

Musculoskeletal System
Metabolic Bone Disorders:
Osteoporosis, Osteomalacia, Paget's Disease

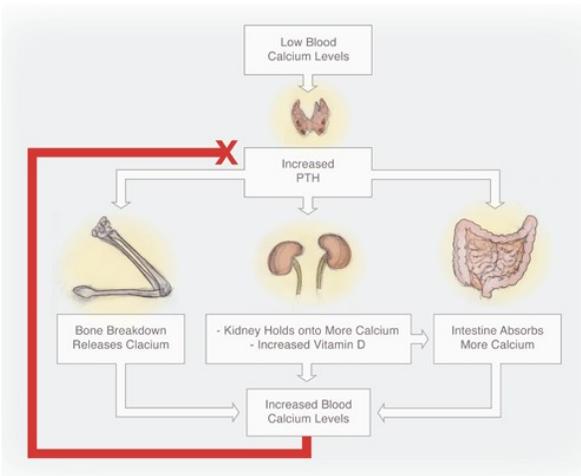
Osteoporosis

- Chronic, progressive metabolic bone disease characterized by
 - Porous bone
 - Low bone mass
 - Structural deterioration of bone tissue

All of this = bone fragility → risk for fractures

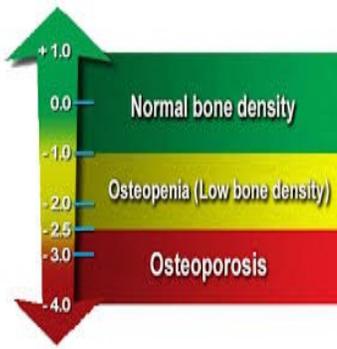
- More common in women than men for several reasons:
 - Lower calcium intake
 - Smaller frame → less bone mass
 - Bone reabsorption begins earlier and accelerates after menopause
 - Pregnancy and breastfeeding ↓ woman's skeletal reserve of calcium; unless intake is adequate
 - Longevity increases likelihood
- **Primary Osteoporosis:**
 - Idiopathic- unknown
 - Hormonal imbalance, faulty metabolism, or poor calcium intake
- **Secondary Osteoporosis:**
 - Caused by diseases & meds
 - Malnutrition, alcohol, rheumatoid arthritis, lactose intolerance, hyperthyroidism, hypogonadism
- **Risk Factors:**
 - Uncontrollable Risk Factors
 - Female gender – white or Asian ethnicity
 - Small frame
 - African American females have > bone mass than white females
 - Less fat and estrogen produced in smaller women
 - Fair complexion – vitamin D status
 - Family history of OP
 - ↑ Age
 - Oophorectomy or early menopause < 45 yrs
 - Immobile for a long period of time
 - Certain diseases – anything that affects intestinal absorption or urinary elimination of Ca⁺
 - Long-term use of corticosteroids
 - Low testosterone level in men
 - Controllable Risk Factors:
 - Excess alcohol intake - ↑ ca⁺ excretion and ↓ ca⁺ absorption
 - Cigarette Smoking - ↓ bone mass, early menopause, ↓ estrogen, ↓ ca⁺ absorption
 - Caffeine - ↑ ca⁺ excretion
 - Carbonated drinks – phosphoric acid
 - Sedentary lifestyle- exercise 3x/week
 - Insufficient Ca⁺ intake
- **Pathophysiology**
 - Bone is dynamic, constantly formed & reabsorbed
 - Bone reabsorption exceeds bone deposition
 - Minerals stored in cortical (compact) bone or trabecular bones; more loss of trabecular bone than compact
 - Youth - Ca⁺ is deposited quicker than loss

- Bone formation > reabsorption
- Bone growth = 10-20 yrs old
- Bone strength = 20-30 yrs old
- Peak bone mass = 30-35 yrs old
- After age 36 yrs, reabsorption > formation
- ↑ loss due to ↓ estrogen levels at menopause or post- oophorectomy
- Blood level of Ca⁺ regulated by parathyroid hormone
- ↓ serum Ca⁺ stimulates the synthesis & release of PTH
- Most commonly in: **spine, hips, & wrist**
- Interference with bone metabolism: medications (warfarin, cyclosporines, glucocorticoids)



- **Clinical Manifestations:**
 - “silent disease” because there are no symptoms
 - Later symptoms include:
 - Sudden strain
 - *Fractures – may be 1st symptom*
 - Pathological fractures = fracture easily under stress that would not normally break
 - **Vertebral fx most common site; hx of fx = risk factor for subsequent fxs**
 - Back pain
 - Loss of height – gradual
 - Spinal deformities – kyphosis
 - Protruding abdomen & breathing issues
- **Diagnostic Studies:**
 - H & P
 - Serum Ca⁺, phosphorus, alkaline phosphatase (elevated after fx), 24^h urine for Ca
 - Bone Mineral Density
 - Looks at peak bone mass and amount of bone loss; can be measured by either US or DXA
 - Quantitative US- sound waves to heel, patella, or tibia
 - Dual energy x-ray absorptiometry (DXA)
 - Trabecular & cortical bones: hip, forearm, & lumbar
 - Used to calculate total body Ca⁺ concentration

- T score – bone mineral density measurements compared with young adult reference population (-2.5 or less = osteoporosis)
- **Bone Mass (Value for BMD):**
- Normal: within 1 SD (+1 or -1) of mean.
- Low bone mass (osteopenia): between 1 and 2.5 SD below (-1 to -2.5 SD).
- OP: 2.5 SD or more below (-2.5 SD or lower).
- Severe: more than 2.5 SD below and there have been one or more osteoporotic fractures



- X-rays only show bone loss of 30% or more
- **Collaborative Care:**
 - Focus on proper nutrition, Ca⁺ supplements, exercise, prevention of fractures, & drugs
 - Prevention & treatment depend on adequate Ca⁺ intake 1000-1500 mg/day plus Vit. D (800 u – 1000 u)
 - Exercise
 - Quit smoking & ↓ ETOH intake
- **Nutritional Therapy:**
 - Pre-menopausal women need 1000mg/day of Ca⁺ (men 19-70yrs)
 - Post-menopausal women need 1200mg/day (men >71yrs)
 - Can take too much Ca⁺ = kidney stones
 - Need to slow bone loss in pts with OP
 - Dairy foods have the highest amount of Ca⁺
 - Good sources: milk & milk products, green leafy vegetables, seafood, orange juice, almonds
 - Poor sources: eggs, poultry
 - Supplemental Vitamin D
 - Necessary for Ca⁺ absorption
 - Need 800 IU
 - Ca⁺ supplements:
 - Check total # of elemental Ca⁺, not mg (1 TUM = 500 mg of Ca carbonate = 200 mg of elemental Ca)
 - Ca⁺ supplements → constipation & bloating
 - Take with a full glass of water to prevent kidney stones
- **Drug Therapy:**
 - **Estrogen replacement after menopause**
 - Estrogen decreases osteoclasts (destruct bones)
 - Not used for postmenopausal osteoporosis due to increased risk for breast cancer, CVA, DVT, & possibly heart disease (short-term)

– **Calcitonin (Fortical, Calcimar)**

- ↓ pain with fracture
- Blocks the effects of PTH on bone reabsorption, inhibits osteoclast activity
- ↓ bone loss
- IM, SC, intranasal
- Will need calcium supplementation to prevent secondary hyperparathyroidism

– **Bisphosphonates (etidronate/didronel, alendronate/fosamax, risedronate/actonel, ibandronate/boniva, zoledronic acid/reclast)**

– prevention and tx of OP

- Inhibit osteoclast activity – mediated bone reabsorption
- Intracellular uptake of med
- Interacts with food → empty stomach; remain sitting
- Take 1st thing in AM with full glass of water
- ulcers & GI side effects
- s/fx – anorexia, wt loss, gastritis; need dental check ups

Zoledronic Acid (Reclast)

- IV bisphosphonate - given once a year or every 2 to prevent OP
- RFP & Serum Ca⁺ prior to admin

– **Selective Estrogen Receptor Modulators (raloxifene /Evista)**

- Binds to estrogen receptor & stimulates estrogen
- Does not ↑ breast CA risk
- S/fx– blood clots, leg cramps, hot flashes

– **Parathyroid Hormone (teriparatide/Forteo)**

- Stops bone loss & helps bone growth (stimulates osteoblasts)
- Injectable (SC) - daily
- S/fx: leg cramps, dizziness

• **Treatment of Vertebral Compression Fractures**

- Bedrest
- Position of comfort
- Muscle relaxants
- Local heat
- Move as a unit - logroll
- OOB ASAP
- Teaching – no forceful movements

• **Safety Measures**

- Prevent injuries & falls
- Proper fitting shoes with non-skid soles
- Regular vision checks

- Caution with meds
- Handrails
- Good posture
- Keep walkways free of clutter
- No loose rugs
- Good lighting

- **Safety Measures**

- **Avoid:**

- Harmful lifting & bending
- Lifting heavy objects
- Straining back
- Bending at the waist
- Twisting body from side to side
- Standing on chairs

- **Nursing Diagnosis:**

- Acute Pain
- Deficient Knowledge
- Risk for Injury/Falls
- Impaired Physical Mobility

Osteomalacia

- **Definition**

- Inadequate mineralization of bone – Vitamin D deficiency
- Softening & deformity of bones 2° to insufficient minerals
- Bones become abnormally soft
- For adults, it's the same as Rickets in children
- ↓ Vitamin D, so ↓ absorption of Ca⁺
- ↓ Vitamin D interferes with normal mineralization of bones, leads to ↓ calcification = soft, deformed

- **Etiology:**

- Poor absorption
- Lack of sunlight exposure (sunscreen= risk factor; long-term nursing home residents; darker skin)
- Chronic diarrhea – Crohn's or ulcerative colitis
- Pregnancy
- Kidney disease
- Inadequate intake
- Drug therapy (phenytoin/dilantin, fluoride, barbiturates)

- **S/Sx:**

- Persistent skeletal pain, difficulty rising or walking
- Progressive weakening, weight loss, progressive deformities, extremity deformities
- Fractures with delayed healing

- **Dx:**

- Labs = ↓ Ca⁺ & phosphorus, ↑ alkaline phosphatase
- X-ray = bone demineralization & deformity

- Looser's Transformation Zones → ribbons of decalcification in bone – diagnosis OM (pseudo fractures)

- **Treatment:**

- Supplements of Vitamin D, Ca⁺, & phosphorus
- ↑ Vitamin D via sunlight & dietary intake

- **Nursing Diagnoses:**

- Impaired Physical Mobility
- Risk for Injury
- Acute Pain
- Imbalanced Nutrition: Less than Body Requirements
- Disturbed Body Image

Paget's Disease (osteitis deformans)

- Chronic bone disease
- Seen more in men
- **Etiology:**
 - Unknown (viral)
 - Often have a family history
 - Possible slow viral infection, biochemical collagen defect, or benign neoplastic condition
- **Pathophysiology**
 - Excessive bone reabsorption followed by **excessive & abnormal bone replacement**
 - Softening, enlargement, & severe deformity
 - ↑ vascularity with bones – new bone is weak and brittle, prone to fractures
 - Common sites = spine, femur, skull, pelvis, & tibia
- Stages:
 - Active: ↑ osteoclastic activity – excessive bone reabsorption
 - Mixed: Compensatory ↑ bone formation – osteoblastic activity
- Thick bones, irregular pattern, ↑ vascularity
- **S/Sx:**
 - May be asymptomatic – earlier stages
 - Skeletal pain – mild to severe
 - Fatigue – early
 - Bowleg – early
 - Waddling gait – early
- **Dx:**
 - ↑ alkaline phosphatase (advanced disease)
 - X-ray = affected bone is curved & the bone cortex is thickened
 - Bone scans – show increased uptake in certain areas
- **Complications:**
 - Pathologic fractures – most common, sometimes 1st sign
 - Osteosarcoma
 - Fibrosarcoma
 - Spine becomes thick & compressed = ↓ height, kyphosis, back pain, SC compression (N/T)
 - Cranium thickens = ↑ hat size, deaf, hydrocephalus, visual deficits, dementia, HA's
- **Treatment:**

- Treat the S/Sx & correct the deformities
 - Analgesics, NSAIDS
 - Bisphosphonates – slows bone resorption
 - Calcitonin – for those who cannot take bisphosphonates
 - Radiation – tumors - ↓ pain
 - Surgery - fracture and ↓ pain
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- **Nursing Diagnoses:**
 - Acute Pain, Impaired Physical Mobility, Risk for Injury - ↑ risk for pathological fractures