WHAT IS OSTEOPOROSIS

DEFINITION

◗ "osteo" = bone  "porosis" = porous
◗ Disease causing bones to become weak, brittle and prone to fractures
◗ ‘Silent Disease’
◗ No symptoms until a fracture or loss of height occurs
◗ Not a normal part of aging

OSTEOPOROSIS

◗ Affects 1 in 4 women over the age of 50
◗ Affects 1 in 8 men over the age of 50
◗ By age 75, 30% of men have osteoporosis
◗ Incidence of Osteoporosis

GLOBALLY

◗ Affects 75 million people in Europe, USA and Japan
◗ Highest rates in USA, Norway, Sweden, New Zealand, Singapore (Indian), South Africa (whites) (Brown, IOF)

PHYSIOLOGY OF NORMAL BONE

OUTER SHELL

◗ Cortical bone = mechanical strength

INNER CORE

◗ Trabecular or cancellous bone – spongy bone, high percentage in vertebral body, wrist, jaw
◗ ‘Mesh work’ that line up with stresses and strains applied to bones
◗ Mineral storage for the body 80% faster rate of turn over rate vs. cortical bone
◗ Minerals including calcium, phosphorus, sodium, magnesium, potassium give firmness to bone

PHYSIOLOGY OF NORMAL BONE

◗ Peak bone density established by age 25 to 30
◗ After 30, bone density decreases 2 to 5% per year until age 75
◗ Rate of decrease determined by genetics, sex, race, diet, activity, medications, disease, functioning of glands (Hodgson) a 5 to 10% increase in peak bone mass can result in a 50% reduction in risk of fracture as an adult (Brown)
◗ All cells of bone are replaced every 3 months
◗ Minerals continuously moving between blood stream and bone as required
◗ Osteoporosis is a ‘long term negative effect of a short term positive reaction’ (Brown)

BONE REMODELING

◗ Osteopenia is 10 to 20% loss of bone density
◗ Osteoporosis is 25% or greater loss of bone density

FRACTURES

◗ 50% of Caucasian women over age 50 will have a fracture in their lifetime
◗ Osteoporotic fractures almost non-existent in rural Africa (Brown)
◗ Low bone density is a risk factor for fractures, it is not predictive of fractures
◗ Most common sites are
◗ Spine
◗ Hip
◗ Wrist
◗ Due to high percentage cancellous bone
◗ 50% of all fractures are spinal
◗ 30% lumbar
◗ 30% thoracolumbar
◗ 30% thoracic (T6-7-8) (Sherman)
◗ Falls preceded
◗ 90% of hip fractures
◗ 33% of spinal fractures
◗ almost all wrist fractures (NOF)
SPINAL FRACTURES

- Compression / wedge fractures
- Burst fractures
- Spinal deformities are permanent
- Surgical interventions may predispose clients to further fractures

WEDGE FRACTURE

- Causes of Spinal Fractures are
  - Lifting heavy object (9%) – flexion lifting 10 lbs adequate to cause fracture
  - Falls (33%)
  - Car accidents (6%)
  - Spontaneously (50%) – cough/sneeze
  - No specific cause (Silva)

- Fractures often occur with high speed, high force, and in people at high risk (Sran)

- Degenerative discs predispose clients to wedge fractures when flexed (Adams)

SPINAL FRACTURE

- Presence of 1 vertebral fracture increases the risk of subsequent fractures 300% to 500%

HIP FRACTURES

- Almost always due to a fall, but only 5% of falls cause fractures (Silva)

- Greatest risk is a sideways fall landing on greater trochanter, especially posterolaterally

- 20 to 25% mortality rate within one year post fracture

PREDISPPOSING FACTORS FOR HIP FRACTURE

- Unable to stand up from a chair without using hands
- Being on the feet less than 4 hours per day
- Not walking for exercise
- Poor depth perception
- Resting heart rate is less than 80 beats per minute
- Anti-convulsant drugs
- History of maternal hip fracture before age 80
- Use of benzodiazepines (tranquilizers and mood altering drugs)
- Poor self-rated health
- Advancing age
- Fracture since age 50
- Weighing less than at age 25
- Caffeine intake is less than 4 cups per day
- Impaired vision
- Being shorter now than at age 25
- Low bone density

RISK OF HIP FRACTURE

- Women with 5 or more risk factors have 27 times higher risk of hip fracture than women with 2 or fewer risk factors (Brown)

WRIST FRACTURES

- Primarily typically due to a fall (NOF)

- 85% fractures are in women

- Incidence of hip or wrist fracture doubles risk of subsequent osteoporotic fracture

FACTORS CONTRIBUTING TO FALLS

- Kyphosis
- Increased body sway (Sinaki 2004)
- Poor lower extremity strength and mobility (Pfeifer)
- Prolonged sitting
  - Sitting 9 hours per day increases risk of fractures 43% compared to sitting 6 hours per day (Pfeifer)
DIAGNOSTIC TESTS: DEXA SCAN

- Most accurate and least harmful test
- Scans lumbar spine and hip
- Results are called T scores
- Compare density to normal 30 year olds

DEXA SCAN T SCORE RESULTS

-1 = 10% bone loss & 2' risk of fractures (osteopenia)
-2 = 20% bone loss & 4' risk of fractures (osteopenia)
-3 = 30% bone loss & 8' risk of fractures (osteoporosis)

- Most fractures occur at -2.5 to -3.5 (IOF)

OTHER DIAGNOSTIC TESTS

- X-ray: 30% loss of bone before visible
- DPA – dual photon absorptiometry
- Less accurate than Dexa scan
- Quantitative Ultrasound
- Performed at the calcaneus

WHAT HELPS BUILD AND MAINTAIN GREAT BONES?

- Regular weight-bearing exercise
- Balanced diet
- Minerals

IMPACT OF EXERCISE

- Stimulates bone growth
- Closed Kinetic Chain
- Compression and release (dynamic loading) is created by weight-bearing or muscular contraction
- Stimulates the bone building cells
- Applying load at higher frequency stimulates more bone building than lower frequency loading (Turner)
- Short bursts of dynamic loading are more stimulating than a consistent routine
- Static loading does not stimulate bone formation, even at high loads

EXERCISE FREQUENCY FOR OPTIMAL BONE BUILDING

- Exercising several times per week (20 to 60 minutes) is better than less frequent longer sessions
- Bones accommodate to a regular routine
- Bone creation requires varied challenge to the bones
- Bone density gains are quickly lost when exercise is discontinued

MUSCLES & BONE DENSITY

- Muscle mass correlates with bone density
- Stronger back extensors correlate with stronger bones (Sinaki)
- Psoas strengthening can increase lumbar bone density (Brown)

EXERCISE OUTCOMES

- Can build bone mass by up to 8% (Brown)
- May decrease falls by up to 10% (Brown)

FLEXION, EXTENSION & ROTATION ISSUES

- In neutral posture, the anterior vertebral body supports 10 to 18% of body weight
- In flexed posture, the anterior vertebral body supports 53 to 59% of body weight (Adams)
- Flexion and lifting generate the largest forces on the spine (Silva)
- Research is inconclusive as to the effects of rotation

EXERCISE & INCIDENCE OF SUBSEQUENT FRACTURE RATES

- Group Movement Percentage (Sinaki 1984)
  - Extension exercises 16%
  - Flexion exercises 89%
  - Flexion & extension 53%
  - No exercise 67%

NATIONAL OSTEOPOROSIS FOUNDATION

- “It is important to maintain flexibility and range of motion in both flexion and rotation, for safety these exercises should be performed with the spine unloaded and with attention to slow easy quality of movements.”

RISK ASSESSMENT

- Look at bone density as well as other risk factors in determining a client’s individual situation
PROGRAMMING GOALS

- Stimulate bone formation. For every 1% increase in bone mass, risk of fracture decreases 6% (Brown)
- Develop mobility and suppleness of movement throughout the body, without risk of creating a fracture
- Develop strength and muscle mass
- Creates stronger bones
- Increases functionality
- Prevents falls
- Optimize posture
- Create ease of movement
- Facilitates recruitment of local stabilizers
- Creates best shock absorption
- Improves balance
- Develop extensor strength and reduce kyphosis as able
- Create stronger bones
- Reduce risk of falling
- Improve balance
- Reduce risk of falling
- Improve proprioception
- Decrease lateral shifting of body during gait
- Obliques
- Hip adductors and abductors
- Hip, ankle and foot mobility
- Be safe
- Create a safe environment to prevent falls
- Choose exercises wisely
- Err on the side of caution
- Educate and enable clients

EXERCISE PROGRAMMING

- Program shorter sessions more frequently
- Ideal: 3 to 5 one hour sessions per week (Brown, Turner)
- Maximum of 7 hours exercise per week
- Vary the routine

INDICATED EXERCISES – FOUR CATEGORIES

- Neutral Spinal Stabilization
- Spinal Extension
- Balance & Proprioception
- Dynamic Loading

NEUTRAL SPINAL STABILIZATION

- Essential Matwork
  - Imprint & Release
  - Arm Circles
  - Arm Scissors
  - One Leg Circle
  - Single Leg Stretch
  - Double Leg Stretch
  - Scissors
  - Side Leg Lift Series (head remains on mat for all exercises)
  - Side Kick
  - Single Leg Extension
  - Double Leg Extension
  - Swan Dive
  - Heel Squeeze Prone
  - One Leg Kick Prep
  - Push Up
  - Leg Pull Front Prep
- Intermediate / Advanced Matwork
  - Slow Double Leg Stretch
  - Shoulder Bridge
  - Double Leg Kick
  - Leg Pull Front
  - Push Up
- Reformer / V2 Max Plus
  - Footwork
  - Bend & Stretch
  - Lift & Lower
  - Adductor Stretch
  - Circles
  - Beat
  - Stag
  - Frogs
  - Back Rowing
  - Front Rowing
  - Chest Expansion
  - Reverse Expansion
  - Side Arm Preps Sitting
  - Side Arm Preps Kneeling
  - Short Box Series
  - Straight Back
  - Tree (maintaining neutral spine)
NEUTRAL SPINAL STABILIZATION cont’d

- Reformer / V2 Max Plus
  - Long Box Series
  - Arms Pulling Straps (without going into thoracic flexion)
  - Feet Pulling Straps
  - Long Stretch
  - Knee Stretches
  - Straight Back
  - Extended Back
  - Side Splits
  - Running
  - Hip Lift
- Essential Stability Chair
  - Footwork
  - Hamstring Press Hips Down
  - Adductor Press
  - Ankle Exercise
  - Swan Dive
  - Scapula Isolation Prone
  - One Arm Press Prone
  - Tricep Press Sitting
  - One Arm Push Hand on Floor Prep
  - Swan Dive from Floor

- Intermediate / Advanced Chair
  - Forward Step Up
  - Side Step Up
  - Backward Step Up
  - Forward Step Down
  - Side Step Down
  - Backward Step Down
  - Knee Raises
  - Beats
  - One Arm Push Hand on Chair
  - One Arm Push Hand on Floor
  - Grasshopper
  - Rotation Prone

- Cadillac
  - Airplane Prep (legs only)
  - Push-Thru with Feet (omit roll up)
  - Midback Series
  - Back Rowing
  - Front Rowing
  - Leg Springs
  - Side-Lying Leg Springs
  - Standing Arm Work
  - Trap Strengthening
  - Chest Expansion
  - Side Arm Work
  - Offering
  - Hug-a-Tree
  - Punches
  - Arms Sideways
  - Pull Up

SPINAL EXTENSION

- Matwork
  - Breast Stroke Prep
  - Breast Stroke Full
  - Swan Dive Prep
  - Swan Dive Full
  - Swimming Prep
  - Swimming Full
  - One Leg Kick
  - Double Leg Kick

- Equipment
  - Flying Eagle with Leg Springs
  - Down Stretch
  - Rotation Prone

BALANCE & PROPRIOCEPTION

- Shoulder Bridge Prep (low hip position)
- Footwork
- Sleeper with Jumpboard
- Standing Arm Work
- Bilateral and unilateral stance
- Foot Press on Long Box
- Rotational Disks
- BOSU
  - Sitting
  - Standing (where possible)
- Prone on Ball

DYNAMIC LOADING

- Plyometrics
- Jumpboard
- Standing Arm Springs

POSSIBLE CONTROVERSIAL EXERCISES

- Mermaid (with support to decrease load on vertebral bodies)
- Spinal Rotation
CONTRAINDICATED EXERCISES

- Flexion
  - Cat Stretch
  - Roll Up
  - Ab Prep (into flexion)
  - Hundred (with head up)
  - Rolling like a Ball
  - Saw
  - Open Leg Rocker
  - Spine Stretch Forward
  - Teaser
  - Elephant – Round Back
  - Up Stretch
  - Knee Stretches – Round Back
  - Stomach Massage

- Combined Flexion & Rotation
  - Saw
  - Obliques Roll Back
  - Porte des Bras
  - Hawk
  - Twist with Round Back
  - Rotation with Port des Bras

- Loaded Rotation
  - Side Twist Sitting
  - Side Twist Kneeling

MODIFICATIONS FOR CONTRAINDICATED EXERCISES

- Short Spine Prep (omit rolling up)
- Ab Prep – supine over stability ball (extension to neutral range only, avoid flexion range)
- Straight or Hinge Back instead of rounding back
- Shoulder Bridge (with head and shoulders on stability ball)

SPECIAL CONSIDERATIONS

- Use props to support the head and neck in alignment based on thoracic kyphosis
- May require pillows under stomach for prone work
- Osteoporotic ribs: avoid compression on ribcage from prone lying over barrels or on hard surfaces; add padding to hard surface or avoid position
- Osteoporotic wrists / forearms: avoid weight-bearing through wrists
- Allow client to wear any prescribed braces during workout
- Provide a safe environment to reduce risk of falling

DECISION MAKING FACTORS

- Work within your comfort range and that of your client; keep learning and following the research
- Assess the number of risk factors for fracture
- Adhere to strict precautions if there has been a previous fracture
- Bone density: T score at or below -2.5 is high risk for fracture

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