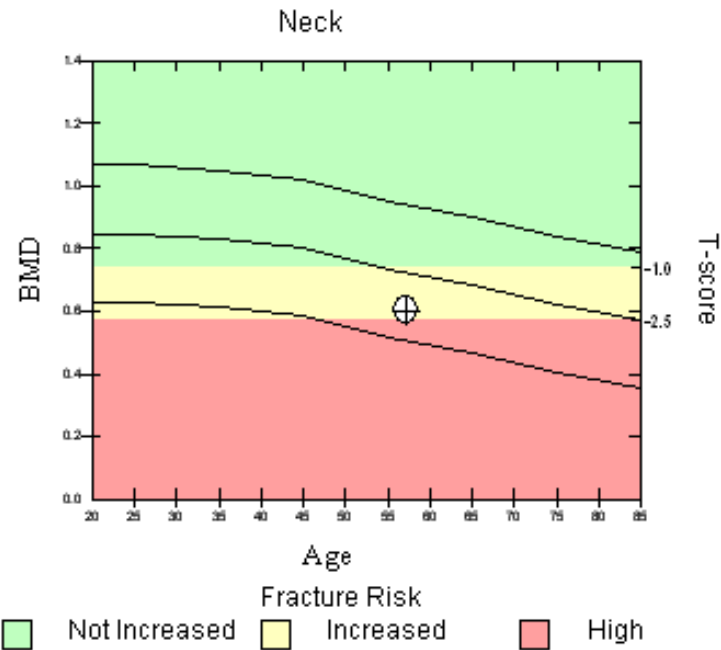
T-score	Classification
$T < -1.0 \text{ SD}$	Normal
$-1.0 \text{ SD} < T < -2.5 \text{ SD}$	Osteopenic
$T < -2.5 \text{ SD}$	Osteoporotic

For every SD of decline, fracture risk increases 2-3x!

—World Health Organization (W.H.O.)

BMD Test Results

- BMD=g/cm² 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



T-score vs. White Female; Z-score vs. White Female. Source: NHANES

Hologic DXA: Femur Report

Name: Discovery Demo	Sex: Female	Height: 63.0 in
Patient ID:	Ethnicity: White	Weight: 130.0 lb
DOB: July 04, 1946	Menopause Age: 42	Age: 60

Referring Physician: Hologic



Image not for diagnostic use
 kV=112.8, dF=2.6
 52 x 52
 Neck: 48 x 18
 Total: 96 mm

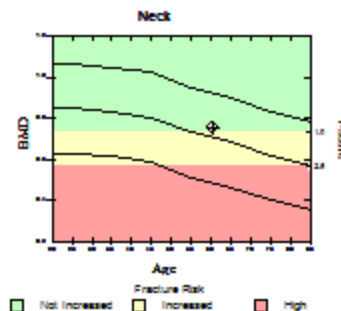
Scan Information:

Scan Date: January 02, 2007 ID: A01020701
 Scan Type: n Left Hip
 Analysis: January 02, 2007 12:24 Version 12.6.1.3
 Left Hip
 Operator: mab
 Model: QDR Workstation (S/N 80000)
 Comment:

DXA Results Summary:

Region	Area (cm ²)	BMC (g)	BMD (g/cm ³)	T-score	Z-score
Neck	4.68	3.53	0.754	-0.9	0.4
Total	20.06	25.24	0.968	-0.6	0.4

Tax BMD CV 10%, ACP=1.02, SGP=1.00, TR=2.125
 WHO Classification: Normal
 Fracture Risk: Not Increased



T-score vs. White Female; Z-score vs. White Female. Source: BMDS/NHANES

Physician's Comment:

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Hologic DXA: AP Spine Report

Name: Discovery Demo Sex: Female Height: 63.0 in
 Patient ID: Ethnicity: White Weight: 130.0 lb
 DOB: July 04, 1946 Menopausal Age: 42 Age: 61

Referring Physician: Hologic



Image not for diagnostic use
 k=1.01, d0=0.0
 116x169

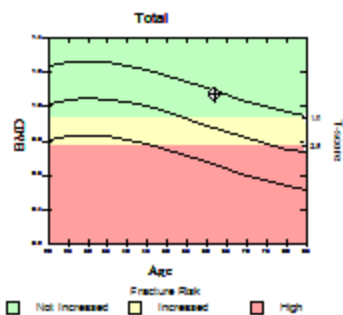
Scan Information:

Scan Date: June 13, 2008 ID: A06130801
 Scan Type: x Lumbar Spine
 Analysis: June 13, 2008 14:44 Version 12.7.3.3
 Lumbar Spine
 Operator:
 Model: QDR Workstation (S/N 12345)
 Comment:

DXA Results Summary:

Region	Area (cm ²)	BMC (g)	BMD (g/cm ³)	T-score	Z-score
L1	14.78	14.33	0.970	0.4	1.6
L2	15.66	16.29	1.040	0.1	1.6
L3	17.42	19.74	1.133	0.4	2.0
L4	19.21	21.32	1.110	-0.1	1.6
Total	67.07	71.68	1.069	0.2	1.7

raw BMD CV: 1.0%, ACF = 1.00, RCF = 1.00, TR = 3.615
 WHO Classification: Normal
 Fracture Risk: Not Increased



T-scores vs. White Female; Z-scores vs. White Female. Source: BMDS Hologic

Physician's Comment:

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HOLOGIC



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

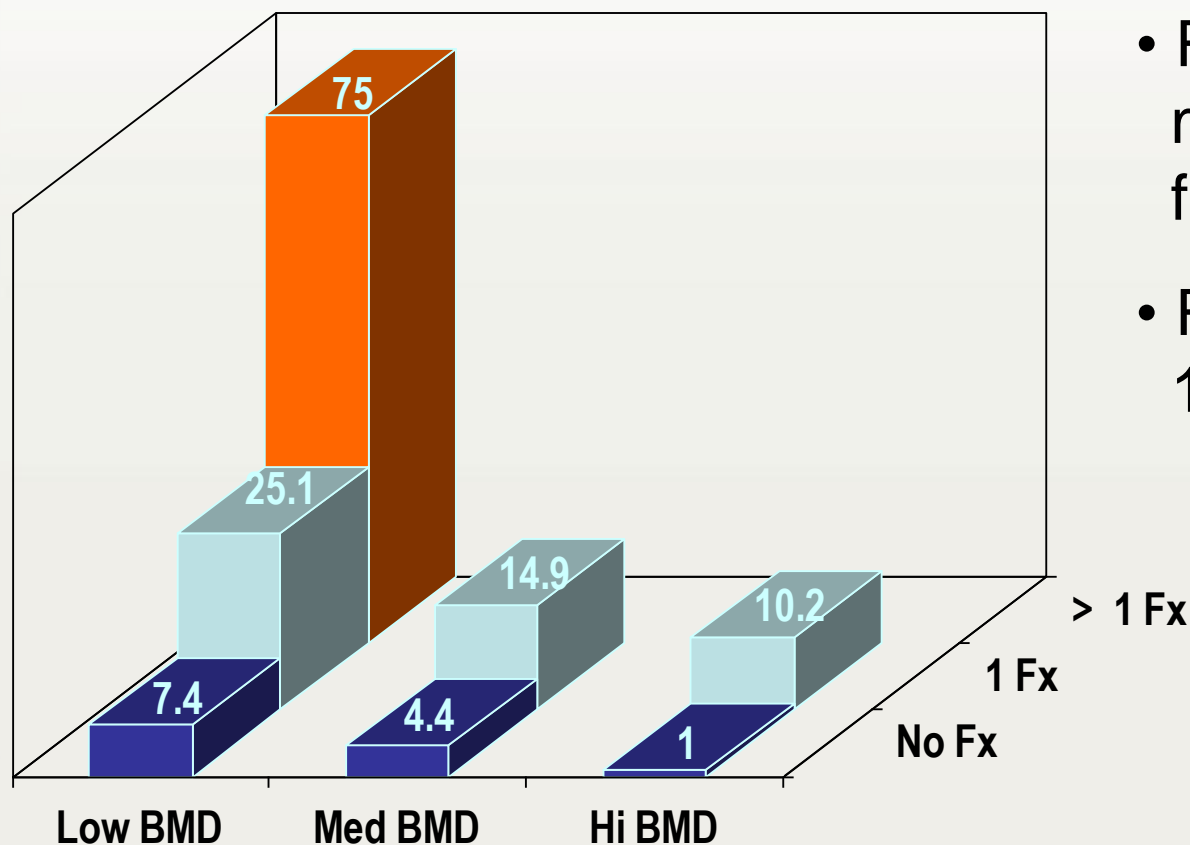
Industry Momentum

- 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

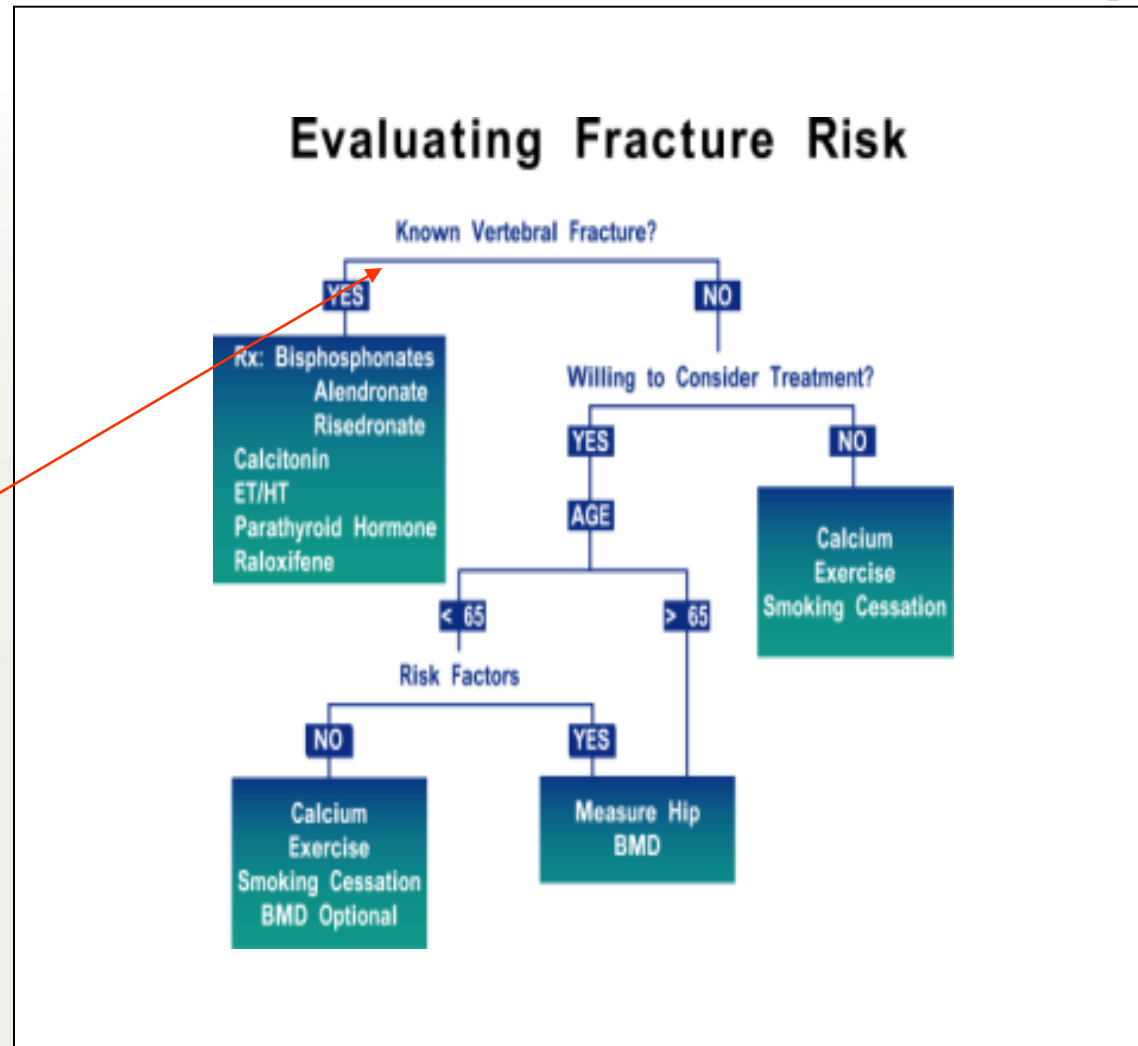


- Risk increases 75x with multiple vertebral fractures and low BMD
- Risk increases 25x with 1 vertebral fracture and low BMD

National Osteoporosis Foundation Guidelines for Patient Evaluation (1999)

**Vertebral
Fracture:**

**The key factor
in patient
evaluation**

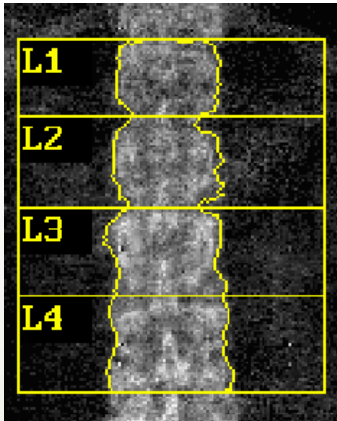


IVA Opportunity

Clinical Importance is Accepted

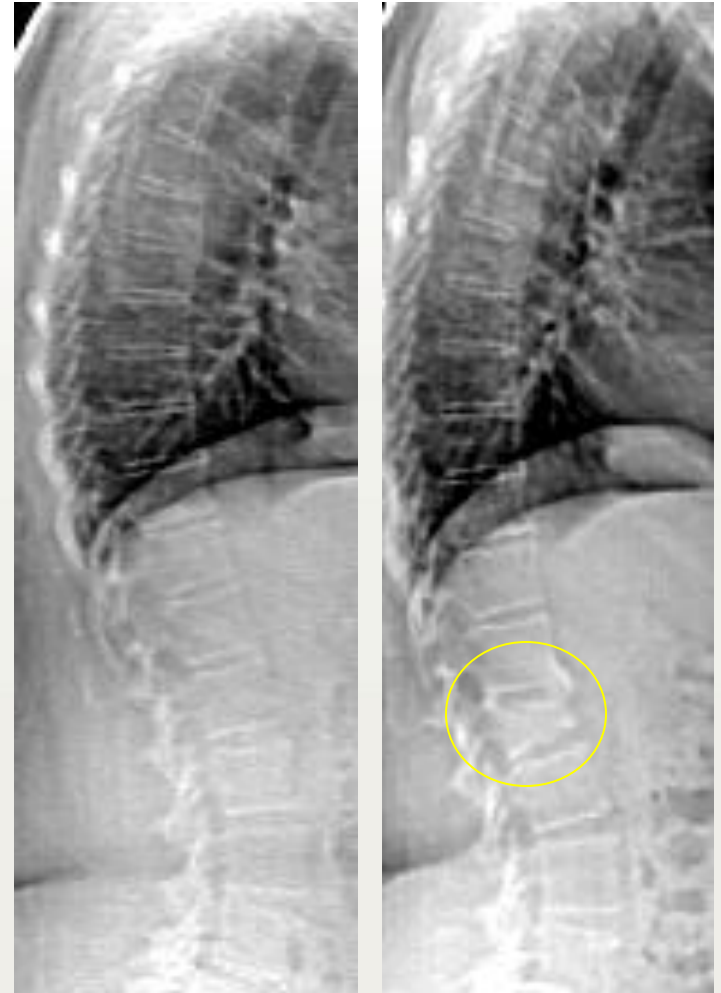
- **Prevalence:** 20 - 25% of postmenopausal women have fractures
- **Mis-classification:** 30% of women needing treatment are missed without IVA
- **High Re-fracture Rate:** 20% will re-fracture within one year
- **Effective Therapies Exist:** Treatment reduces fracture risk in these women by 50% in 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



70 year-old female

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



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

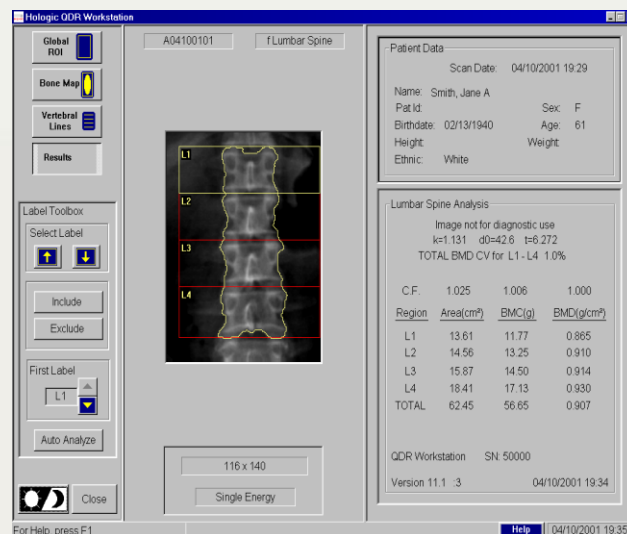
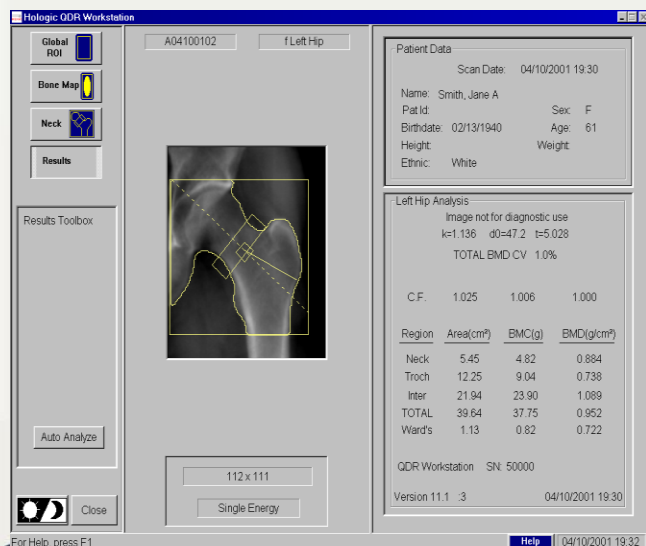
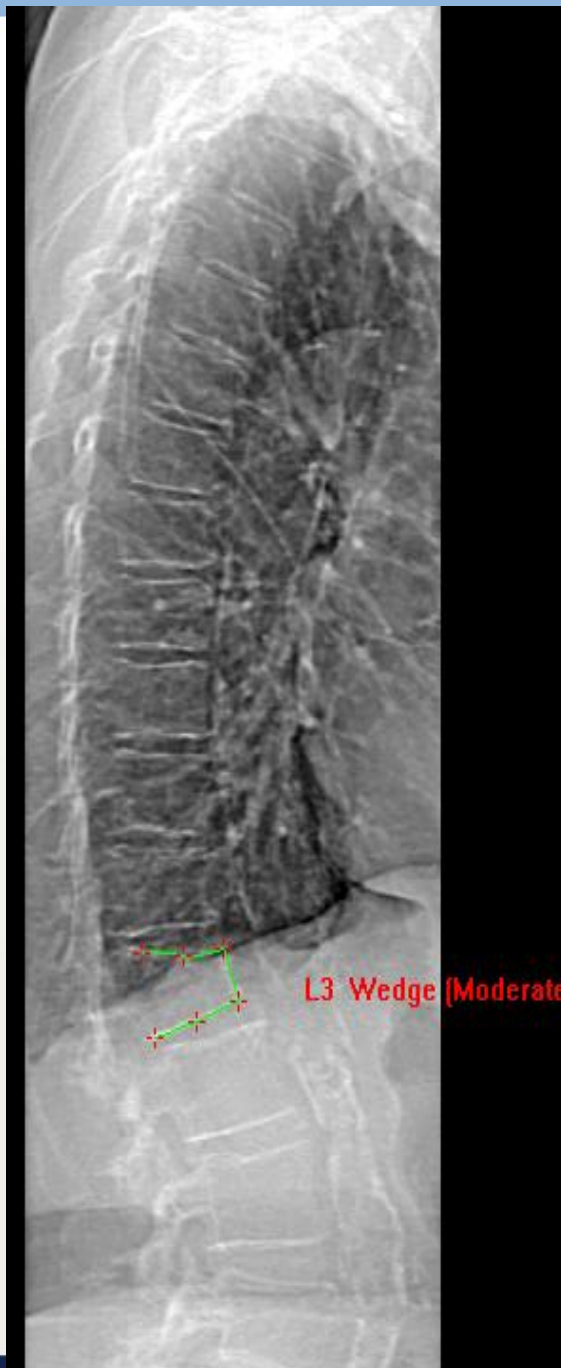




Instant Vertebral Assessment and Abdominal Aortic Calcifications

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

Osteoporos Int
DOI 10.1007/s00198-006-0255-2

ORIGINAL ARTICLE

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

Y. Z. Bagger • H. B. Rasmussen • P. Alexandersen •
T. Werge • C. Christiansen • L. B. Tankó •
PERF study group

Received: 18 August 2006 / Accepted: 9 October 2006
© International Osteoporosis Foundation and National Osteoporosis Foundation 2006

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.

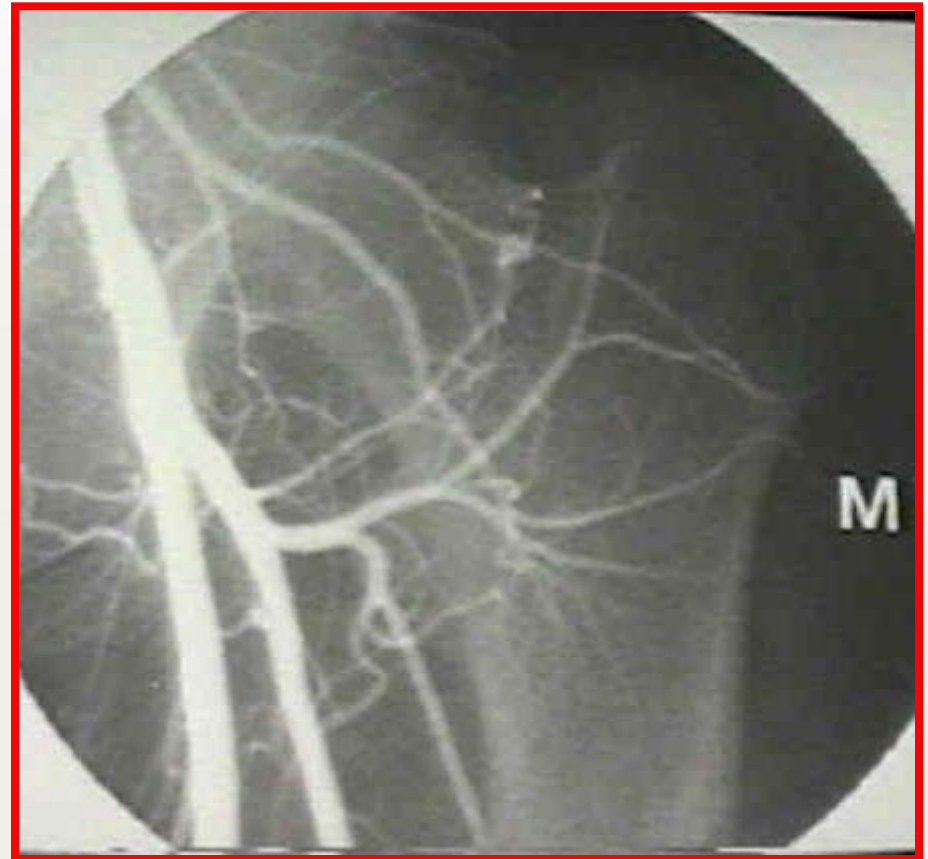
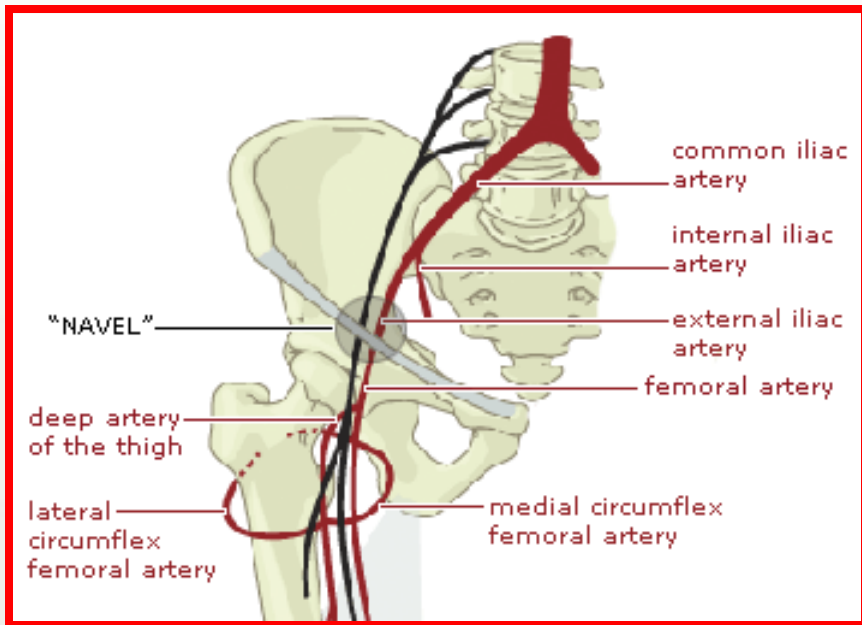
Methods This was an observational study including 1176

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.

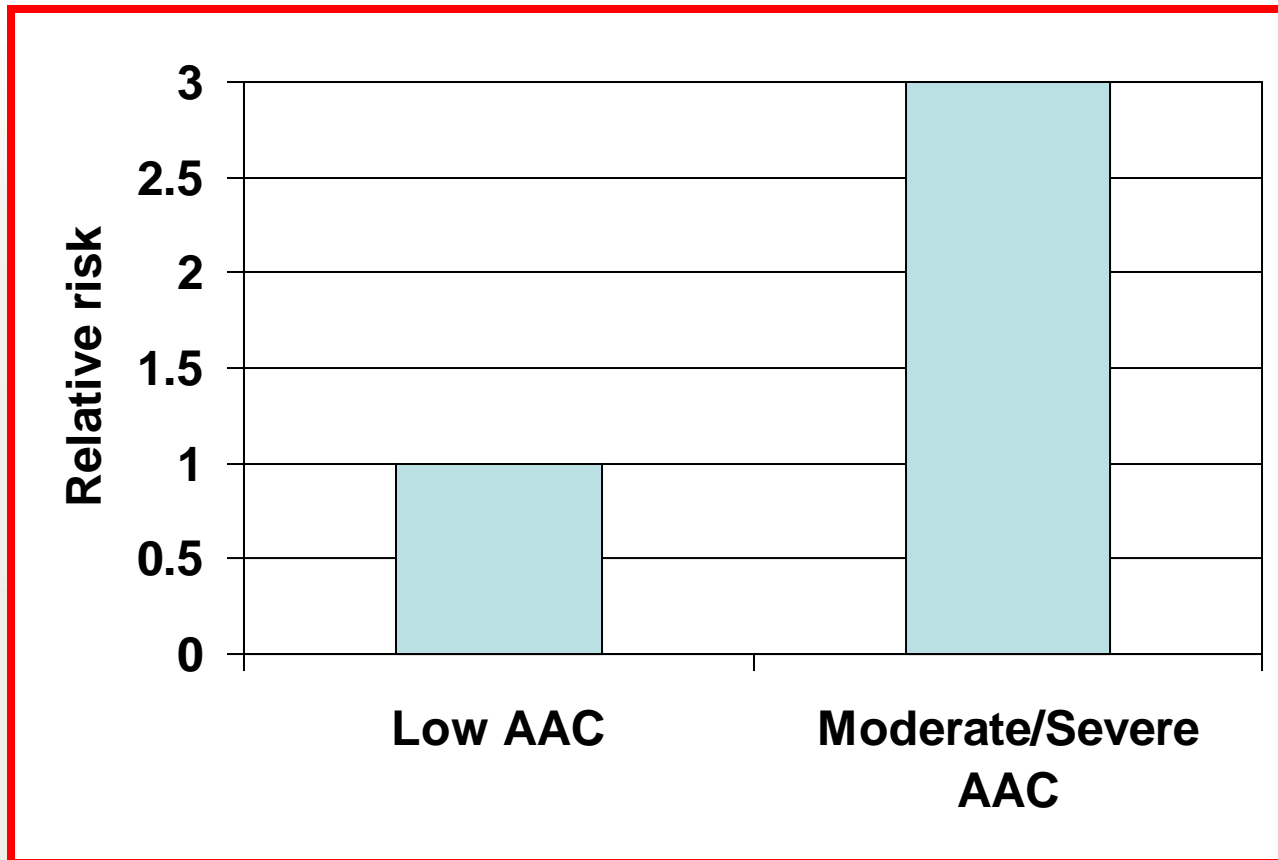
Conclusion The contribution of serum lipids to the modulators of BMD does not seem to be direct but rather indirect via promotion of atherosclerosis, which in turn can affect

Abdominal Aortic Calcification

New Links to Fracture Risk



Moderate/Severe AAC 3X Risk for Hip Fracture



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)



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Osteoporosis Can Be Prevented!

