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RCSI UNIVERSITY OF MEDICINE AND HEALTH SCIENCES

From Brittle to Better

Osteoporosis

IMA CGP Golden Jubilee Dr. Arulrhaj Oration
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Introduction

"…a systemic skeletal disease characterized by **low bone mass** and **microarchitectural deterioration** with a consequent increase in bone fragility with susceptibility to fracture…"

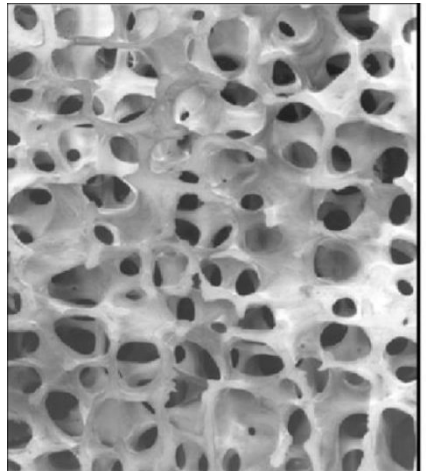
WHO definition

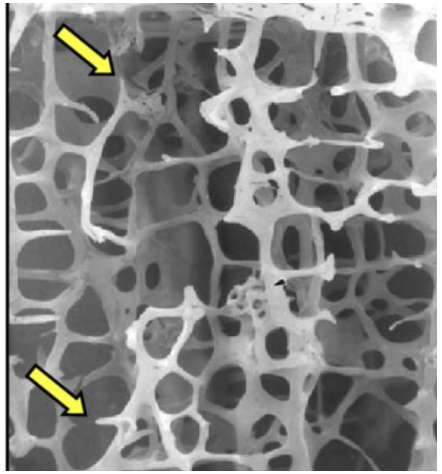
Osteopenia

Osteoporosis

Continuum of conditions presents with

- **decrease** in **bone mass**
- disrupted bone **microarchitecture**





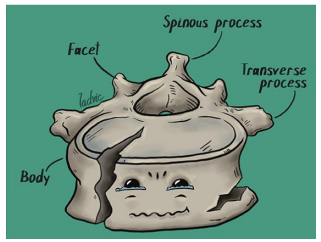
Common Causes:

- Increased age
- Menopause
- Metabolic abnormalities

Importance in primary care: Epidemiology

200 million people worldwide

- **Male: female** ratio is **1:4**
  - Men have a higher prevalence of **secondary osteoporosis (60%)** including
    - Hypogonadism, glucocorticoid excess, alcoholism
- Age bracket
  - Osteoporosis
    - **Postmenopausal** osteoporosis is highest in women aged 50-70 years
      - **Senile** osteoporosis begins after 70 years
      - **Secondary** osteoporosis begins at any age
  - Fractures
    - **Wrist** fractures most commonly 50-60 years
    - **Vertebral** most commonly 60-70 years
    - **Hip** fractures most commonly 70-80 years



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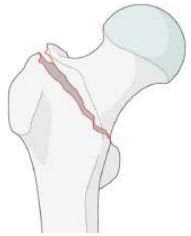

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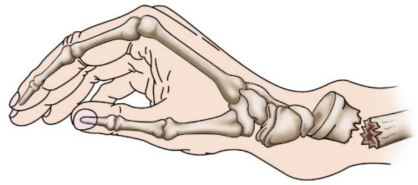


Etiology

Quantitative (not qualitative) disorder of **bone mineralization**

Primary: Age related, post-menopausal

Secondary: Underlying conditions (Endocrine, chronic illness)

Risk factors

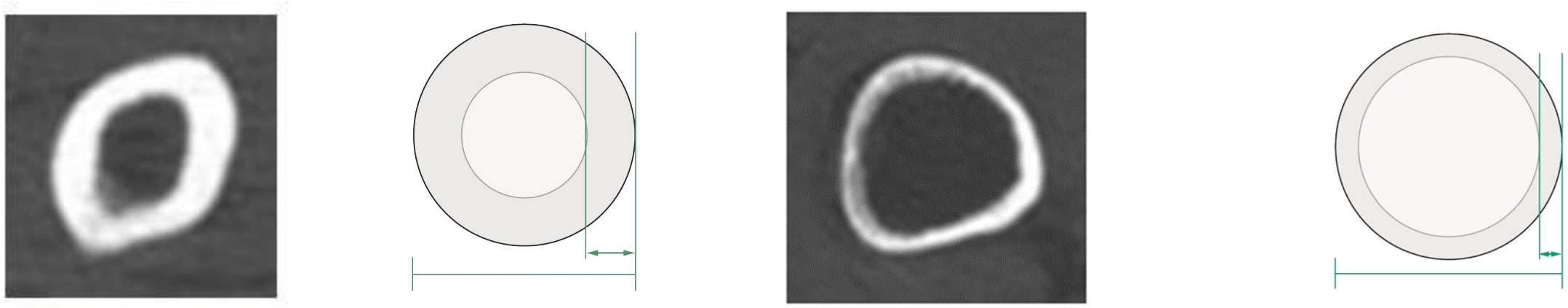
Non-modifiable: Age, gender, family history, genetics
Modifiable: Lifestyle (smoking, alcohol, sedentary behavior), nutritional deficiencies, low BMI
Medications: Steroids, anticonvulsants, proton pump inhibitors

OFTEN ASYMPTOMATIC

Changes in cortical bone

Decreased thickness

- Increase of bone diameter to maintain bending stiffness

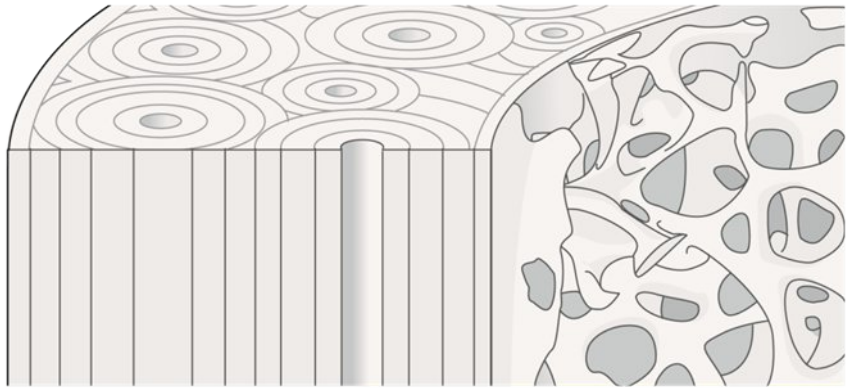


CT cross sections of the femur

Changes in cortical bone

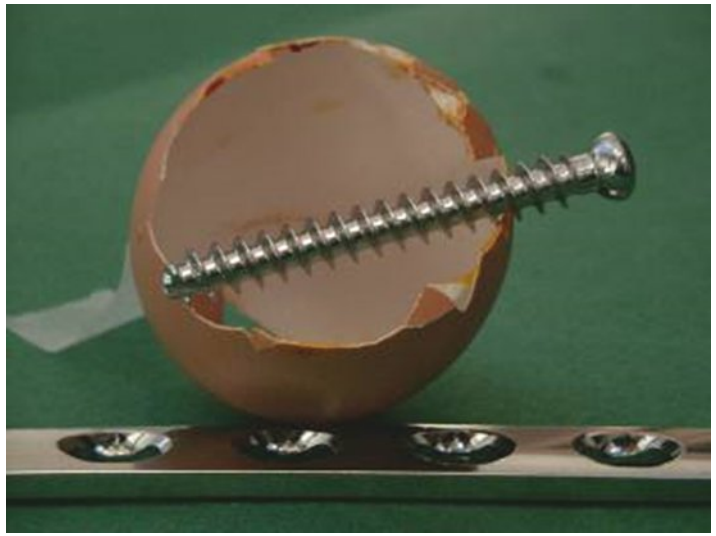
Increased Haversian canal areas (lacunae formation)

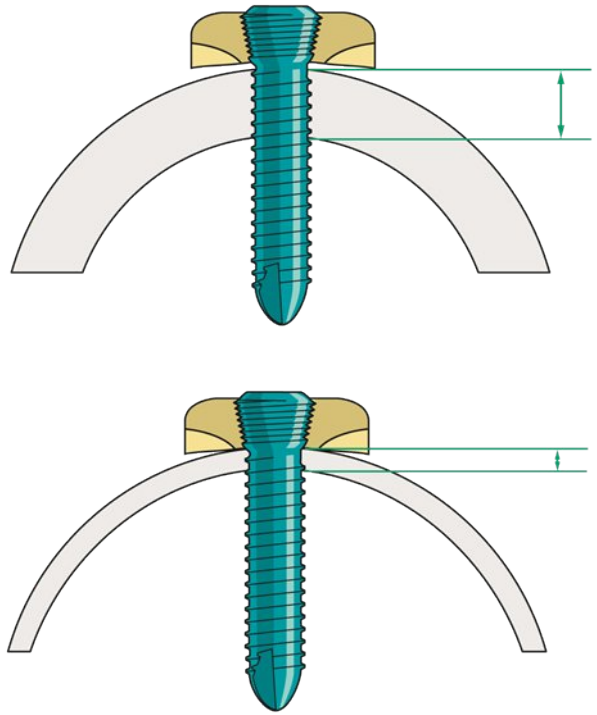
- Increased weakness and predisposition to low-energy fractures



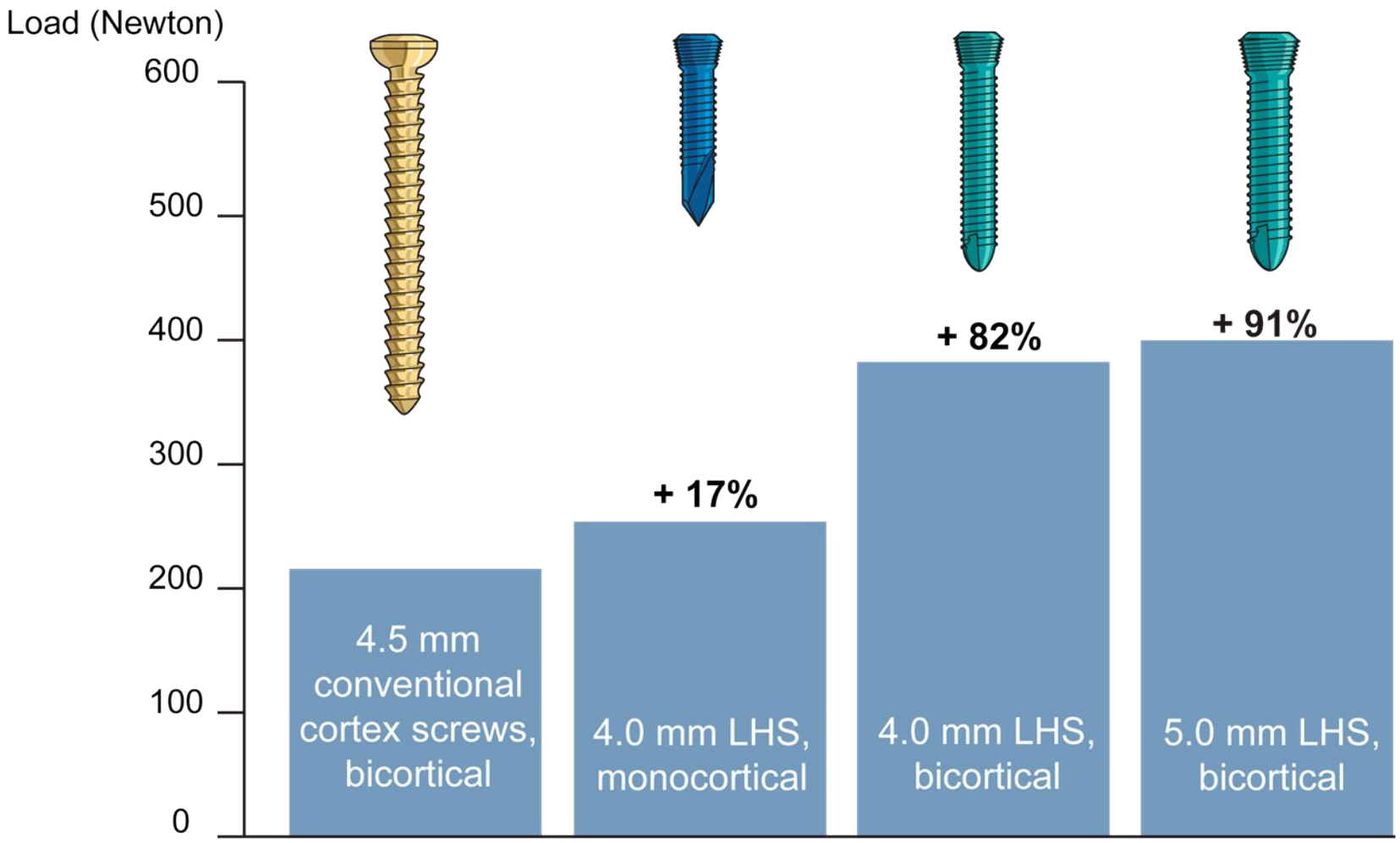
Decreased thickness

- Less “working length” of implants





Test results in an osteopenic bone model



loading…..stiffness…failure…example…

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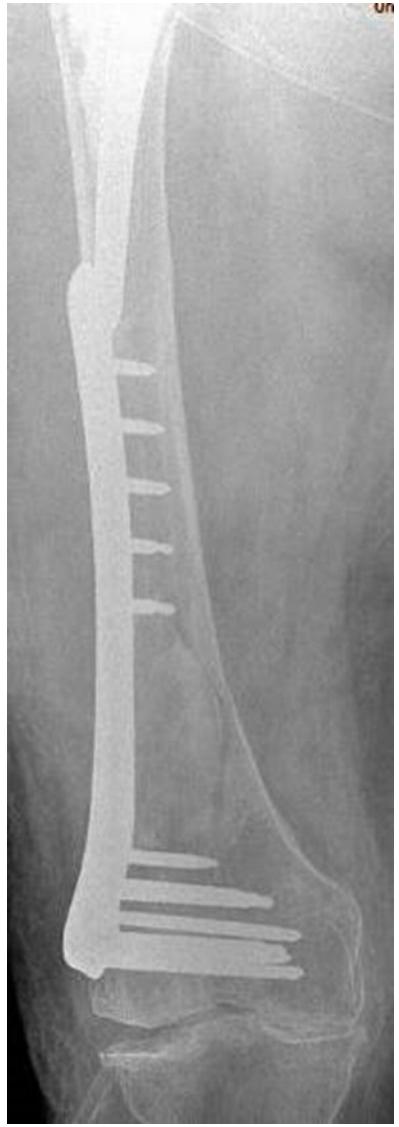
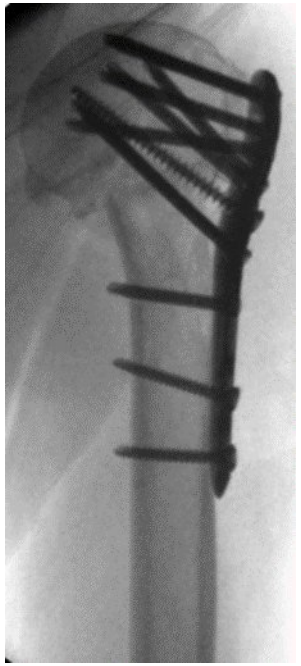
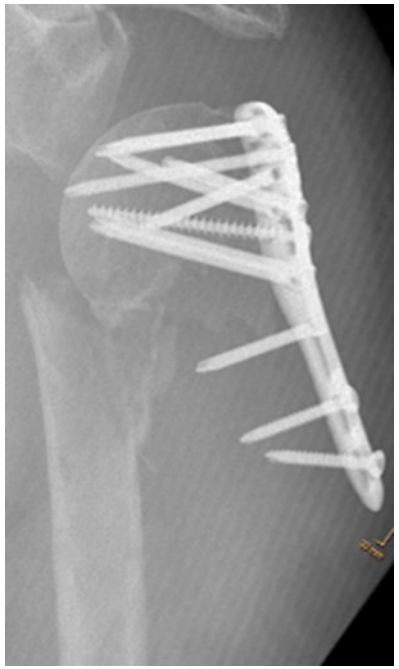


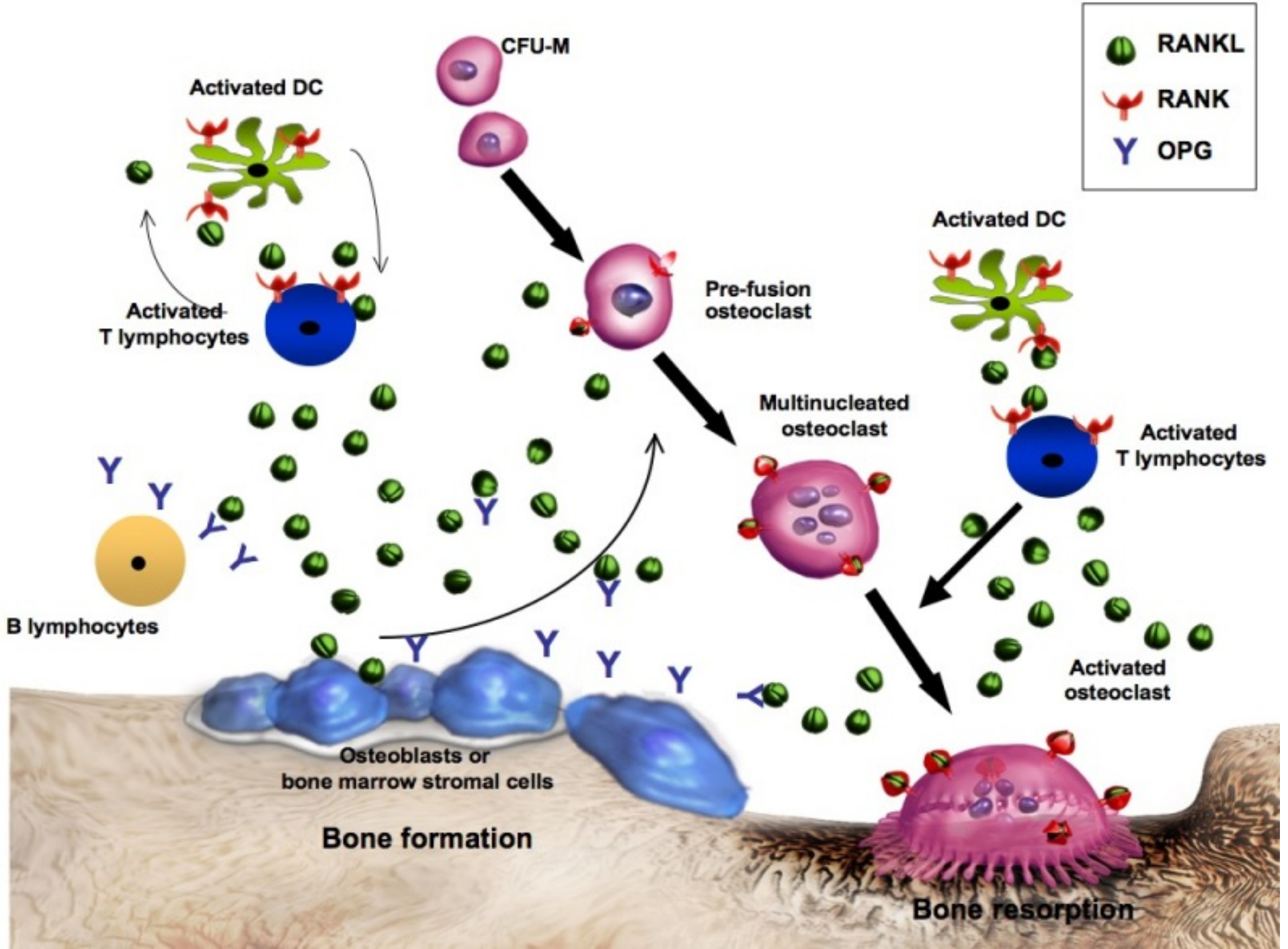
5 days later

10 months postoperatively

Signs of poor bone quality

- Multiple vertebral compression fractures
- Previous hip, radial, or tibial plateau fractures
- End-stage renal disease
- Steroid or anticonvulsant therapy



Rosen CJ *et al*

Diagnosis: Imaging

DEXA Scan (Dual Energy Xray Absorptiometry)

Performed in

- **Lumbar spine:** measures BMD from L2 to L4 and compiles scores
- **Hip:** measure BMD from femoral neck, trochanter, and intertrochanter region and compiles scores

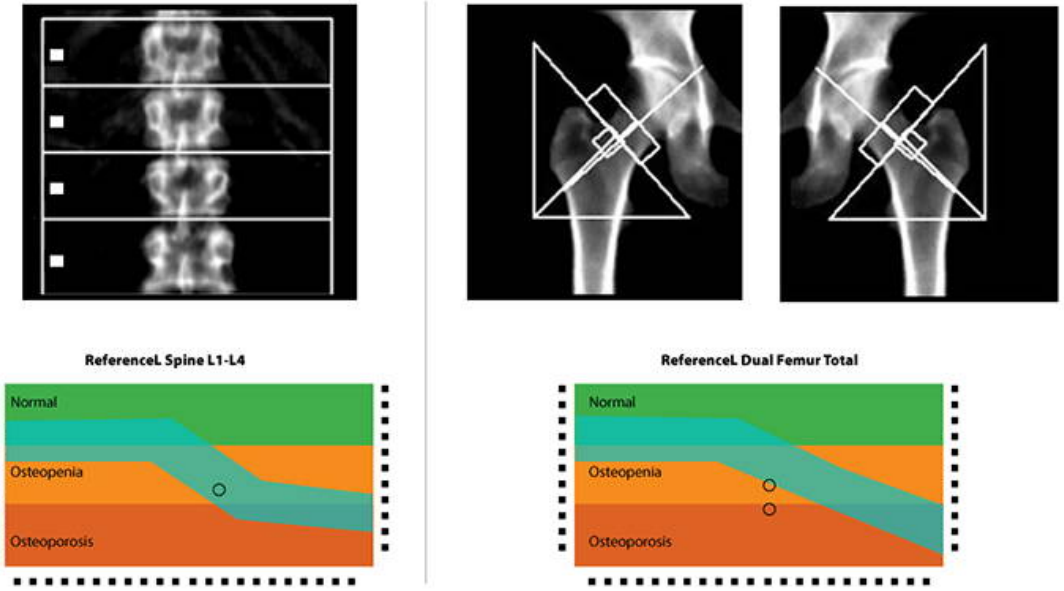
Sensitivity and specificity

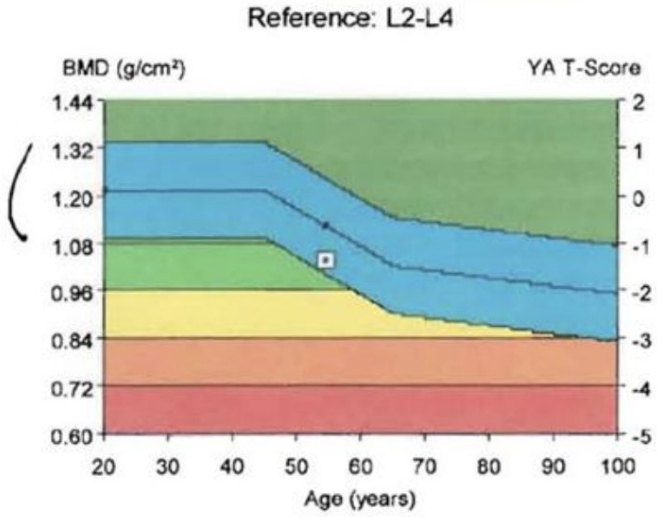
- most accurate with the least amount of radiation exposure

T-Score

Osteopenia: -1 to -2.5 standard deviations

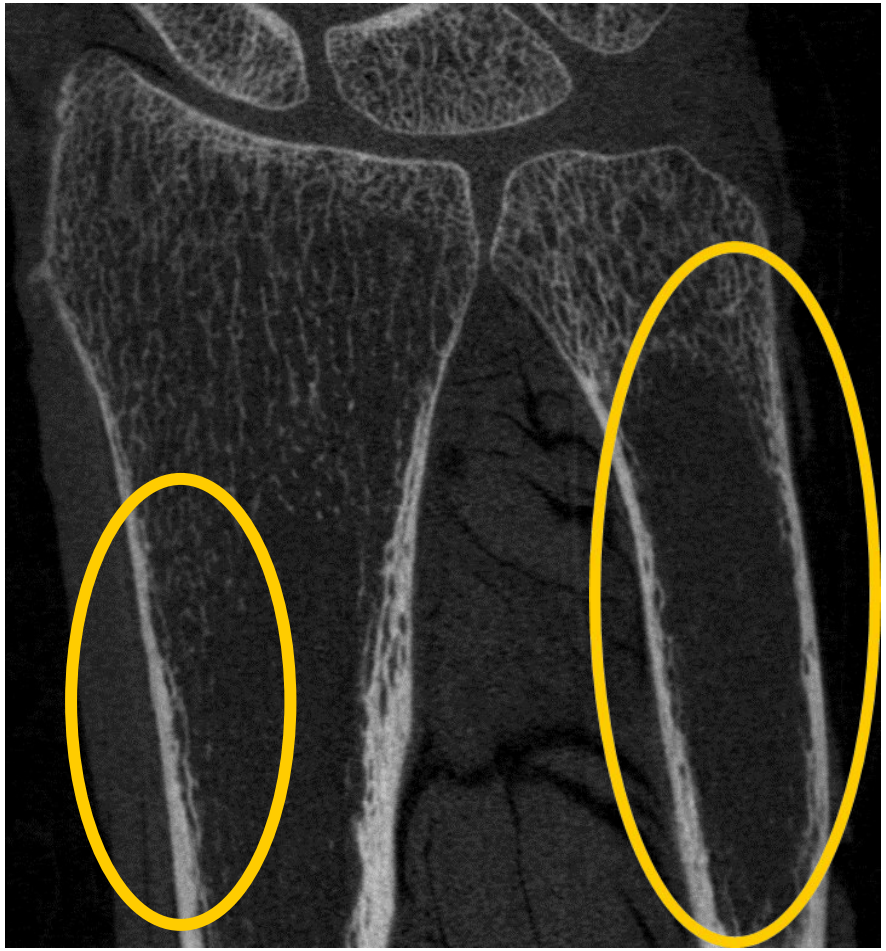
Osteoporosis: >-2.5 standard deviations





Region	BMD[1] (g/cm²)	Young-Adult[2] T-Score	Age-Matched[3] Z-Score
L2-L4	1.037	-1.4	-0.7

Changes in cortical and cancellous bone



Diagnosis: Lab studies

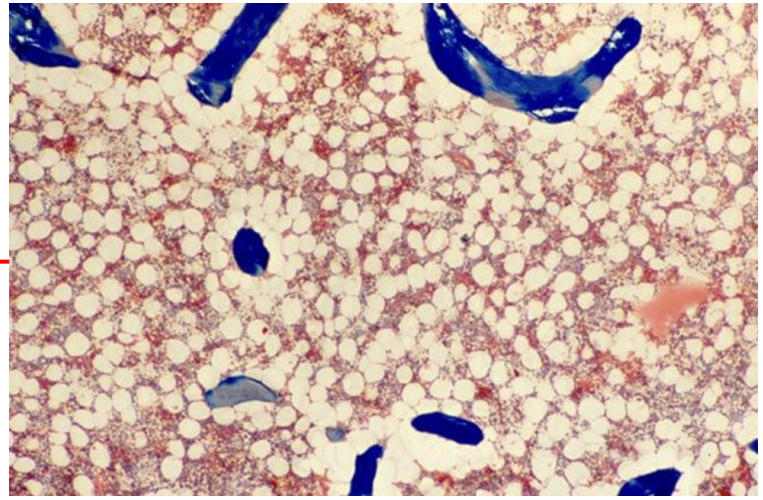
- **25-hydroxyvitamin D** level
- Other labs may be drawn to rule out other causes of osteoporosis (endocrine, hematologic, malignancy, etc)
- Complete blood count (CBC), calcium, phosphate, alkaline phosphatase

Special Tests to Rule Out Secondary causes

- **T**hyroid **f**unction **t**ests, **vit**amin **D** levels, parathyroid hormone (**PTH**)
- Serum protein electrophoresis (**SPEP**) for multiple myeloma
- Other endocrine and metabolic markers as indicated

Histology

- Thinned trabeculae
- Decreased osteon size
- Enlarged Haversian and marrow spaces
- Osteoclast ruffled border



Screening + Risk Assessment

Who Should be Screened?

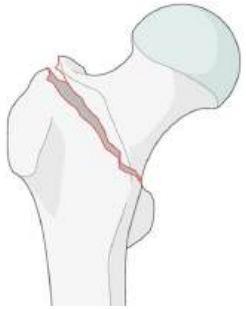
Women ≥65 years and men ≥70 years

Postmenopausal women <65 years with additional risk factors

Patients with a history of fractures or on long-term corticosteroids

Risk Assessment Tools

FRAX (Fracture Risk Assessment Tool): **10-year probability** of **fracture**
Recommendations for incorporating BMD into risk calculation



Choice of Antiosteoporotic Treatment

- the level of fracture risk,
- additional clinical risk factors,
- cost-effectiveness of treatment,
- resemblance of the patient’s characteristics to the populations of effectiveness studies of antiosteoporotic medicines
- patient preferences

When to refer to Osteoporosis Specialist

- A recent vertebral fracture [within the last 2 years]
- ≥2 vertebral fractures [whenever they have occurred]
- BMD T-Score ≤-3.5
- Treatment with high dose glucocorticoids [≥7.5 mg/day of prednisolone or equivalent over 3 months] (refer urgently given rapid loss in bone post initiation of glucocorticoids; if any delay is anticipated, start an oral bisphosphonate in the meantime)
- The presence of multiple clinical risk factors, particularly with a recent fragility fracture indicating high imminent risk of re-fracture,
- Or other indicators of very high fracture risk.

www.nogg.org.uk/full-guideline/section-4-intervention-thresholds-and-strategy

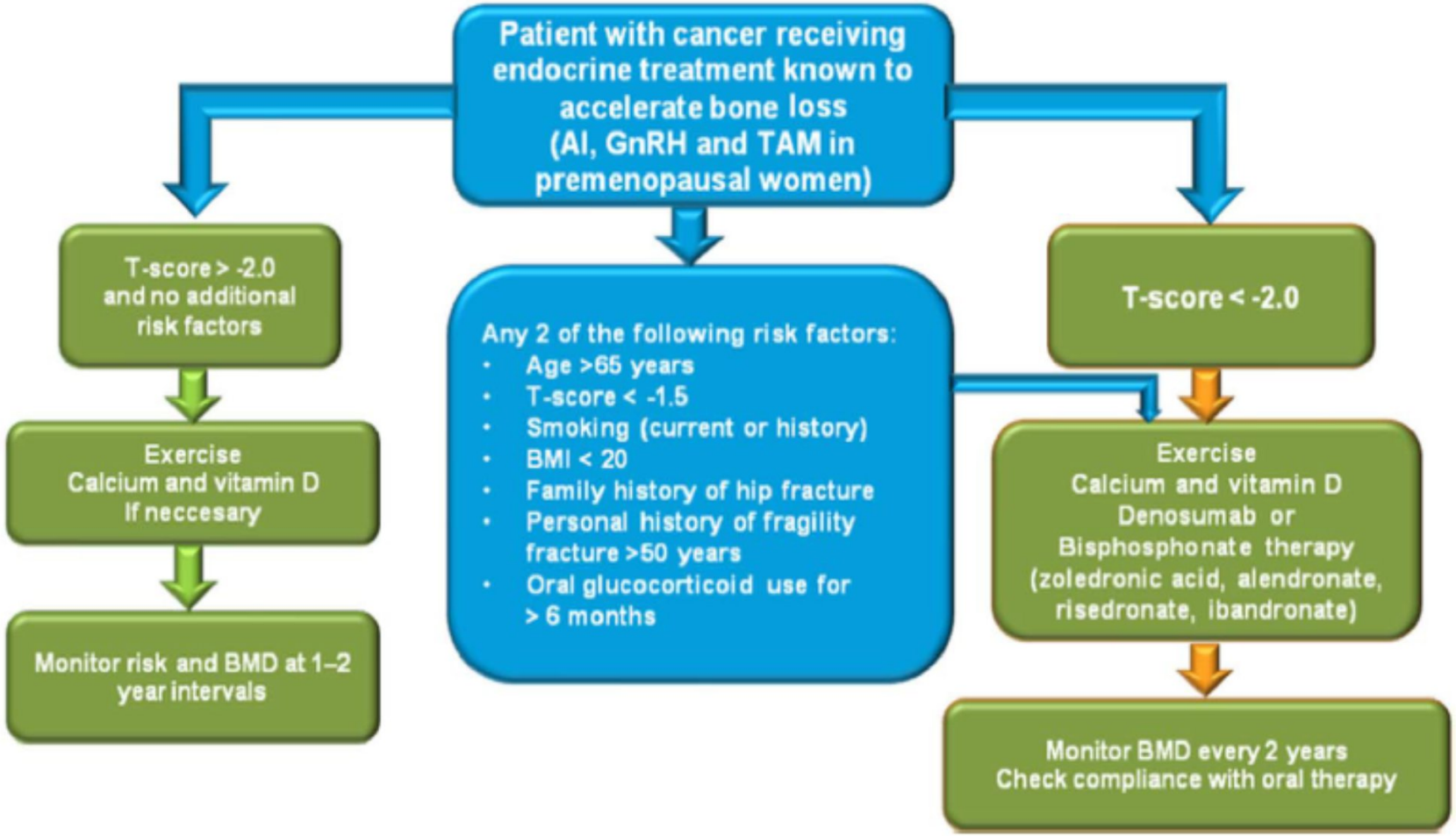
Management: Lifestyle + non-pharmacological treatment

Dietary Recommendations — **Calcium** and **vitamin D** intake, role of other nutrients (e.g., magnesium, vitamin K)

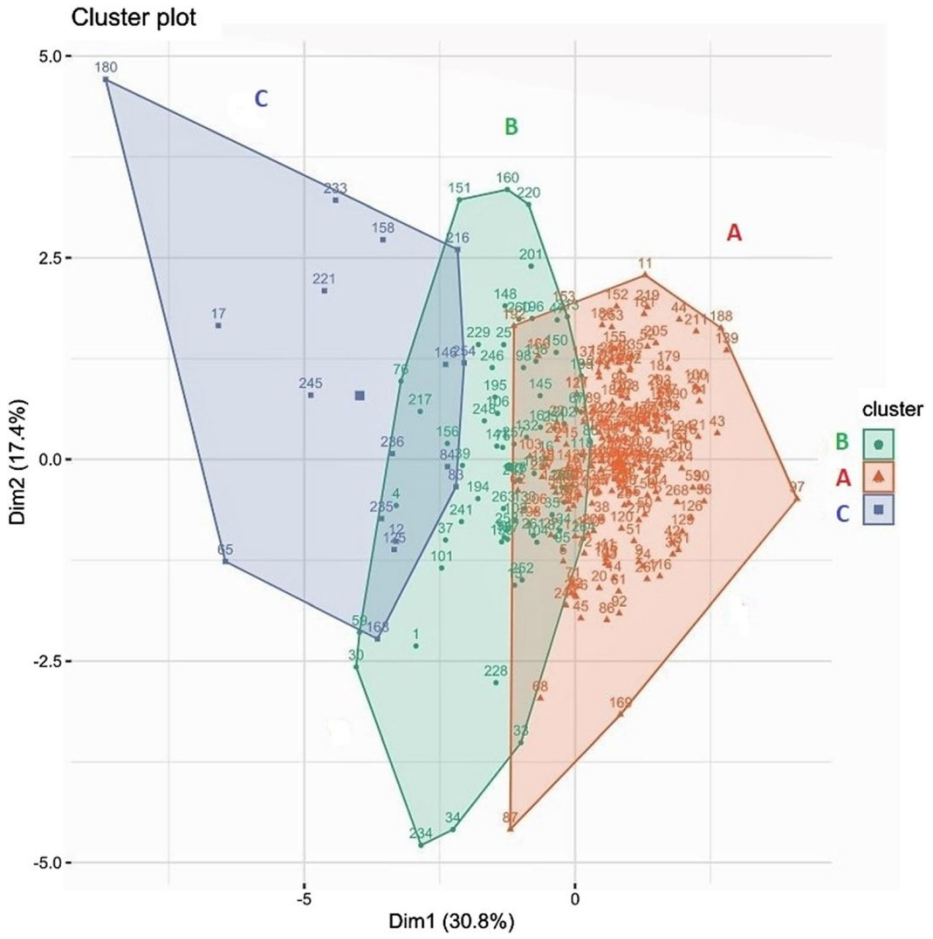
Exercise and Physical Activity — Activity **Weight-bearing** and muscle-strengthening exercises

Lifestyle Modifications — Smoking cessation, alcohol moderation, **fall prevention strategies** (fracture liaison services)

Cancer Induced Osteoporosis



Osteoporosis patterns in Hip fracture patients



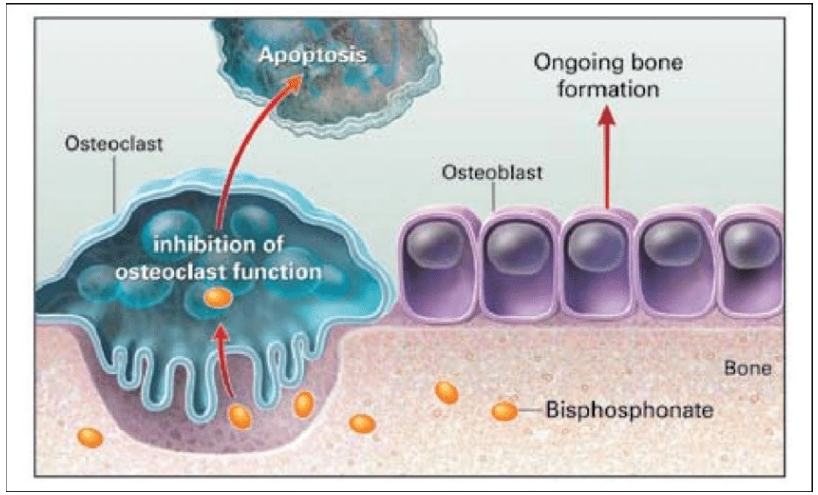
- A: normal bone formation and slightly increased bone resorption.
- B and C: secondary hyperPTH and increased bone turnover, related to CKD and hypovitaminosis D
- C: as B with worse e-GFR and very high bone turnover

E. Papakitsou et al. Hormones 2021. Bone metabolism subgroups identified as hip fracture patients via clustering

Management: Pharmacological treatment

First-Line Therapies

Bisphosphonates: Alendronate, risedronate, zoledronic acid



Alternative Options

Denosumab: Mechanism and administration

Selective Estrogen Receptor Modulators (SERMs): Raloxifene

Anabolic Agents

Teriparatide, romosozumab for severe osteoporosis or high fracture risk

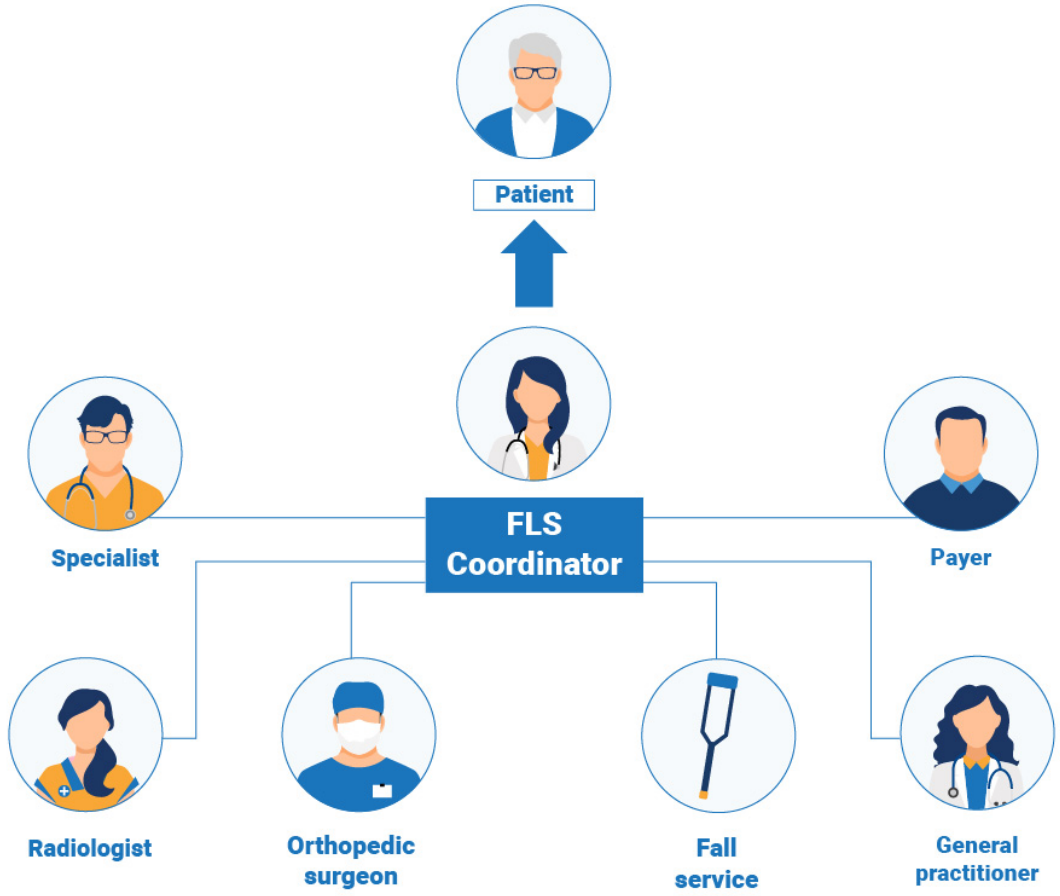
Monitoring and follow up

Prevention strategies

Primary Prevention in At-Risk Populations
Educating patients on diet, exercise, and lifestyle

Secondary Prevention Post-Fracture
Early rehabilitation, fall prevention in elderly

Role of multidisciplinary team for fracture liaison services (FLS)



Denosumab discontinuation

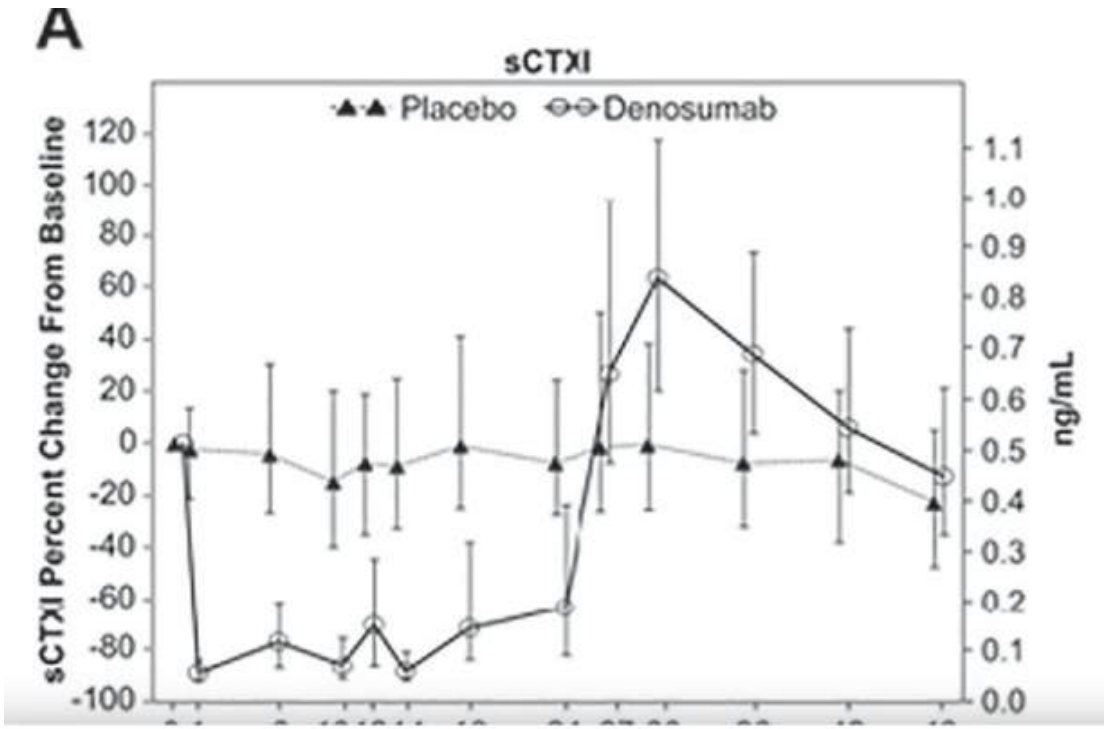
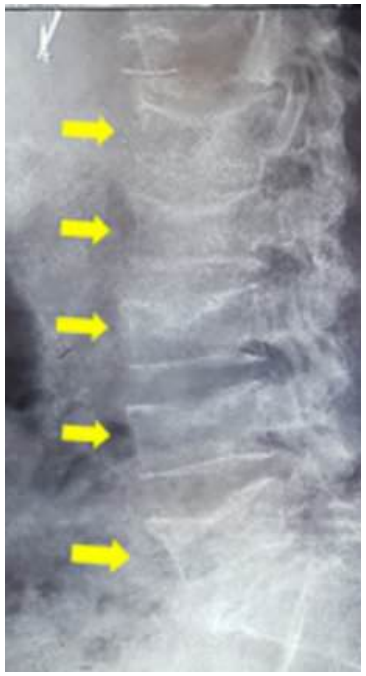


Fig. 3. Effects of stopping denosumab on bone turnover.

Reprint form Tsourdi et al Bone

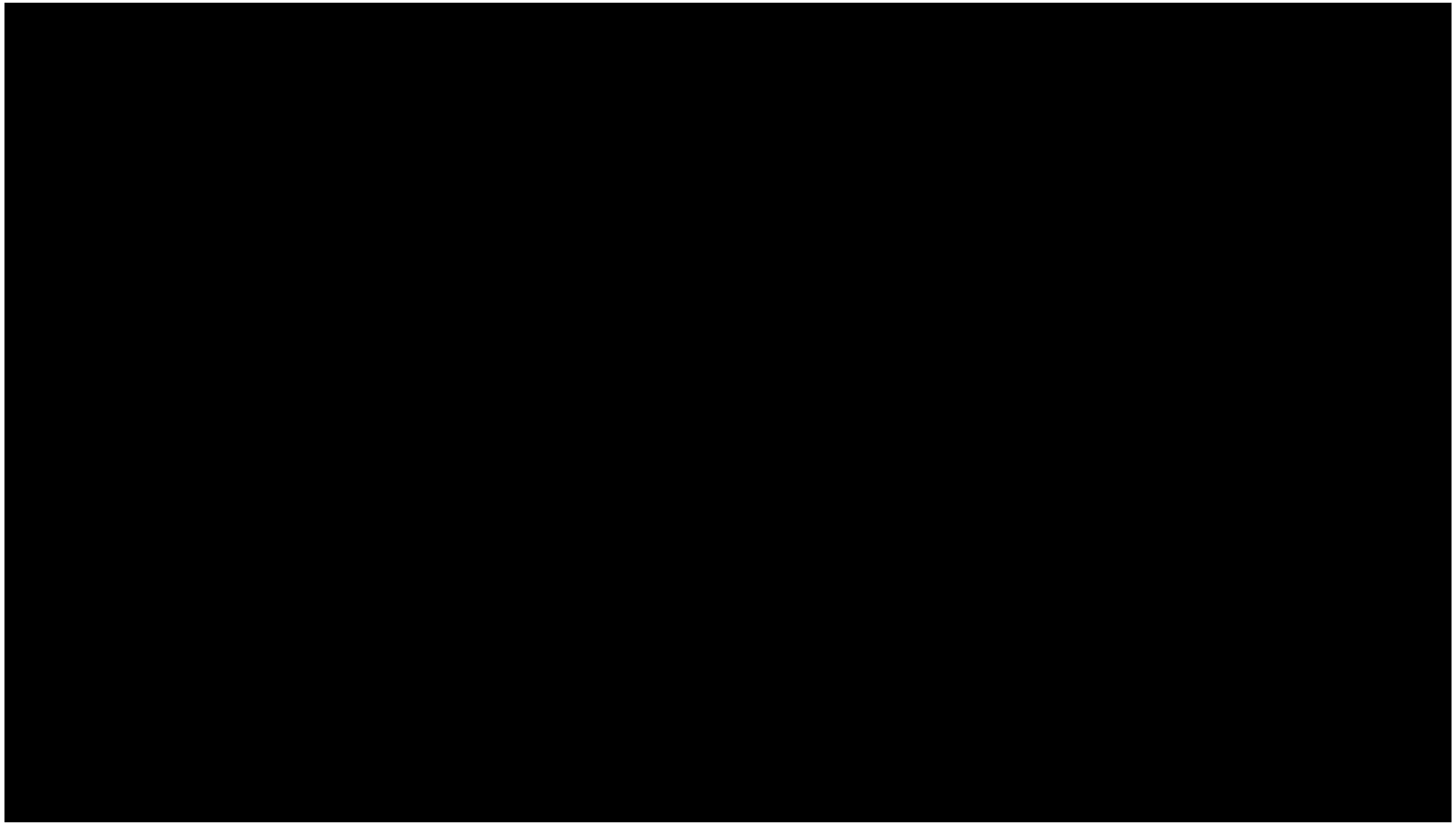


Reprint from Anastasilakis et al.

CMAJ 2018 23;190(16). Warning of an increased risk of vertebral fracture after stopping denosumab

Key take away points

Importance of **early diagnosis** and **regular screening**

Comprehensive treatment combining **lifestyle, exercise** and **pharmacotherapy**

Role of GP's in **patient education** and **follow-up**