

*INTRODUCTION  
TO OSTEOPOROSIS*

## Bone has three major functions:

1. Provide rigid support to extremities and body cavities containing vital organs.
2. Provide efficient levers and sites of attachment of muscles which are all crucial to locomotion.
3. Provide a large reservoir of ions such as calcium, phosphorus, magnesium and sodium which are critical for life and can be mobilized when the external environment fails to provide them

# Types of Bone

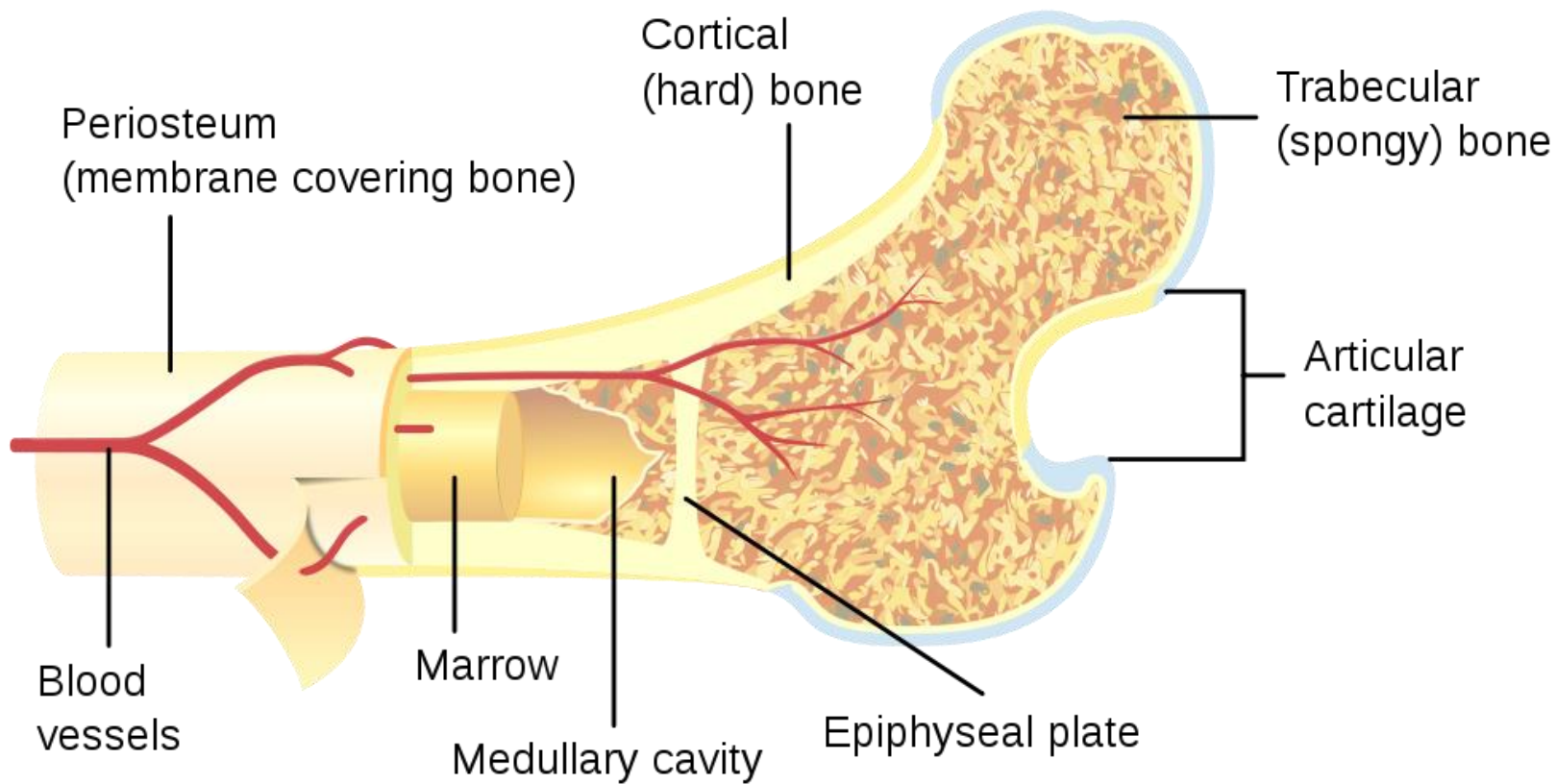
## I. Cortical Bone:

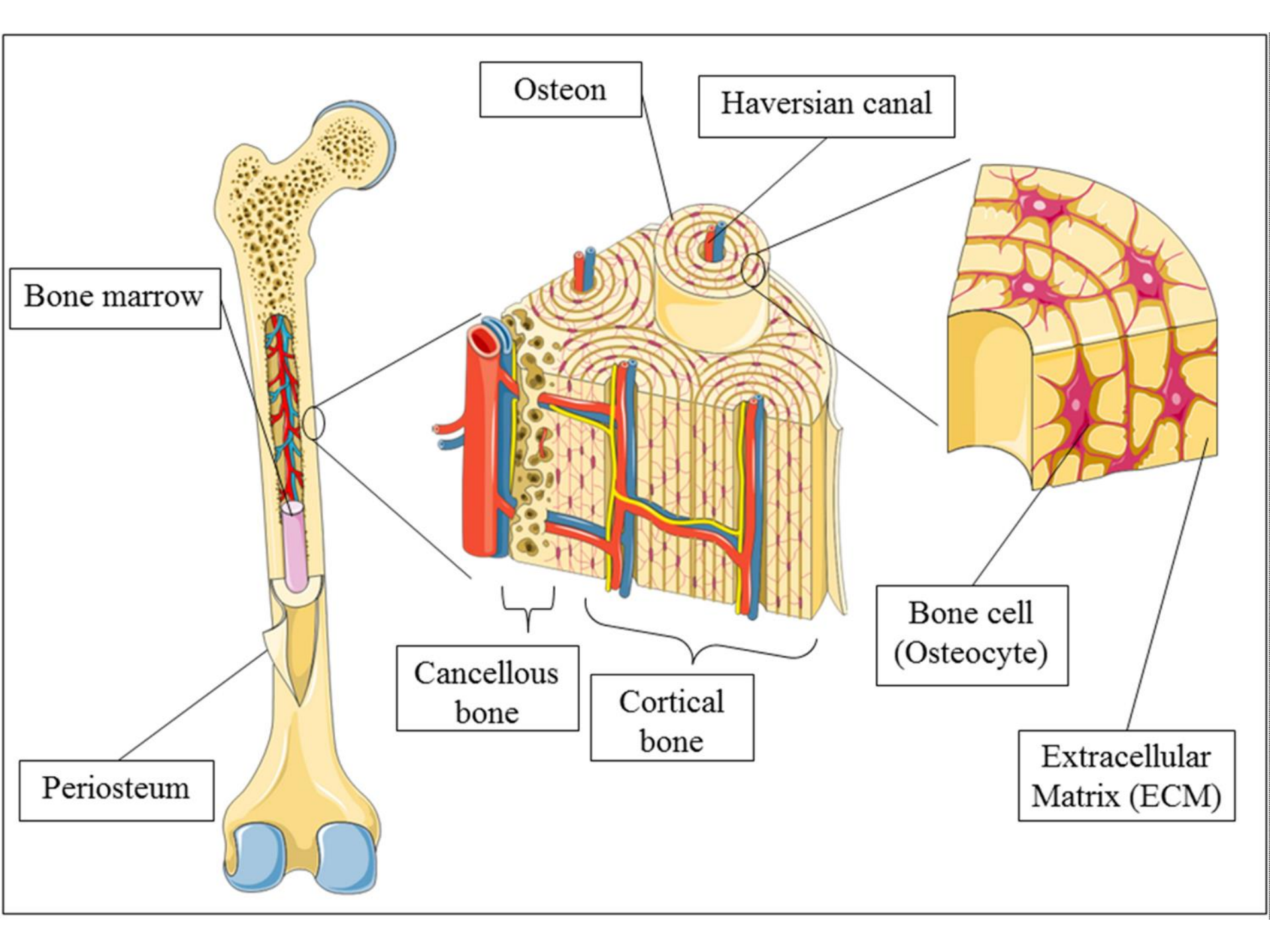
The compact bone of Haversian systems such as in the shaft of long bones.

## II. Trabecular Bone:

**The lattice – like network of bone found in the vertebrae and the ends of long bones.**

**The difference pattern of bone loss affecting trabecular and cortical bone results in two different fracture syndrome.**

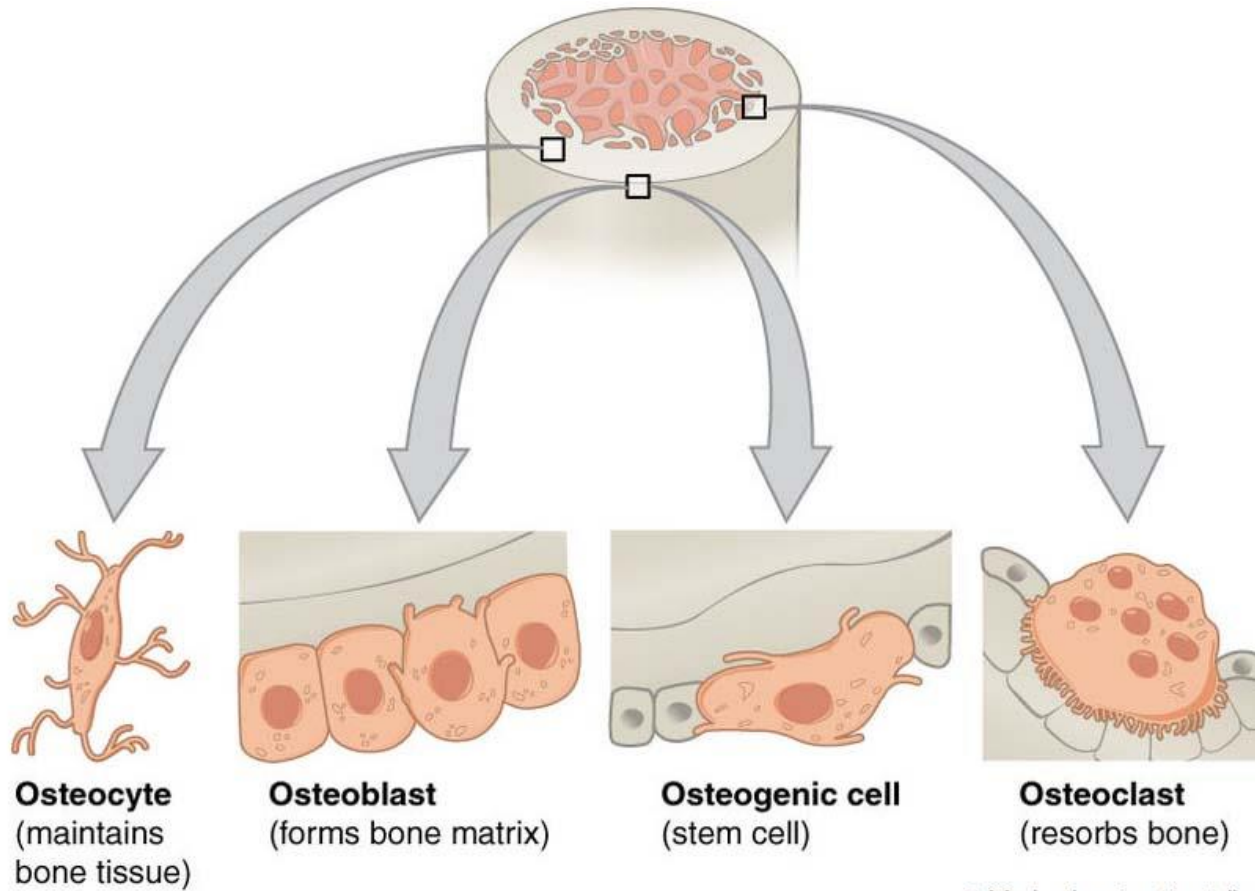




**Disorders in which cortical bone is defective or scanty lead to fractures of long bones**

**Disorders in which trabecular bone is defective or scanty lead to vertebral fractures .**

**Bone is resorbed and formed continuously throughout life and these important processes are dependent upon three major types of bone cells.**



Original author: OpenStax College

## I. Osteoblasts:

The bone forming cells which are actively involved in the synthesis of the matrix component of bone (primarily collagen) and probably facilitate the movement of minerals ions between extracellular fluids and bone surfaces.

## II. Osteocytes:

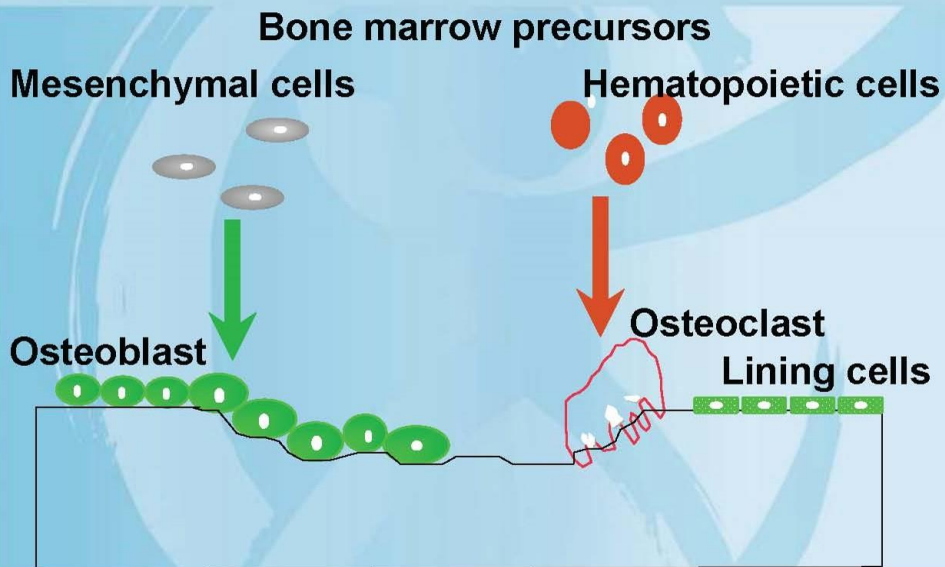
**The are believed to act as a cellular syncytium that permits translocation of mineral in and out of regions of bone removed from surfaces.**

## III. Osteoclasts:

**The bone resorption cells.**



# Bone remodeling



# Osteoporosis

**“THE SILENT THIEF”**

# Definition

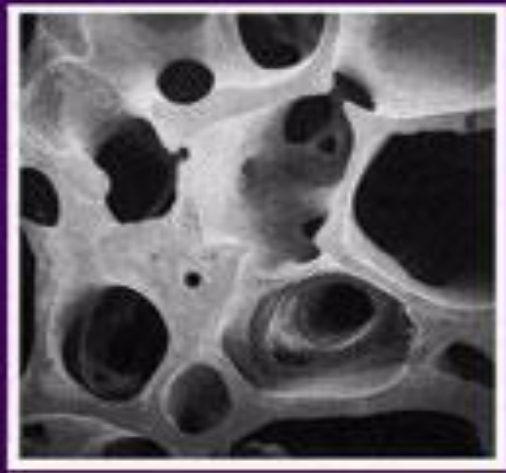
**Decrease in bone mass and strength associated with an increased tendency to fractures**

# Osteoporosis Definition

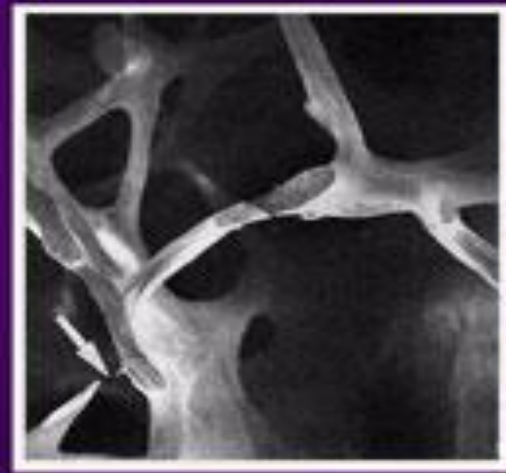
## NIH Consensus Conference

A skeletal disorder characterized by compromised bone strength predisposing to an increased risk of fracture

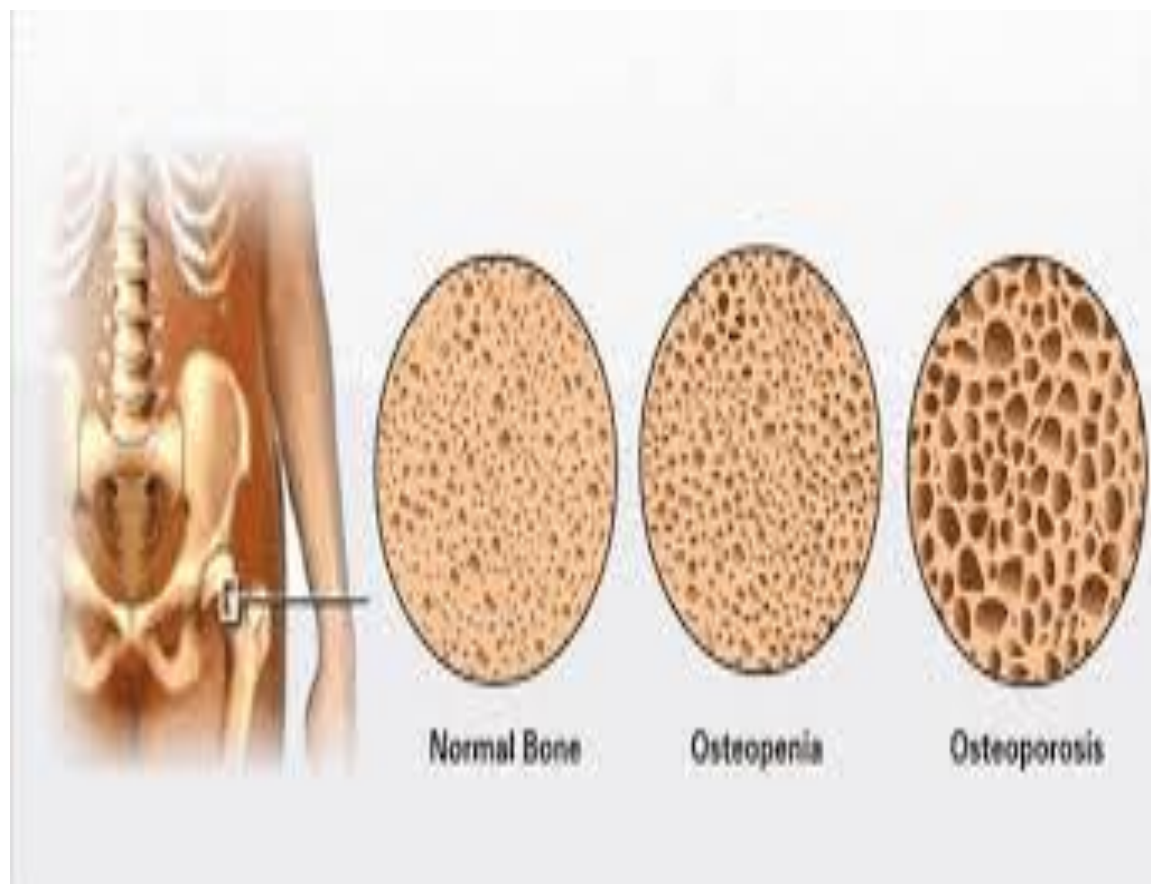
Bone strength = Bone density + Bone quality



Normal



Osteoporosis

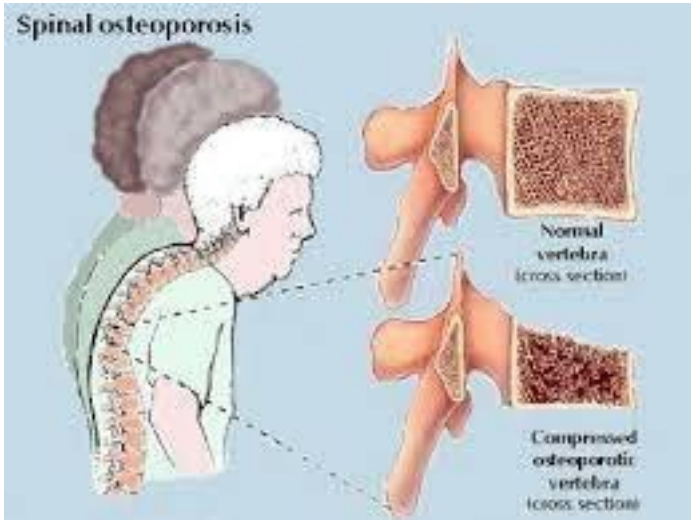


# Osteoporosis



**1** in 3 women and **1** in 5 men over 50 will experience osteoporosis fracture

### Spinal osteoporosis



# Clinical Features

It is usually an **asymptomatic** disease until fractures occur.

The first manifestation of reduced bone mass is usually a wrist fracture or a vertebral crush fracture caused by a small amount of force which produces severe localized pain.



Subsequent vertebral fractures may contribute to chronic back pain.

In well established osteoporosis dorsal Kyphosis and loss of height occurs.

Hip fractures with its fatal complications also occur commonly as osteoporosis become more severe.

***Primary  
Osteoporosis***

# Type I Osteoporosis (Post Menopausal)

Fractures of bones composed mainly of Trabecular bone.

e.g., Distal Radius - Colle's fracture

Vertebra - Crush & Wedge  
fractures

Usually affects woman within 15 years of menopause.

# Type II Osteoporosis (Senile)

Fractures of bones composed of both cortical & Trabecular bone.

e.g., Hip - Femure neck fracture

Usually affects individual over age of 70 years.

# Difference in the two types of Osteoporosis

## Type I

## Type II

Age (Yr.)	51 : 75	>70
Sex Ratio (F:M)	6 : 1	2 : 1
Type of bone loss	Mainly trabecular	Trabecular & Cortical
Rate of bone loss	Accelerated	Not accelerated
Fracture sites	<b>Vertebrae</b> (Crush) & distal radius	Vertebrae (Multiple wedge), <b>hip, pelvis</b> , proximal humerus
Parathyroid Hormone	Decreased	Increased
Calcium absorption	Decreased	Decreased
Metabolism of 25(OH) <sub>2</sub> D to 1,25(OH) <sub>2</sub> d	Secondary Decreased	Primary Decreased
Main causes	Factors related to menopause	Factors related to aging

# Secondary Factors causing Bone Loss

## Factors Associated with Decreased Bone density

### Medical Conditions

Premature menopause

Hypogonadism (in men)

Liver disease

Hyperthyroidism

Hyperparathyroidism

Hemiplegia

Chronic obstructive lung dis.

### Drug Therapy

Glucocorticoids

Anticonvulsants (Phenytoin,  
Phenobarbitone)

### Nutrition

? Low calcium & Vit. D intake

? High phosphorus, protein,  
sodium, caffeine intake

### Behavioral factors

Smoking & Alcohol abuse

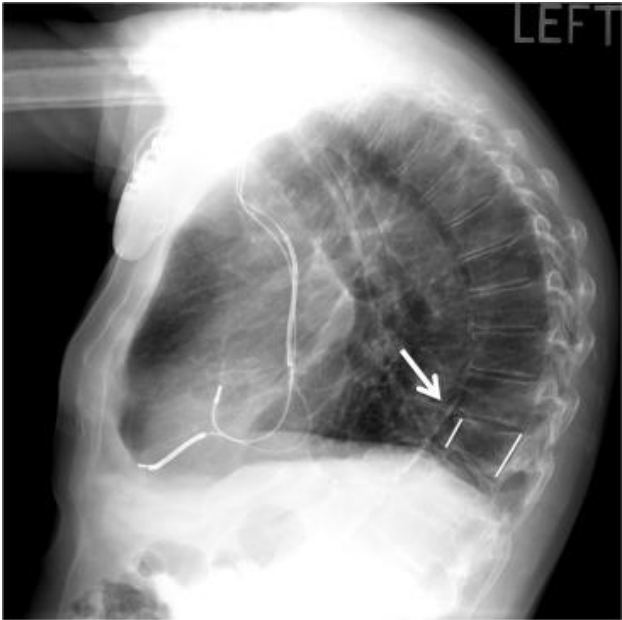
# Laboratory & Radiological Findings

Bone profile ,ALP and PTH are within normal in patients with osteoporosis due to sex hormones deficiency and aging.

X-rays of skeleton do not show a decrease in osseous density until at least 30% of bone mass has been lost.



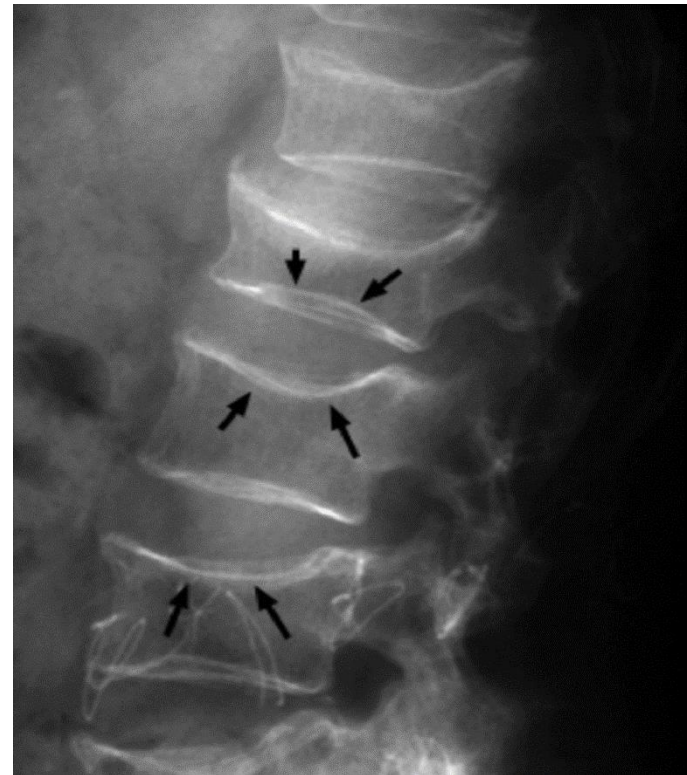




X-ray of spine show prominent trabeculae and prominent end plates of the vertebral bodies.

**Cod fish appearance** indicates protrusion of the disk into the body of the vertebrae secondary to mechanical failure.

X-ray of the upper part of the femur may also be helpful in assessing reduced bone mass and calculating the risk for hip fracture.



# Assessment of bone mass available methods

- Single-Photon absorptiometry SPA
- Dual-Photon absorptiometry DPA
- Computed Tomography CT
- Dual-Energy X-ray Absorptiometry DEXA/DXA

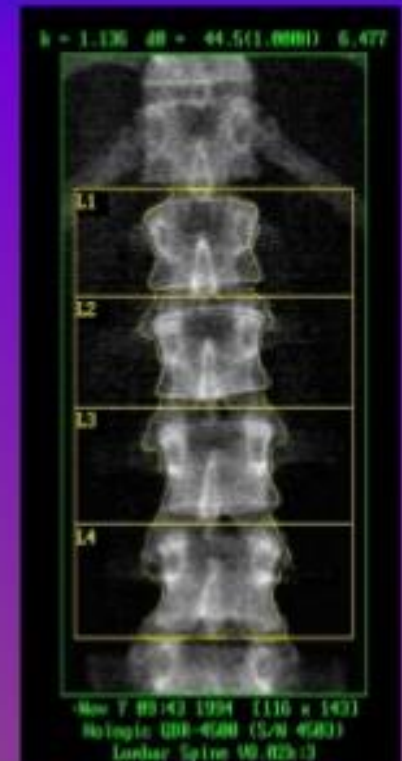
They measure **bone mass** by the ability of the tissue to absorb the photons emitted from the radionuclide source or the X-ray tube.

Age related bone loss particularly trabecular bone in the spine begins in women before menopause.

# Assessment of bone mineral density by DXA

Current gold standard for diagnosis of osteoporosis

$$\text{BMD (g/cm}^2\text{)} = \text{Bone mineral content (g)} / \text{area (cm}^2\text{)}$$



Diagnosis based on comparing patient's BMD to that of young, healthy individuals of same sex



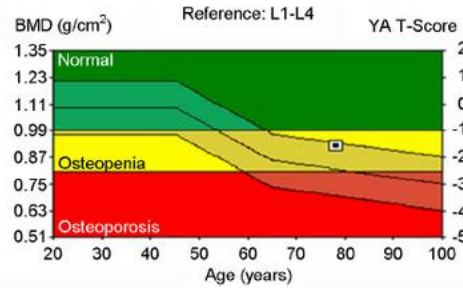
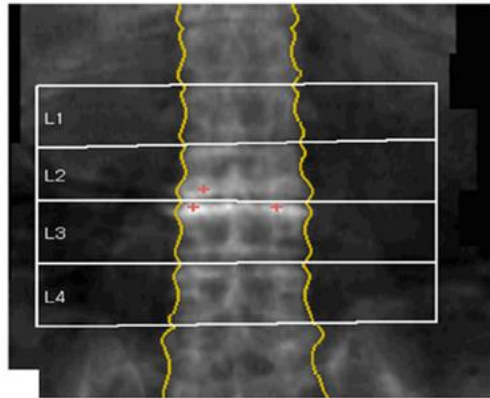
# WHO criteria for diagnosis of osteoporosis

T-score: Difference expressed as standard deviation compared to young (20's) reference population

	T-score
<b>Normal</b>	<b>- 1.0 and above</b>
<b>Osteopaenia</b>	<b>- 1.0 to - 2.5</b>
<b>Osteoporosis</b>	<b>- 2.5 and below</b>
<b>Severe (established) osteoporosis</b>	<b>- 2.5 and below, plus one or more osteoporotic fracture(s)</b>

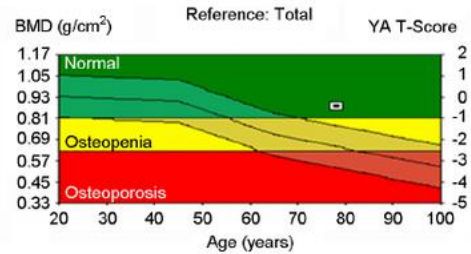
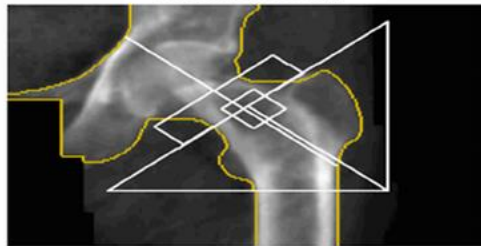


AP Spine Bone Density



Region	<sup>1</sup> BMD (g/cm <sup>2</sup> )	Young (%)	<sup>2</sup> Adult T-B core	Age (%)	<sup>3</sup> Matched Z-B core
L1	0.881	64	-3.2	89	-0.7
L2	1.030	92	-0.8	125	1.7
L3	1.097	98	-0.2	133	2.3
L4	0.846	76	-2.3	102	0.2
L1-L4	0.920	83	-1.6	113	0.9

Left Femur Bone Density



Region	<sup>1</sup> BMD (g/cm <sup>2</sup> )	Young (%)	<sup>2</sup> Adult T-B core	Age (%)	<sup>3</sup> Matched Z-B core
Neck	0.806	90	-0.8	134	1.7
Upper Neck	0.710	-	-	-	-
Wards	0.506	57	-2.9	110	0.3
Troch	0.731	97	-0.2	129	1.5
Shaft	1.032	-	-	-	-
Total	0.883	95	-0.4	135	1.9

# Assessment of bone mass available methods

It is appropriate to begin to look for risk factors that predispose a person to osteoporosis and develop a rational prevention program tailored to person's risk before the menopause.

Women with thin light frame, history of low calcium intake, decreased physical activity, or caffeine consumption, smoking, family history of osteoporosis, history of prior menstrual disturbances or history of drug like antiepileptic's or steroids are all high risk groups and in the presence of one or more of such risk factors measurement of BMD provides further information to the risk of fractures.



# Strategy for Management of Osteoporosis

- Prevent Osteoporosis
- Detect and treat early to decrease further progression
- Limit disability and provide rehabilitation

# Treatment

## The Adolescent Group (Peak bone mass attainment)

- A calcium intake of 1200 mg/day is recommended.
- Adequate sun exposure or vit D supplementation to ensure
- adequate level
- A reasonable exercise program is recommended.

# Treatment

## The Premenopausal Female (Maintenance of bone mass)

- A. Adequate calcium intake; 1000-1500 mgm/day disease.
- B. Adequate sun exposure or vit D supplementation
- C. A reasonable exercise program is recommended
- D. Avoidance of osteopenia-producing conditions/medications/lifestyle:
  1. Smoking , excessive caffeine/protein intake.
  2. Amenorrhea/oligomenorrhea.
  3. **Cortisone**, excessive thyroid hormone replacement (?), loop diuretics, prolonged heparin exposure.

# Treatment

## The Immediately Postmenopausal Female (Prevention of bone mass loss)

Consideration of Hormone replacement therapy (conjugated equine estrogen (CEE) or its equivalent, 0.625 mg daily or cycled, or transdermal estrogen by patch 0.05-0.1 mg/day daily or cycled).

**If intact uterus, consideration of medroxyprogesterone 5-10 mg daily or cycled**

# Treatment

## The Immediately Postmenopausal Female (Prevention of bone mass loss)

Other modalities of therapy:

1. Bisphosphonates
2. SERMS (Selective estrogen receptor modulators  
e.g., Evista)
3. Anabolic hormones e.g.PTH

## Treatment

The elderly (>62) postmenopausal female with low bone mass but no compression fractures  
(Prevention of bone mass loss & restoration of bone mass previously lost)

- A. Adequate calcium intake: 1000-1500 mgm/day
- B. A reasonable exercise program with physical therapy instruction in paraspinous muscle group strengthening exercise.
- C. Avoidance of osteopenia-producing conditions/medications/lifestyle:
  - 1. Smoking , excessive caffeine/protein intake.
  - 2. Cortisone, excessive thyroid hormone replacement (?), loop diuretics, prolonged heparin exposure.

## Treatment

The elderly (>62) postmenopausal female with low bone mass but no compression fractures  
(Prevention of bone mass loss & restoration of bone mass previously lost)

D. Adequate supplementation with vitamin D

E. Consideration of Hormone replacement therapy

## Treatment

The elderly (>62) postmenopausal female with low bone mass but no compression fractures  
(Prevention of bone mass loss & restoration of bone mass previously lost)

### F. Other modalities of therapy

1. Bisphosphonates
2. SERMS (Selective estrogen receptor modulators e.g. Evista)
3. Anabolic Hormones e.g. PTH



# Treatment

## **The elderly (age>62) postmenopausal female with fragility fractures (Prevention of further fractures)**

- A. Adequate calcium intake; 1000-1500 mgm/day disease.
- B. A careful exercise program with physical therapy instructions
- C. Consideration of short-term back bracing (non-rigid brace)
- D. Avoidance of osteopenia-producing conditions/medications/lifestyle:
  - 1. Smoking , excessive caffeine/protein intake.
  - 2. Cortisone, excessive thyroid hormone replacement (?), loop diuretics, prolonged heparin exposure.

Treatment

**The elderly (age>62) postmenopausal female with fragility fractures  
(Prevention of further fractures)**

E. Adequate supplementation with vitamin D

F. Consideration of Hormone replacement therapy

# Treatment

The elderly (age>62) postmenopausal female with fragility fractures  
(Prevention of further fractures.)

## G. Other modalities of therapy

1. Bisphosphonates
2. SERMS (Selective estrogen receptor modulators e.g. Evista)
3. Anabolic Hormones e.g. PTH

# Treatment

**The male with low bone mass and/or fractures (Prevention of bone mass loss & restoration of bone mass previously lost; prevention of further fractures.)**

- A. A program of reasonable calcium intake (1000-1500 mg daily), exercise, short term back bracing and avoidance of osteopenia-producing situation is indicated.
- B. Consideration of testosterone therapy if total and free testosterone levels are low.
  - 1. Prostate concerns
  - 2. Cholesterol concerns

# Treatment

**The male with low bone mass and/or fractures  
(Prevention of bone mass loss & restoration of bone  
mass previously lost; prevention of further  
fractures.)**

C. Other modalities of therapy

1. Bisphosphonates

2. Anabolic Hormones e.g. PTH

# Treatment

## **The male or female with corticosteroid induced osteopenia**

**(Prevention of bone mass loss & restoration of bone mass previously lost)**

- A. Bone mass measurement if possible to identify bone mass loss
- B. Lowest possible dose of corticosteroids.
- C. A program of reasonable calcium intake (1000-1500 mg), exercise, & avoidance of other osteopenia-producing situations is indicated.

# Treatment

The male or female with corticosteroid induced osteopenia

(Prevention of bone mass loss & restoration of bone mass previously lost)

C. Adequate supplementation with vitamin D

D. Other modalities of therapy

Estrogen (Females), Testosterone (males), Bisphosphonates, PTH

# Treatment

The amenorrheic female (Exercise induced amenorrhea, eating disorders, etc)  
(Prevention of bone loss)

- A. General measures; decrease exercise if appropriate, regain body weight, adequate calcium intake (1000-1500 mg/day) and avoidance of other osteopenia-producing situations.
- B. Regain menses
- C. Other modalities of therapy
  1. Estrogen replacement
  2. Bisphosphonates