

# Metabolic disorders

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# Metabolic disorders- osteopathy

- Osteoporosis
- Osteomalatia
- Primary hyperparathyreoidisms
- Secondary hyperparathyreoidisms:
  - renal osteodystrophy
  - gastrointestinal osteodystrophy

# Composition of bone

50 % anorganic material (hydroxyapatit crystals)

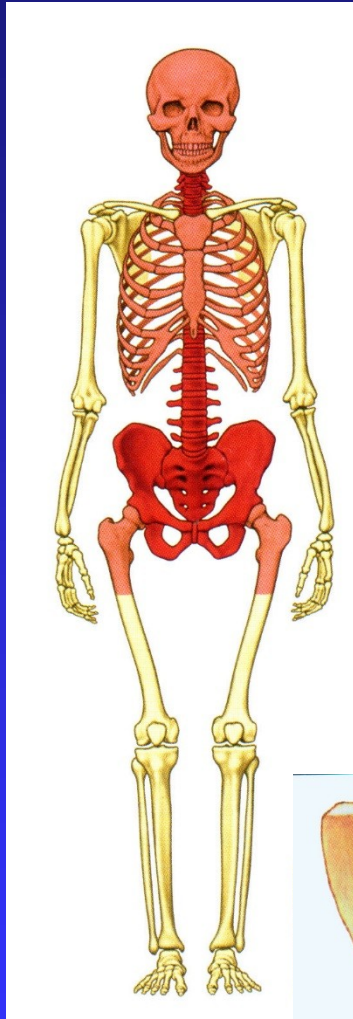
25 % organic bone matrix (osteoid):

90 % collagen type I

10 % other proteins (osteocalcin,  
osteonectin, proteoglycans, enzymes)

25 % water binding on collagen and proteoglycans

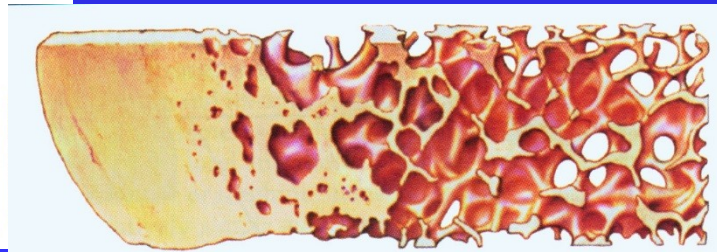
# Skeleton



Weight 5 kg

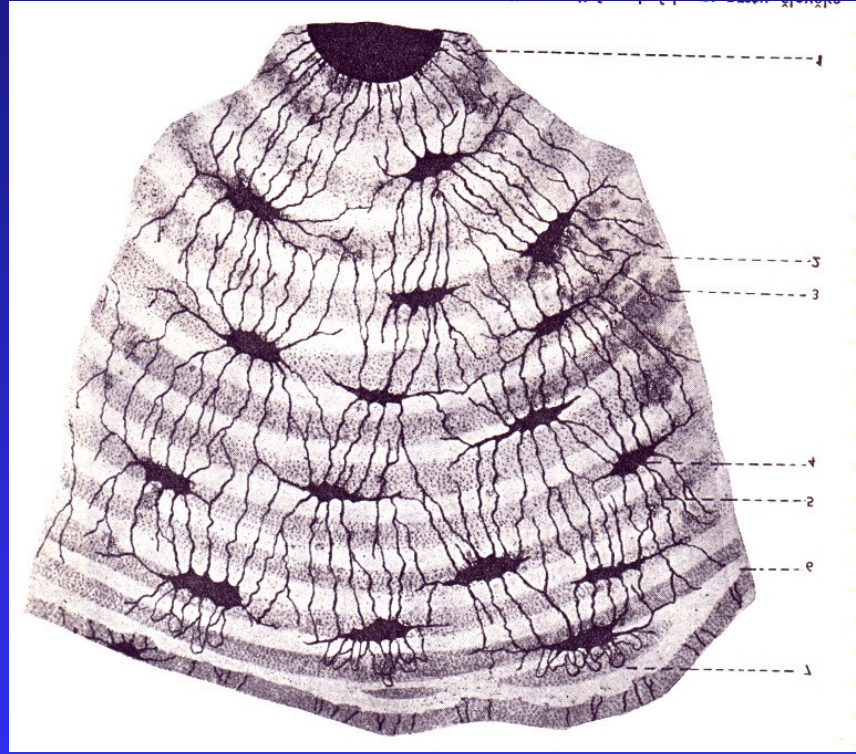
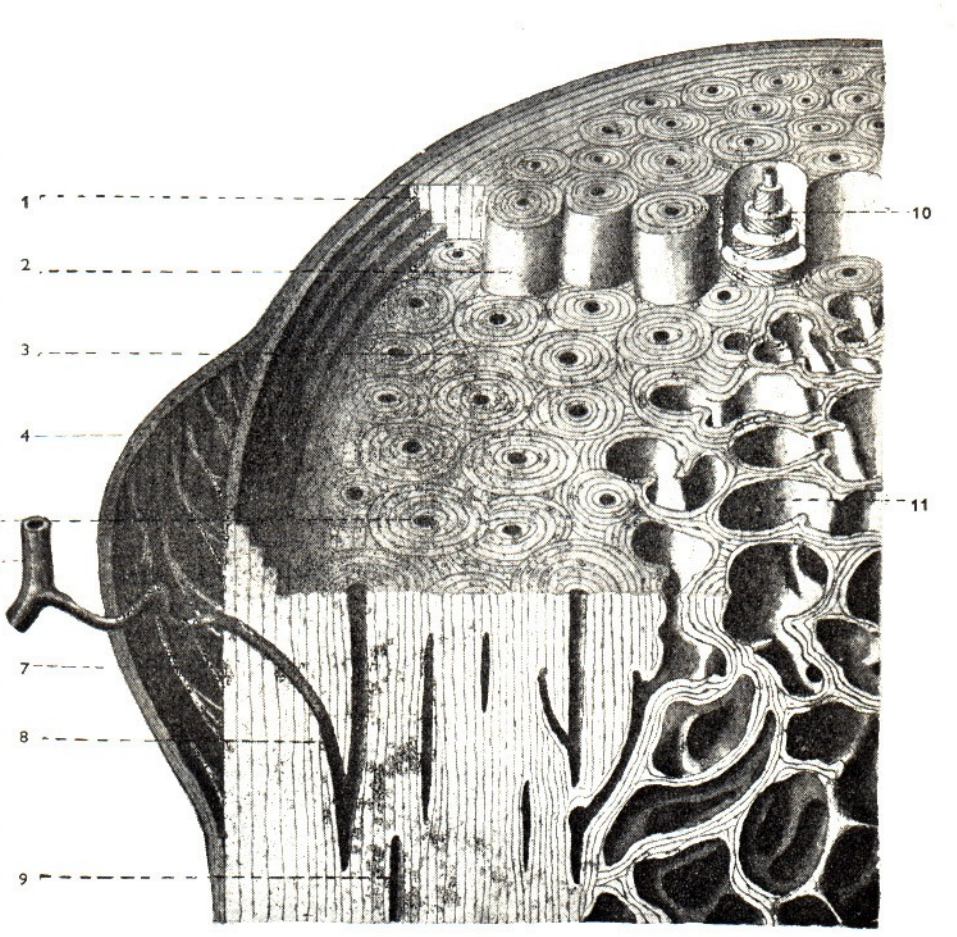
Cortical bone 4 kg

Trabecular bone 1 kg

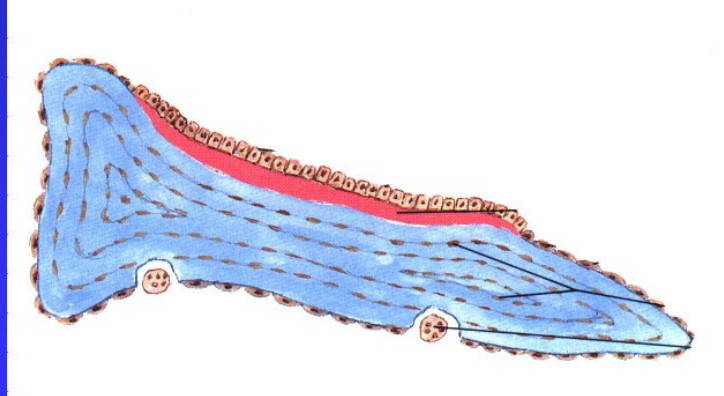
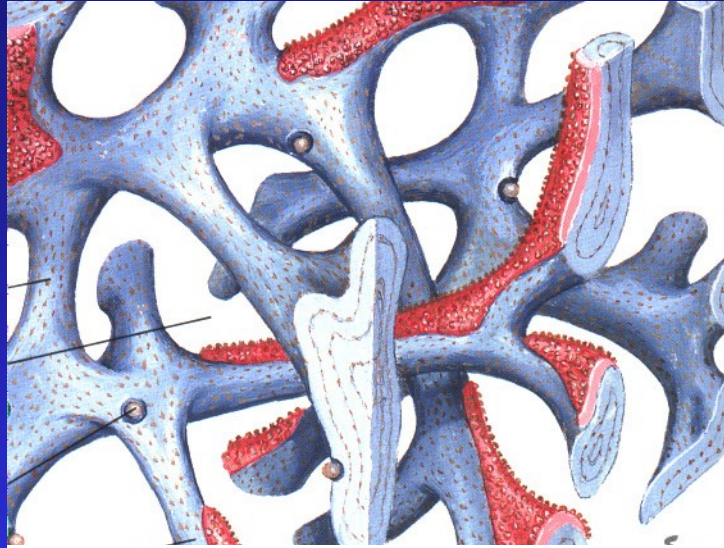


Cortical bone    Trabecular bone

# Cortical bone- Haversian system



# Trabecular bone

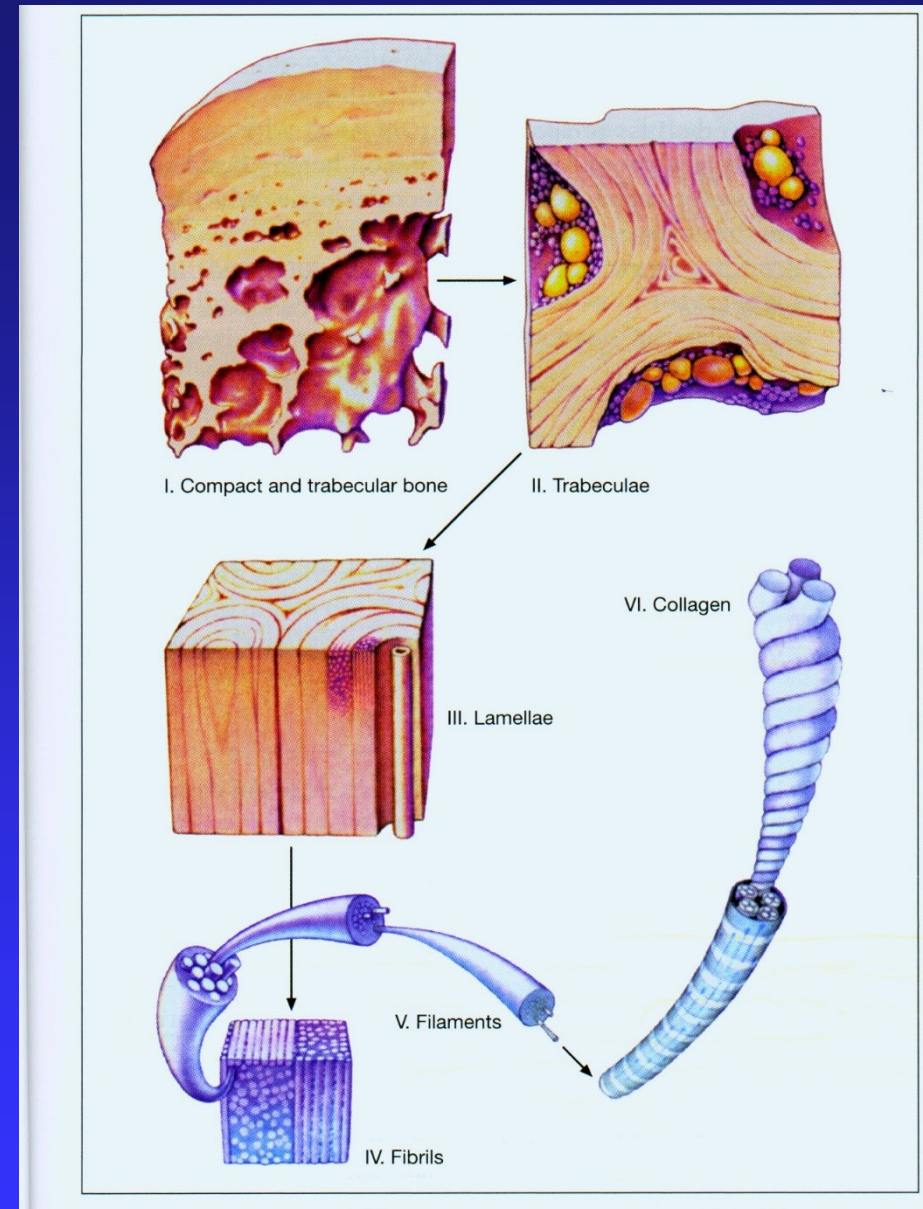


## Trabecular bone:

- 20% of the skeleton
- 80% of remodelling

## Cortical bone:

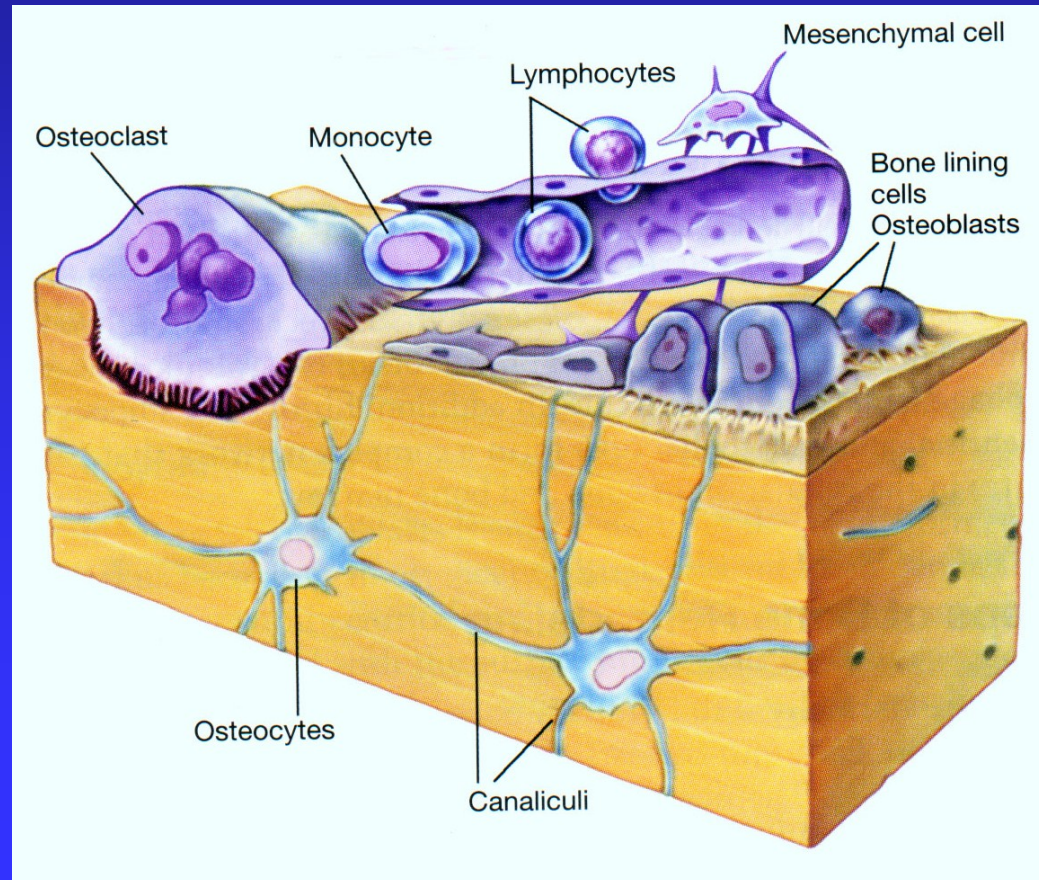
- 80% of the skeleton
- 20% of remodelling



Collagen type I.

# Osteoblasts:

- They produce osteoid- organic part of matrix
- They provide mineralisation of bone
- They produce alkaline phosphatase  
– indicator of the synthesis of proteins





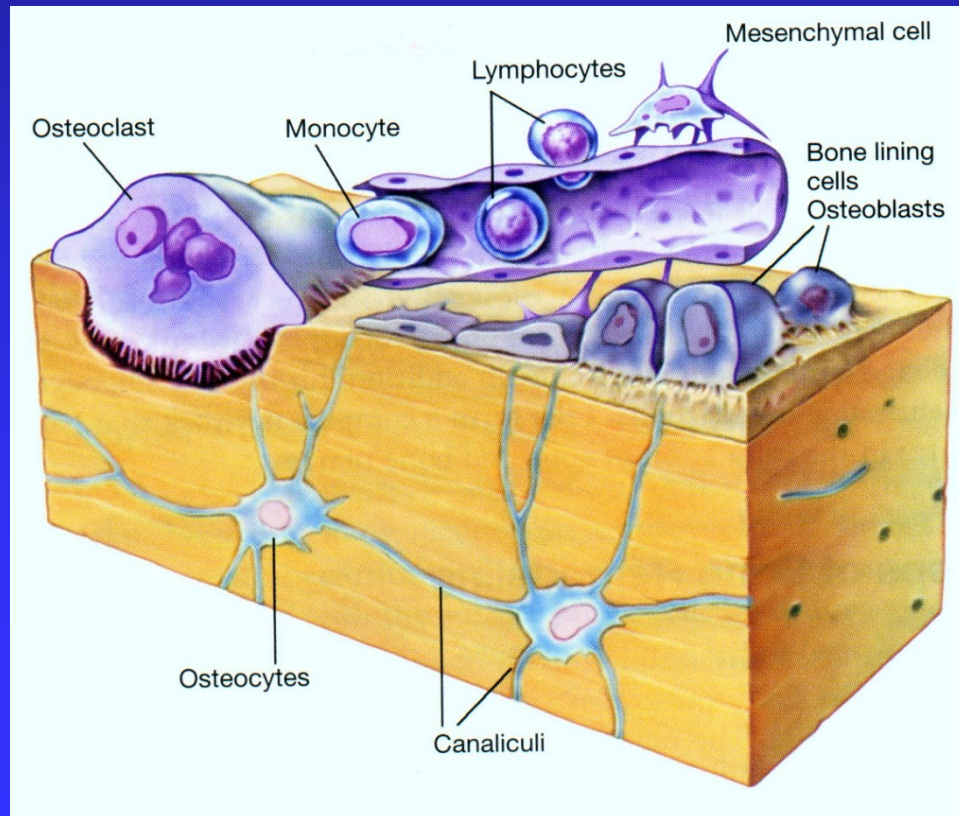
# Osteoclasts:

Large multinuclear cells

They are localised in Howship lacunae on the surface of bone

They produce acid phosphatase and lytic enzymes

They dissolve hydroxyapatite crystals and bone matrix

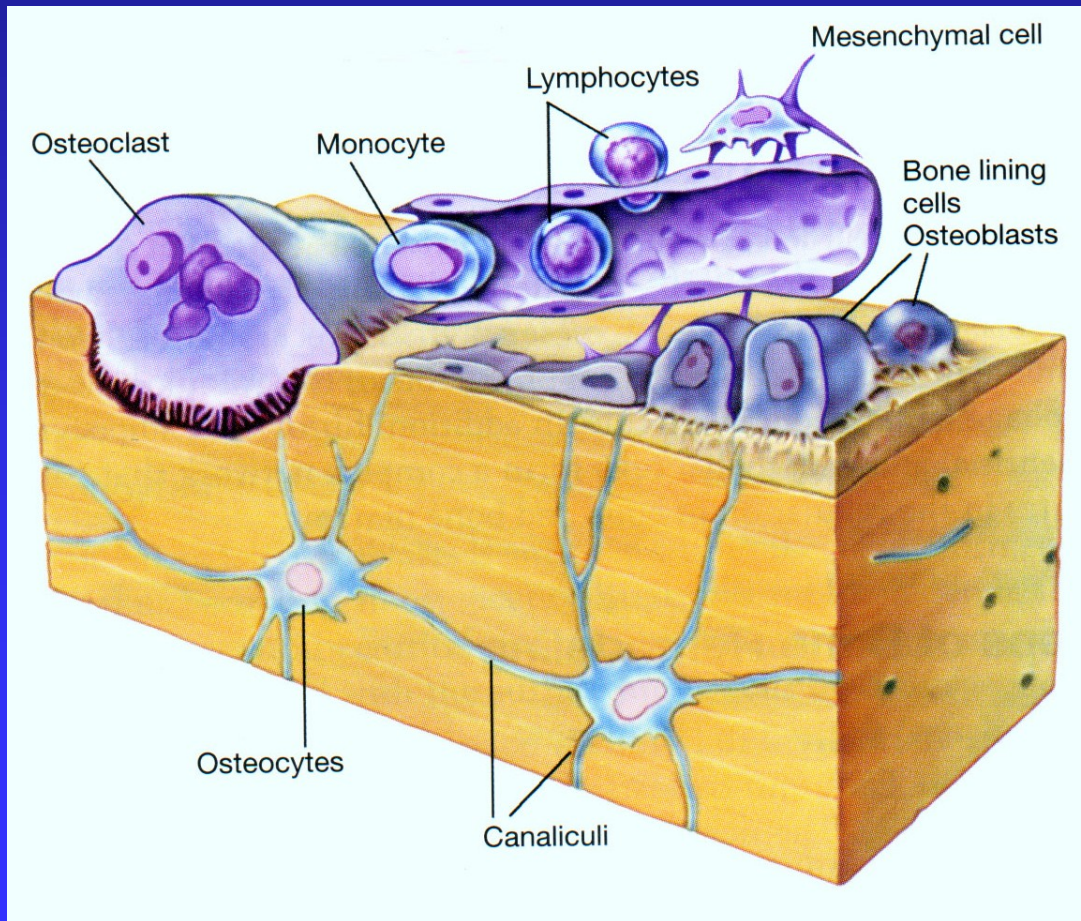


# Osteocytes

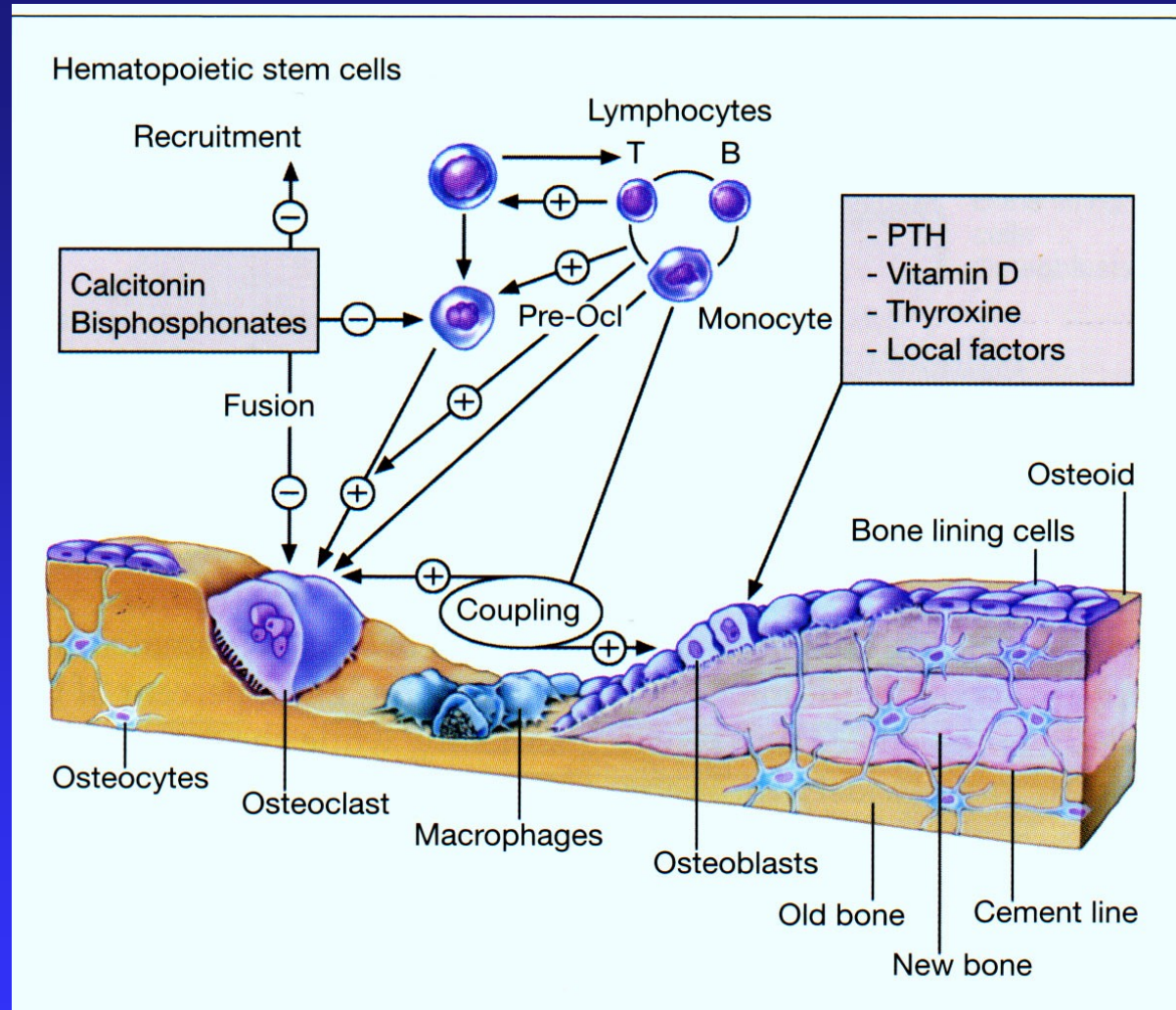
They lie in lacunae of corticals and trabecular bone

They are connected with canaliculi

They maintain metabolism of bone



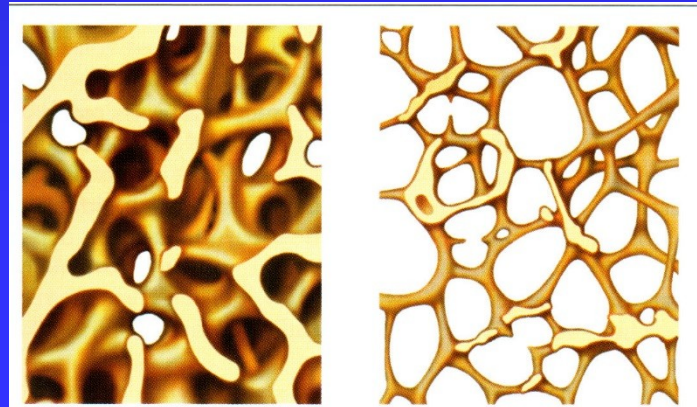
# Remodelling of bone



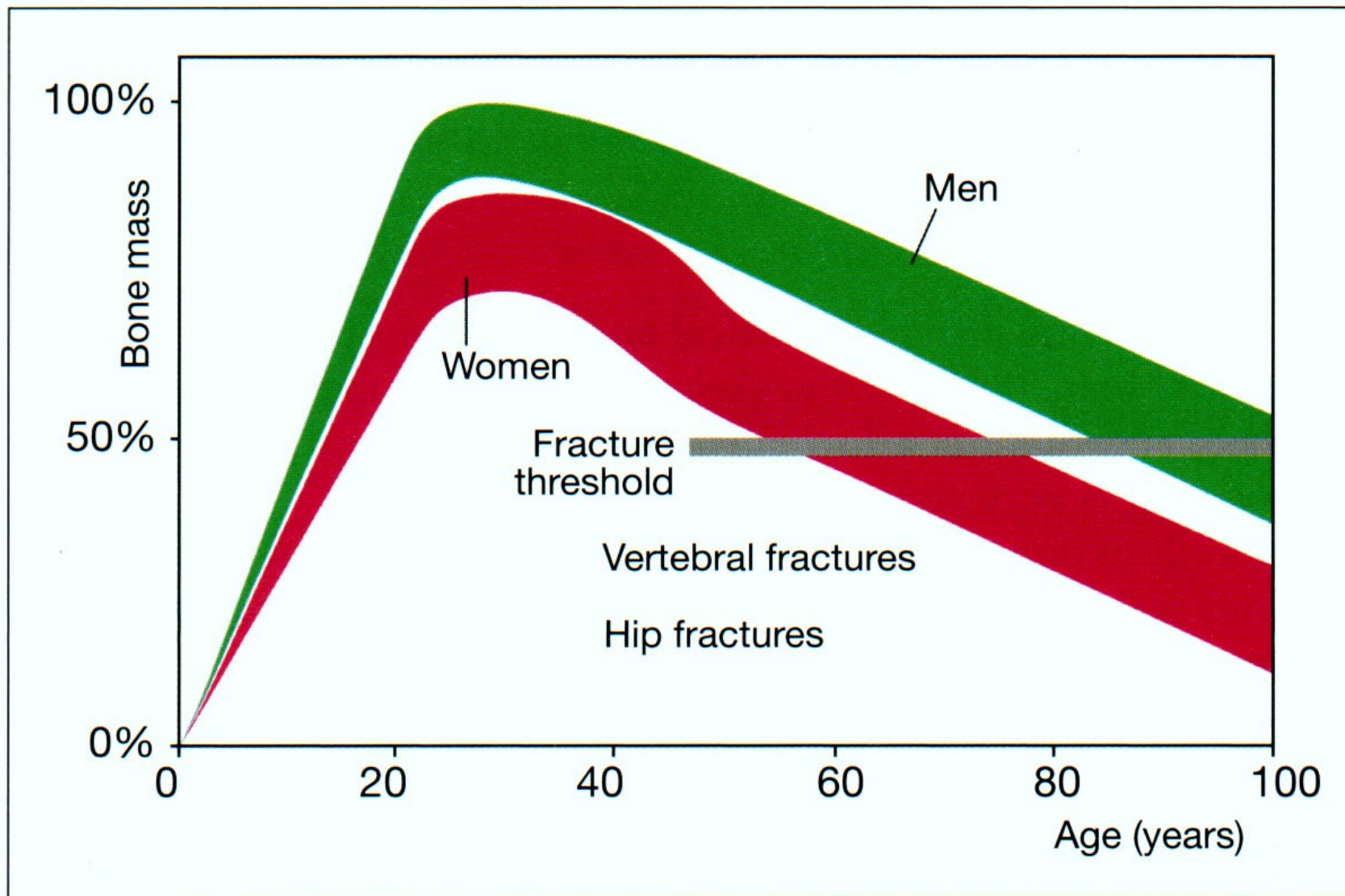
Resorption is finished in 2 weeks  
Mineralisation up to six months

# Osteoporosis is a systemic disorder of the skeleton

- Diminished strength of bone
- Low bone density
- Impaired microarchitecture
- Tendency to fractures
- Loss of organic and anorganic bone



# Peak bone mass - in 25-30 years of age



# Bone loss

- Before menopause 0,3 % / year
- After menopause 3 % / year

# Osteoporosis

- primary:
  - idiopathic
  - postmenopausal - type I.
  - involutional (senile) - type II.
- secondary - type III.

# Clinical symptoms

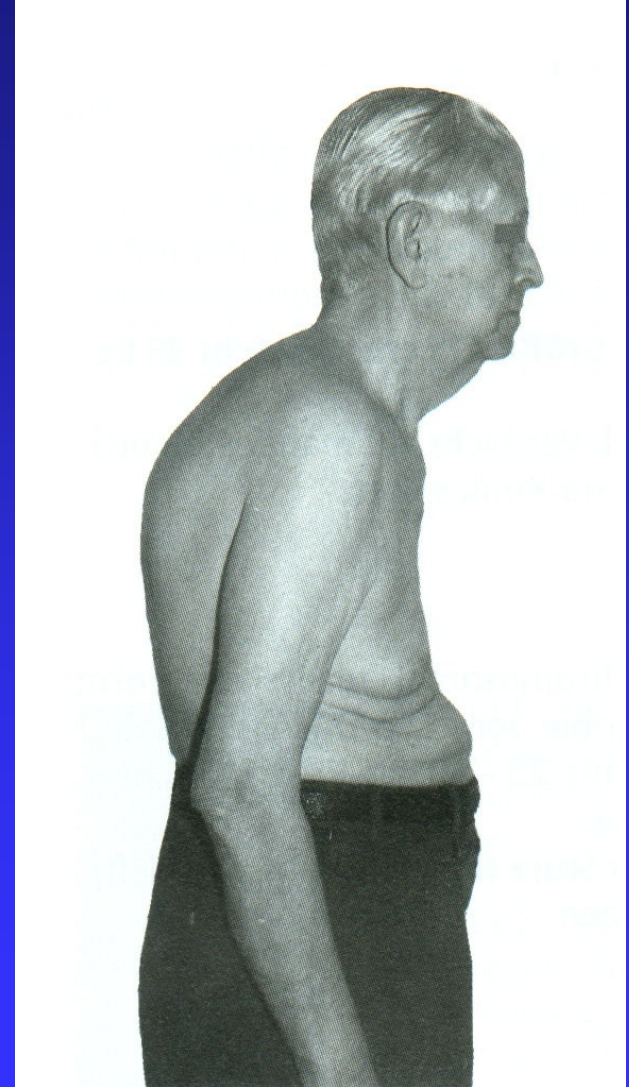
- Back ache
- Diminished ability to work
- Problems with walking and standing
- Problems with lifting heavy objects
- Sharp pain- in a case of fracture





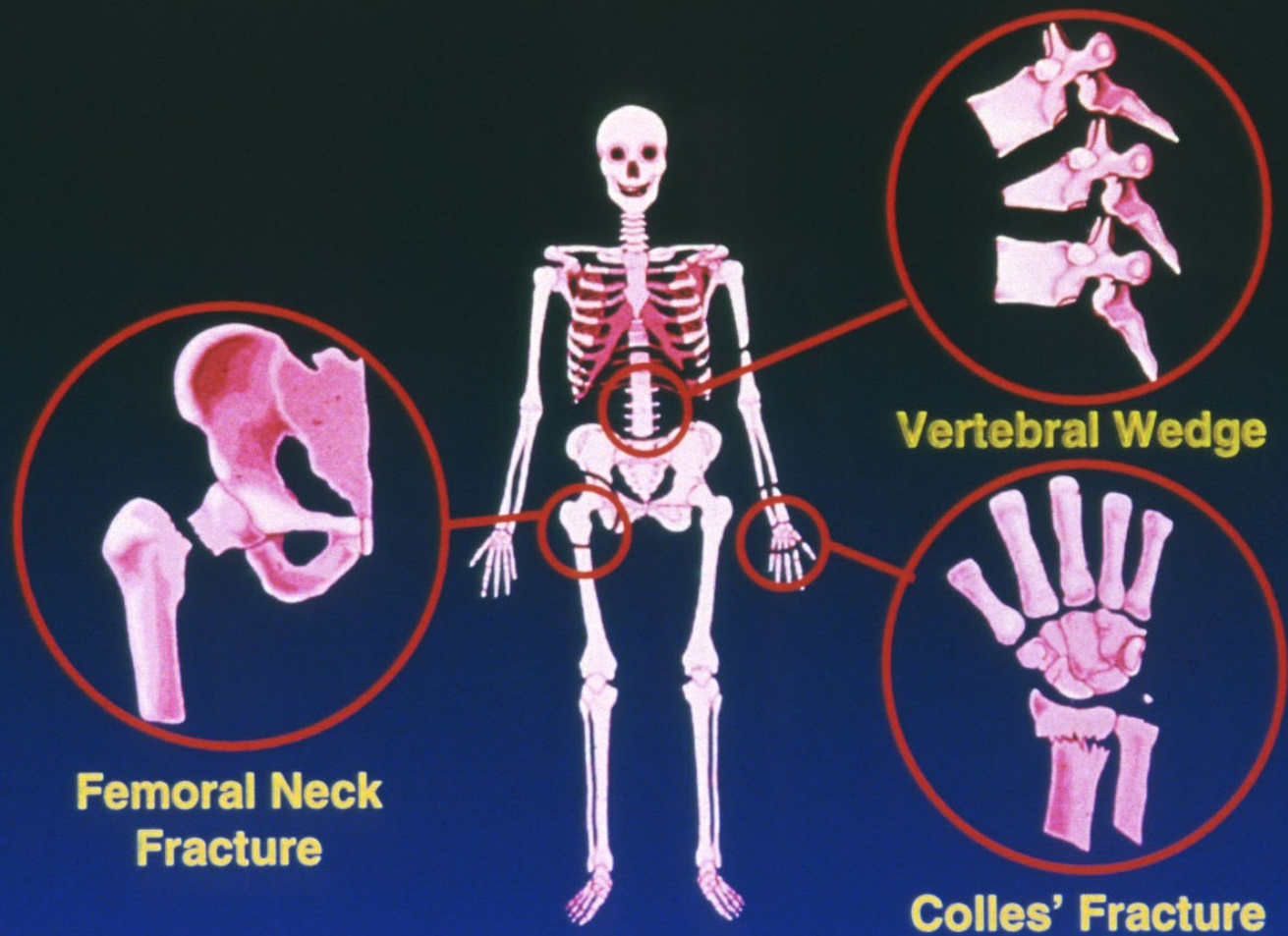
# Examination

- Tenderness on spinous process
- Limited movements of the spine
- Paravertebral spasm
- Thoracic kyphosis
- Widow's hump
- Lower length of the stature



# THE COMMON FRACTURES OF OSTEOPOROSIS

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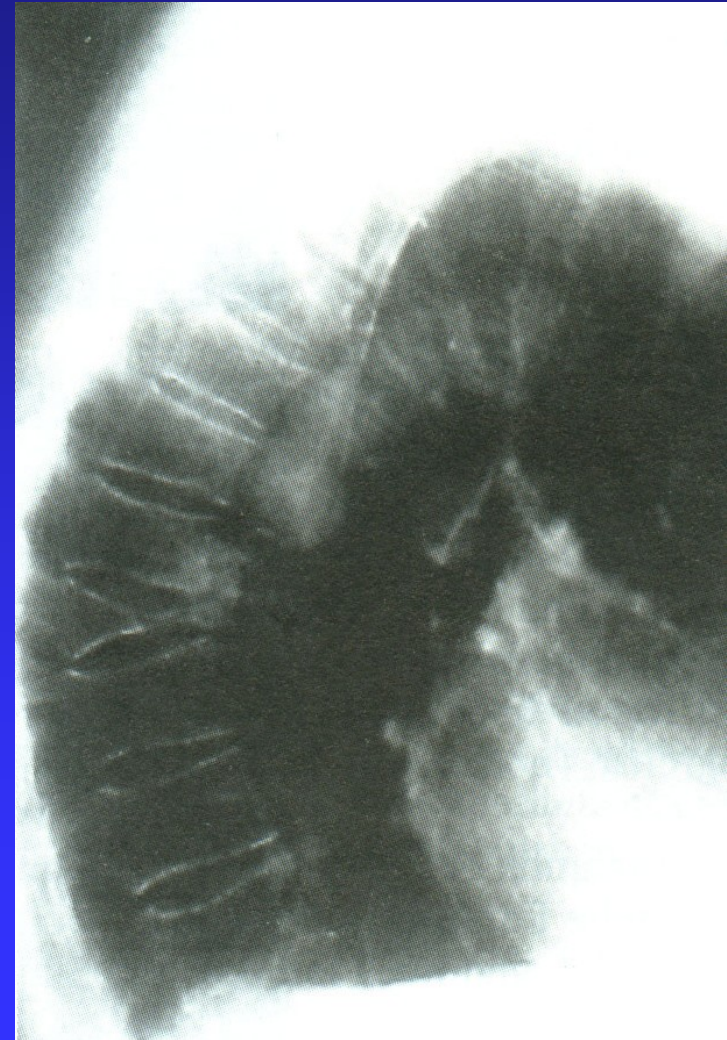
**Femoral Neck  
Fracture**

**Vertebral Wedge**

**Colles' Fracture**

# Imaging techniques

- X- ray shows bone loss of 30 % or more
- DEXA
- QCT
- Ultrasonography



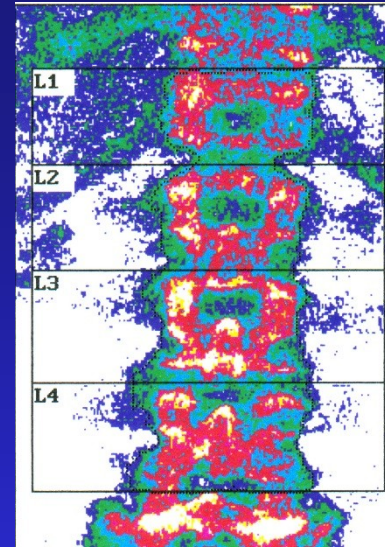
# DEXA – Dual Energy Absorptiometry

BMD in  $\text{g}/\text{cm}^2$

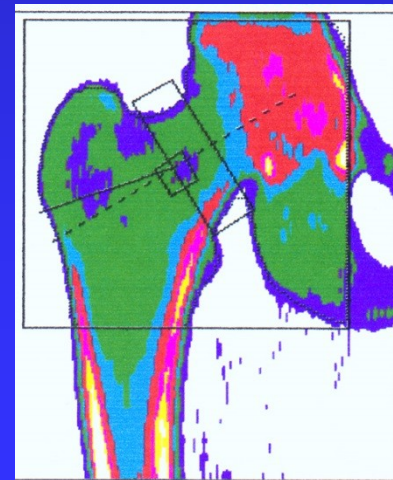
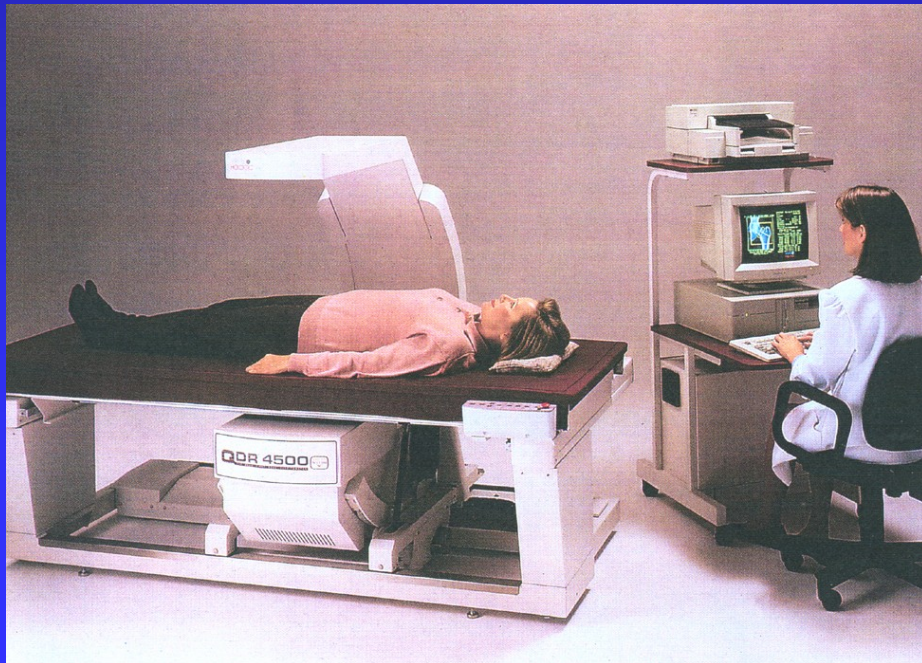
T score

Z score

Change



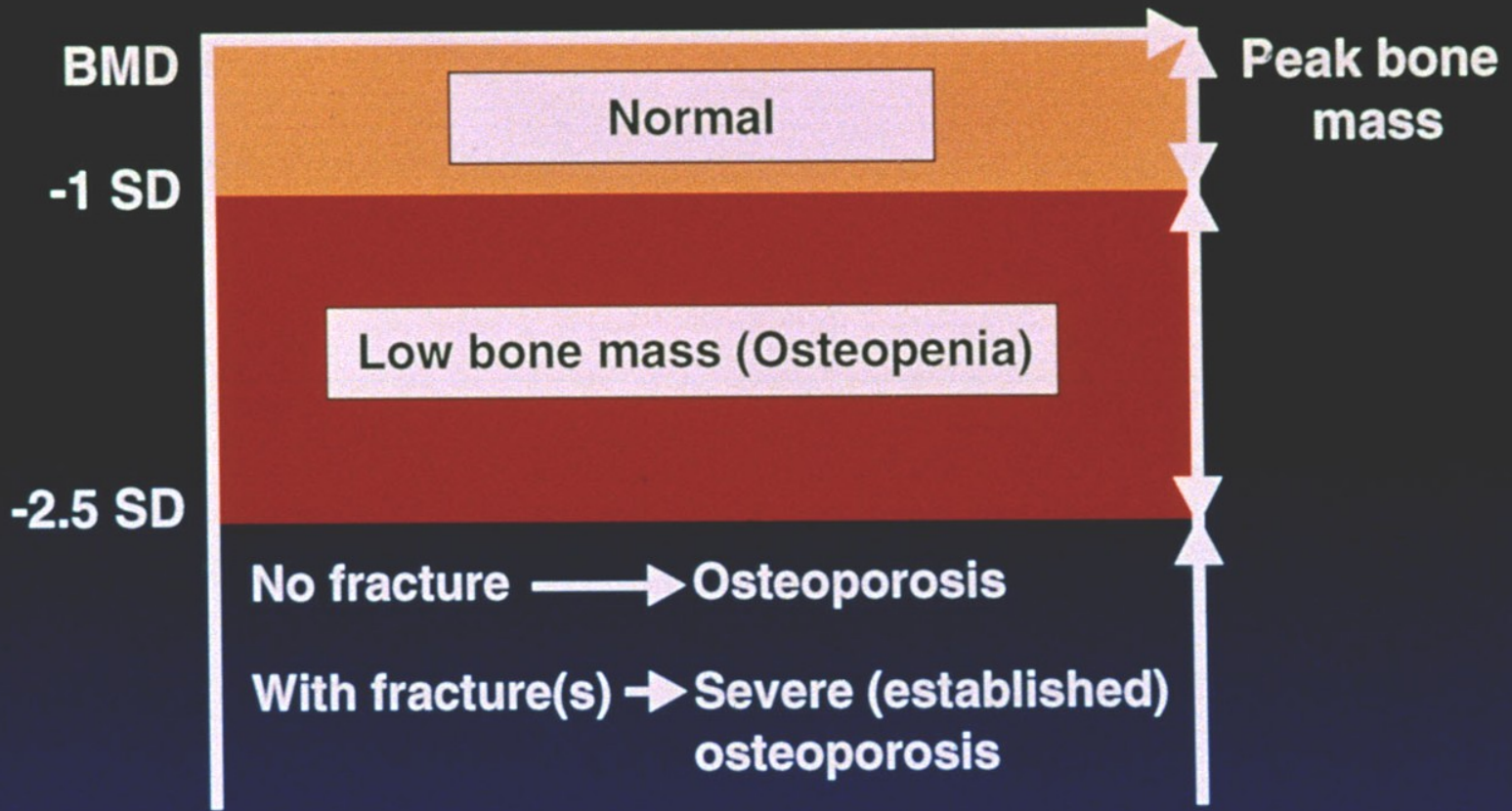
L1-L4



Hip Total

Hip neck

# WHO DEFINITION OF OSTEOPOROSIS



# Postmenopausal osteoporosis

- 80% of all cases
- 25 % of female are involved
- Between 50- 65 years
- Loss of estrogens- high activity of osteoclasts
- Trabecular bone most often affected

# Senile osteoporosis

Over 70 years, ratio female: male = 2 : 1

The cause: no production of osteoblasts in bone marrow

Cortical and trabecular bone



# Secondary osteoporosis

- Corticosteroids
- Hyperthyreosis
- Malabsorption
- Alcoholisms
- After trnsplantations



# Osteoporosis in men

- Primary
- Hypogonadism

# Risk factors

- Low stature
- White and yellow ethnics
- Low physical activity
- Low nutrition with calcium

# Risk factors

- Higher age
- Low BMI
- Occurrence in family

# Hypogonadal conditions

- premature amenorrhoea
- surgery of ovaria
- oligomenorrhoea, amenorrhoea
- nullipara
- low endogen estrogen
- mental anorexia

# Risk factors- drugs

- corticosteroids
- anticonvulsives
- diuretics
- heparin

# Risk factors

- malabsorption
- chronic disorders of liver
- chronic disorders of kidney
- alcohol

# Prevention of osteoporosis

- Maximal peak bone mass
- Management of disorders in children
- Removal of risk factors
- Management of gastrointestinal disorders
- Nutrition with calcium and vitamin D
- Physical activity

# Management

Analgetics

Physiotherapy

Nutrition (proteins, calcium)

Calcium - 1300 mg/day

Vitamin D - 800 I.U./day

Drugs

Orthesis

Surgery





# Nutrition

BMI 23-25

Proteins 1,0 g/kg/day

+ 30g of proteins /day

IGF-1 – insulin like growth factor

# Calcium

1,5 g / day

Application in the evening

# Calcium

- Calcium eff. Pharmavit 500, 1000 mg
- Calcium Sandoz forte 500 mg eff.
- Calcium Slovakofarma eff.
- Maxi-Kalz eff tbl, 100, 500 mg.
- Vitacalcin pulvis, tablety
- Biomin H plv.- Ca, Mg + IGF-1.



# Calcium

- Kombi-Kalz pulv, 1000Ca+ 880 IU vit D.
- Osteocare tbl.
- Caltrate plus tbl
- Calcium 500 + vit D3 eff.
- Calcium D forte cps
- Calcicew



# Vitamin D

7-dihydrocholesterol

In the skin -UV beams -cholecalciferol

In liver conversion to 25-OH vit. D3

In kidneys conversion to 1,25 dihydroxy-vit. D3

Active agent is calcitriol 1,25 (OH) D3.

80-90% of daily use is covered by sun radiation

# Vitamin D

60 % of seniors have hypovitaminosis of vitamin D

Optimal level in blood is 80 nmol/l

Hypovitaminosis - below 20 nmol/l

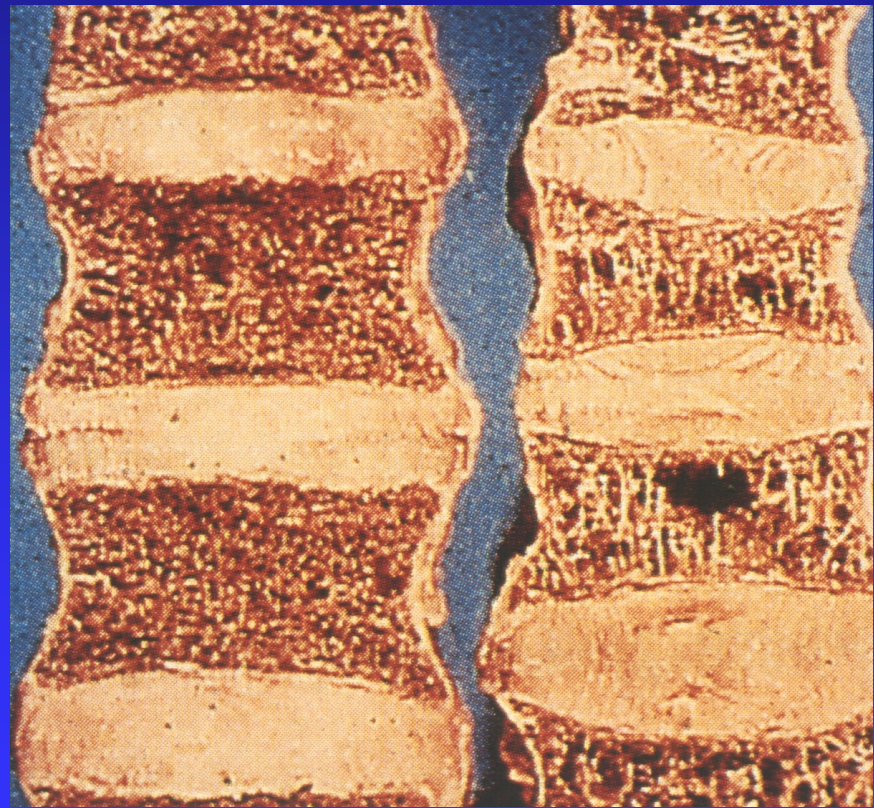
Dosage: 800 IU/day

# Vitamin D

- Infadin gtt, vit D cps., Vigantol oel, gtt
- Rocaltrol cps, Vitamín D Slovakofarma cps
- Calciferol inj.
- 1 alfa (OH) D3 – alfakalcidol - Alpha D3
- 1 alfa (OH) D2 – doxercalciferol ( Hectorol)
- 22 oxakalcitriol (OCT)
- 19 nor 1,25 (OH)<sub>2</sub> D2 – parikalcitriol (Zemplar)

# Inhibition of bone resorption

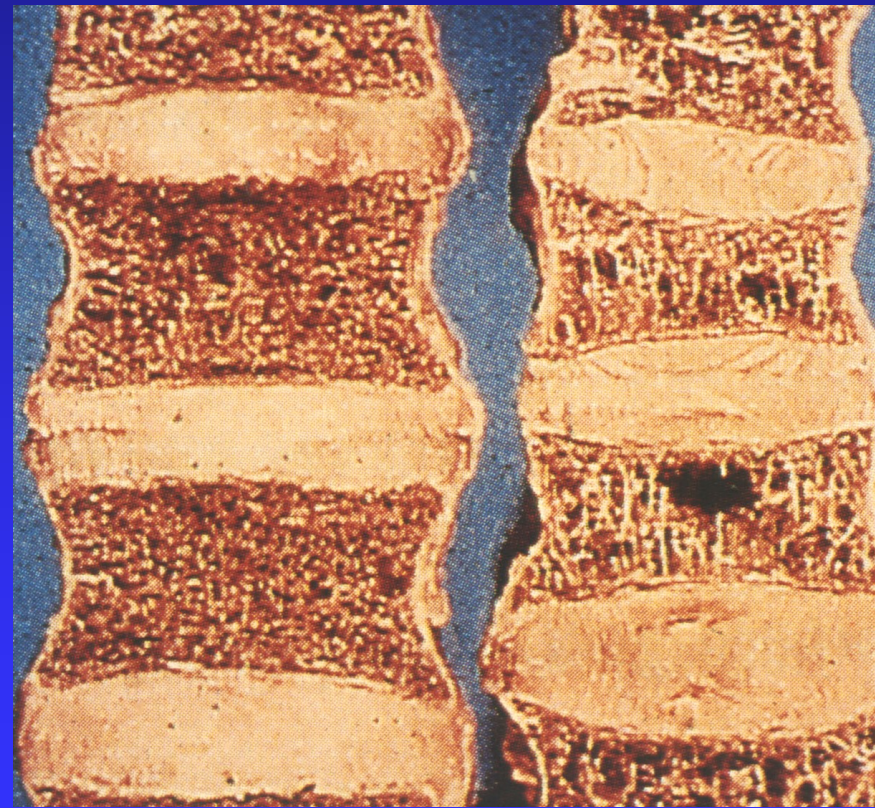
- Bisphosphonates
- SERM
- Stroncium ranelate
- Calcium





# Stimulation of bone formation

- Vitamin D
- Anabolics
- Teriparatid
- Stroncium ranelate



# HRT

no evidence of effect

# Livial®

tibolone

**The tissue-specific therapy with  
an estrogenic effect on bone<sup>1</sup>**

enhances mood and  
libido<sup>5, 6</sup>

treats climacteric  
symptoms<sup>7</sup>

no proliferation of  
breast cells (*in vitro*)<sup>8</sup>

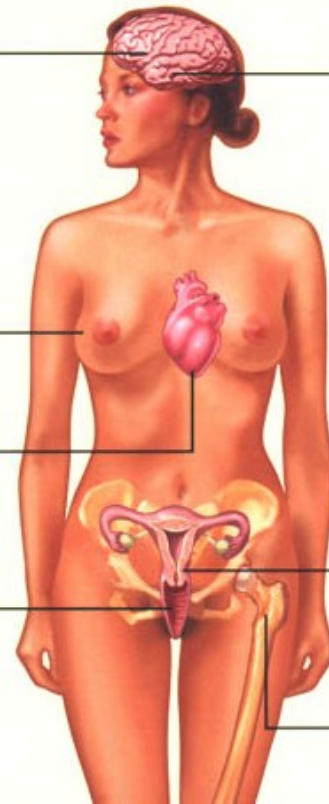
low incidence of  
side effects  
(eg breast tension)<sup>9</sup>

beneficial effects on the  
cardiovascular system<sup>10</sup>

treats vaginal atrophy<sup>12</sup>

no endometrial  
stimulation<sup>11</sup>

prevents postmenopausal  
bone loss<sup>4</sup>

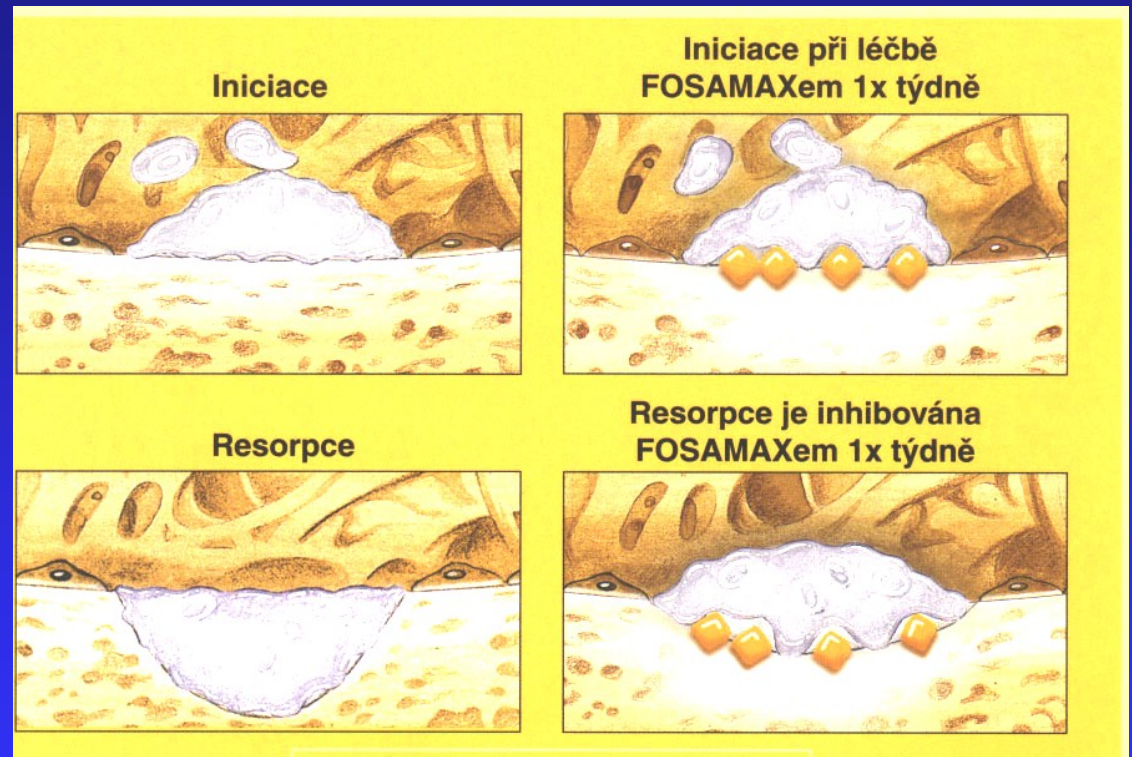


# Bisphosphonates

Incorporation in HA  
crystals and matrix

Inhibition of formation,  
agregation and  
dissolution of crystals

Inhibition of bone  
resorption



Fosamax

# Bisphosphonates

- Reduction of activity of osteoclasts
- Induction of apoptosis of osteoclasts

# Bisphosphonates - indications

Osteoporotic fractures

All forms of osteoporosis

Paget 's disease of bone

Hypercalcemia in carcinomas od myeloma

# Bisphosphonates

Pamidronate - Aredia inj.

Clodronate – Bonefos inj, cps., Lodronat inj, cps.

Ibandronate – Bonviva tbl., Bondronate inj.

Alendronate – Fosamax 70 mg tbl., Alendros tbl.

Risedronate - Actonel tbl.

Zoledronate – Aclasta inj.

# SERM - selective modulators of estrogen receptors

- Raloxifen (Evista)
- Agonists on bone and cardiovascular apparatus
- Antagonists on endometrium and breast
- They bind on the same place as estrogens (receptors  $\alpha$ ,  $\beta$  )

# Strontium ranelate

Dual affect-

Reduces bone resorption

Increases bone formation

Prevents loss of trabecular bone  
and stimulates its apposition

Increases mineralisation of bone



**PROTELOS<sup>®</sup> 2g**  
Stroncium-ranelát

- **Unikátní duální mechanismus účinku<sup>1,2</sup>**  
zvysuje kostní formaci a současně redukuje kostní resorpci
- **Snižuje riziko vzniku osteoporotické zlomeniny<sup>3,4</sup>**  
obratlů i kyčle

**NOVINKA**  
V LÉČBĚ  
POSTMENOPAUZÁLNÍ  
OSTEOPOROZY

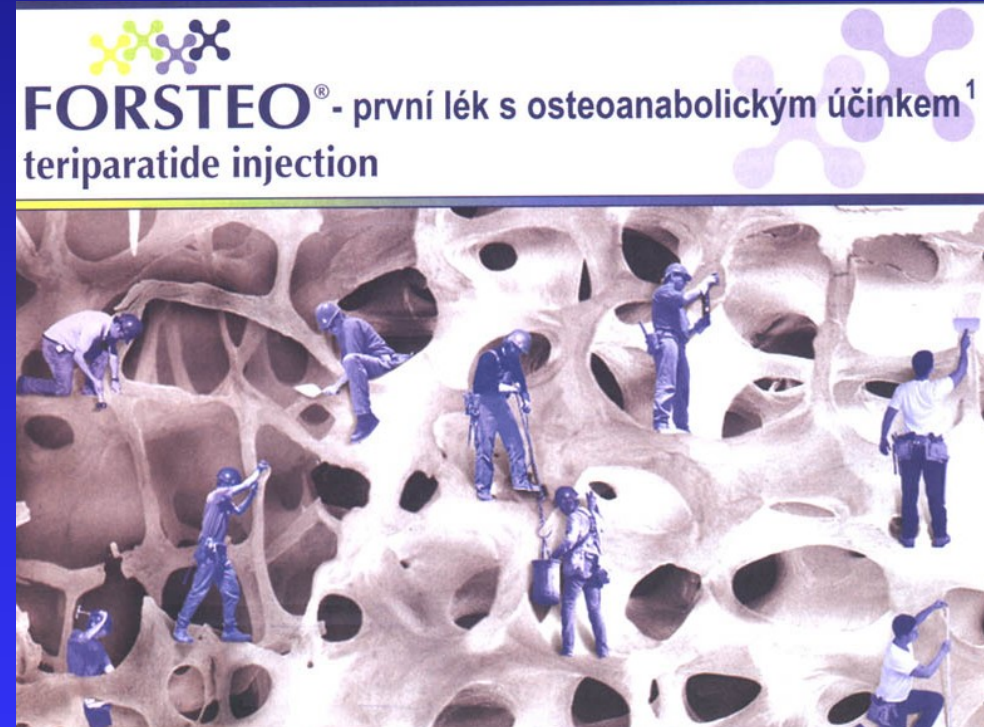
**PROTELOS<sup>®</sup> 2g**  
28 sáčků

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# Teriparatid – synthetic parathormon 1- 34 fragment

Stimulates bone formation  
Stimulates osteoblasts  
and remodeling  
Improves the strength  
of trabecular and cortical  
bone



# Differential diagnosis

Osteoporosis with corticosteroids

Condition after transplantations

Cushing syndrom

Hyperthyreosis

Rheumatoid arthritis

Osteogenesis imperfecta

Fibrous osseous dysplasia

Osteomyelitis

Myeloma, tumors, osteolytic metastasis

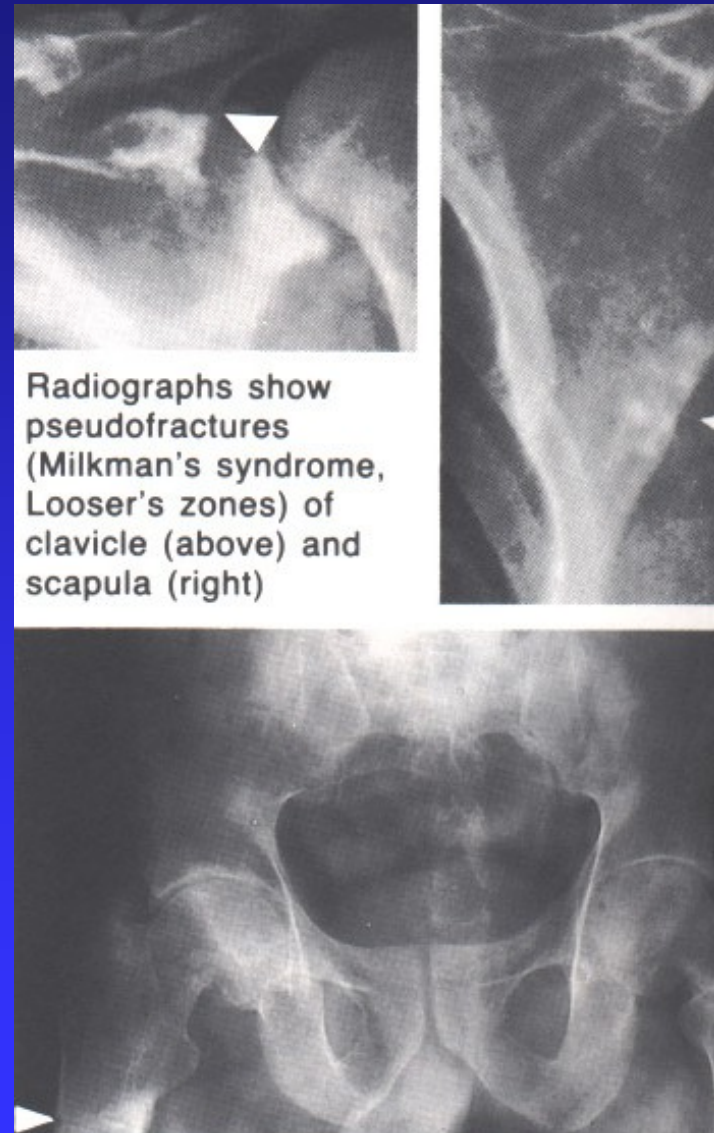
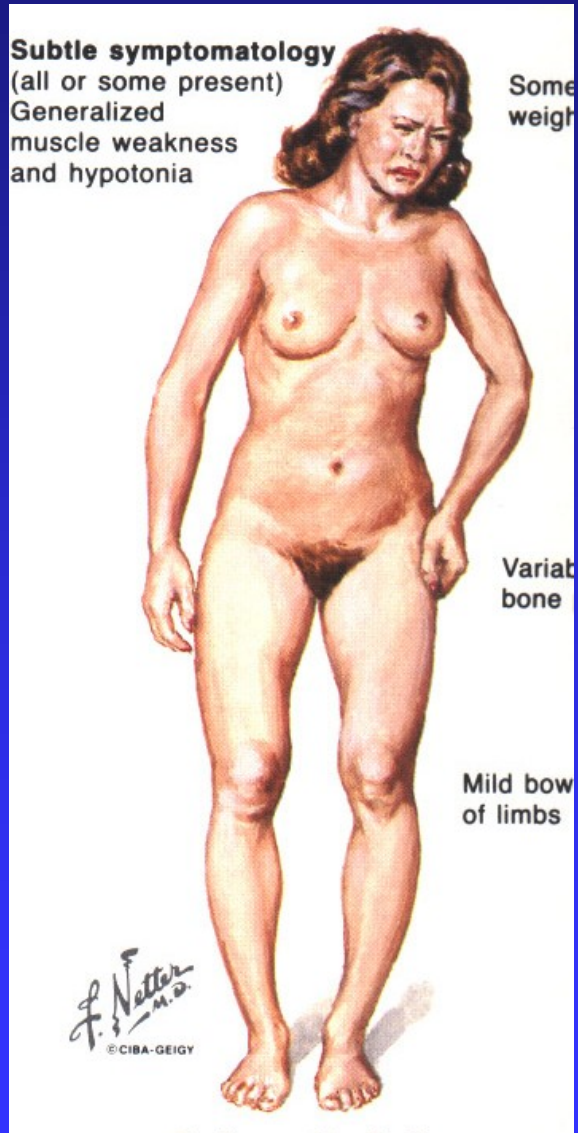
Malnutrition

Algoneurodystrophy

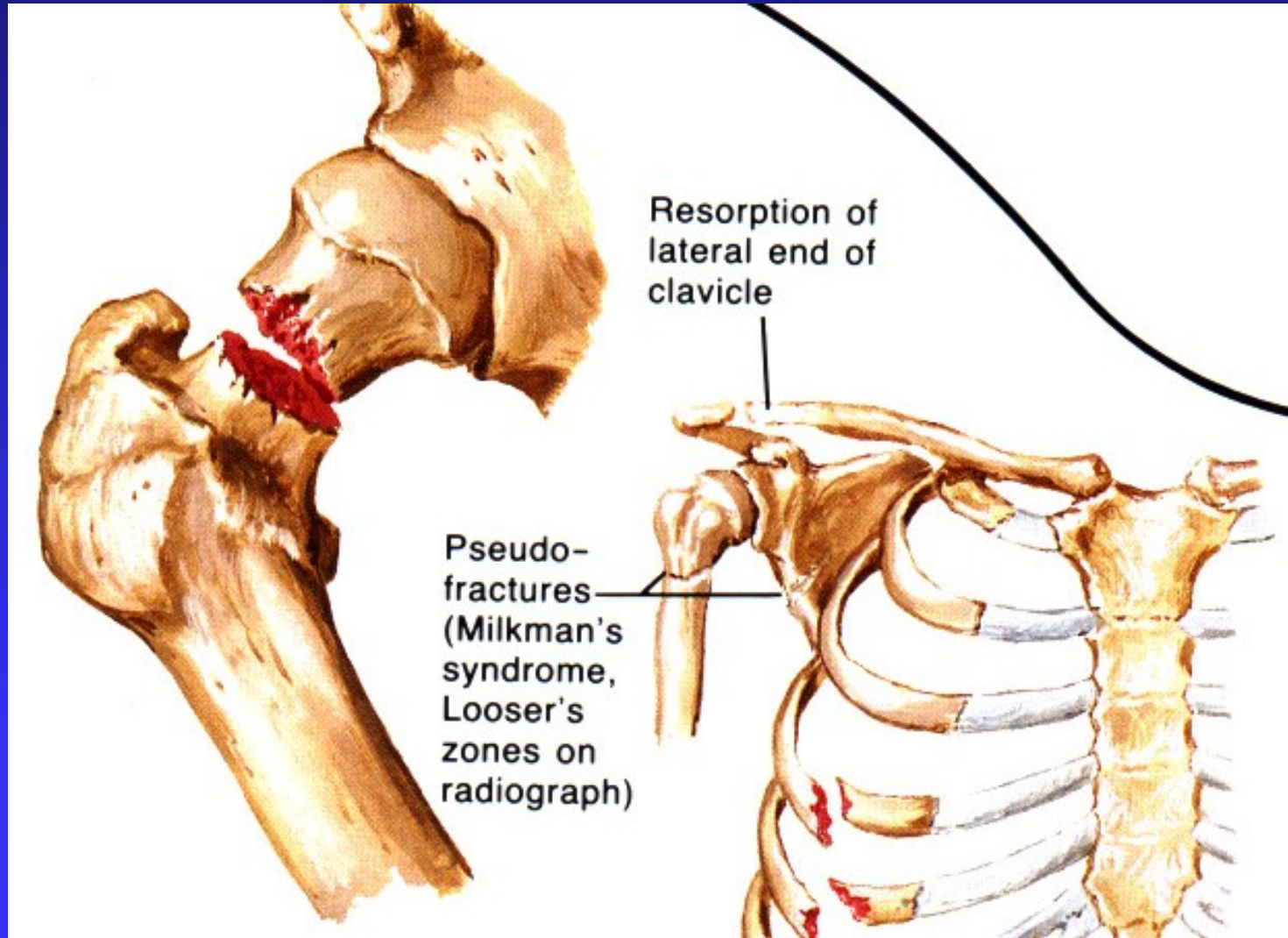
# Osteomalatia

- Systemic disorders in adults
- Bone is in a form of nonmineralised osteoid
- Calcium is not layed in HA crystals
- Bone is soft
- The cause: lack of vitamin D

# Osteomalatia



# Osteomalatia



# Symptoms

- Diffuse pain in skeleton
- Muscle weakness
- Tenderness of bones
- Deformities of bones
- Thoracic kyphosis

# Laboratory tests

- High level of alkaline phosphatase
- High level of bone isoenzyme of ALP
- Low level of calcium
- Normal level of phosphorus

# Radiological finding

Rarefaction of skeleton

Narrow cortical bone

Looser's zone of remodelling  
- non mineralised osteoid

Biconcave shape of vertebrae  
coxa vara

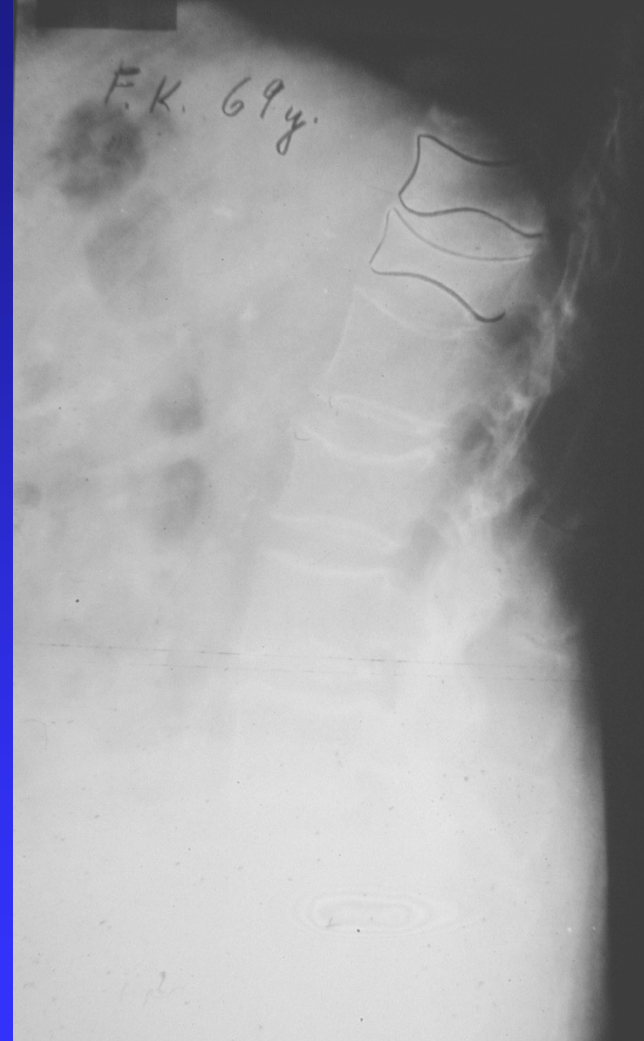
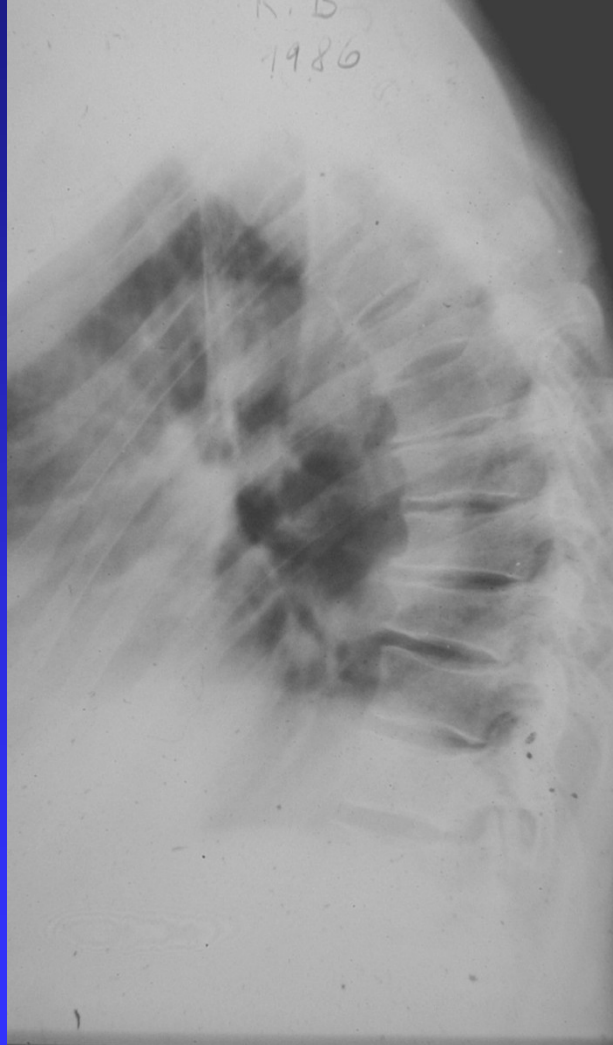
Protrusion of acetabulum

Thoracic hyperkyphosis





# Osteomalatia



# Prevention

- Vitamin D - sun radiation and in food
- Application of vitamin D in renal and liver disorders

# Therapy

- Vit. D 10 000 IU per day i.m.
- Calciferol inj.
- Vit. D p.os 2000 IU daily
- Calcium 1000 - 2000 IU daily
- Food with milk, sea fish

# Rickets

1. Lack of vitamin D
2. Lack of phosphates

Inability to calcify of matrix

Bone is soft

Bending of bone

Wide growth plates

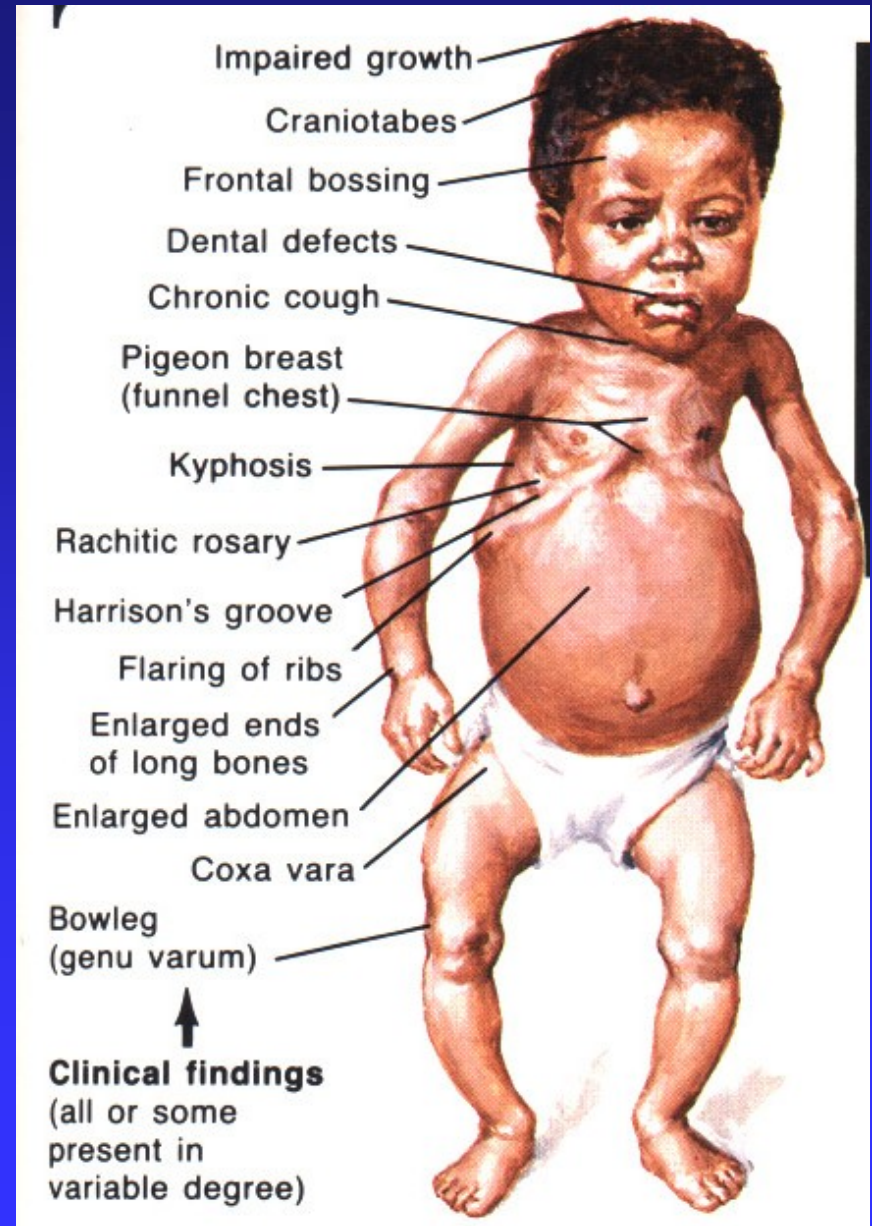
Metaphysis is wide

Deformities of bones



# Rickets

- Fatigue
- Enlargement of abdomen
- Walking ability - worsened
- Craniotabes
- Large fontanel
- Dentic disturbances
- Caput quadratum
- Harrison's groove
- Rachitic rosary
- Pectus carinatum
- Crura et coxa vara
- Pedes plani



# Management

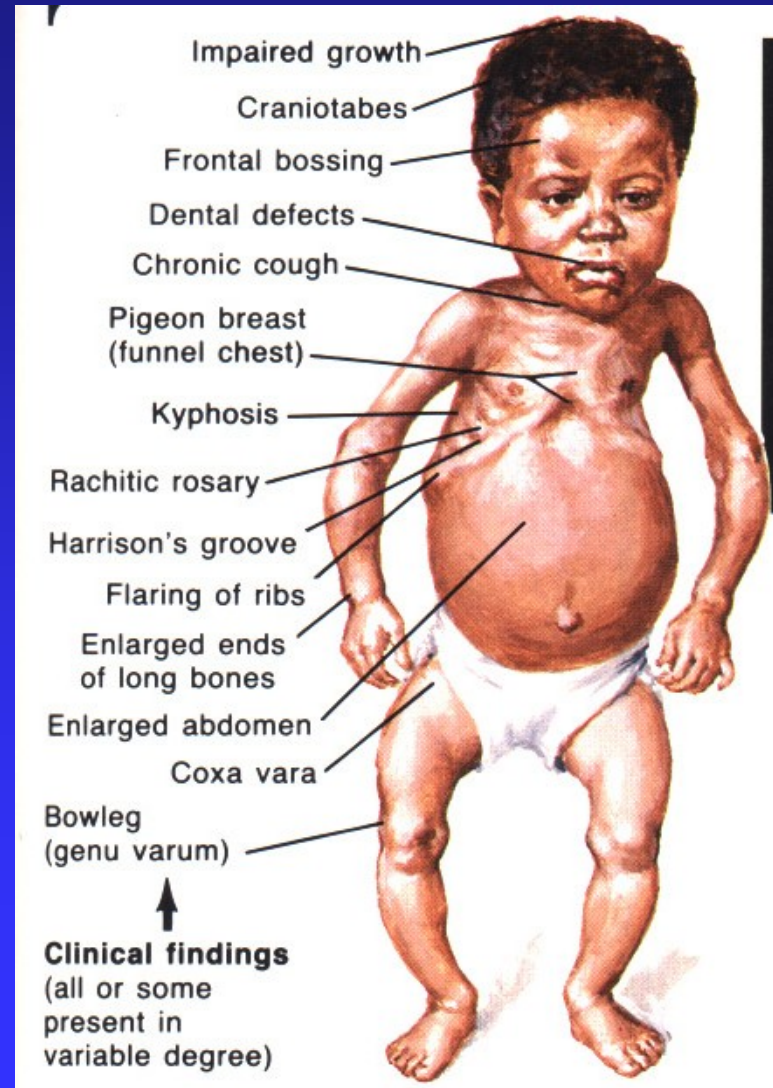
Vitamin D 500- 1000 IU/day 10 weeks

Sun radiation

Milk products with vitamin D

Orthosis

Osteotomies

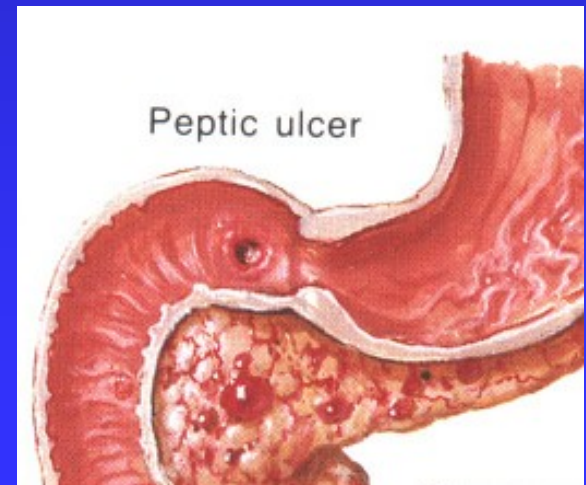
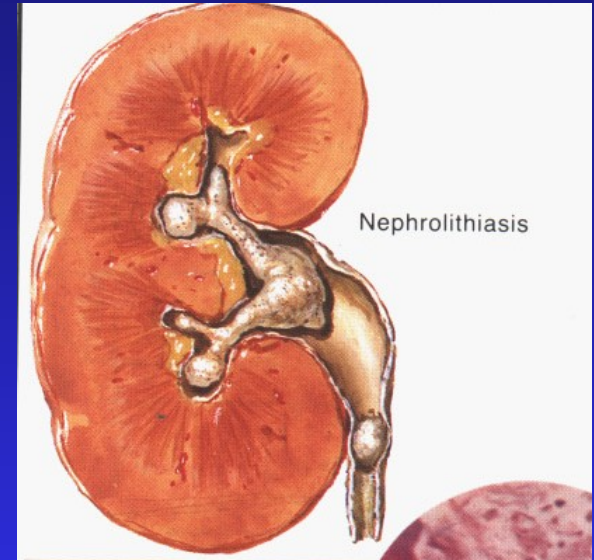


# Hyperparathyreoidisms - HPT

- Adenoma of parathyroid glands
- Hyperplasia of parathyroid glands
- Carcinoma of parathyroid glands

# Primary HPT

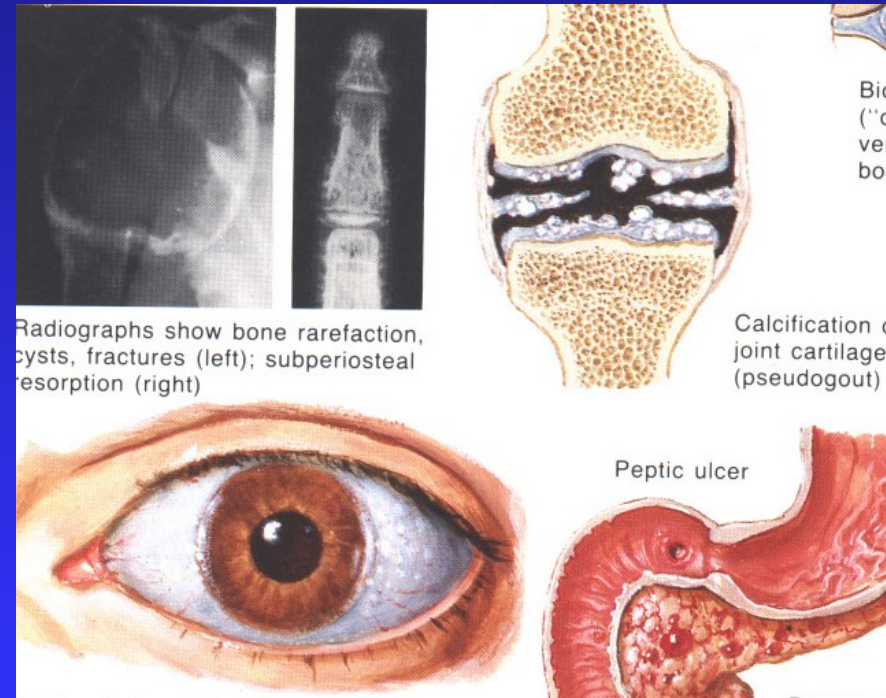
- Nephrolithiasis, polyuria, polydypsia
- Osteodystrofia fibrosa cystica generalisata
- Gastrointestinal problems
- Acute pancreatitis, cholelithiasis
- Muscle weakness, fatigue, bone pain
- Chondrocalcosis, calcifications





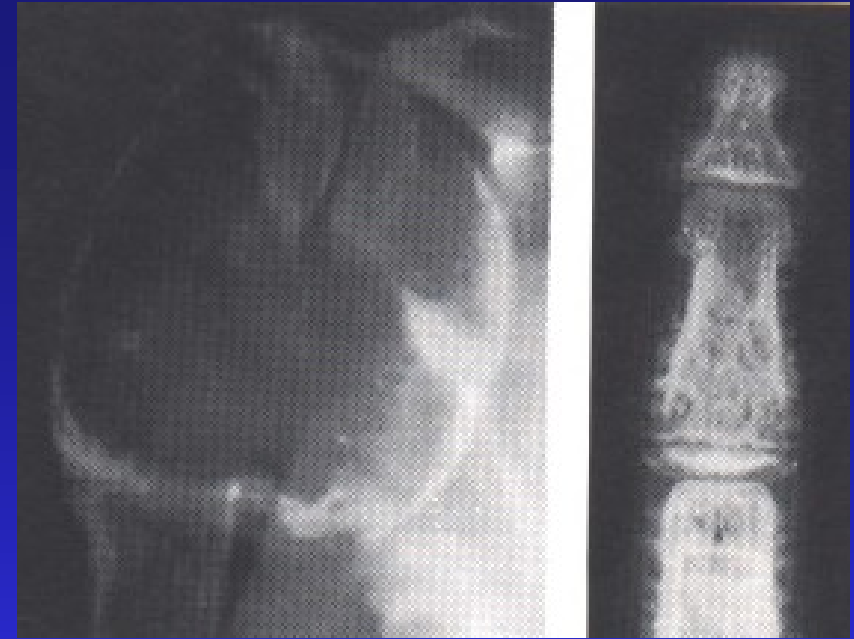
# Primary HPT

- High level of calcium
- Hypofosfatemia
- Hyperfosfaturia
- High level of ALP
- High level of parathormon

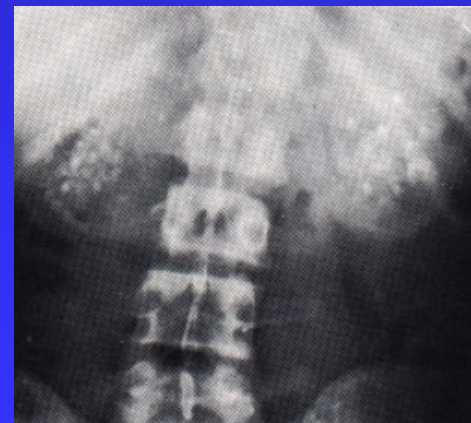


# Radiological finding

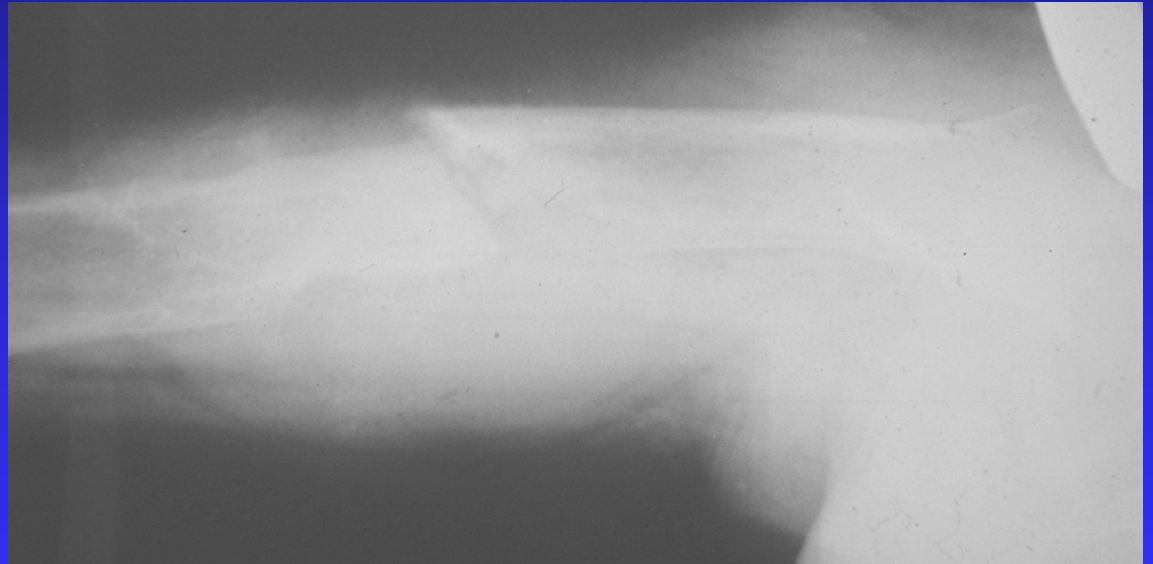
- Rarefaction in skeleton
- Narrow corticalis bone
- Resorption in phalangs
- Large cysts as bone tumors



- Kyphosis
- Coxa vara
- Fisures and complete fractures



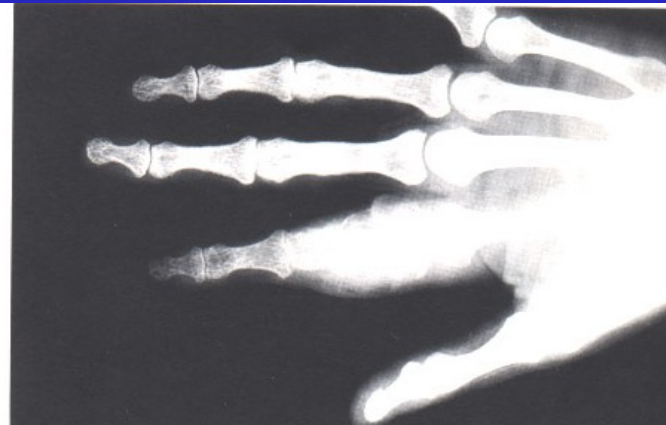
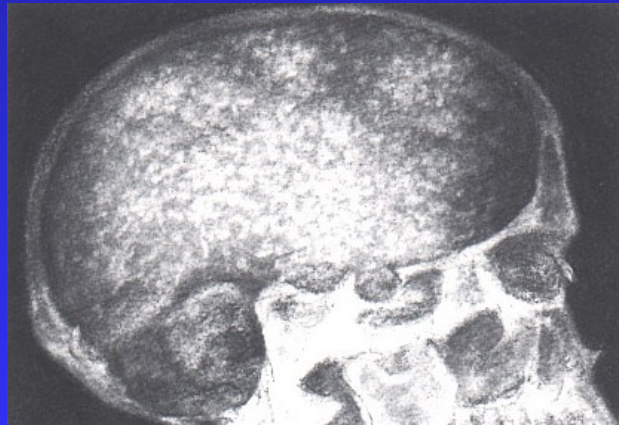
# Primary HPT



# Renal osteodystrophy

- secondary HPT in renal disorders

Secondary hyperplasia of parathyroid glands



# Renal osteodystrophy

Fatigue, bone pain

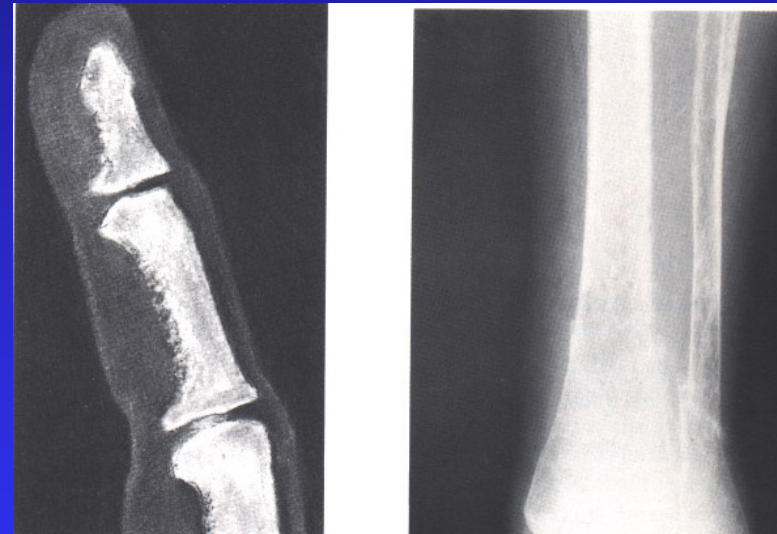
Muscle weakness

Fractures

Th: Treatment of renal disorders

vitamin D3

calcium



# Secondary HPT

## - Malabsorption of vitamin D

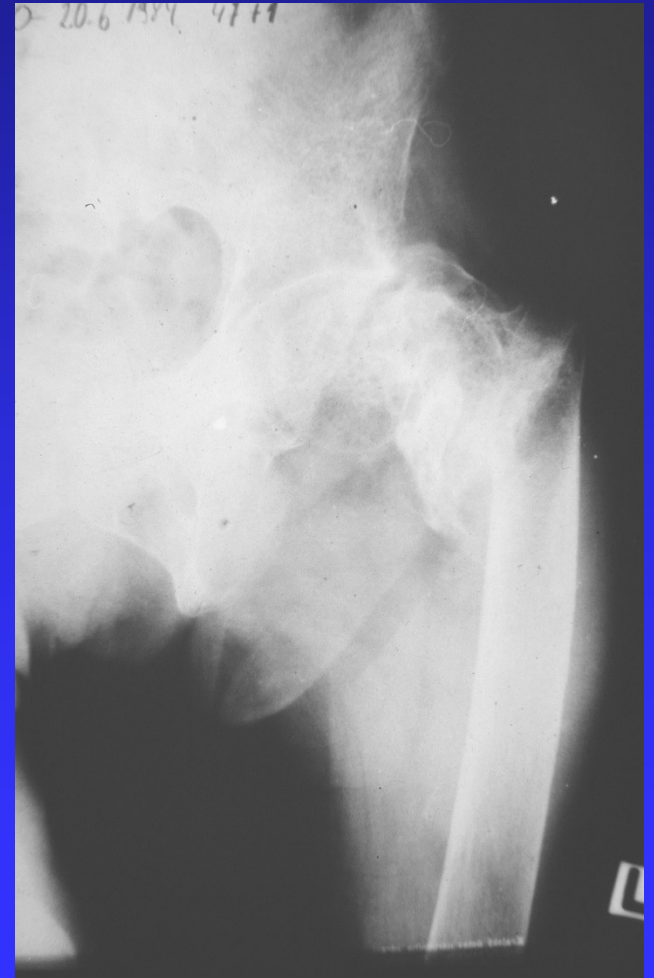
Resection of the stomach or intestine,  
gall bladder problems, coeliakia,  
pancreatitis

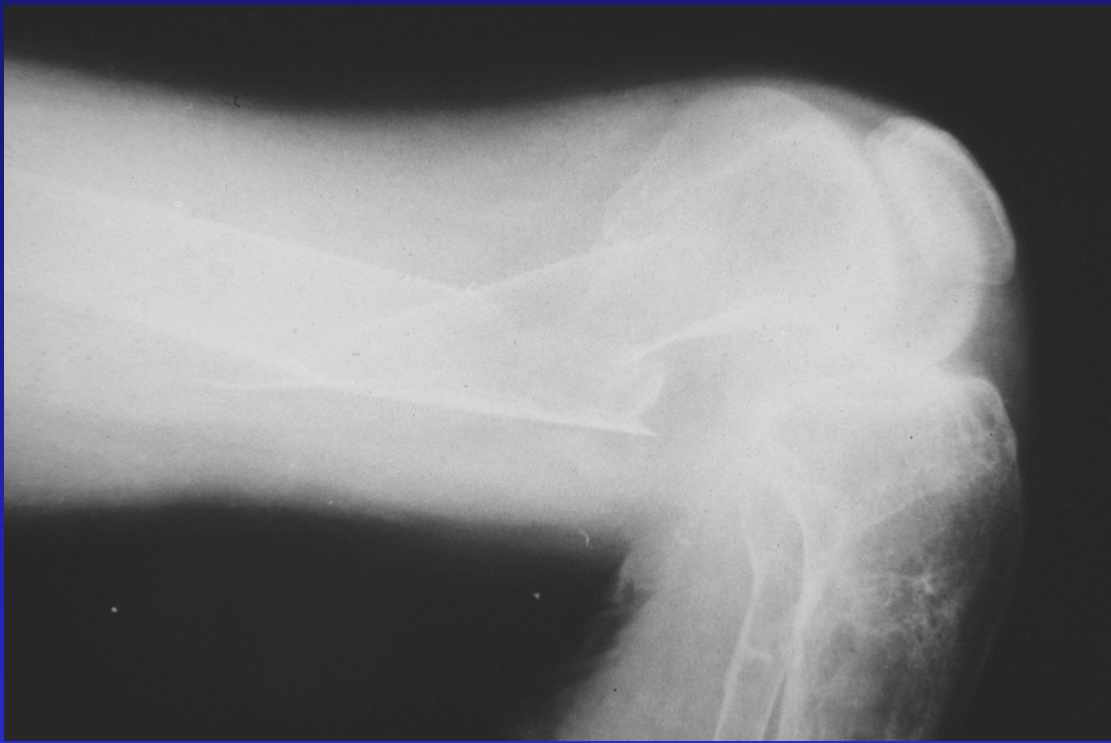
Pain in bones

Muscle weakness

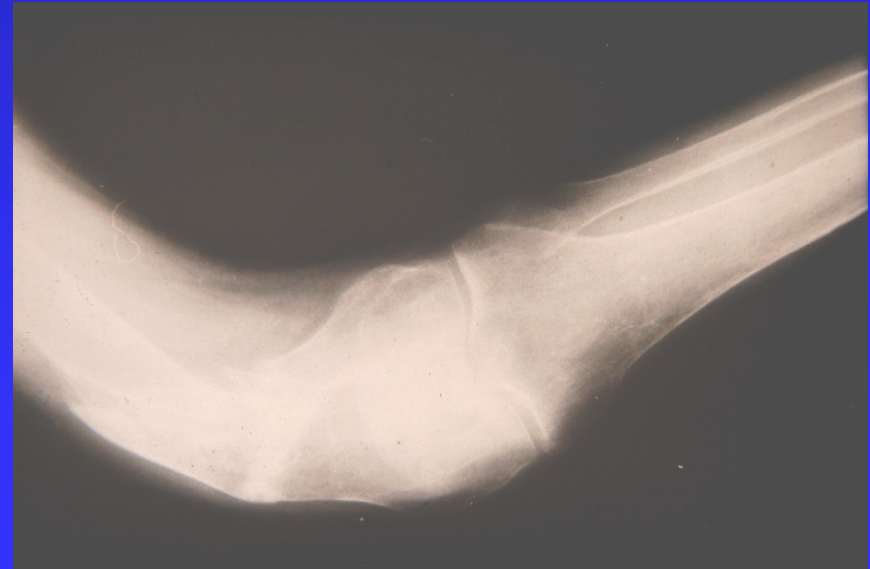
Pseudofractures

Deformities of bone





Secondary HPT  
- malabsorption of vitamin D



# Paget 's disease of bone

- Sir James Paget in 1876
- Chronic disease
- Slow viral infection (distemper virus from group of paramyxoviruses)
- GB, USA, Australia, New Zealand, France  
Germany, Malta.



# Morbus Paget

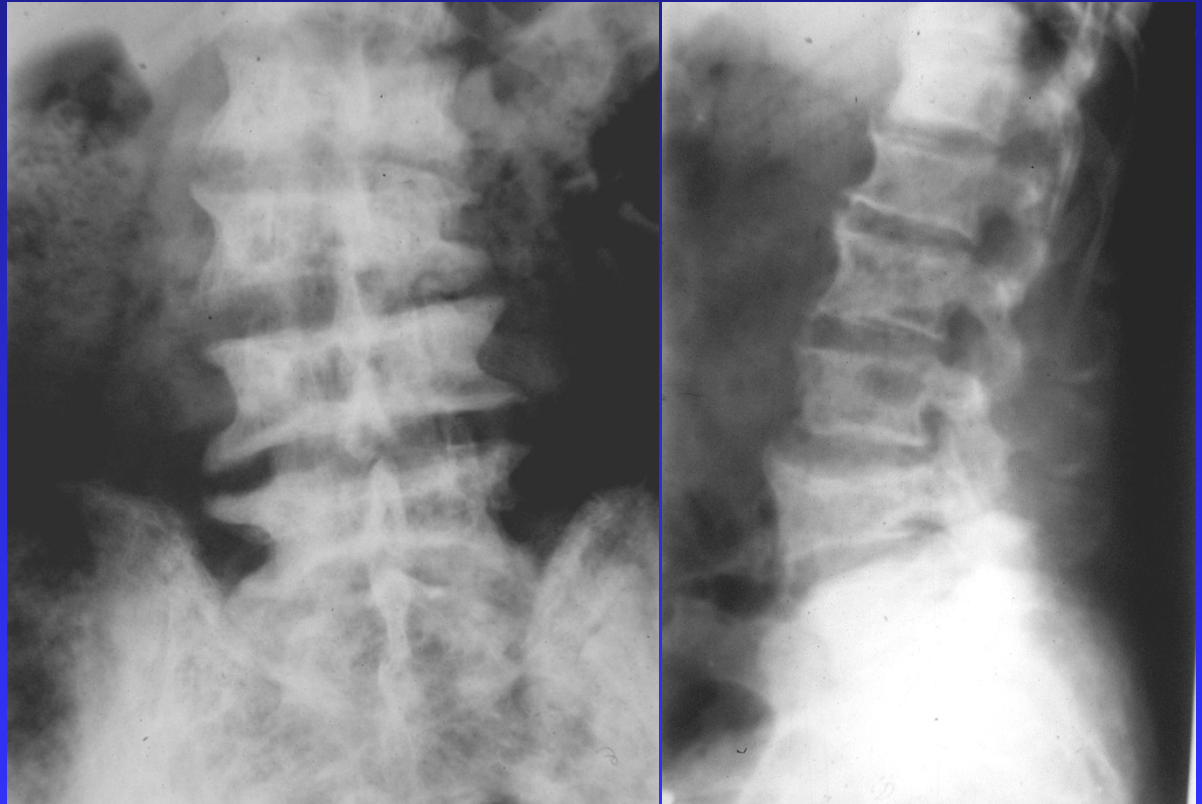
- 1. Osteolytic phase
- 2. Mixed phase
- 3. Osteoblastic phase

# Morbus Paget

- Monoostotic form - 20 %
- Polyostotic form
- 95 % are asymptomatic
- 5% symptomatic

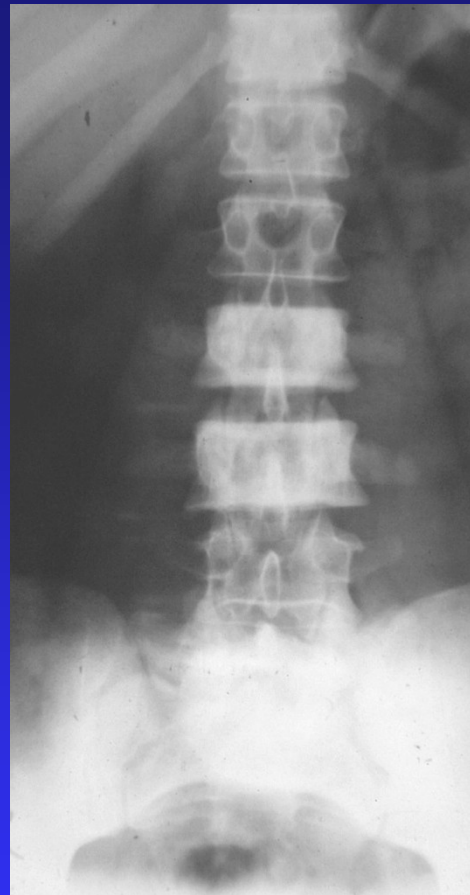
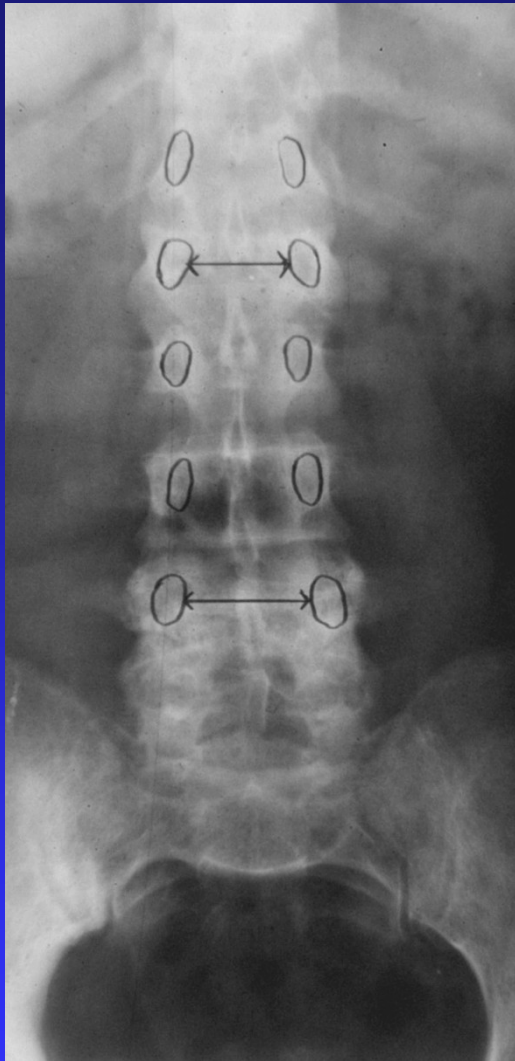
# Symptoms

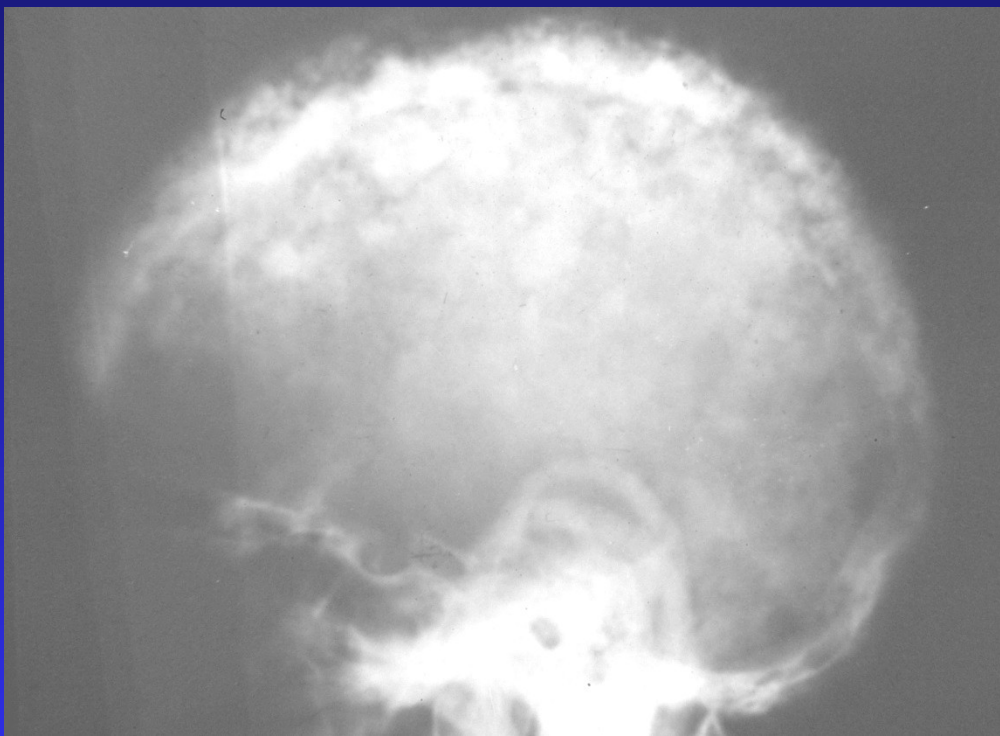
- Pain
- Fatigue
- Deformities
- Complications

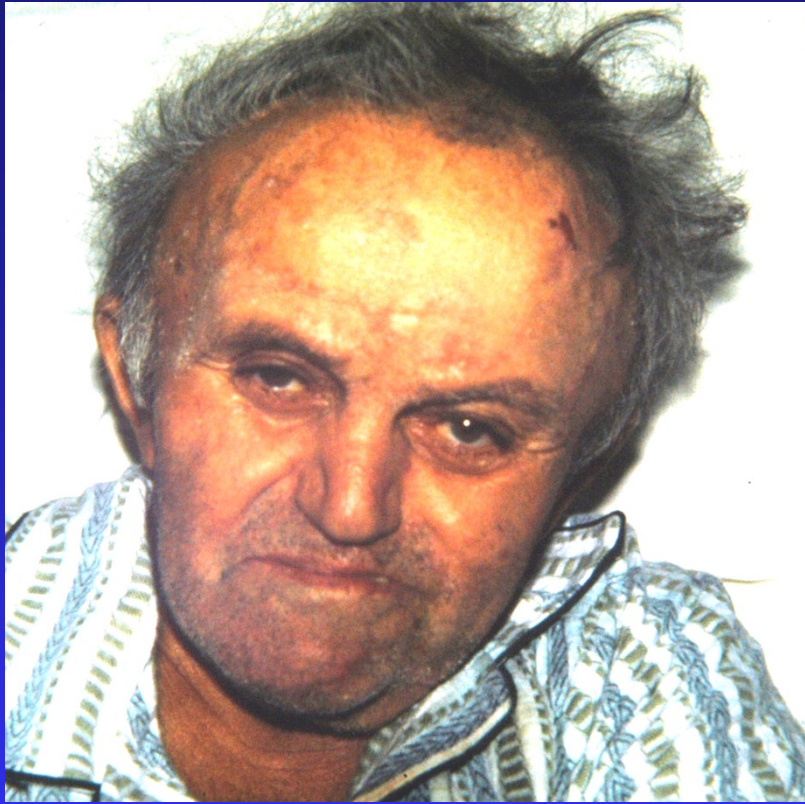


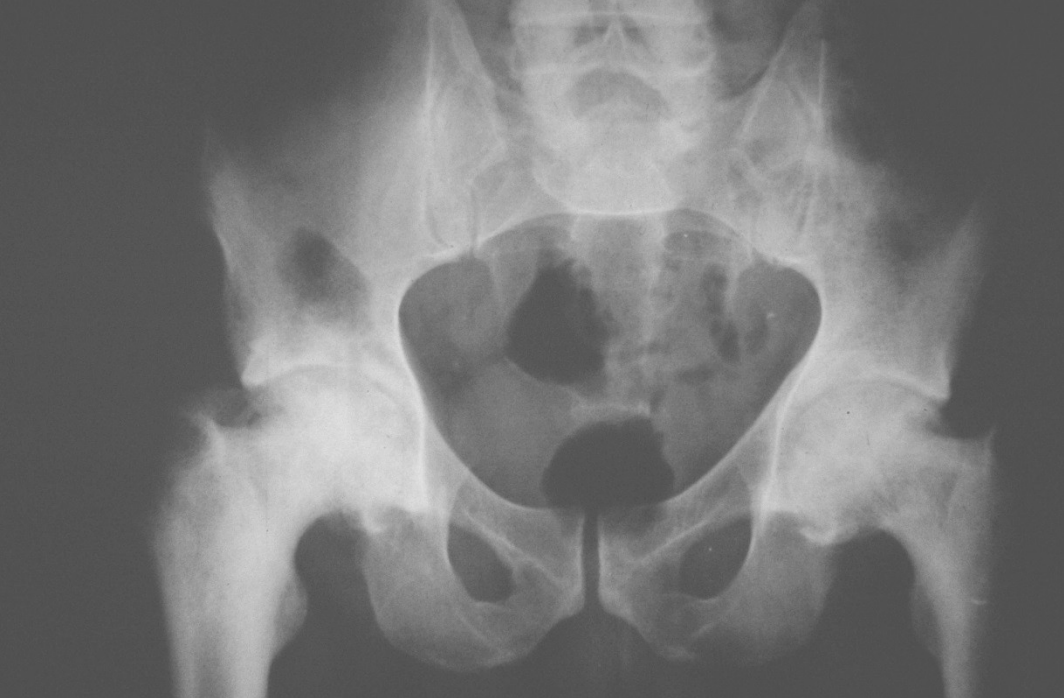
# Clinical symptoms

- Mild
- Moderate
- Severe

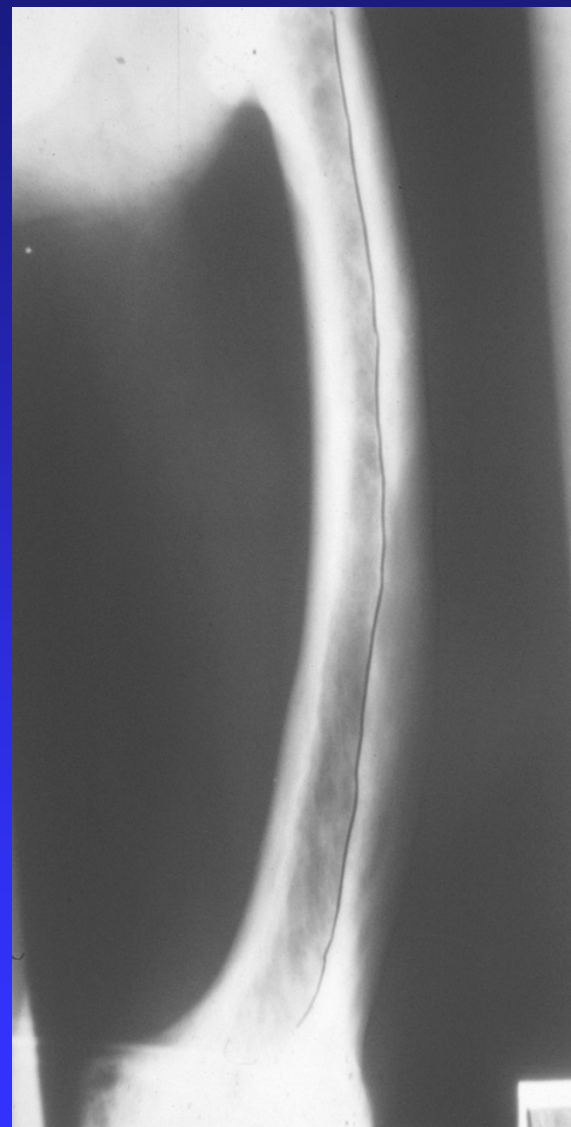
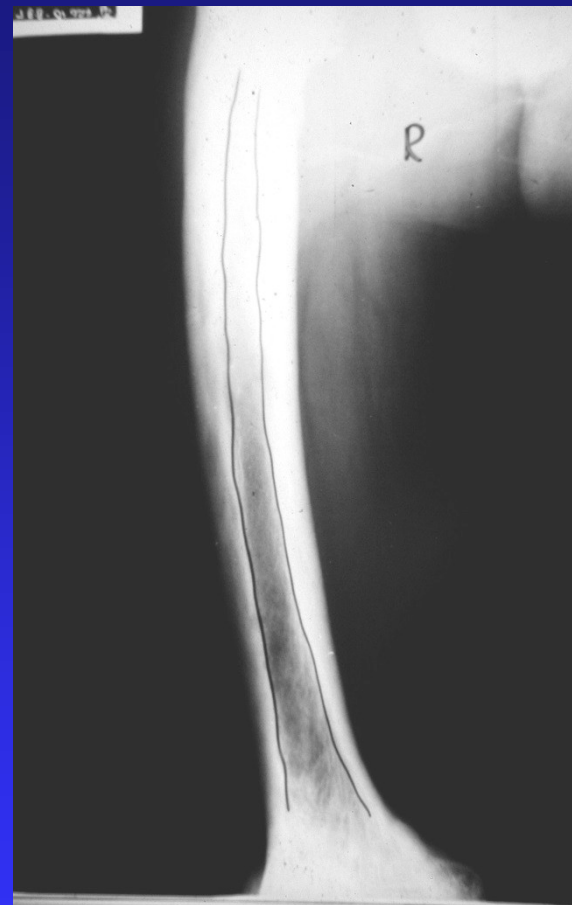


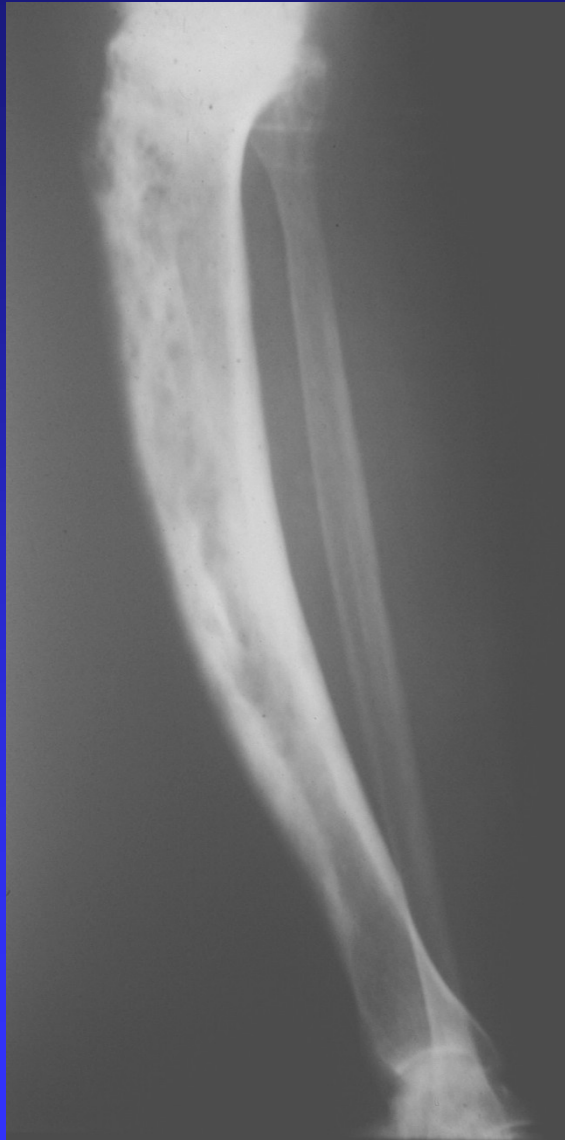
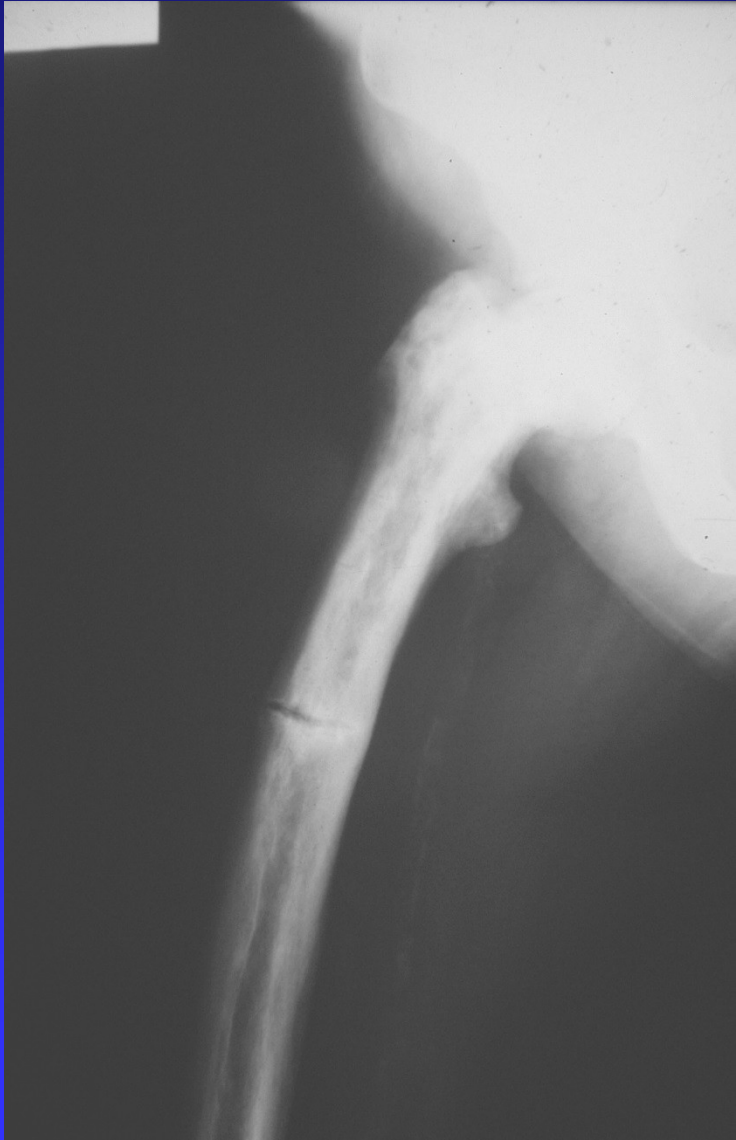


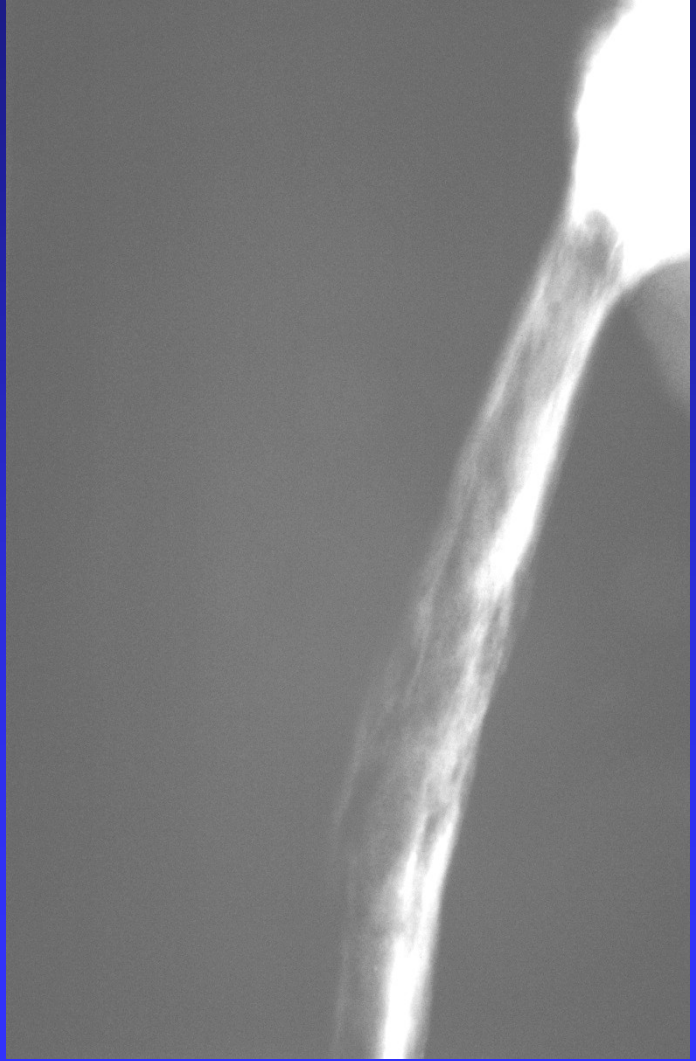
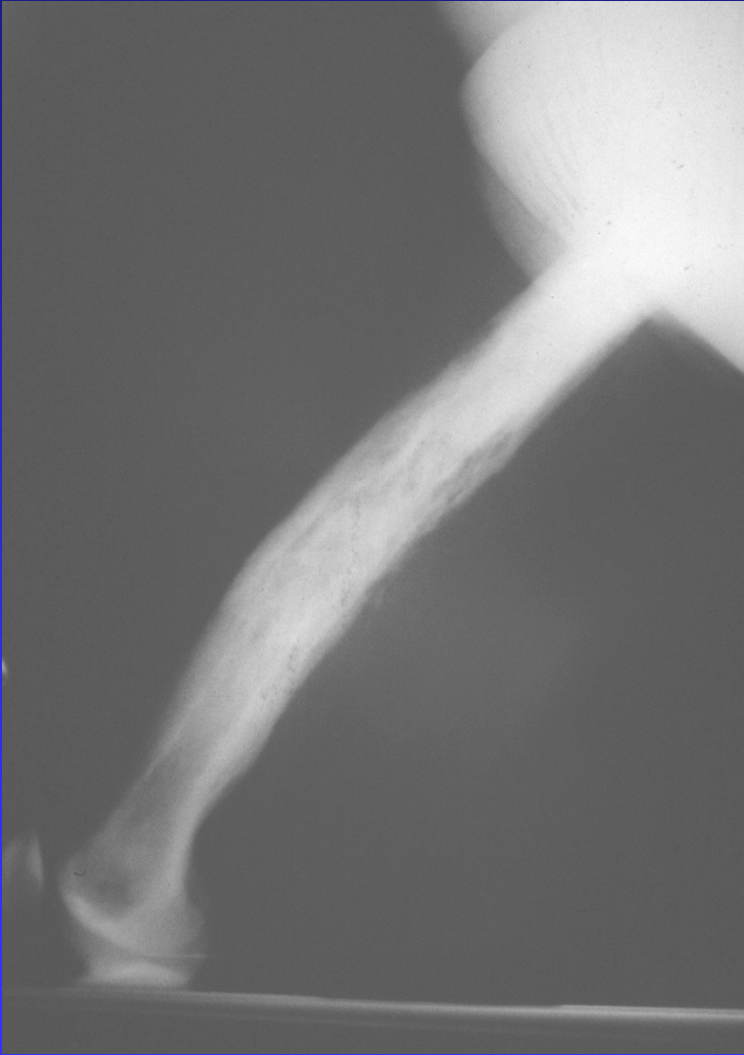














Gothic arch







# Complications

Fissures

Fractures

Osteoarthritis

Deafness

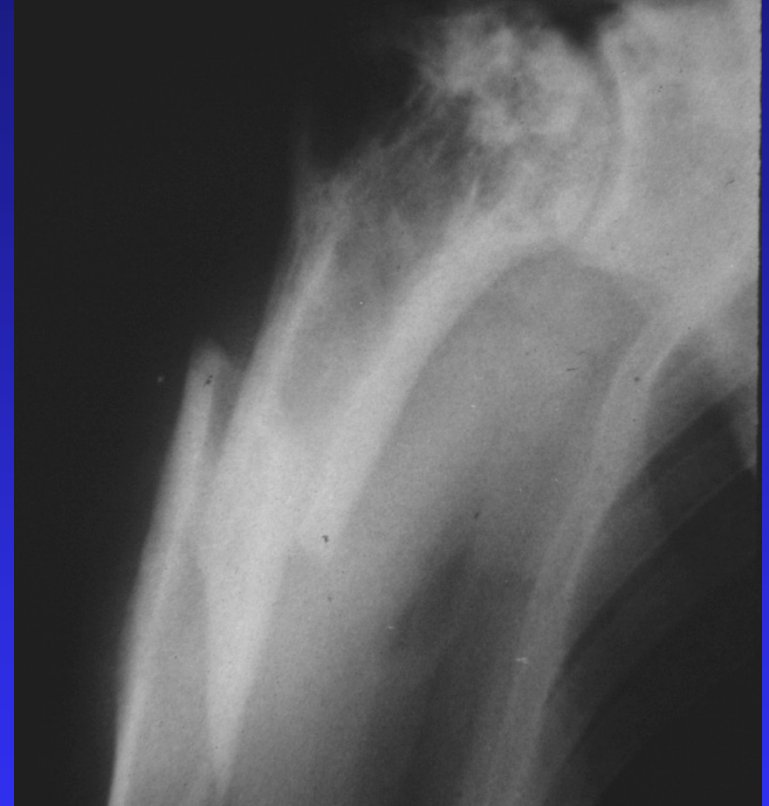
Neuralgia n. trigeminus

Basilar invagination

Vertebrobasilar insufficiency

Paraparesis, sciatica

Dental problems



# Complications

Hypertension

Ischemic heart disease

Cardiomegaly

Neoplastic degeneration

sarcoma

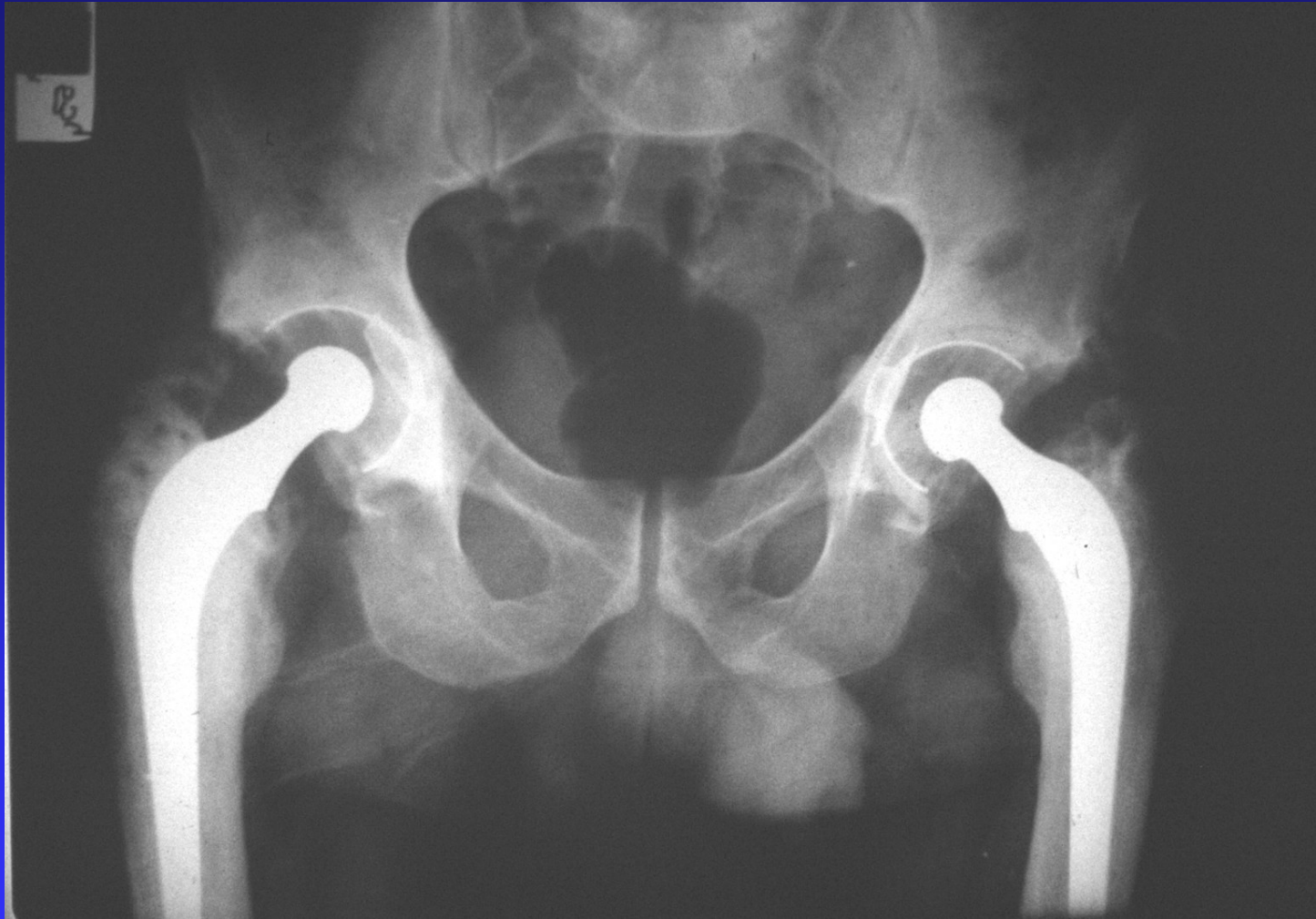
Nephrolithiasis

Calcifications



# Management

- Bisphosphonates (Fosamax 40 mg daily three months, Pamidronate, Zoledronate)
- Calcitonin nasal spray, s.c.
- Calcium
- Therapy of complications
- Osteosynthesis of fx
- Total knee and hip replacement



Charnley total hip arthroplasty