

Osteoporosis

MAJ David Boyd

CPT Jeff Negard

CPT Anne Sheahan

Objectives

- Describe the pathophysiology of osteoporosis
- List the anatomic and physiologic changes that occur
- Explain the complications and risk factors
- Identify diagnostic criteria
- Identify the treatment modalities
- Understand military implications for military members

What is Osteoporosis

- A systemic skeletal disorder characterized by low bone mass and microarchitectural deterioration of bone tissue, with a consequent increase in fragility of bone and susceptibility to risk of fracture – Nathan, 2013
- Spinal or hip bone mineral density (BMD) of 2.5 SD or more below the mean for healthy, young women (T-score of -2.5 or below) as measured by dual energy x-ray absorptiometry –World Health Organization, 2004

Or more simply...

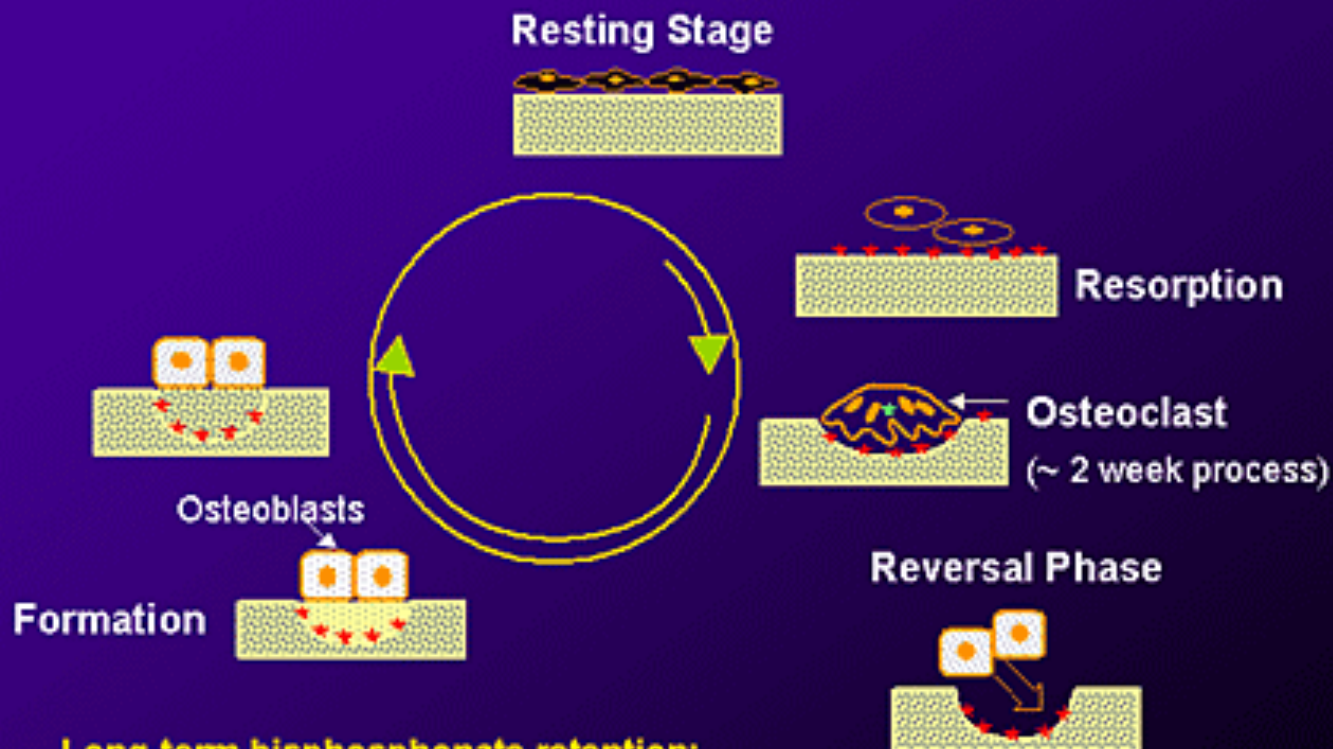
- It is bone that is normal in composition, but reduced in amount.

Some facts...

- It is the most common metabolic bone disease and more than 10 million Americans are affected
- The most common fx's are at the distal radius, in the vertebrae, and in the hip
- Peak bone mass is accomplished at ~25yoa
- Bone loss is accelerated in women after cessation of ovarian function and women can lose up to 20% of their bone mass in the 5-7 years after menopause.
- It is most severe in women who have had early oophorectomy or premature ovarian failure

Physiology

Bone Remodeling Process



**Long-term bisphosphonate retention:
25% to 65% of initial bone uptake**

Physiology

Bone Formation

- Occurs when osteoblasts lay down osteoid, an organic matrix composed of type 1 collagen and other proteins.
- It is a slow process, occurring over several months

Bone Resorption

- Releases calcium into the circulation by the removal of damaged or old bone by osteoclasts, which are cells derived from macrophages and monocytes.
- Is a rapid process and occurs on a matter of days to weeks

Physiology

- Bone serves as a large calcium reservoir and normal bone remodeling allows for access to the body of that reservoir for:
 - proper neural, MSK, and cardiac function
 - replacement or repair of old and damaged bone

Pathophysiology

- Normally, bone resorption and formation proceed as equal rates.
- In osteoporosis, the rate of bone resorption exceeds that of bone formation, producing a net loss of bone.
- This uncoupling of bone resorption and bone formation occurs in all people with aging, but occurs earlier in women as consequence of estrogen deficiency and is most pronounced in the first 5-10 years after menopause.

Risk Factors

Modifiable

- Smoking
- Excessive ETOH or caffeine
- Low calcium intake
- Low body weight (<127lbs)
- Decreased physical activity
- Glucocorticoid use
- Recurrent falls

Non-modifiable

- Poor diet / malnutrition
- Advanced age
- Female gender
- White or Asian
- Personal hx of fracture
- Hx of fracture in 1st degree relative
- Dementia
- RA
- Endocrine disorders
- GI disorders

Differential Diagnosis

- Leukemia
- Lymphoma
- Metastases
- Pathologic fractures secondary to cancer
- Hyperparathyroidism
- Mastocytosis
- Multiple Myeloma
- Osteomalacia and Renal Osteodystrophy
- Paget Disease
- Scurvy
- Sickle Cell Anemia

Signs/Symptoms

(Osteoporosis not clinically apparent until fracture occurs)

- Decrease in height (2-3 cm each vertebral fx)
- Acute pain following fall or minor trauma
- Pain localized mid-thoracic to lower thoracic or upper lumbar spine (may radiate to abdomen)
- Paravertebral spasms
- Progressive kyphosis-curve of spine
- Pain with ambulation (hip fx)
- 2/3 vertebral fx painless
- Receding gums (need panoramic x-ray)
- Decreased grip strength (physical test factor BMD)

Diagnosis

- Medical history
- Physical Examination
- Bone Mineral Density / DEXA Scan
- FRAX- the WHO Fracture Risk Assessment Tool
- Laboratory tests
- Other tests
 - Biochemical marker tests
 - Nuclear bone scans, CT scans, or MRIs

Dual-energy x-ray absorptiometry (DXA or DEXA)

- Used to determine the bone mineral density (BMD)
- Should be performed on all patients who are at risk for osteoporosis or osteomalacia or have pathologic fractures or radiographic evidence of diminished bone density.
- A single screen is recommended within 2yrs of menopause and a follow-up 2-5yrs later to determine both absolute bone density and rate of loss

Dual-energy x-ray absorptiometry (DXA or DEXA)

- BMD is measured at the spine or hip and results are reported using T and Z scores.
- The T-score is the number of standard deviations (SD) above or below the mean bone mineral density for sex-matched young normal controls.
 - T score ≥ -1.0 : Normal
 - T score -1.0 to -2.5 : Osteopenia (low bone density)
 - T score < -2.5 : Osteoporosis
 - T score < -2.5 with a fracture: Severe osteoporosis

Dual-energy x-ray absorptiometry (DXA or DEXA)

- Somewhat arbitrary and there really is no BMD fracture threshold.
- Fr risk increases two-fold for each SD drop in BMD.
- Surveillance recommended for postmenopausal women with a frequency according to their T-scores:
 - For T-scores: -1.0 to -1.5 (every 5 yrs); -1.5 to -2.0 (every 2-5yrs); for scores under -2.0 (every 1-2yrs).
- Z-score: used to express bone density in premenopausal women, younger men, and children.

National Osteoporosis Foundation Guidelines for using BMD

- 1) All postmenopausal pts younger than age 65 who have ≥ 1 additional risk factors for osteoporosis (other than being white, postmenopausal, and female)
- 2) All women age 65 and older regardless of additional risk factors
- 3) Postmenopausal women who present with fractures
- 4) Women considering therapy for osteoporosis if testing would facilitate that decision
- 5) Women who have been on hormone replacement therapy for prolonged periods
- 6) Women who have been on treatment to monitor the treatment effect
- 7) Women considering discontinuation of treatment


FRAX- the WHO Fracture Risk Assessment Tool

FRAX[®] WHO Fracture Risk Assessment Tool

Home Calculation Tool Paper Charts FAQ References English

Welcome to FRAX[®]

The FRAX[®] tool has been developed by WHO to evaluate fracture risk of patients. It is based on individual patient models that integrate the risks associated with clinical risk factors as well as bone mineral density (BMD) at the femoral neck.




Dr. John A Kanis
Professor Emeritus,
University of
Sheffield


The FRAX[®] models have been developed from studying population-based cohorts from Europe, North America, Asia and Australia. In their most sophisticated form, the FRAX[®] tool is computer-driven and is available on this site. Several simplified paper versions, based on the number of risk factors are also available, and can be downloaded for office use.

The FRAX[®] algorithms give the 10-year probability of fracture. The output is a 10-year probability of hip fracture and the 10-year probability of a major osteoporotic fracture (clinical spine, forearm, hip or shoulder fracture).


FRAX Desktop Application


Click here to view the applications available 


Web Version 3.8


View Release Notes 

Links


www.iofbonehealth.org 

www.nof.org 

www.jpof.or.jp 

www.esceo.org 

FRAX available as iPhone App


View in iTunes 

8546646
Individuals with fracture risk assessed since 1st June 2011

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Lab/Diagnostic Test

Primary test for FNPs:

- CBC (r/o anemia or alcoholism)
- Serum Chemistry (usually nml in osteoporosis)
- Serum calcium (r/o parathyroid, kidney, pancreas problem)
- Phosphate (bal. w/ Ca for bone density)
- LFTs (elevation may indicate alcoholism)
- Alkaline phosphatase (metabolic bone Dz assess. & severity)
- Vitamin D (deficiency predisposes to osteoporosis; r/o osteomalacia)
- Creatinine clearance(r/o renal Dz)
- Magnesium (contributes to structural bone development)
- TSH (thyroid dysfunction assoc. w/ osteoporosis)
- Serum iron and ferritin levels (r/o malabsorption or hemochromatosis (Fe overload) is suspected)

Lab/Diagnostic Test cont...

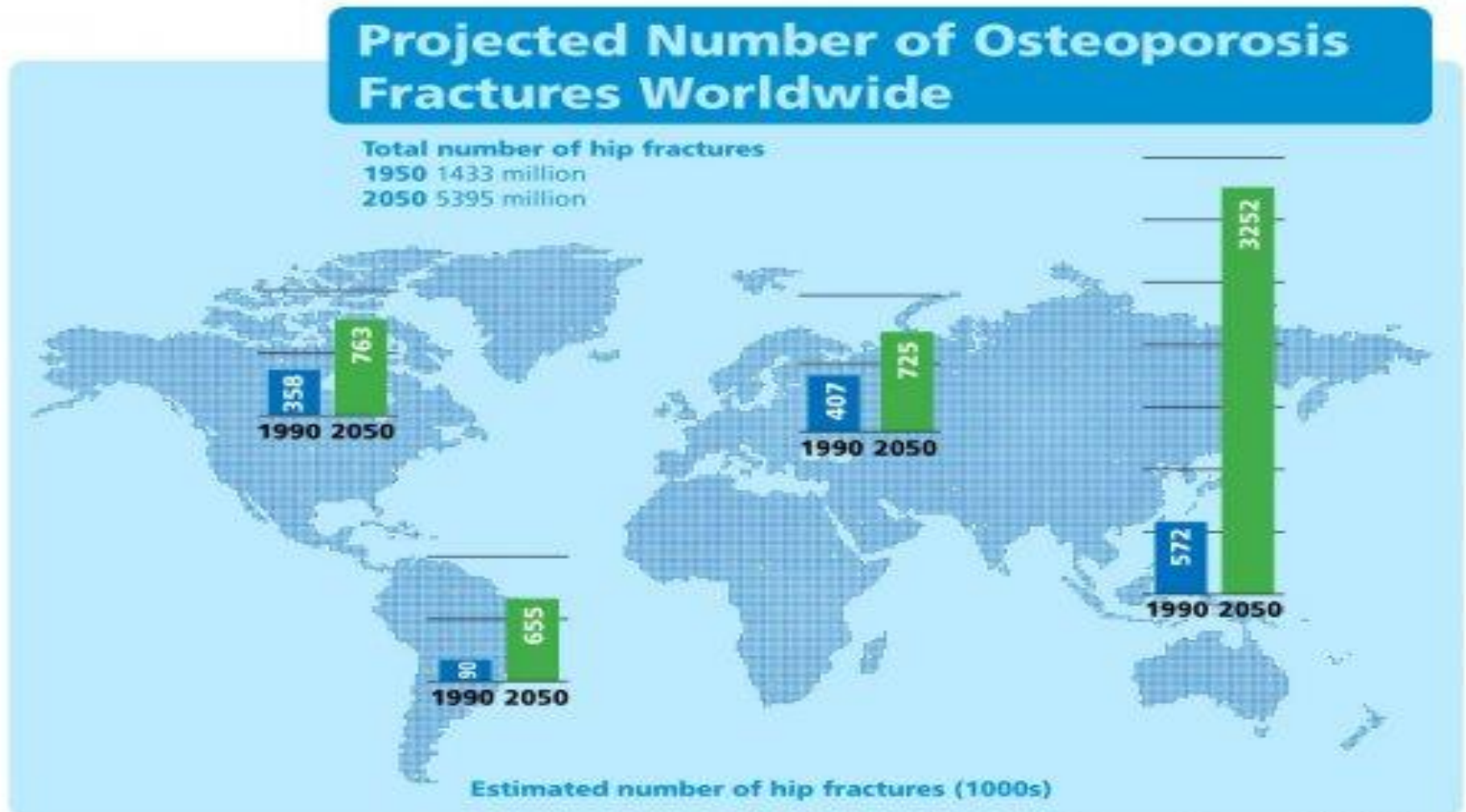
Secondary test (Consult with Specialist)

- Endocrinologists
- Rheumatologists
- Family doctors
- Geriatricians
- Gynecologists
- Internists
- Orthopaedic surgeons
- Psychiatrists

Osteoporosis Epidemiology

- 200 million people worldwide suffer disease
 - 1 in 2 women and 1 in 5 men > 50 yoa
 - Approx. 30% postmenopausal women in U.S. and Europe
 - 40% of these women and 15-30% of men will suffer fragility fractures
- Vertebral fractures
 - Rarely reported by physicians and undiagnosed most of time
 - < 10% result in hospitalization
 - Frequently in mid-thoracic or thoracolumbar regions of spine
- Hip fractures
 - Annual incidence approx 1.7 million worldwide
 - 10-20% higher mortality than expected for age
 - 90% hip fx occur in persons > 50 yo
 - Aging men > risk hip fx than spinal fx compared to women
- Distal forearm (wrist) fractures
 - Occur women > 65 yo (increase white women 45-60 yo observed)
 - 15 % men and rate does not increase with age , indicate bone fragility

2050 hip fracture incidence projected to increase 240% in women and 310% in men.



Adapted from C. Cooper et al, Osteoporos Int 1992; 2:285-9

Pharmacological Treatment

- Medications
 - Bisphosphonates
 - Fosamax 5-70mg PO QWEEK
 - Hormone
 - Calcitonin 100 unit QD IM/SC/NASAL
 - Monoclonal antibody
 - Denosumab 60mg SC Q 6months
 - Estrogen agonist/Estrogen Receptor modulator
 - Raloxifene 60mg PO QD
- Hormone Replacement Therapy
 - Premenopausal patients
 - Postmenopausal (Controversial)
 - Male patients over 60
 - Estrogen
 - Testosterone
 - Growth Hormone

Non-pharmacologic Treatment

- Life Style Modification
 - Stop smoking
 - Exercise
 - Decrease ETOH intake
 - Fall precautions (Elderly)
- Dietary Supplements
- Balanced diet
 - Calcium
 - Phosphorus
 - Magnesium
 - Vitamin D

Other Considerations

- Treatment of secondary causes or underlying disease processes
 - Hyperparathyroidism
 - Hyperthyroidism
 - Malabsorption disorders
 - Renal Disease
 - COPD
 - Space Flight
- Caution when the patient is prescribed:
 - Steroids (Prednisone)
 - Anticoagulants (Heparin)
 - Antiepileptics (phenytoin, Phenobarbital, Valproate)
 - Antipsychotics (Lithium)

Patient Education & Prevention

- Dietary Recommendations
 - Dairy products (yogurt, milk)
 - Green leafy vegetables
 - Calcium at least a 800-1000mg QD
 - Vitamin D 600-700 iu/QD
- Exercise
 - Weight Bearing and/or aerobic exercise for at least 30 min/QD
 - Maintain BMI between 18.5-24.5
- Lifestyle
 - Smoking cessation programs or products
 - ETOH, limit 2 beverages a day

Military Environment

- Equipment
 - Load bearing equipment and weight impact joint and skeletal structures
 - Mimic obesity consideration
- Dietary restrictions
 - Field rations
 - Lack of variety and fresh food products
 - Preparation and prepackaging food quality
 - Lack of supplements
- Austere environment
 - Lack of sleep
 - Stress
 - Fatigue
 - Dehydration
 - Injuries

Resources and Links

CDC sites

<http://www.cdc.gov/nccdphp/sgr/sgr.htm>

<http://www.cdc.gov/powerfulbones/>

<http://www.cdc.gov/powerfulbones/parents>

http://www.cdc.gov/nccdphp/dnpa/physical/growing_stronger

International Osteoporosis Foundation

www.iofbonehealth.org

IBMS BoneKEy®

www.bonekey-ibms.org

National Osteoporosis Foundation

www.nof.org

www.osteoporosis.ca

Best Bones Forever.

www.bestbonesforever.gov

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Questions?