



# **BONE DENSITOMETRY & OSTEOPOROSIS**

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# OSTEOPOROSIS

- ★ **Definition(NIH):**  
“A skeletal disorder characterized by compromised bone strength predisposing to an increased risk of fracture. Bone strength reflects the integration of two main features: bone density and bone quality.”



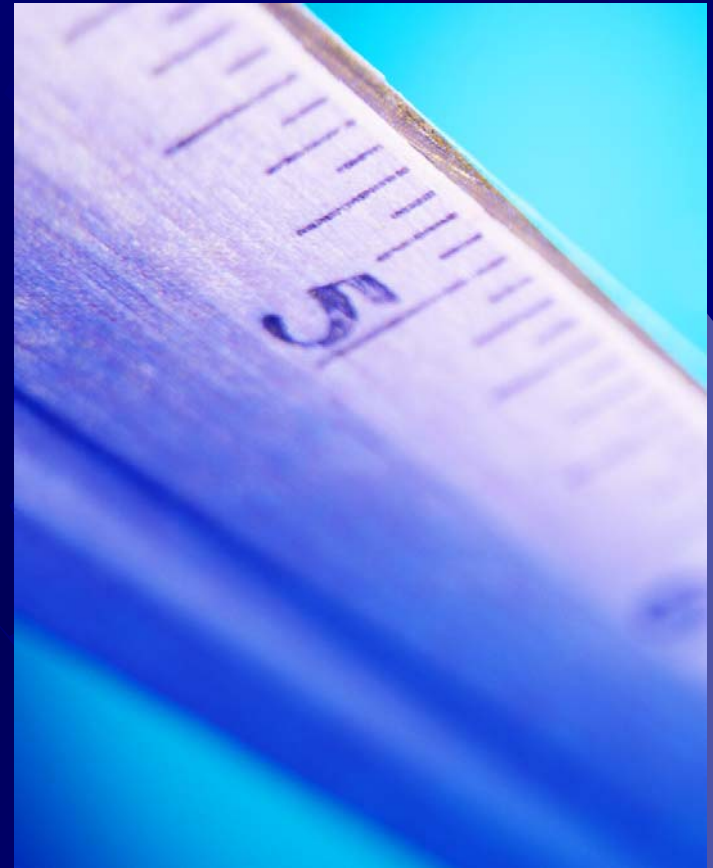
# OSTEOPOROSIS

- ★ **The “Get Real”  
definition (Dr. Phil):  
Weakened, brittle  
bones.**



# BONE DENSITOMETRY

- ✱ A method for measuring bone density.
- ✱ Reported in grams per centimeter squared.



# WAYS OF MEASURING BONE DENSITY

- ✱ **DEXA**
- ✱ **Quantitative CT**
- ✱ **Quantitative US**
- ✱ **Single X-ray absorptiometry**

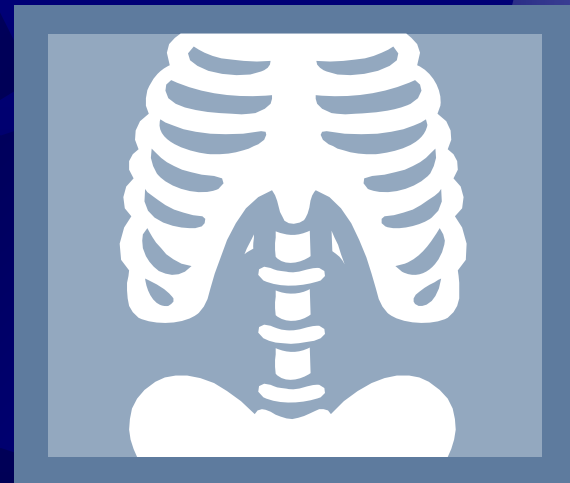
# DEXA

- ★ **Central DEXA**

- **Spine and hip**

- ★ **Peripheral DEXA**

- **Other sites, such as wrist**



# WHO CLASSIFICATION

- ✱ **Osteoporosis:** T-score of  $-2.5$  or less.
- ✱ **Osteopenia:** T-score between  $-1.0$  &  $-2.5$ .
- ✱ **Normal equals** T-score at or above  $-1.0$ .

# PEAK BONE MASS

- ✱ Occurs when growth of bone and mineralization of bone have stabilized.
- ✱ Different skeletal sites reach maturity at different times.
- ✱ Spine: 21-27 y.o.
- ✱ Hip: 19-25 y.o.



# Bone Mineral Density Test

- ✦ Can detect osteoporosis before a fracture occurs
- ✦ Can help predict risk of future fracture
- ✦ Determine rate of bone loss &/or monitor effects of treatment

# CENTRAL DEXA

- ✦ Preferred method for measuring bone density clinically.
- ✦ (ISCD) Routine measurements are AP L-spine and one of hips.



# DETERMINANTS OF PEAK BONE MASS

- ✱ **Hereditary factors (70%)**

- **Sex**

- **Ethnicity**

- ✱ **Lifestyle factors (30%)**

- **Calcium intake**

- **Vitamin D intake**

- **Exercise**

- **Smoking**

- **Others**

# BONE LOSS

- ✱ Occurs when resorption is greater than formation.
- ✱ Occurs with advancing age.
- ✱ Women reach lower peak bone mass than men and lose more bone than men.
- ✱ There is loss of bone quantity and microarchitectural deterioration.
- ✱ Asymptomatic unless a fracture occurs.

# PREVALENCE OF BONY DEMINERALIZATION

- ✦ **Increases with increasing age in men and women.**
- ✦ **Prevalence higher in women than men (W 4x > M)**
- ✦ **Higher in Caucasians than African-Americans.**



# IN THE U.S.

- ★ **10 million people have osteoporosis (T-scores less than -2.5).**
    - **8 million women and 2 M men.**
  - ★ **34 M people have osteopenia (T-score between -1.0 and -2.5).**
    - **22 M women and 12 M men.**
- (N.O.F., 2002)**

# EPIDEMIOLOGY OF OSTEOPOROTIC FRACTURES

- ✳ **Fracture incidence is bimodal:**
  - **Peak in youth (15-25 y.o.) and in the very elderly (85+ y.o.).**
  - **In young people, fractures of long bones predominate, often occur following substantial trauma, and the incidence is greater in young men than young women.**
  - **Above the age of 45, fracture incidence in women increases so that the rate in women become twice that of men.**

# EPIDEMIOLOGY OF OSTEOPOROTIC FRACTURES

- \* **Fracture incidence in the United States**
  - **More than 1.5 million osteoporotic fractures per year.**

This includes 700,000 spine fractures, 300,000 hip fractures, 250,000 wrist fractures, and 300,000 other fractures.
  - **1 in 2 women and 1 in 4 men over age 50 will have an osteoporotic fracture in her or his lifetime.**
  - **Ratio of women to men is about 2:1 (age-adjusted)**



# VERTEBRAL FRACTURE

- ✱ **Most common osteoporotic fracture.**
- ✱ **Falls account for 30%-60%.**
- ✱ **Reported prevalence and incidence vary due to different diagnostic methods and definitions of fracture.**



# HIP FRACTURE

- ✱ **Second most common osteoporotic fracture.**
- ✱ **Most are caused by fall from standing height.**
  - **Only about 5% are “spontaneous”.**
  - **Only 1% of falls lead to hip fracture.**



# CONSEQUENCES OF HIP FRACTURES

- ✱ **24% excess mortality within 1 year.**
- ✱ **Nearly 65,000 American women die from complications of hip fracture each year.**
- ✱ **50% of hip fracture survivors are permanently incapacitated.**
- ✱ **20% of hip fracture survivors require long-term nursing home care.**

# MORTALITY

- ✱ **Hip fractures are associated with excess mortality of 10-20%.**
  - **Increases as the age at which the fracture occurs increases.**
  - **Increases as the number of co-morbid conditions increases.**
  - **Higher in men than in women.**
- ✱ **Vertebral fractures are associated with excess mortality of 1-4%.**

# **DISTAL FOREARM FRACTURES**

- \* Third most common osteoporotic fracture.**
- \* Most caused by fall on outstretched hand.**
- \* No excess mortality.**
- \* Morbidity difficult to ascertain.**
- \* Reflex sympathetic dystrophy is a common complication.**

# ECONOMIC COSTS OF OSTEOPOROSIS

## ★ Cost of osteoporosis in the United States:

- Direct costs of osteoporosis are \$13.8 billion per year. These estimates are from 1995 and include hospitalization, rehabilitation, and nursing home care.
- Indirect cost due to loss of productivity and wages is difficult to measure but is likely to be substantial.

## ★ Economic cost of fractures in the United States:

- All fractures: \$35-41 billion per year
- Osteoporotic fractures: \$10-15 billion per year
- Hip fractures: \$4-6 billion per year
- Hip fracture cost per case: \$26-37 thousand

# OSTEOPOROSIS COMPARED WITH OTHER CHRONIC DISEASES

- ★ The prevalence of common chronic diseases in the United States:
  - Osteopenia & osteoporosis 44 million
  - Hypercholesterolemia 54 million
  - Hypertension 30-54 million
  - Diabetes 21 million

# Risk Factors - I

- ✦ Personal history of fracture after age 50
- ✦ Current low bone mass
- ✦ History of fracture in first degree relative
- ✦ Being female
- ✦ Being thin or having a small frame



# Risk Factors - II

- ✱ Advanced age
- ✱ Family history of osteoporosis
- ✱ Estrogen deficiency (postmenopausal or S/P hysterectomy and oophorectomy)
- ✱ Amenorrhea
- ✱ Anorexia nervosa

# Risk Factors - III

- ✱ Vitamin D deficiency
- ✱ Low calcium intake
- ✱ Low testosterone
- ✱ Cigarette smoking
- ✱ Other causes...

# VITAMIN D

- ✦ **Essential for increasing efficiency of intestinal calcium absorption.**
- ✦ **With vitamin D, 30-80% of calcium can be absorbed from the diet.**



# SERM (Selective Estrogen Receptor Modulator)

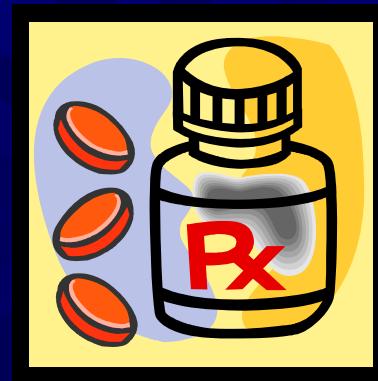
- ✱ Maintains bone mass and decreases fracture risk in estrogen deficient women.
- ✱ Estrogen-like effect on bone, i.e. maintains bone mineral density.
- ✱ E.g., raloxifene (Evista)

# BISPHOSPHONATES

- ✱ Proven to decrease bone resorption (osteoclastic activity) allowing osteoblasts to lay down new bone and resulting in an increase in bone mineral density. The net effect is to markedly reduce fracture risk of hip, spine and wrist.
- ✱ Useful in prevention and treatment of steroid-induced bone loss and osteoporosis.
- ✱ First line drug therapy.

# FOSAMAX (Alendronate)

- ✦ Type of bisphosphonate.
- ✦ Can expect on average a 1 to 2% increase in BMD in hip and 2 to 3% increase in BMD in L-S spine each year.
- ✦ Duration of treatment; effective for at least 7 years.



# ACTONEL (Risedronate)

- ✱ A bisphosphonate.
- ✱ Can expect 1-2% and 1-3% increase in bone mineral density of hip and L-spine respectively.
- ✱ Therapeutically effective for at least 5 years.



# PARATHYROID HORMONE

- ✱ Regulates calcium homeostasis.
- ✱ Increases osteoclastic activity (increases serum calcium).
- ✱ Increases renal recovery of calcium.
- ✱ Stimulates vitamin D production by kidneys. (Vitamin D improves intestinal calcium absorption.)





# PTH (1-34)

- ✱ **There are PTH receptors on osteoblasts.**
- ✱ **The PTH receptor agonist (PTH 1-34) stimulates osteoblasts.**
- ✱ **Increases bone density in both spine and hip.**
- ✱ **Approved for treatment of osteoporosis in men**


# FORTEO

- ✱ **PTH 1-34.**
- ✱ **Improves bone density in spine and hip.**
- ✱ **Decreases risk of spine fractures by 65-70%.**
- ✱ **Second line therapy.**

# KEEP YOUR BONES HEALTHY

- ✦ Do resistance or weight-bearing exercise.
- ✦ Get adequate vitamin D and calcium.
- ✦ Don't smoke.
- ✦ Limit alcohol consumption.





☀ Learn more about osteoporosis from the  
National Osteoporosis Foundation  
website:

**[www.nof.org](http://www.nof.org)**