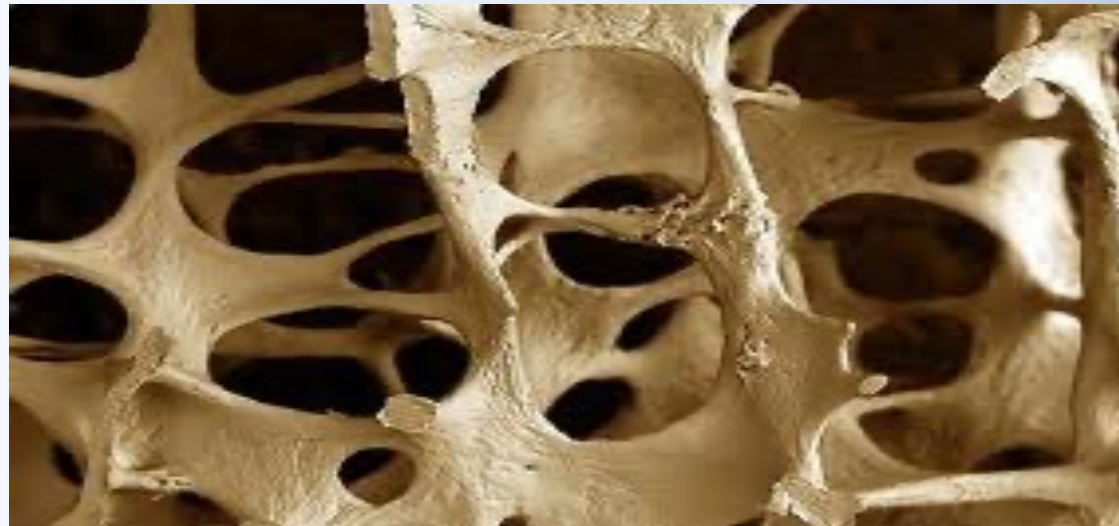




# Osteoporosis Assessment & Management

Dennis K-Borna, MD, FACSM

No disclosures to report



# Epidemiology



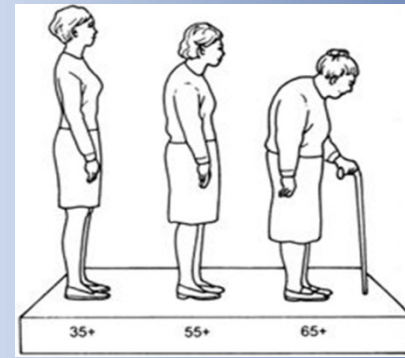
- 🦷 2 million osteoporotic fractures in the United States each year
- 🦷 about 50 million people in the U.S. are at risk for fracture
  - 🦷 Diabetes: 34 million
  - 🦷 Hyperlipidemia: 94 million
  - 🦷 Hypertension: 75 million\*

# Epidemiology



- 🦷 Lifetime probability of a hip fracture in women is 10-15%
- 🦷 Lifetime probability of breast cancer is 12-13%

# Morbidity & Mortality



- ✚ 15-20% will die within 1 year of a hip fracture
- ✚ 30% will have permanent disability
- ✚ 40% will be unable to walk independently
- ✚ 50% will no longer be able to live independently
- ✚ Mortality rates are higher for men than for women

# Assessing Risk: Who to Screen?

## ☞ DEXA scan

- ☞ All women 65 and older

- ☞ All men 70 and older\*

- ☞ Patients 50 and older with any non-phalangeal fracture

- ☞ Patients at higher risk....

# Patients at Increased Risk

- ⚡ Long-term glucocorticoid use
- ⚡ Smokers
- ⚡ Heavy alcohol use
- ⚡ Inactivity
- ⚡ Malabsorptive conditions
- ⚡ Rheumatologic conditions
- ⚡ Hematologic conditions
- ⚡ Neuromuscular diseases

# Patients at Increased Risk

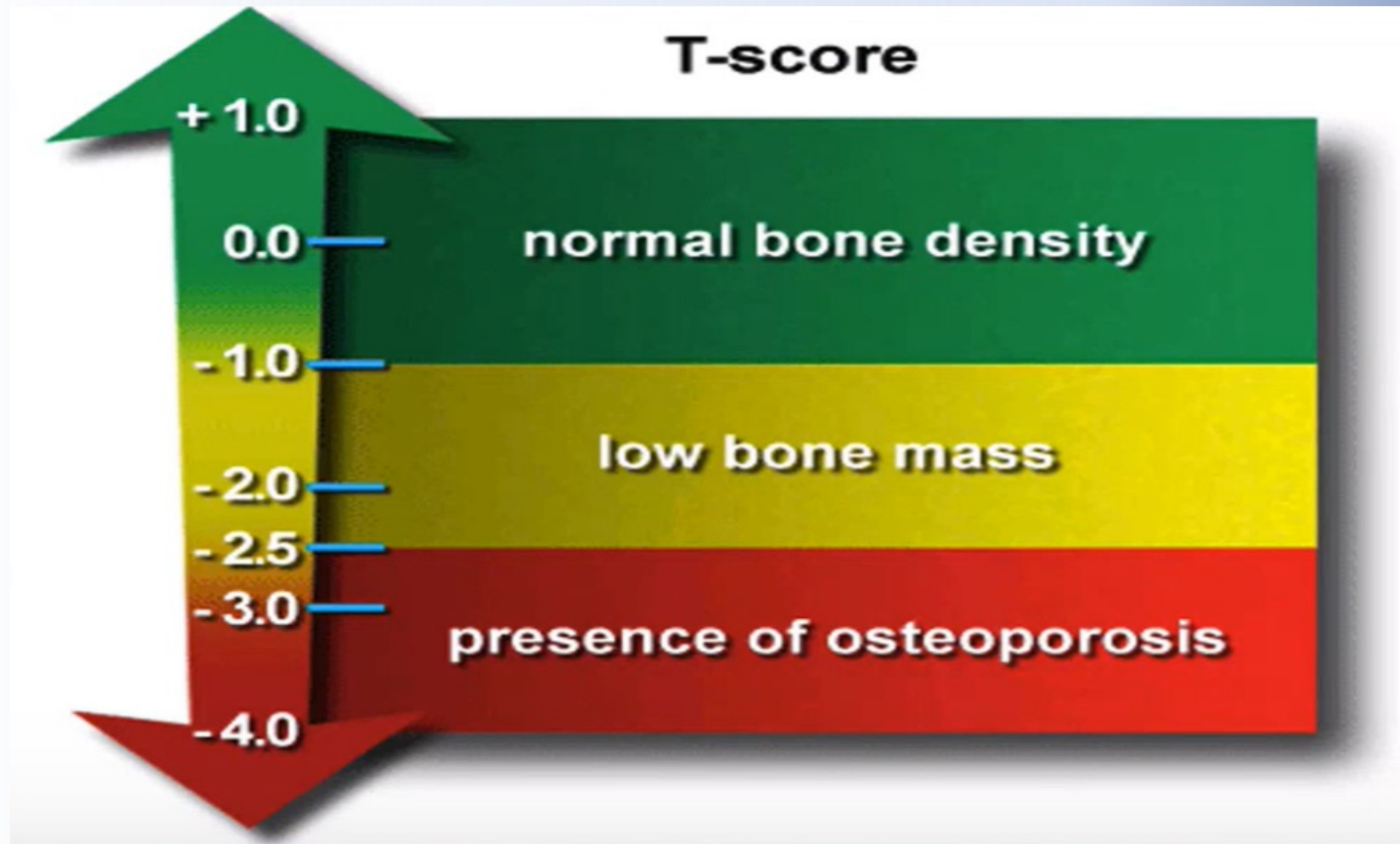
- 🦴 Postmenopausal women <65
  - 🦴 FRAX score for major osteoporotic fracture >8.4% should get DEXA scan
  - 🦴 OST (osteoporosis self-assessment tool)
    - 🦴 Score < 2 should get DEXA scan
    - 🦴  $OST = \frac{(\text{weight in kg}) - (\text{age})}{5}$

# Patients at Increased Risk





# DEXA Scan



# DEXA Scan Rescreening

🦷 For women 65 and older who are not taking prescription antifracture medication, suggested rescreening intervals are based on initial T-score:

Initial T-score	Suggested Minimum Interval
$\geq -1.4$	10 years
-1.5 to -1.9	5 years
-2.0 to -2.4	2 years

# Who to Treat?

- Start treatment in patients with hip or vertebral fractures\*\*
- Start treatment in patients with a T-score  $\leq -2.5$  SD at femoral neck, total hip, or spine on DEXA
- Treat postmenopausal women and men aged 50+ with osteopenia (T-score **-1 to -2.4**) with increased fracture risks
  - a 10-year **hip fracture** probability of **3%** or more or
  - a 10-year **major osteoporosis-related fracture** probability of **20%** or more
- Osteoporosis based on clinical judgment

# FRAX

🦴 **[www.shef.ac.uk/FRAX](http://www.shef.ac.uk/FRAX)**

🦴 The gold standard tool for assessing fracture risk

🦴 In some cases, can be calculated without a DEXA score

🦴 Can be quite useful for some of us if we aren't sure

Welcome to FRAX - Windows Internet Explorer

http://www.shef.ac.uk/FRAX/

Google

File Edit View Favorites Tools Help

Favorites

Welcome to FRAX

Home

Calculation Tool

Paper Charts

FAQ

References

English

FRAX<sup>®</sup>

WHO Fracture Risk Assessment Tool

Home

Calculation Tool

Paper Charts

FAQ

References

English

Welcome to FRAX<sup>®</sup>

The FRAX<sup>®</sup> tool has been developed to provide individual patient models that estimate the 10-year probability of a major osteoporotic fracture (clinical spine, forearm, hip or shoulder fracture) based on bone mineral density (BMD) at the femoral neck.



Dr. John A Kanis  
Professor Emeritus,  
University of Sheffield

The FRAX<sup>®</sup> models have been developed based on cohorts from Europe, North America, Asia and Australia. In their most sophisticated form, the FRAX<sup>®</sup> 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<sup>®</sup> 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).

Web Version 3.1

View Release Notes

Links

www.iofbonehealth.org

www.nof.org

www.jpof.or.jp

www.esceo.org

International Osteoporosis Foundation

NATIONAL OSTEOPOROSIS FOUNDATION

JOINT JAPANESE-AMERICAN OSTEOPOROSIS FOUNDATION

ESCEO

FRAX available as iPhone App

View in iTunes

Asia

Europe

North America

Latin America

Oceania

Canada

US (Caucasian)

US (Black)

US (Hispanic)

US (Asian)

http://www.shef.ac.uk/FRAX/tool.jsp?country=9

Internet 100%

The logo for Kaiser Permanente Sports Medicine, featuring a stylized figure in motion and the text "KAISER PERMANENTE Sports Medicine".



## Calculation Tool

Please answer the questions below to calculate the ten year probability of fracture with BMD.

Country: **US (Caucasian)**

Name/ID:

[About the risk factors](#) 

### Questionnaire:

1. Age (between 40-90 years) or Date of birth

Age:

Date of birth:

Y:  M:  D:

2. Sex

☐ Male ☐ Female

3. Weight (kg)

4. Height (cm)

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 per day

☒ No ☐ Yes

12. Femoral neck BMD (g/cm<sup>2</sup>)

Select DXA

Clear

Calculate



### Weight Conversion

Pounds  Kgs

Convert

### Height Conversion

Inches  Cms

Convert

Home

Calculation Tool

Paper Charts

FAQ

References

English

# Calculation Tool

Please answer the questions below to calculate the ten year probability of fracture with BMD.

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About the risk factors

## Questionnaire:

1. Age (between 40-90 years) or Date of birth  
Age:  Date of birth: Y:  M:  D:

2. Sex ☐ Male ☒ Female

3. Weight (kg)

4. Height (cm)

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 per day ☒ No ☐ Yes

12. Femoral neck BMD (g/cm<sup>2</sup>)  

T-Score

Clear Calculate

**BMI 24.2**  
**The ten year probability of fracture (%)**  
**with BMD**

■ Major osteoporotic	11
■ Hip fracture	1.8

## Weight Conversion

Pounds kg

## Height Conversion

Inches cm

01130944


Individuals with fracture risk assessed since 1st June 2011

## Calculation Tool

Please answer the questions below to calculate the ten year probability of fracture with BMD.

Country: **US (Caucasian)**

Name/ID:

[About the risk factors](#) 

### Questionnaire:

1. Age (between 40-90 years) or Date of birth

Age:

Date of birth:

Y:

M:

D:

2. Sex

☐ Male

☒ Female

3. Weight (kg)

4. Height (cm)

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 per day

☒ No

☐ Yes

12. Femoral neck BMD (g/cm<sup>2</sup>)

T-Score

**BMI 24.2**

The ten year probability of fracture (%)

with BMD

☒ Major osteoporotic

**12**

☒ Hip fracture

**3.1**



### Weight Conversion

Pounds  kg

### Height Conversion

Inches  cm

**01141754**

Individuals with fracture risk  
assessed since 1st June 2011



# Treatment – Primary Prevention

- According to the Bone Health and Osteoporosis Foundation (BHOFF), all people aged 50 and above should:
  - be encouraged to engage in regular weightbearing and muscle strengthening exercises to reduce the risk of falls
  - safety-proof their home
  - avoid smoking and excessive alcohol
  - take 1000-1200mg of calcium daily\*
  - take 800-1000 IU of vitamin D



# Treatment – Primary Prevention

➤ According to the United States Preventive Services Task Force (USPSTF):

- exercise to prevent falls
- insufficient evidence to assess balance risks/benefits for vitamin D and calcium for primary prevention



- recommends against  $\leq 400$  IU/day of vitamin D or  $\leq 1000$  mg/day of calcium in postmenopausal women

## Supplemental Vitamin D and Incident Fractures in Midlife and Older Adults

Meryl S. LeBoff, M.D., Sharon H. Chou, M.D., Kristin A. Ratliff, B.A., Nancy R. Cook, Sc.D., Bharti Khurana, M.D., Eunjung Kim, M.S., Peggy M. Cawthon, Ph.D., M.P.H., Douglas C. Bauer, M.D., Dennis Black, Ph.D., J. Chris Gallagher, M.D., I-Min Lee, M.B., B.S., Sc.D., Julie E. Buring, Sc.D., and JoAnn E. Manson, M.D., Dr.P.H.

### ABSTRACT

#### BACKGROUND

Vitamin D supplements are widely recommended for bone health in the general population, but data on whether they prevent fractures have been inconsistent.

#### METHODS

In an ancillary study of the Vitamin D and Omega-3 Trial (VITAL), we tested whether supplemental vitamin D<sub>3</sub> would result in a lower risk of fractures than placebo. VITAL was a two-by-two factorial, randomized, controlled trial that investigated whether supplemental vitamin D<sub>3</sub> (2000 IU per day), n-3 fatty acids (1 g per day), or both would prevent cancer and cardiovascular disease in men 50 years of age or older and women 55 years of age or older in the United States. Participants were not recruited on the basis of vitamin D deficiency, low bone mass, or osteoporosis. Incident fractures were reported by participants on annual questionnaires and adjudicated by centralized medical-record review. The primary end points were incident total, nonvertebral, and hip fractures. Proportional-hazards models were used to estimate the treatment effect in intention-to-treat analyses.

#### RESULTS

Among 25,871 participants (50.6% women [13,085 of 25,871] and 20.2% Black [5106 of 25,304]), we confirmed 1991 incident fractures in 1551 participants over a median follow-up of 5.3 years. Supplemental vitamin D<sub>3</sub>, as compared with placebo, did not have a significant effect on total fractures (which occurred in 769 of 12,927 participants in the vitamin D group and in 782 of 12,944 participants in the placebo group; hazard ratio, 0.98; 95% confidence interval [CI], 0.89 to 1.08; P=0.70), nonvertebral fractures (hazard ratio, 0.97; 95% CI, 0.87 to 1.07; P=0.50), or hip fractures (hazard ratio, 1.01; 95% CI, 0.70 to 1.47; P=0.96). There was no modification of the treatment effect according to baseline characteristics, including age, sex, race or ethnic group, body-mass index, or serum 25-hydroxyvitamin D levels. There were no substantial between-group differences in adverse events as assessed in the parent trial.

#### CONCLUSIONS

Vitamin D<sub>3</sub> supplementation did not result in a significantly lower risk of fractures than placebo among generally healthy midlife and older adults who were not selected for vitamin D deficiency, low bone mass, or osteoporosis. (Funded by the National Institute of Arthritis and Musculoskeletal and Skin Diseases; VITAL ClinicalTrials.gov number, NCT01704859.)

From the Division of Endocrinology, Diabetes, and Hypertension (M.S.L., S.H.C., K.A.R.), the Division of Preventive Medicine (N.R.C., E.K., I.-M.L., J.E.B., J.E.M.), and the Department of Radiology (B.K.), Brigham and Women's Hospital, Harvard Medical School (M.S.L., S.H.C., N.R.C., B.K., I.-M.L., J.E.B., J.E.M.), and the Department of Epidemiology, Harvard T.H. Chan School of Public Health (N.R.C., I.-M.L., J.E.B., J.E.M.) — all in Boston; California Pacific Medical Center Research Institute (P.M.C.), and the Departments of Epidemiology and Biostatistics (P.M.C., D.C.B., D.B.) and Medicine (D.C.B.), University of California, San Francisco — both in San Francisco; and the Department of Endocrinology, Creighton University School of Medicine, Omaha, NE (J.C.G.). Dr. LeBoff can be contacted at [mleboff@bwh.harvard.edu](mailto:mleboff@bwh.harvard.edu) or at the Division of Endocrinology, Diabetes, and Hypertension, Brigham and Women's Hospital, 221 Longwood Ave., Boston, MA 02115.

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**CME**  
at NEJM.org



# Calcium

- ✚ Dietary supplementation is considered safest
- ✚ No more than 2000mg/day of supplements
- ✚ Calcium carbonate
  - ✚ cheapest
  - ✚ max absorption with 500mg doses
  - ✚ better absorption after meals
  - ✚ helps with heartburn
- ✚ Calcium citrate
  - ✚ best absorption
  - ✚ preferred if on acid-blocking medication
  - ✚ preferred if history of renal stones



# Treatment

➤ First-line treatment of osteoporosis is with **bisphosphonates**

➤ alendronate (Fosamax)

➤ 70mg, once weekly

➤ ibandronate (Boniva)

➤ 150mg, once monthly

➤ lack of evidence for non-vertebral fx risk

➤ zolendronic acid (Reclast)

➤ IV, once yearly

➤ risedronate (Actonel)

➤ best tolerated

➤ most expensive



# Bisphosphonates

- ✚ Bisphosphonates reduce the incidence of vertebral fractures by almost 50% over 3 years
- ✚ Alendronate has a little better data than the other bisphosphonates
- ✚ The number needed to treat to prevent **one** hip fracture per year is about **100**

# Other Medications

**Estrogen receptor modulator**

**Raloxifene (Evista)**

- ➡ May reduce vertebral fractures by 30-55%
- ➡ Not clinically proven to reduce hip fractures
- ➡ Incidentally lowers breast cancer risk
- ➡ Increased risk of hot flashes, leg cramps, and blood clots/DVTs

# Other Medications

## Calcitonin

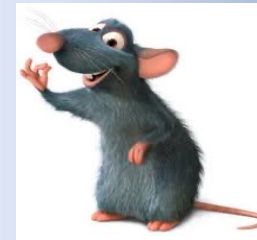
- ✚ Intranasal
- ✚ Can help the pain associated with vertebral fractures
- ✚ Questionably decreases risk for new vertebral fractures in established osteoporosis, but no evidence of significant effect on hip fractures
- ✚ Not frequently used for fracture prevention



# Other Medications

## Parathyroid hormone analogs

- 💪 Teriparatide (Forteo)
- 💪 Abaloparatide (Tymlos)
- 💪 Daily subcutaneous injections
- 💪 May reduce hip fractures by 65%, and other nonvertebral fractures by 53%
- 💪 May increase risk of osteosarcoma
- 💪 Used for a maximum of two years



# Other Medications

## Receptor activator of nuclear factor kappa-B (RANK) ligand inhibitor

- ✚ Denosumab (Prolia, Xgeva)
- ✚ Monoclonal antibody bone-modifying agent, used for bony metastases
- ✚ Subcutaneous injection every 6 months
- ✚ Cardiovascular, neurologic, and gastrointestinal side effects are not uncommon
- ✚ **Possibly worse bone density and increased fracture risk after discontinuation**
- ✚ Possible alternative for women at high risk for fracture who cannot take bisphosphonates

# Other Medications

## Sclerostin Inhibitors

- ✚ Romosoxumab (Evenity)
- ✚ Monoclonal antibody bone-modifying agent
- ✚ Subcutaneous injection monthly for 12 months
- ✚ **Increased risk of MI, stroke, and cardiovascular death**
- ✚ Possible alternative for women at high risk for fracture who cannot take bisphosphonates
- ✚ Unlike the PTH analogs, can be used again after stopping

# Treatment

- ✚ First check: creatinine, calcium, albumin, and vitamin D level
  - ✚ GFR should be  $\geq 30$
  - ✚ Hypocalcemia can be worsened by bisphosphonates
  - ✚ Albumin to get the corrected calcium
  - ✚ Vitamin D level should be above 20 ng/ml before initiating treatment with bisphosphonates
    - ✚ If vitamin D level is below 20 ng/ml, treat with vitamin D2 -- 50,000 units once weekly for 6-12 weeks
    - ✚ Re-check a level before starting bisphosphonates

# Contraindications to Alendronate

- ✚ True Allergy
- ✚ Renal
  - ✚ GFR <30
- ✚ Gastrointestinal
  - ✚ esophageal stricture
  - ✚ achalasia
  - ✚ inability to remain upright for 30 minutes
  - ✚ history of bariatric surgery
  - ✚ IV bisphosphonate may be a good choice
- ✚ Endocrine
  - ✚ hypocalcemia



# Bisphosphonates – Adverse Effects

- ✠ Gastrointestinal issues
  - ✠ Difficulty swallowing
  - ✠ Gastric ulcer
  - ✠ Esophageal inflammation
- ✠ Atrial fibrillation?
- ✠ Osteonecrosis of the jaw
- ✠ Atypical femur fractures\*



# Atypical Femur Fractures



# Atypical Femur Fractures

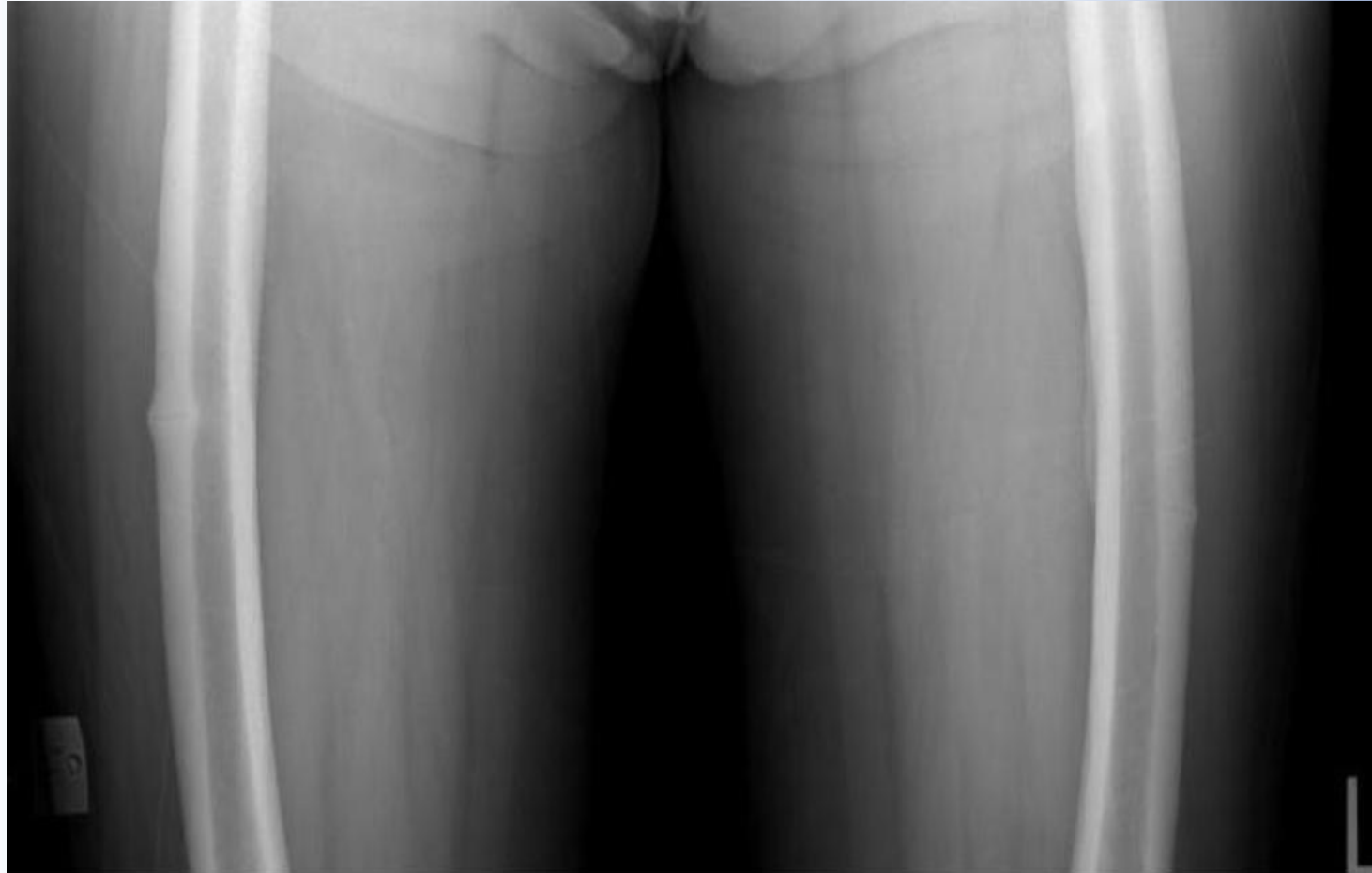




# Overall Benefit of Bisphosphonates

🦴 **NNT** for alendronate is about **100** patients

🦴 **NNH** for alendronate is about **5000** patients\*



<b>Years of Rx with a oral Bisphosphonate</b>	<b>Risk/Year per 100,000 for an Atypical Femur Fracture</b>
<b>&lt;1 year</b>	<b>2 in 100,000</b>
<b>1 - 1.9 years</b>	<b>2 in 100,000</b>
<b>2 - 2.9 years</b>	<b>3 in 100,000</b>
<b>3 - 3.9 years</b>	<b>12 in 100,000</b>
<b>4 - 4.9 years</b>	<b>16 in 100,000</b>
<b>5 - 5.9 years</b>	<b>24 in 100,000</b>
<b>6 - 6.9 years</b>	<b>43 in 100,000</b>
<b>7 - 7.9 years</b>	<b>78 in 100,000</b>

Dell R, Greene D, Ott S, et al. A retrospective analysis of all atypical femur fractures seen in a large California HMO from the years 2007 to 2009. ASBMR 2010 Annual Meeting, Toronto, Canada. 2010

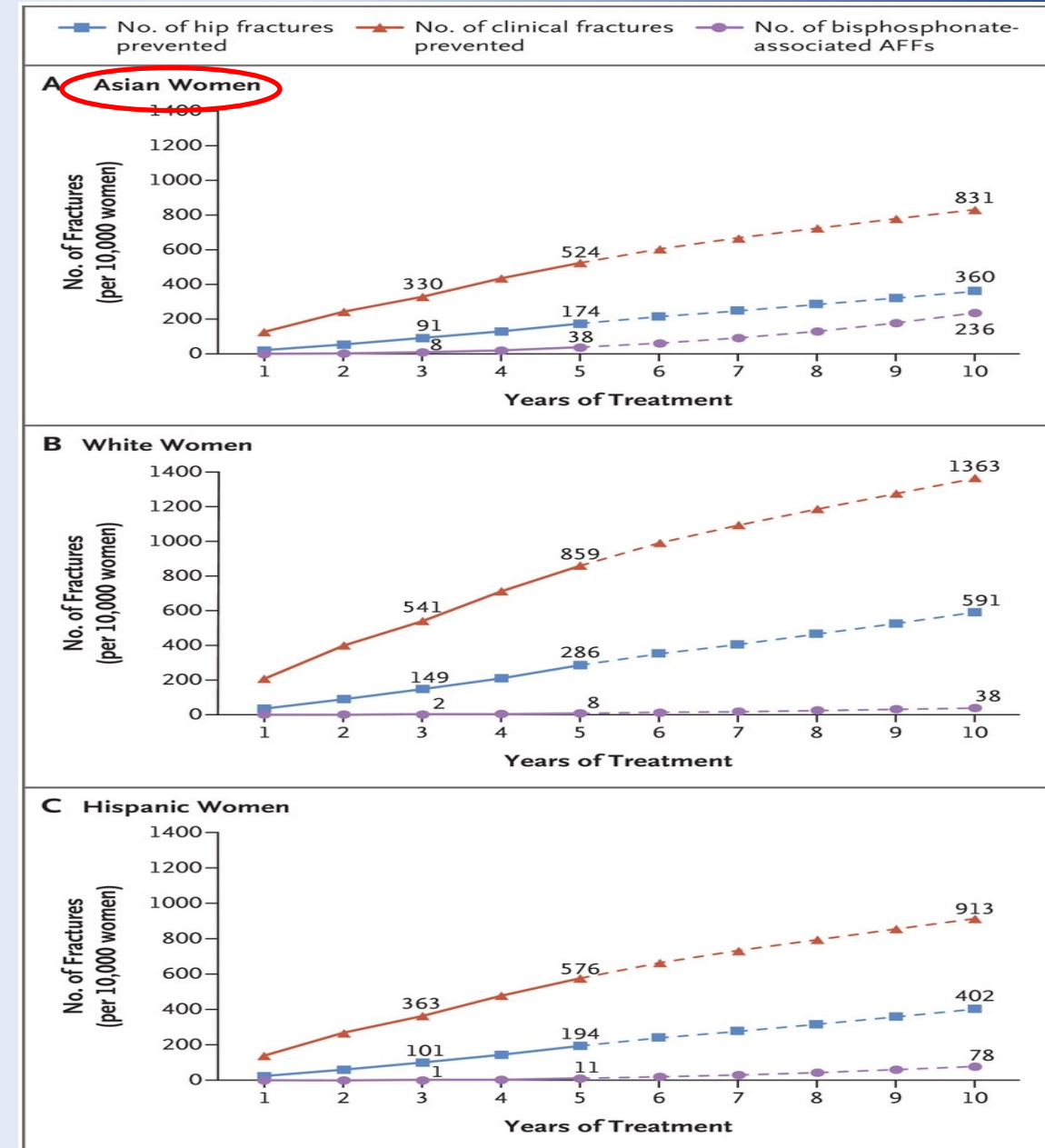
# Atypical Femur Fractures

🦴 Highest incidence in **Asian** women

🦴 Glucocorticoid use > 1 year also a risk factor

🦴 Benefit still outweighs risk

D.M. Black, E.J. Geiger, R. Eastell, *et al.* Atypical femur fracture risk versus fragility fracture prevention with bisphosphonates  
N. Engl. J. Med., 383 (8) (2020), pp. 743-753



# Drug Holiday



- After 5 years of oral bisphosphonate therapy (or 3 years of IV bisphosphonate), there should be a drug holiday if:
  - DEXA T-score is better than -2.5, **and**
  - No history of fragility fracture, **and**
  - Not on bone-losing medication
- Reassess with DEXA scan every 2 years
  - Resume treatment for any of the above changing or for bone loss >5% between tests

# Summary

- Osteoporotic hip fractures affect as many as 1 in 8 women, resulting in 10-20% excess mortality
- Screening with DEXA is recommended in:
  - all women 65 and older
  - all men 70 and older\*
  - fracture patients 50 and older
  - higher risk patients (50 and older)

# Summary

- ✚ Primary prevention in people 50+ (BHOF):
  - ✚ 1000-1200mg of calcium daily
  - ✚ 800-1000 IU of vitamin D\*
  - ✚ regular weightbearing and muscle strengthening exercises to reduce the risk of falls
  - ✚ safety-proofing the home
  - ✚ avoid smoking and excessive alcohol

# Summary

- Start treatment in patients with:
  - a hip or a vertebral fracture
  - a Dexa T-score of -2.5 or lower
  - a FRAX 10-year probability of:
    - 3% or more for hip fracture
    - or
    - 20% or more for major osteoporotic fracture

# Summary

- ✚ Bisphosphonates are the medication of choice to treat osteoporosis
  - ✚ Most side effects are gastrointestinal in nature
  - ✚ Serious side effects are rare but notable
  - ✚ Benefits outweigh serious risks by 50 to 1
  - ✚ A 5-year timespan of treatment is currently recommended, with reassessment and a possible 2-year drug holiday
  - ✚ A repeat DXA scan can be checked at 2 years



# Questions/Comments

