

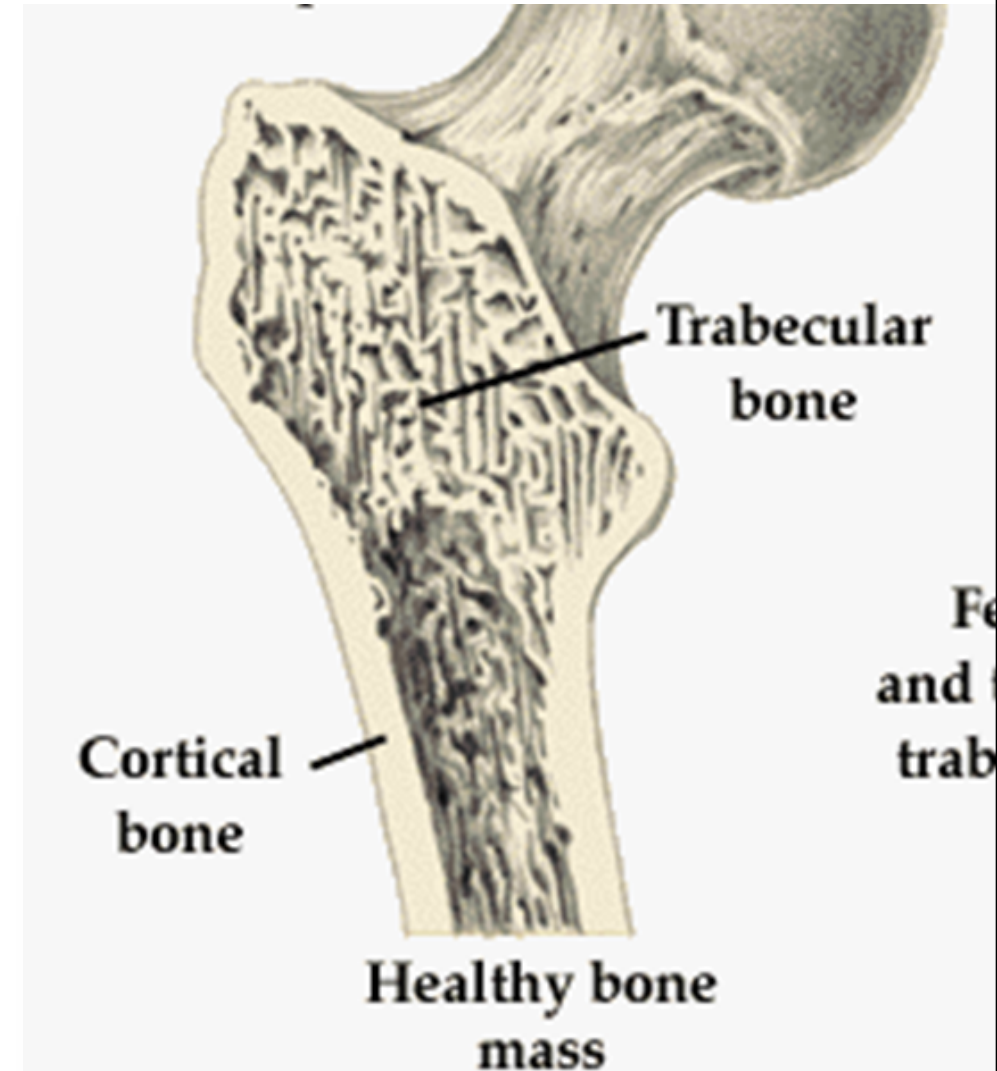
Osteoporosis

Dr. Mohammad Hamdan

Why important

- 10 million Americans and 200 million people worldwide have osteoporosis
- 1.5 million osteoporotic fractures occur each year
- Hip Fx mortality 20%
- Vertebra Fx mortality 15%

Types



COMPOSITION OF BONE

EXTRACELLULAR MATTER

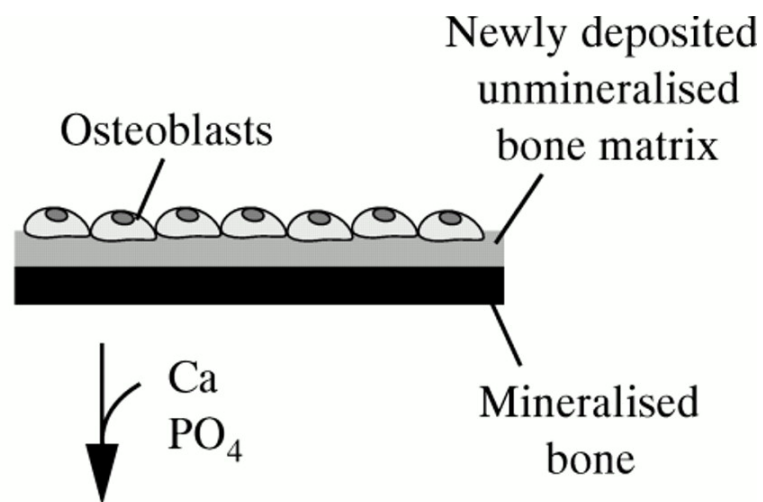
CELLULAR COMPONENT

ORGANIC MATRIX
(Osteoid Tissue)
Collagen fibrins bound
by amorphous
mucopolysaccharide
substance

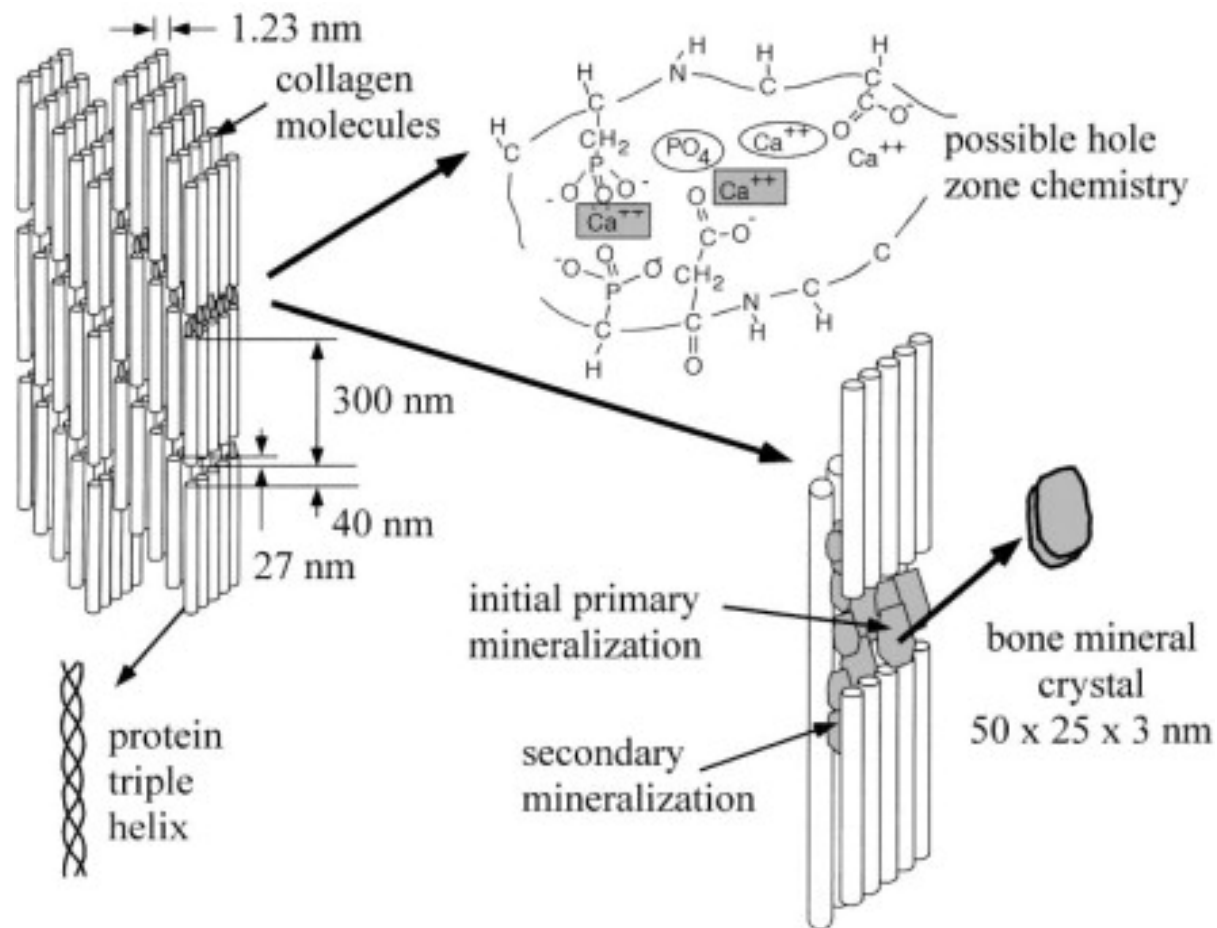
INORGANIC MATRIX
(Bone Mineral)
Calcium phosphate
(hydroxyapatite)

OSTEOBLASTS
OSTEOCLASTS
OSTEOCYTES

Step 1:
Deposition of
osteoid



Step 2:
Mineralisation



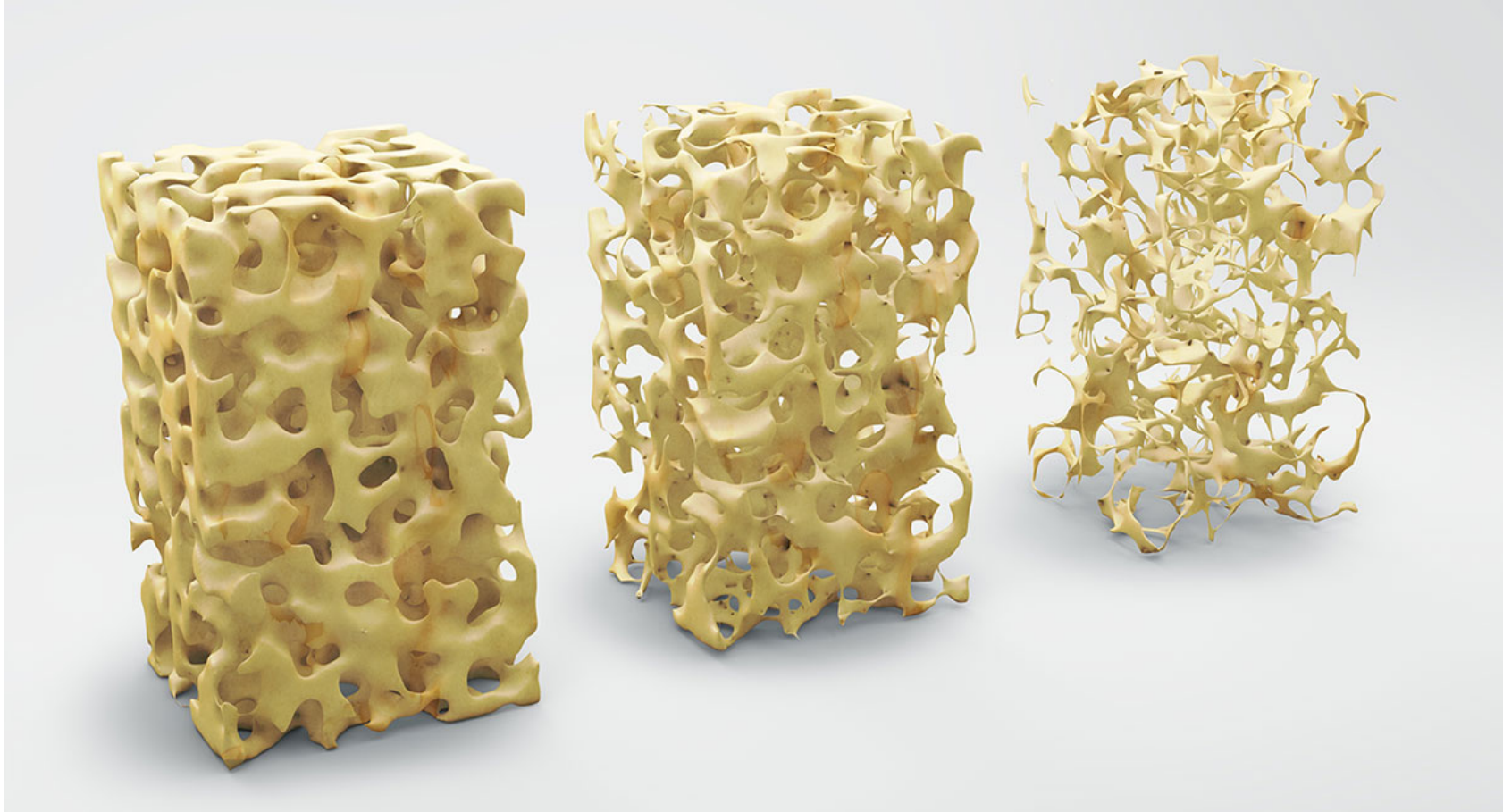


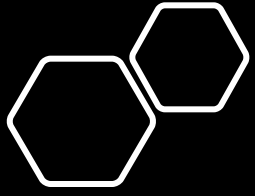
Osteoporosis is...

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

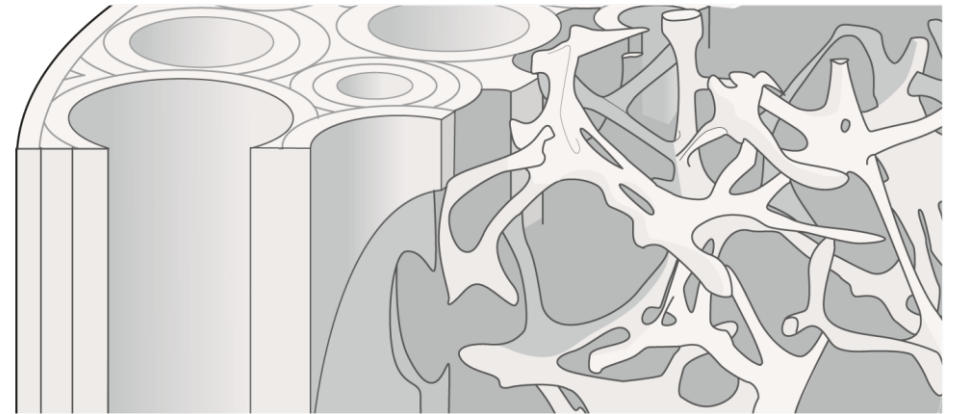
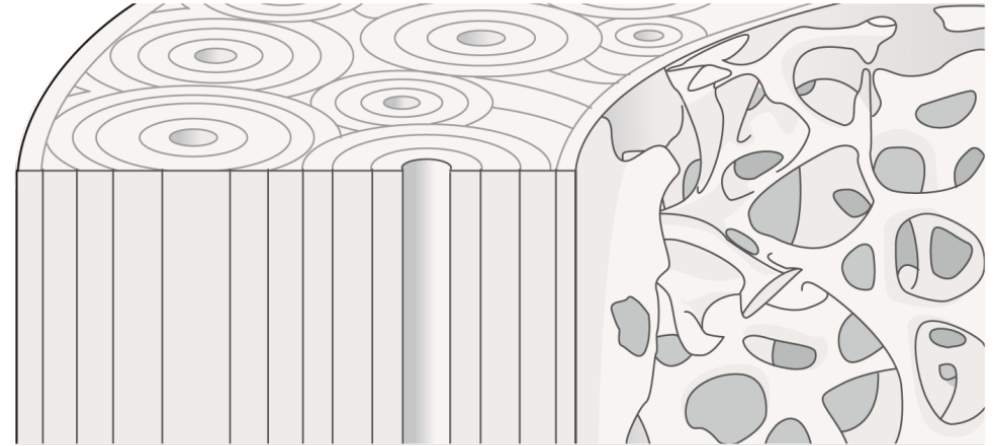
Definition from WHO

Trabecular bone

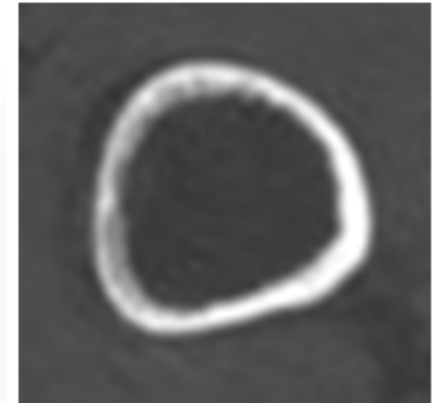
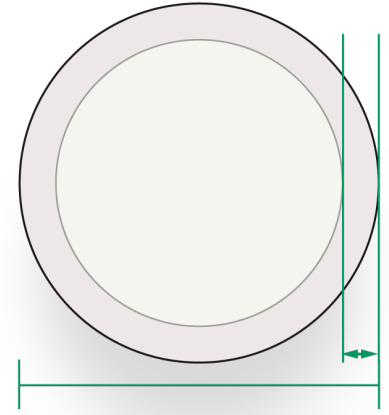
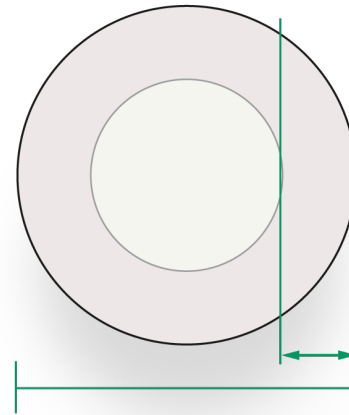




cortical bone



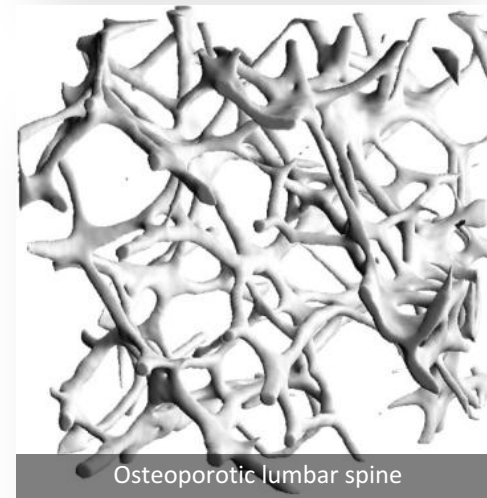
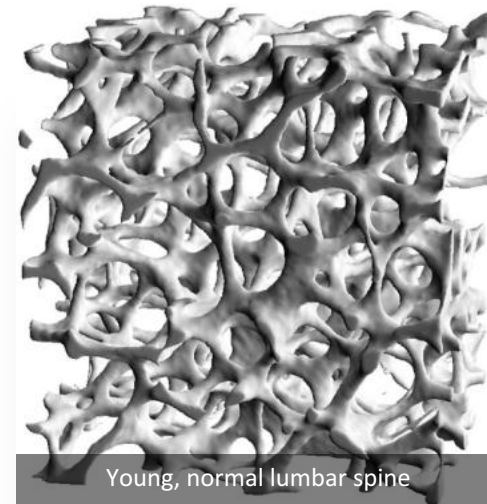
Cortical bone





Cancellous bone

Less and thinner trabeculae with fewer, often broken interconnections



Types

Primary Osteoporosis

Primary: Is the more common form and is due to the typical age-related loss of bone from skeleton.

Type 1 (Postmenopausal Osteoporosis)

- Due to decrease in estrogen or testosterone deficiency

Type 2 (Senile Osteoporosis)

- Inability to produce adequate vitamin D3
- Decrease in bone formation

Secondary Osteoporosis

Secondary: Results from the presence of other diseases or conditions that predispose to bone loss.

- Medications
- Hyperparathyroidism
- Excess Alcohol
- Smoking

Location of fractures

- vertebral body > hip > wrist fractures



Risk factors

Thin, smoker and alcoholic old Caucasian white female with freckles and fair hair known to have RA on steroid

F more than M

Medications

- Steroid
- Phenytoin
- LMWH
- Omeprazole

Diseases

- Malabsorption syndromes
- Hyperthyroidism
- DM1
- Hypogonadism
- Cancers



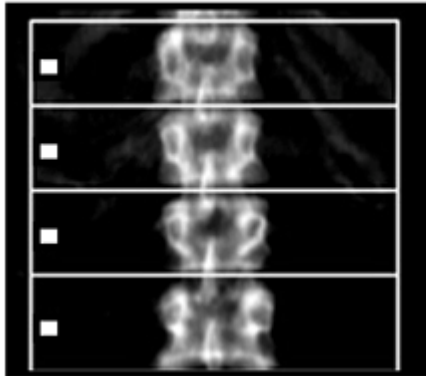
Symptoms and Signs

Patients with osteoporosis are asymptomatic unless a fracture has occurred

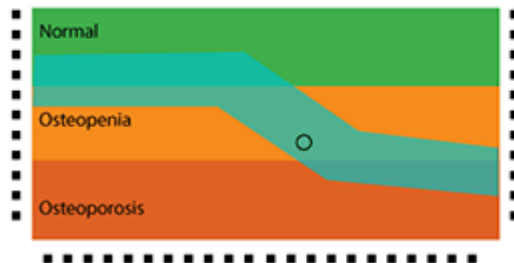
Signs follow the same rule

Diagnosis

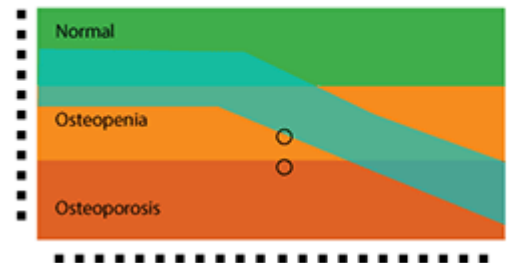
- Dexa Scan (Dual Energy Xray Absorptiometry)



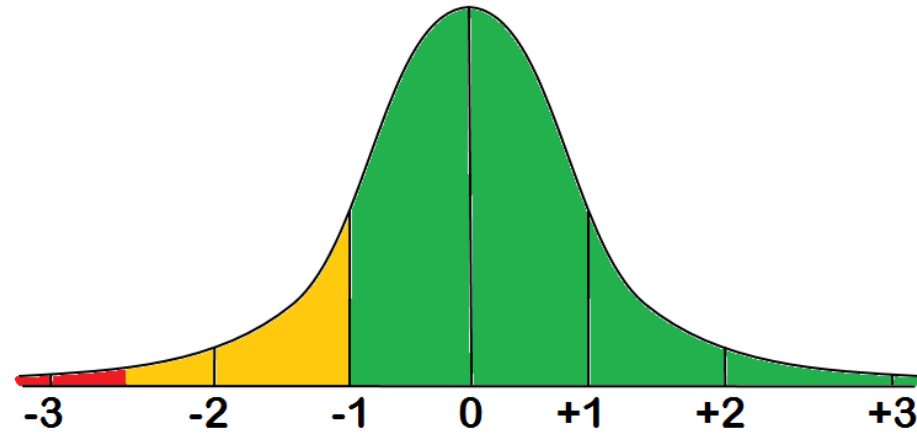
ReferenceL Spine L1-L4



ReferenceL Dual Femur Total

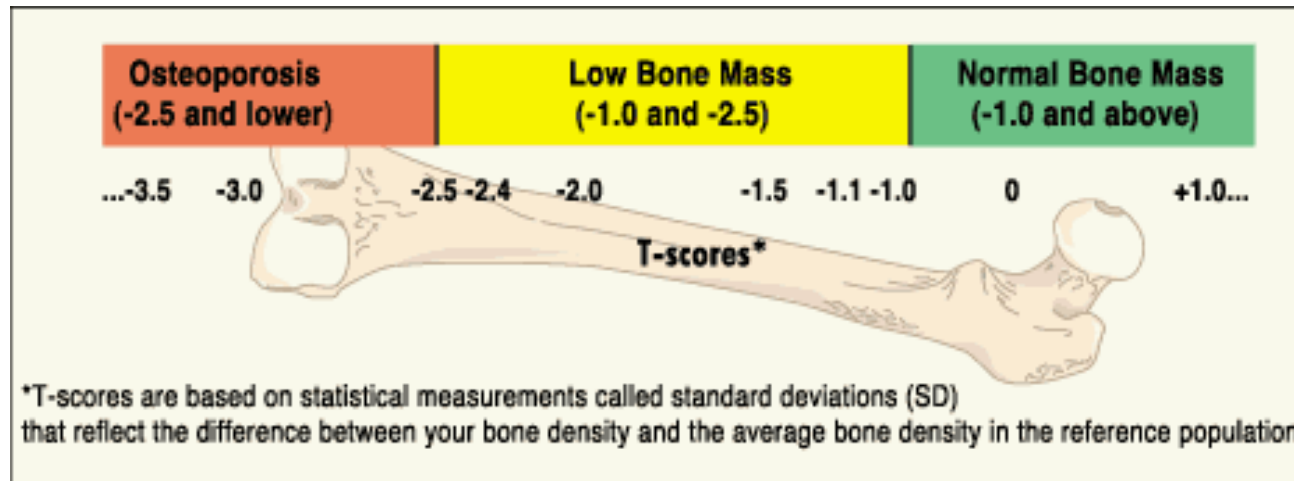
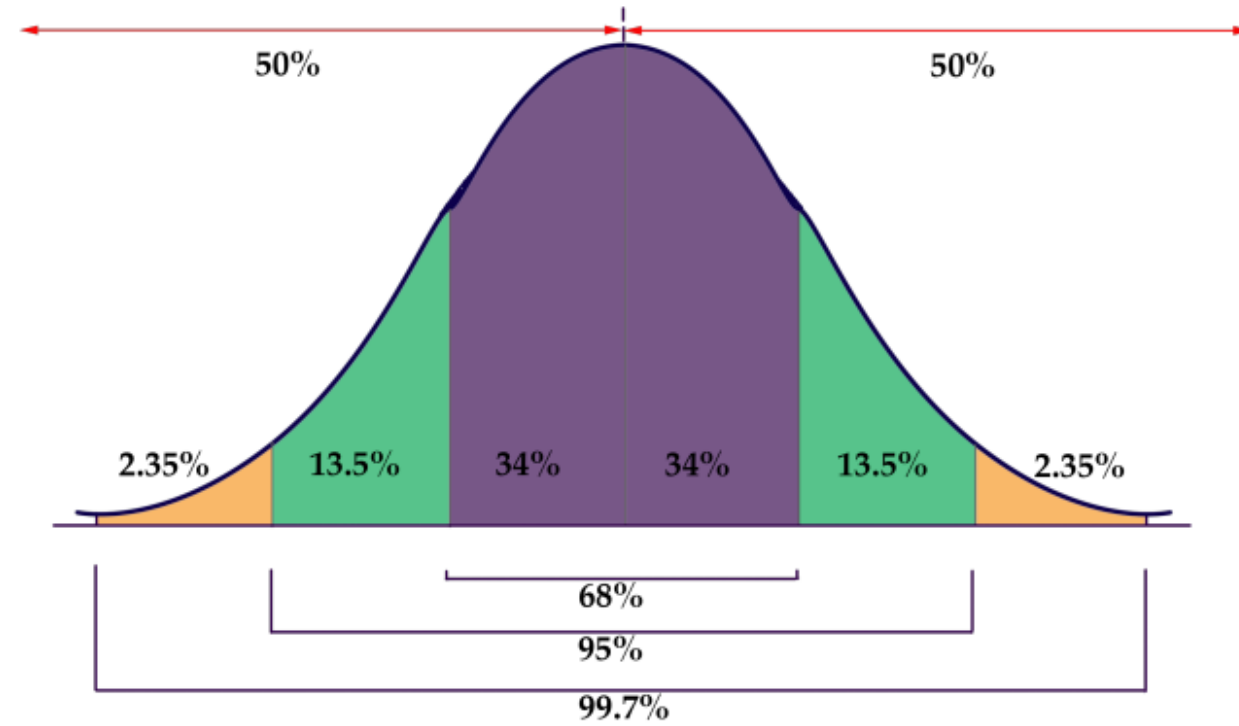


DEXA T-Scores

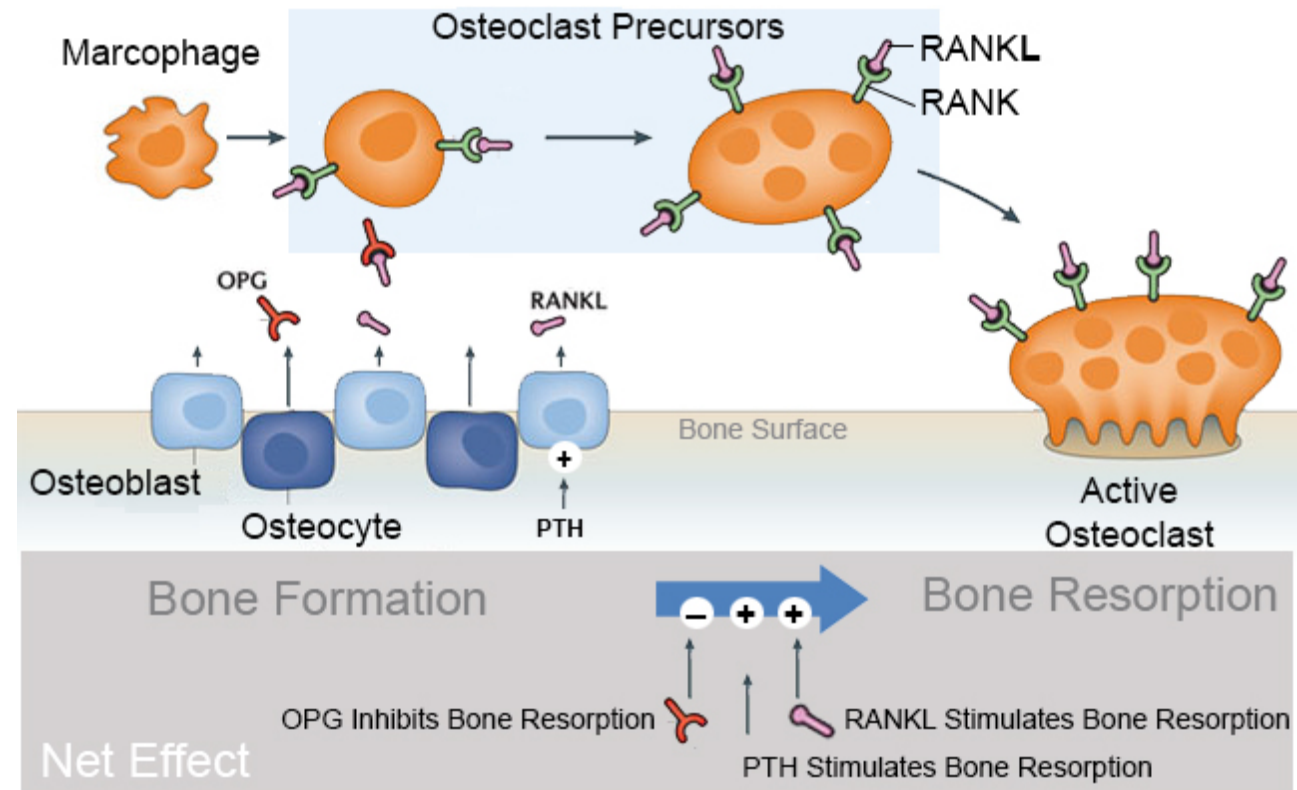


Osteopenia: -1 to -2.5

Osteoporosis: ≤ -2.5



Bone signaling



Treatment



lifestyle modification



pharmacologic
treatment

calcium and
Vitamin D
Bisphosphonates
Raloxifene
Denosumab

Osteomalacia

A metabolic bone disease where defective mineralization results in a large amount of unmineralized osteoid

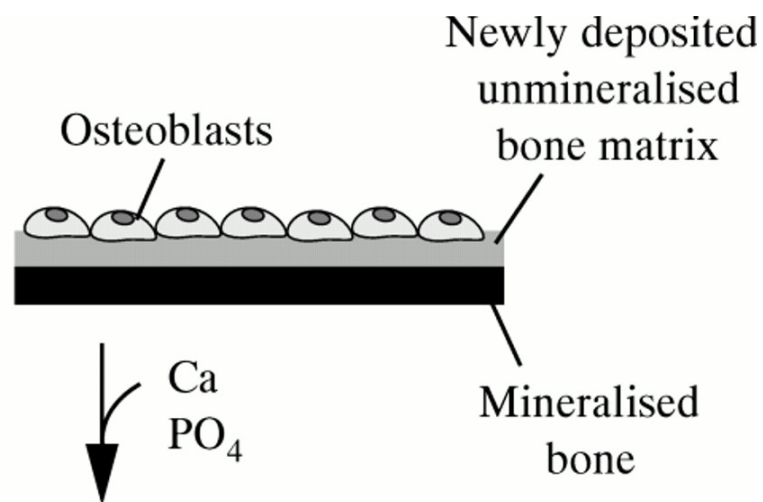


Osteomalacia = Rickets

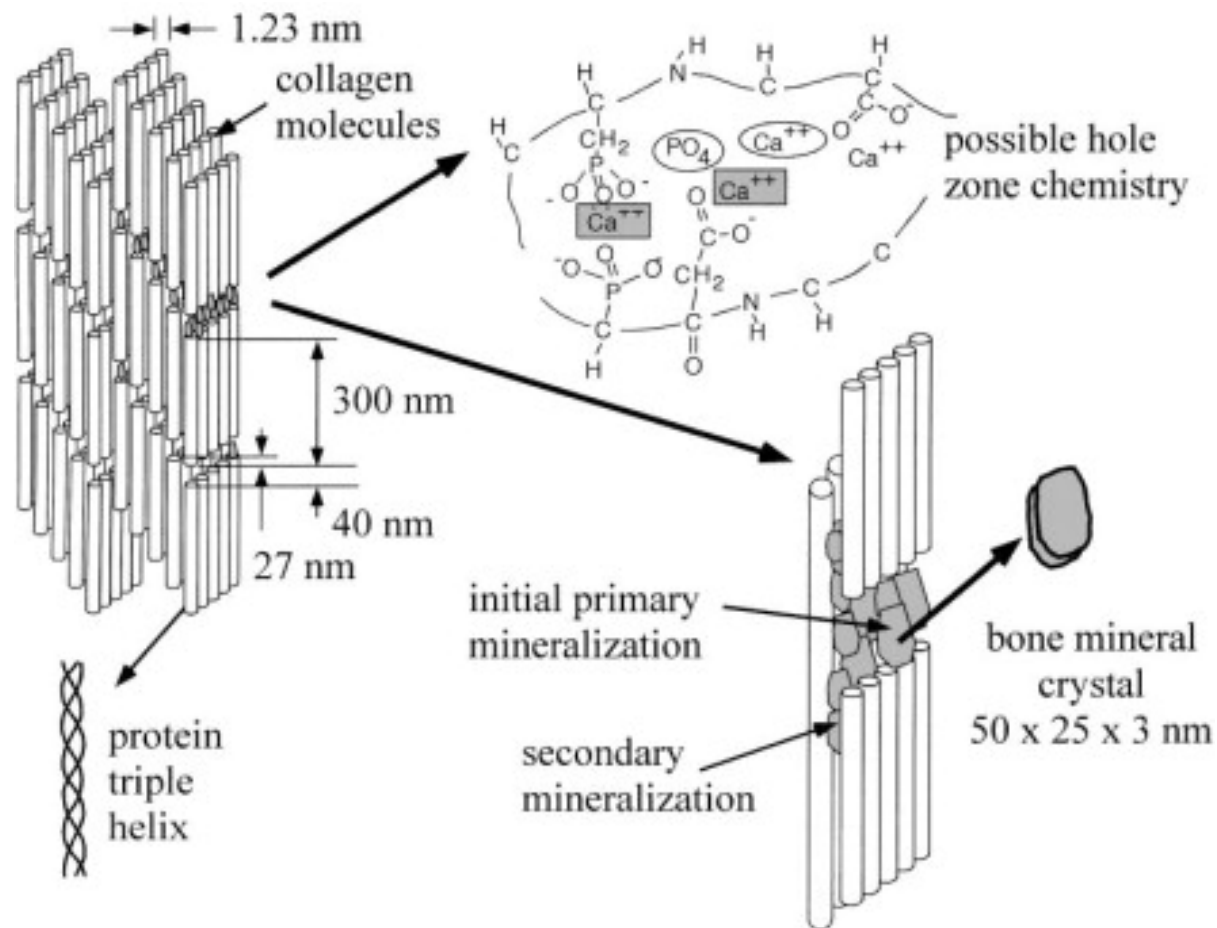
rickets is found in children (open physis)

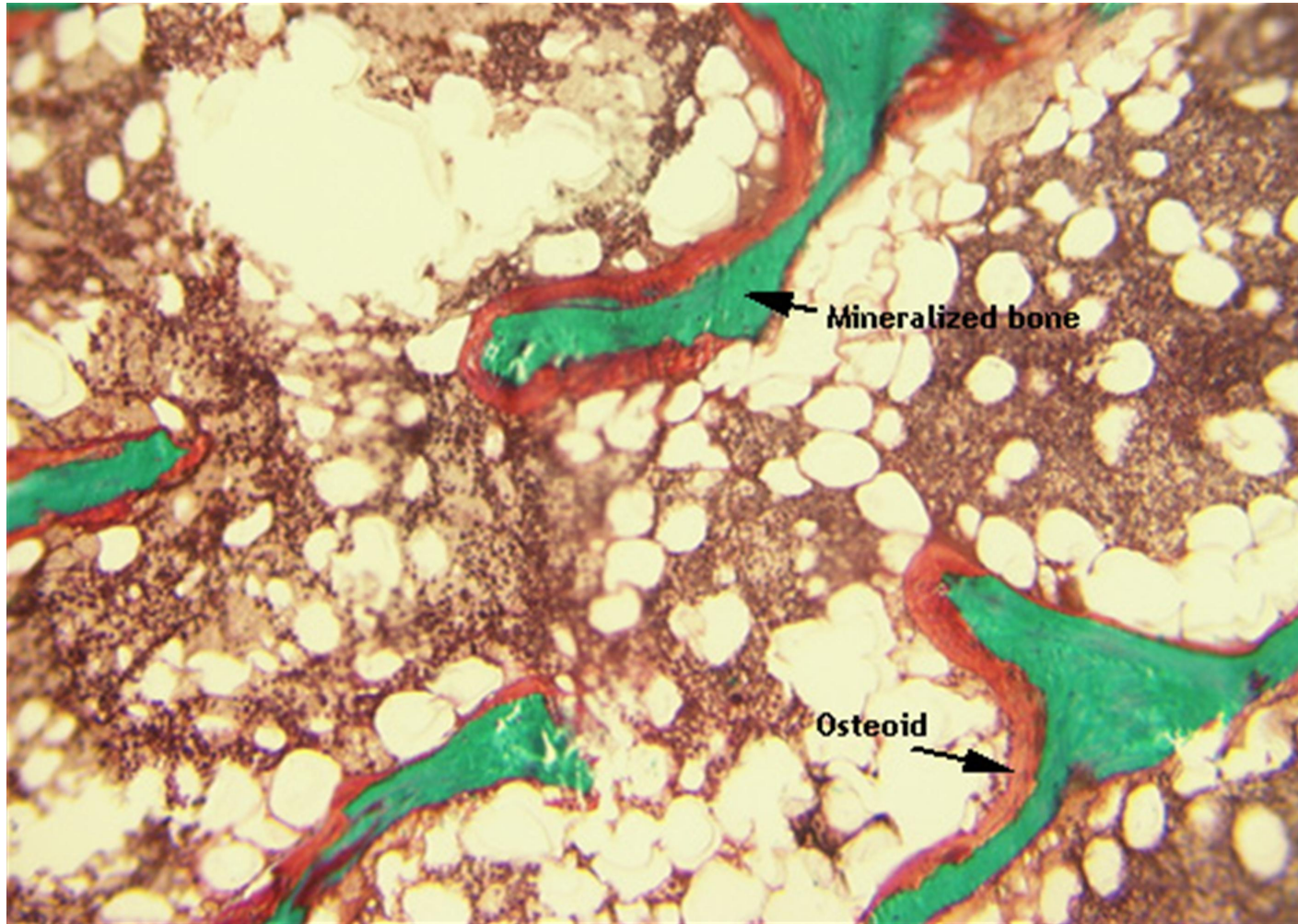
osteomalacia is found in adults (closed physis)

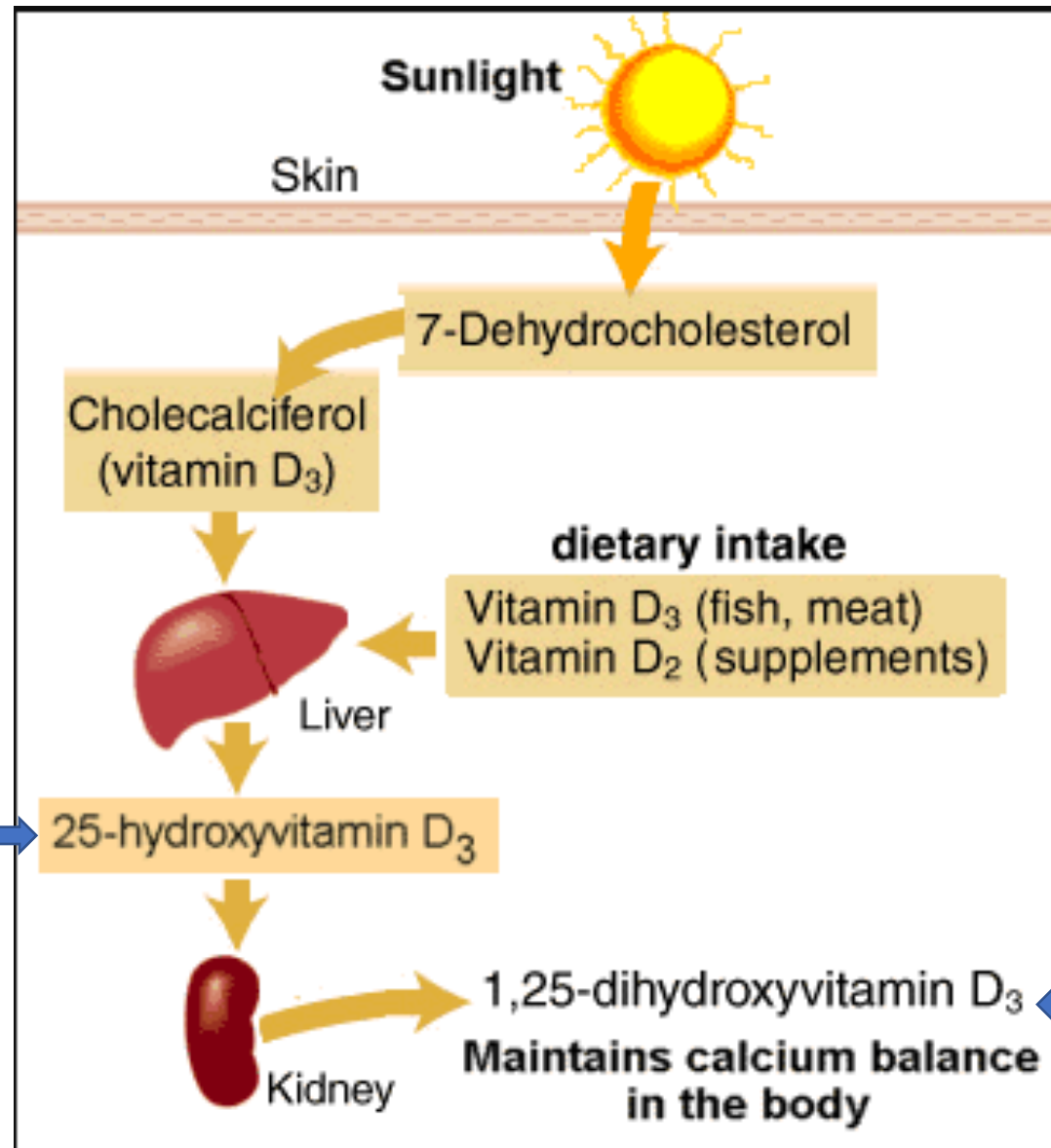
Step 1:
Deposition of
osteoid



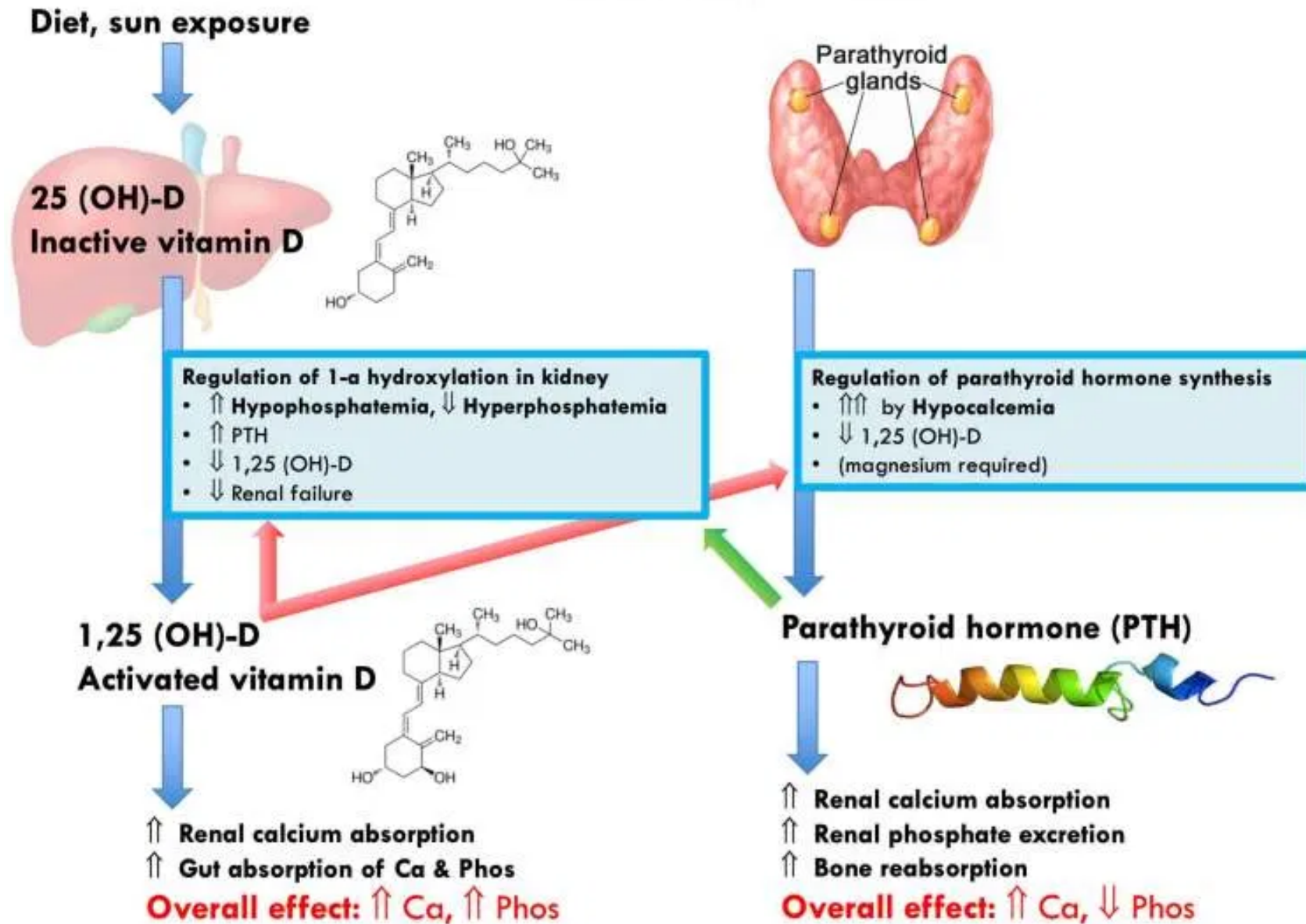
Step 2:
Mineralisation

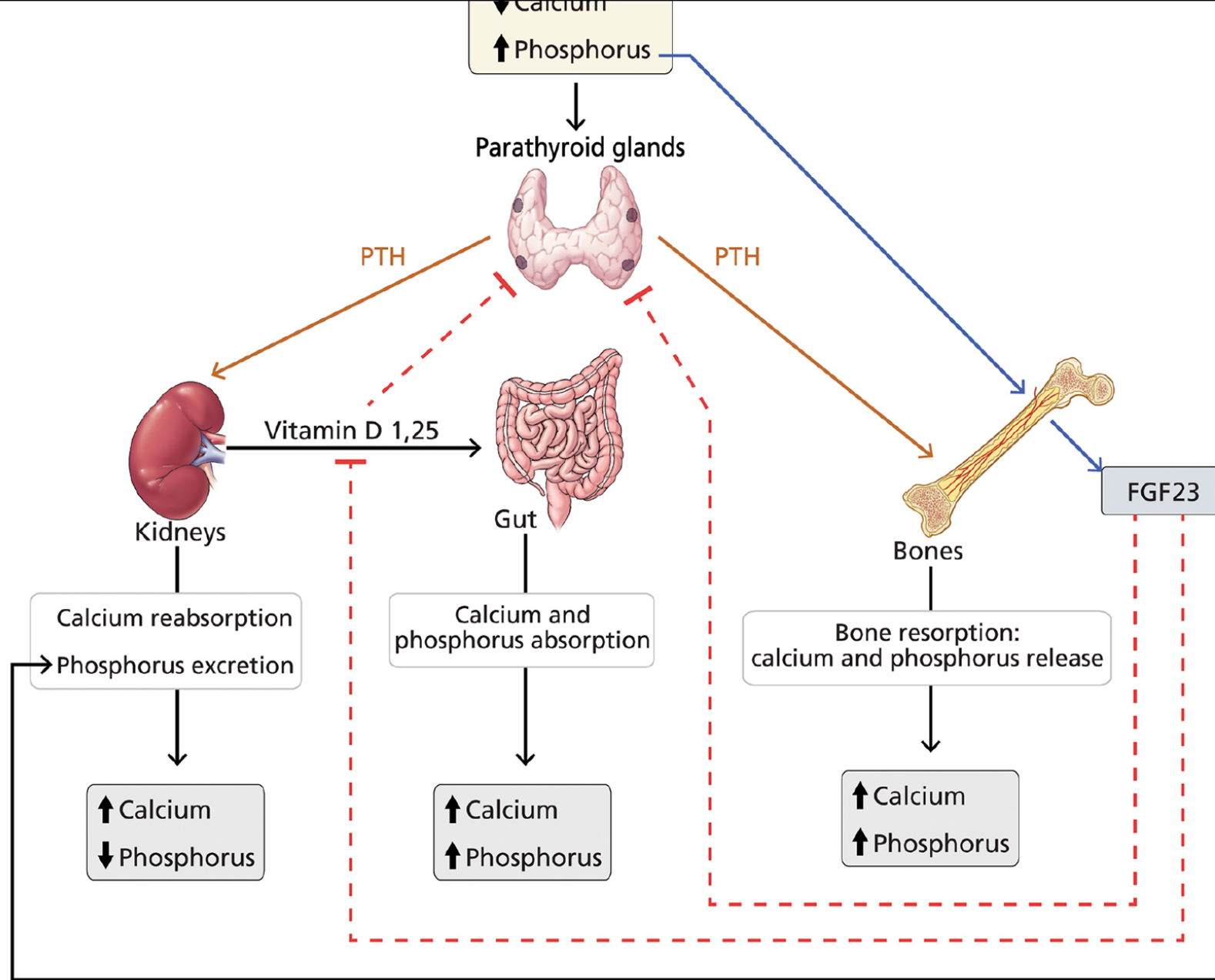






Overview of Ca & Phos metabolism





risk factors

Vitamin-D deficient
diets

malabsorption e.g.
celiac disease

renal osteodystrophy

hypophosphatemia

chronic alcoholism

tumors (tumor-induced
osteomalacia)
phosphatonin

Drugs

- Phenytoin
- Glucocorticoids
- Ifosfamide
- etidronate

Symptoms



GENERALIZED BONE
AND MUSCLE PAIN



FRACTURES OF LONG
BONES, RIBS AND
VERTEBRAE



PROXIMAL MUSCLE
WEAKNESS WEAKNESS



FATIGUE

Physical exam

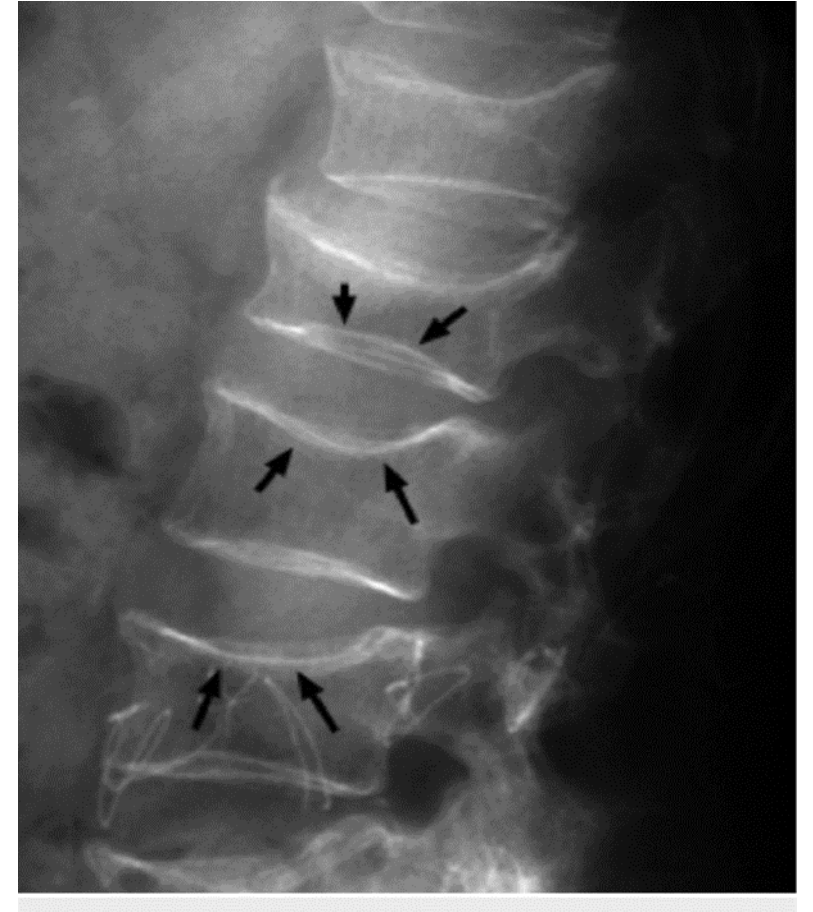
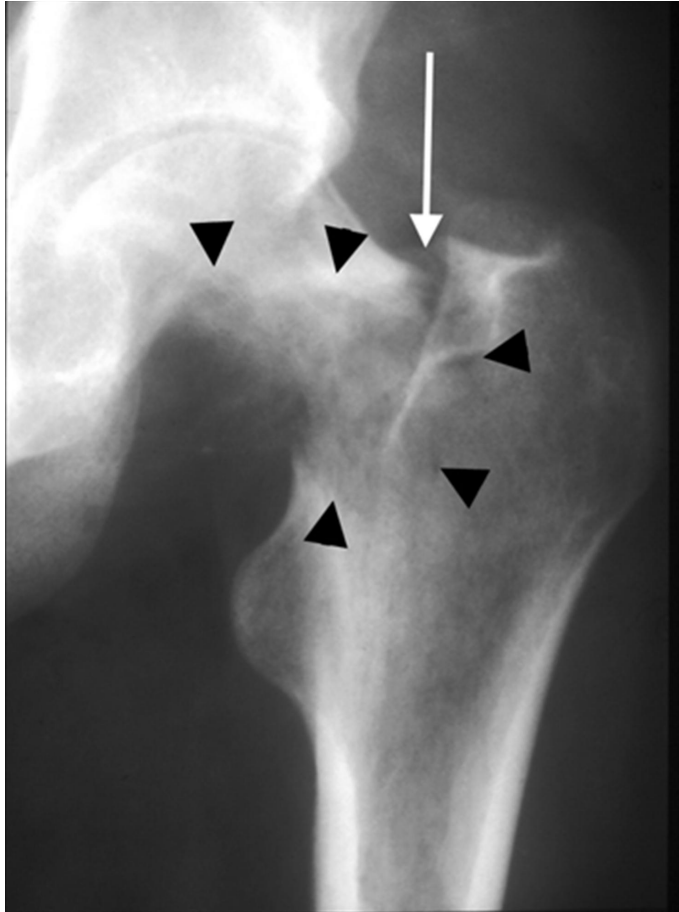


waddling gait



difficulty rising from
chair and climbing stairs

Imaging

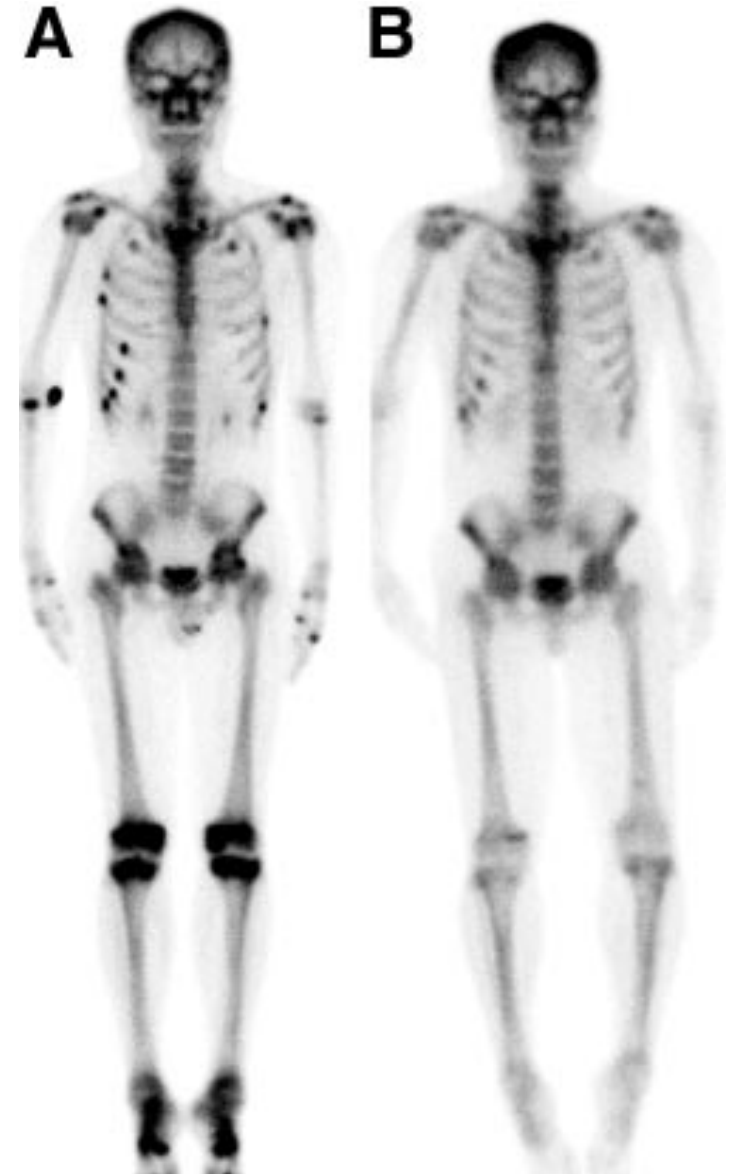




Trefoil Pelvis



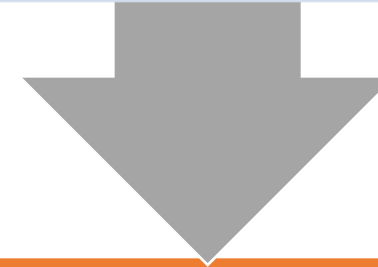
Bone scan



Treatment

large doses of oral vitamin D
(1000IU/day), treat underlying cause

Most Pts



specific subgroups of patients

on long-term
anticonvulsant therapy

- supplement with 400-800IU/day of vitamin D

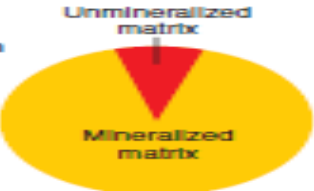
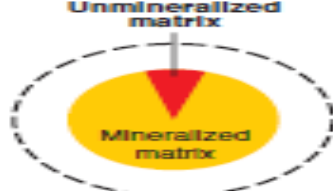
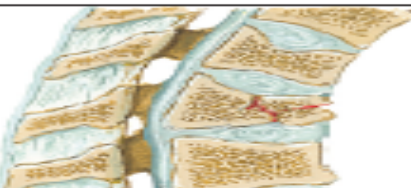
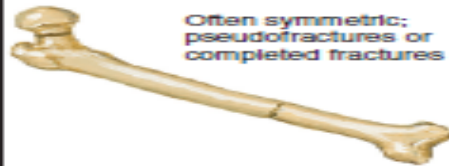
with hepatobiliary
disease

- supplement with 25(OH)-vit D

with renal disease

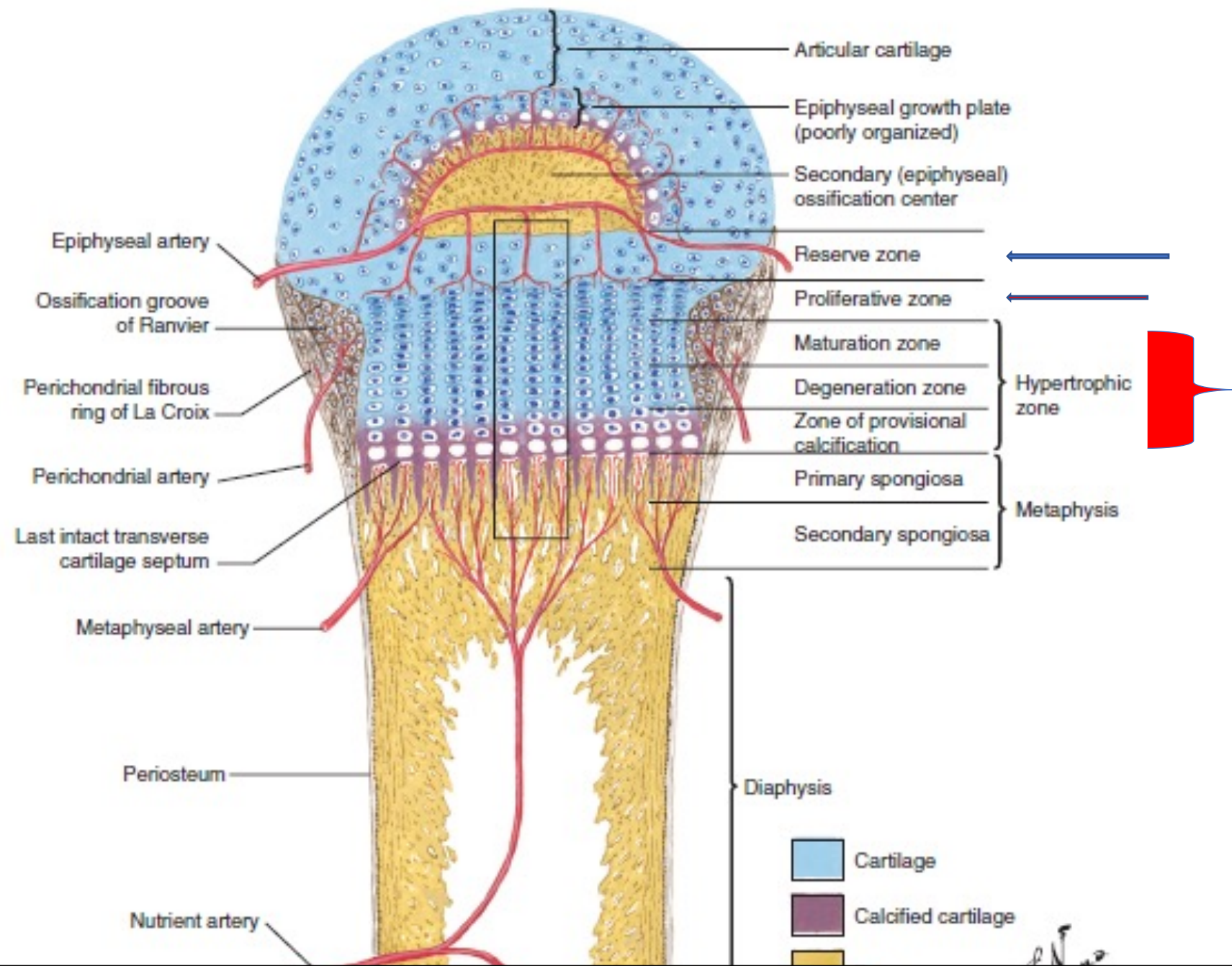
- supplement with 1,25(OH)₂ vit D

Comparison of Osteoporosis and Osteomalacia

	Osteoporosis	Osteomalacia
Definition	 Normal	 Bone mass decreased, mineralization normal  Bone mass variable, mineralization decreased
Age at onset	 Generally in old age, after menopause	 Any age
Etiology	Endocrine abnormality, age, idiopathic cause, inactivity, disuse, alcoholism, calcium deficiency	Vitamin D deficiency, abnormality of vitamin D pathway, hypophosphatemic syndromes, renal tubular acidosis, hypophosphatasia
Symptoms	 Pain referable to fracture site	 Generalized bone pain
Signs	Tenderness at fracture site	Tenderness at fracture site and generalized tenderness
Radiographic features	 Axial predominance	 Often symmetric; pseudofractures or completed fractures Appendicular predominance
Laboratory findings	Serum Ca^{2+} Normal Serum P_i Normal $\text{Ca}^{2+} \times \text{P}_i > 30$ Alkaline phosphatase Normal Urinary Ca^{2+} High or normal Bone biopsy Tetracycline labels normal	Low or normal (high in hypophosphatasia) Low or normal $\text{Ca}^{2+} \times \text{P}_i > 30$ if albumin normal (high in renal osteodystrophy) Elevated, except in hypophosphatasia Normal or low (high in hypophosphatasia) Tetracycline labels abnormal

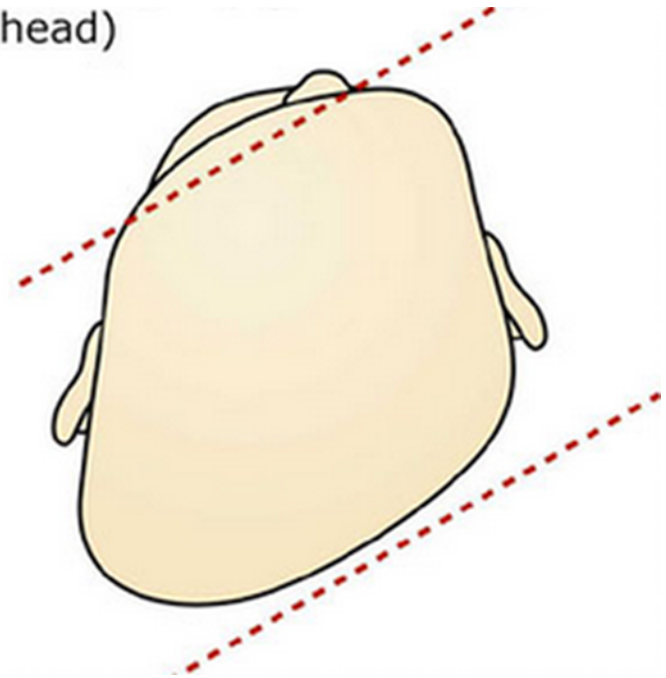
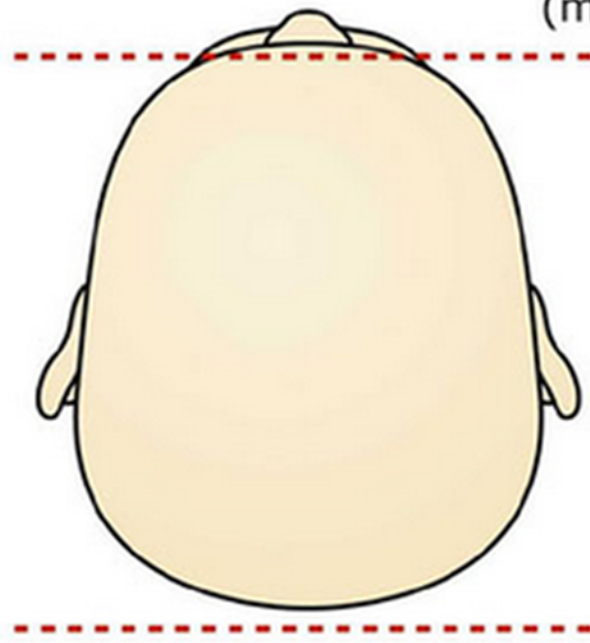
	<i>Serum Ca</i>	<i>Serum P</i>	<i>Alk phos</i>	<i>PTH</i>	<i>25-(OH)vit D</i>	<i>1,25-(OH)vit D</i>	<i>Urinary Ca</i>
Osteomalacia	low	low	high	high	low	low	low
Osteoporosis	normal	normal	variable	normal	normal	normal	normal
Tumor induced	low	very low	low	low	low	low	low

CLOSE-UP VIEW OF DEVELOPING EPIPHYSIS AND EPIPHYSEAL GROWTH PLATE

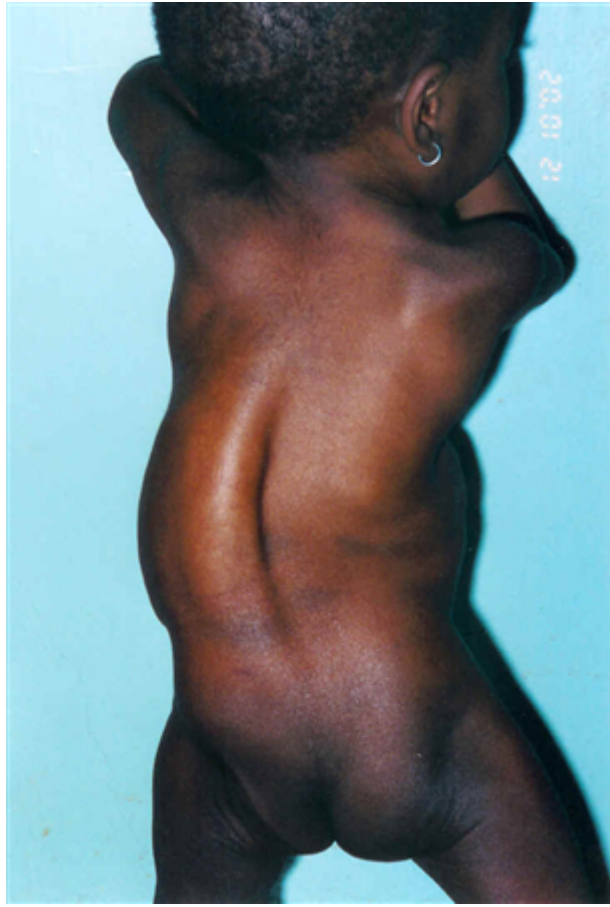




(misshapen head)







Classification

Vitamin D-deficient
(nutritional)

Vitamin D-resistant
(familial
hypophosphatemic)

Vitamin D-dependent

Other causes:
hypophosphatasia,
Renal osteodystrophy,
hyperparathyroidism

Inability of renal
tubules to absorb
phosphate

I mutation in renal 25-
(OH)-1 α -hydroxylase

II mutation in
intracellular receptor
for 1,25-(OH)₂-vitamin
D

Condition	Genetics	Ca	Phos.	Alk Phos	PTH	Vit D	1,25 (OH)VitD
Vitamin D Resistant Rickets (Hypophosphatemic)	X linked dominant	-	↓	↑	-	-	
Vitamin D Deficiency Rickets (Nutritional)	Nutritional	↓	↓	↑	↑	↓	
Type I Vitamin D Dependent	Auto. Recessive	↓	↓	↑	↑		↓ ↓
Type II Vitamin D Dependent	Auto. Recessive	↓	↓	↑			↑ ↑
Hypophosphatasia	Auto. Recessive	↑	↑	↓ ↓	-	-	
Renal Osteodystrophy	Renal Disease	↓	↑	↑	↑		
Hyperparathyroidism	90% adenoma	↑	↓	↑	↑		

Treatment

Calcitriol

phosphate replacement

Vitamin D

corrective surgery (severe
bowing)