Your Bones and Osteoporosis: What You Need to Know

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MGH Rheumatology Fellow
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Overview

• Bone structure
• Osteoporosis risks
• Screening
• Osteoporosis diagnosis
• Treatment
Osteoporosis

- Causes the bones to lose density, become weak, and fracture easily
- Affects all bones throughout the body
- Increases risk of fracture
Bone physiology

• Bone is first torn down (resorption) then rebuilt
  • Resorption
    • Initiated by osteoclasts, cells that break down bone
  • Formation
    • Initiation by osteoblasts, cells that make new bone

Image from Pediaaa.com
Osteoporosis

Image from Bamboo Core Spine, 2019
How bad are fractures?

• Most osteoporotic fractures occur in the spine, hip, and wrists
• Most spine fractures are asymptomatic
• Fractures can lead to disability and increased mortality (up to 20% in the first year following fracture)
Osteoporosis: Facts & Figures

• Affects around 200 million women worldwide
• The lifetime risk of hip, forearm, or vertebral fracture is around 40%
• 1 in 3 women over age 50 will experience an osteoporotic fracture (compared with 1 in 5 men over 50)
• Only around 1/3 of vertebral fractures cause pain and lead to a medical visit
• A 10% loss of bone mass in the spine can double the risk of vertebral fracture

International Osteoporosis Foundation, www.iofbonehealth.org
Fig. 2.
Age-specific incidence of all proximal femur fractures among Olmsted County, Minnesota, women (A) and men (B) ≥ 50 years of age, comparing 2009–11 with comparable data from 1989–91.

Amin et al, Trends in Fracture Incidence: A Population-Based Study Over 20 Years, J Bone Miner Res, 2014
Osteoporosis: Facts & Figures

Fig. 3.
Age-specific incidence of all vertebral fractures among Olmsted County, Minnesota, women (A) and men (B) ≥ 50 years of age, comparing 2009–11 with comparable data from 1989–91.

Amin et al, Trends in Fracture Incidence: A Population-Based Study Over 20 Years, J Bone Miner Res, 2014
Who’s most at risk?

- Older age
- Cigarette smoking
- Malabsorption
- Parental hip fracture
- Alcohol use
- Steroid use
- Vitamin D deficiency
- Low testosterone
- Low estrogen
- Hyperparathyroidism
- Hyperthyroidism
- Diabetes
- Low body weight
Screening for osteoporosis

- DXA (bone mineral density) scan
- Women 65 years or older
- Women younger than 65 whose 10-year risk is estimated to be similar to a 65 year old
- Adults with a disease or medication associated with bone loss
- Recommendations for men less clear
Screening for osteoporosis
Diagnosing osteoporosis

- DXA (dual energy x-ray absorptiometry) scan
  - Gold standard for assessing osteoporosis
  - Measures hip, spine, and sometimes wrist
  - Measures the T-score (comparison of bone density to the bone density of a young, healthy adult)
  - T-score of 1.0 would be the same as a young adult
  - T-score of -2.5 is 2.5 standard deviations below the young adult range and is diagnostic of osteoporosis
What symptoms do people have?

• Often NONE until a fracture occurs
• Vertebral fractures
  • Back pain
  • Height loss
• Hip fracture, forearm/wrist fracture: often have symptoms and are discovered at the time of the fracture
Prevention & Fall Risk Reduction

• Nutrition
  • Calcium containing foods – more on this later

• Exercise
  • Weight bearing exercise

• Medication
  • Avoid medications known to reduce bone density

• Fall reduction
Fall Prevention

• Hand rails on stairs and in bathroom
• Keep rooms clutter-free
• Keep floors clean but not slippery
• Wear supportive shoes. Don’t walk in socks or floppy shoes/slippers
• Use bright light bulbs in all rooms
• Use a rubber mat in the shower/tub
• Keep a flashlight at bedside
• Physical therapy

Image from Barrier Free Modifications
Diagnosis

• Bone mineral density
• T-score < -2.5
  • Bone density is 2.5 or more standard deviations below the young healthy reference average
• “Osteoporotic fracture” = fall from a standing height resulting in a fracture
  • Does *not* relate to fractures caused by car accidents, trauma, etc
Treatment

• Recommended for anyone with osteoporosis
  • T-score < -2.5
  • Osteoporotic fracture

• But what if the T-score is low, but not low enough to be in the osteoporosis range?
  • Osteopenia: T-score ranging from -1 to -2.5
  • Separate recommendations for whom to treat within this category
Treatment for osteopenia

• Deciding whom to treat
• FRAX calculator: calculates your 10-year probability of hip fracture or other major osteoporotic fracture
• Recommend medications if 3% or higher risk of hip fracture or 20% or higher risk of major fracture
Fracture Risk: FRAX Score

• Online calculator incorporating age, gender, BMI, prior fracture, parental hip fracture, smoking, steroids, rheumatoid arthritis, alcohol, bone mineral density, and other cause of osteoporosis

• Predicts the 10-year probability of
  • 1) Major osteoporotic fracture
    • Includes fractures at hip, spine, forearm, and humerus (excluding trauma)
  • 2) Hip fracture
Questionnaire:

1. Age (between 40 and 90 years) or Date of Birth
   Age: 87
   Date of Birth: Y: [ ] M: [ ] D: [ ]

2. Sex
   □ Male □ Female

3. Weight (kg)
   55

4. Height (cm)
   170

5. Previous Fracture
   □ No □ Yes

6. Parent Fractured Hip
   □ No □ Yes

7. Current Smoking
   □ No □ Yes

8. Glucocorticoids
   □ No □ Yes

9. Rheumatoid arthritis
   □ No □ Yes

10. Secondary osteoporosis
    □ No □ Yes

11. Alcohol 3 or more units/day
    □ No □ Yes

12. Femoral neck BMD (g/cm²)
    Hologic: 0.678 T-score: -1.5

BMI: 19.0
The ten year probability of fracture (%)

with BMD

- Major osteoporotic 26
- Hip Fracture 16

If you have a TBS value, click here: Adjust with TBS
Treatment

• Other than medications...
  • Stop smoking!
  • Diet
  • Exercise
  • Fall prevention

• Calcium & Vitamin D
Treatment

- Calcium & Vitamin D
  - Recommendation to get 1,200 mg of Calcium daily and 1,000 units of Vitamin D daily
  - Example: Centrum Silver Women Multivitamins
    - Calcium: 300mg/pill
    - Vitamin D: 1,000 units/pill

Supplement Facts

<table>
<thead>
<tr>
<th>Amount Per Serving</th>
<th>% Daily Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vitamin A 3,500 IU (43% as Beta-Carotene)</td>
<td>70%</td>
</tr>
<tr>
<td>Vitamin C 100 mg</td>
<td>167%</td>
</tr>
<tr>
<td>Vitamin D 1,000 IU</td>
<td>250%</td>
</tr>
<tr>
<td>Vitamin E 35 IU</td>
<td>117%</td>
</tr>
<tr>
<td>Vitamin K 50 mcg</td>
<td>63%</td>
</tr>
<tr>
<td>Thiamin 1.1 mg</td>
<td>73%</td>
</tr>
<tr>
<td>Riboflavin 1.1 mg</td>
<td>65%</td>
</tr>
<tr>
<td>Niacin 14 mg</td>
<td>70%</td>
</tr>
<tr>
<td>Vitamin B₆ 5 mg</td>
<td>250%</td>
</tr>
<tr>
<td>Folic Acid 400 mcg</td>
<td>100%</td>
</tr>
<tr>
<td>Vitamin B₁₂ 50 mcg</td>
<td>833%</td>
</tr>
<tr>
<td>Biotin 30 mcg</td>
<td>10%</td>
</tr>
<tr>
<td>Pantothenic Acid 5 mg</td>
<td>50%</td>
</tr>
<tr>
<td>Calcium 300 mg</td>
<td>60%</td>
</tr>
<tr>
<td>Iron 8 mg</td>
<td>44%</td>
</tr>
<tr>
<td>Phosphorus 20 mg</td>
<td>2%</td>
</tr>
<tr>
<td>Iodine 150 mcg</td>
<td>100%</td>
</tr>
<tr>
<td>Magnesium 100 mg</td>
<td>25%</td>
</tr>
<tr>
<td>Zinc 15 mg</td>
<td>100%</td>
</tr>
<tr>
<td>Selenium 22 mcg</td>
<td>31%</td>
</tr>
<tr>
<td>Copper 0.5 mg</td>
<td>25%</td>
</tr>
<tr>
<td>Manganese 2.3 mg</td>
<td>11.5%</td>
</tr>
<tr>
<td>Chromium 52 mcg</td>
<td>43%</td>
</tr>
<tr>
<td>Molybdenum 50 mcg</td>
<td>67%</td>
</tr>
<tr>
<td>Chloride 72 mg</td>
<td>2%</td>
</tr>
<tr>
<td>Potassium 80 mg</td>
<td>2%</td>
</tr>
<tr>
<td>Nickel 5 mcg</td>
<td>*</td>
</tr>
<tr>
<td>Silicon 2 mg</td>
<td>*</td>
</tr>
<tr>
<td>Vanadium 10 mcg</td>
<td>*</td>
</tr>
<tr>
<td>Lutein 300 mcg</td>
<td>*</td>
</tr>
</tbody>
</table>

*Daily Value not established.
Treatment

• How much calcium??
  • Total of 1,200mg daily
  • Can come in the form of pills and/or food
  • Calcium carbonate: not as well absorbed if on acid blocking medications (H2 blockers or PPI) (for acid reflux, for example)
    • Ex: ranitidine (Zantac), omeprazole (Prilosec)

• How much vitamin D??
  • At least 800-1,000 units daily
  • Aim for normal vitamin D level; may require higher doses
Calcium content of food & drink

<table>
<thead>
<tr>
<th>Food</th>
<th>Calcium, milligrams</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milk (skim, 2 percent, or whole, 8 oz [240 mL])</td>
<td>300</td>
</tr>
<tr>
<td>Yogurt (6 oz [168 g])</td>
<td>250</td>
</tr>
<tr>
<td>Orange juice (with calcium, 8 oz [240 mL])</td>
<td>300</td>
</tr>
<tr>
<td>Tofu with calcium (1/2 cup [113 g])</td>
<td>435</td>
</tr>
<tr>
<td>Cheese (1 oz [28 g])</td>
<td>195 to 335 (hard cheese = higher calcium)</td>
</tr>
<tr>
<td>Cottage cheese (1/2 cup [113 g])</td>
<td>130</td>
</tr>
<tr>
<td>Ice cream or frozen yogurt (1/2 cup [113 g])</td>
<td>100</td>
</tr>
<tr>
<td>Soy milk (8 oz [240 mL])</td>
<td>300</td>
</tr>
<tr>
<td>Beans (1/2 cup cooked [113 g])</td>
<td>60 to 80</td>
</tr>
<tr>
<td>Dark, leafy green vegetables (1/2 cup cooked [113 g])</td>
<td>50 to 135</td>
</tr>
<tr>
<td>Almonds (24 whole)</td>
<td>70</td>
</tr>
<tr>
<td>Orange (1 medium)</td>
<td>60</td>
</tr>
</tbody>
</table>

Total calcium goal = 1,200mg daily
“Mary, you haven't been taking your calcium pills, have you?”
Treatment

• Bisphosphonates
  • Oral: alendronate (Fosamax), risedronate (Actonel), ibandronate (Boniva)
  • IV: zoledronic acid (Reclast), pamidronate, ibandronate

• Denosumab (Prolia) (subcutaneous)

• Raloxifene (Evista) (oral)

• Teriparatide (Forteo), abaloparatide (Tymlos) (subcutaneous)

• Romosozumab (Evenity) (subcutaneous)
Treatment

• **Bisphosphonates**
  - Oral: alendronate (Fosamax), risedronate (Actonel), ibandronate (Boniva)
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Overview of Bisphosphonates

• Anti-resorptive therapy

• Oral: alendronate (Fosamax), risedronate (Actonel), ibandronate (Boniva)

• IV: zoledronic acid (Reclast), pamidronate, ibandronate

• Oral: must take in the morning on an empty stomach, with a full glass of water, without any food or drink for 30 minutes afterwards and must not lie down for 30 minutes afterwards
Complications of Bisphosphonates

• Esophageal discomfort with oral therapy
  • If bad acid reflux consider using IV treatment

• Osteonecrosis of the jaw
  • More on next slide

• Atypical femoral fractures
  • Not clear evidence that they are caused by bisphosphonates
  • Due to fragility of the femur bone
Complications of Treatment

• Osteonecrosis of the jaw
  • Occurs when the bone is exposed and has poor blood supply
  • Often has occurred in patients receiving IV treatment for cancer who have high calcium levels

• Risk factors
  • IV bisphosphonates at high dose (>10x higher than used for osteoporosis alone)
  • Dental trauma, surgery, or infection

• Recommendations
  • Complete dental work prior to bisphosphonate treatment
  • Maintain good dental hygiene with regular cleanings
Complications of Treatment

• IV dose only
  • Up to 30% of patients have a flu-like reaction (chills, muscle aches) for 1-2 days afterwards
  • Can reduce this risk with 2 tablets of Tylenol one hour prior to the dose and again 6 hours later
  • Need to have normal vitamin D level
Treatment

• Bisphosphonates
  • Oral: alendronate (Fosamax), risedronate (Actonel), ibandronate (Boniva)
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Denosumab

• Anti-resorptive
• Given as a subcutaneous injection every 6 months
• Need to have normal vitamin D level
• Needs to be followed by another medication
  • Risk of increased loss of bone mineral density after discontinuation
• Can be used in patients with kidney disease
• Can worsen eczema
Treatment

• Bisphosphonates
  • Oral: alendronate (Fosamax), risedronate (Actonel), ibandronate (Boniva)
  • IV: zoledronic acid (Reclast), pamidronate, ibandronate
• Denosumab (Prolia) (subcutaneous)
• Raloxifene (Evista) (oral)
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• Romosozumab (Evenity) (subcutaneous)
Raloxifene

- Selective estrogen receptor modulator (SERM)
- Works like estrogen in the bone to prevent bone loss
- Blocks effects of estrogen in the breast and uterine tissues
- Can increase risk of blood clot
- Once daily pill
Treatment

• Bisphosphonates
  • Oral: alendronate (Fosamax), risedronate (Actonel), ibandronate (Boniva)
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• Romosozumab (Evenity) (subcutaneous)
Teriparatide, abaloparatide

• Anabolic agent/builds up bone
• Works like PTH
• Black box warning
  • Not to be used in patients with an increased risk of osteosarcoma (or other bone cancer or metastases to bone)
  • Cannot be used in patients with Paget’s, history of radiation therapy, elevated alkaline phosphatase without explanation
  • This was based on rat studies where they received 15,000 times the dose given to humans
Treatment

- Bisphosphonates
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Romosozumab

- Newly FDA approved for osteoporosis
- Inhibits sclerostin, anabolic as well as anti-resorptive therapy
- Given as two subcutaneous injection once monthly
- Indicated for severe osteoporosis and very high fracture risk
Monitoring on therapy

- Monitor DXA scan every ~2 years
- Monitor for new fractures and consider evaluation for other causes of low bone density
- Consider switching therapy if decline in BMD or new fracture(s) during therapy
Take Home Points

• Osteoporosis significantly increases the risk of fracture
• Fractures are associated with disability as well as increased mortality
• Osteoporosis can be detected prior to fracture
• Many of the risk factors are modifiable, and falls can be prevented by taking the appropriate steps
• Osteoporosis is treatable
Questions/Comments?