

# *INTRODUCTION TO OSTEOPOROSIS*

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## 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

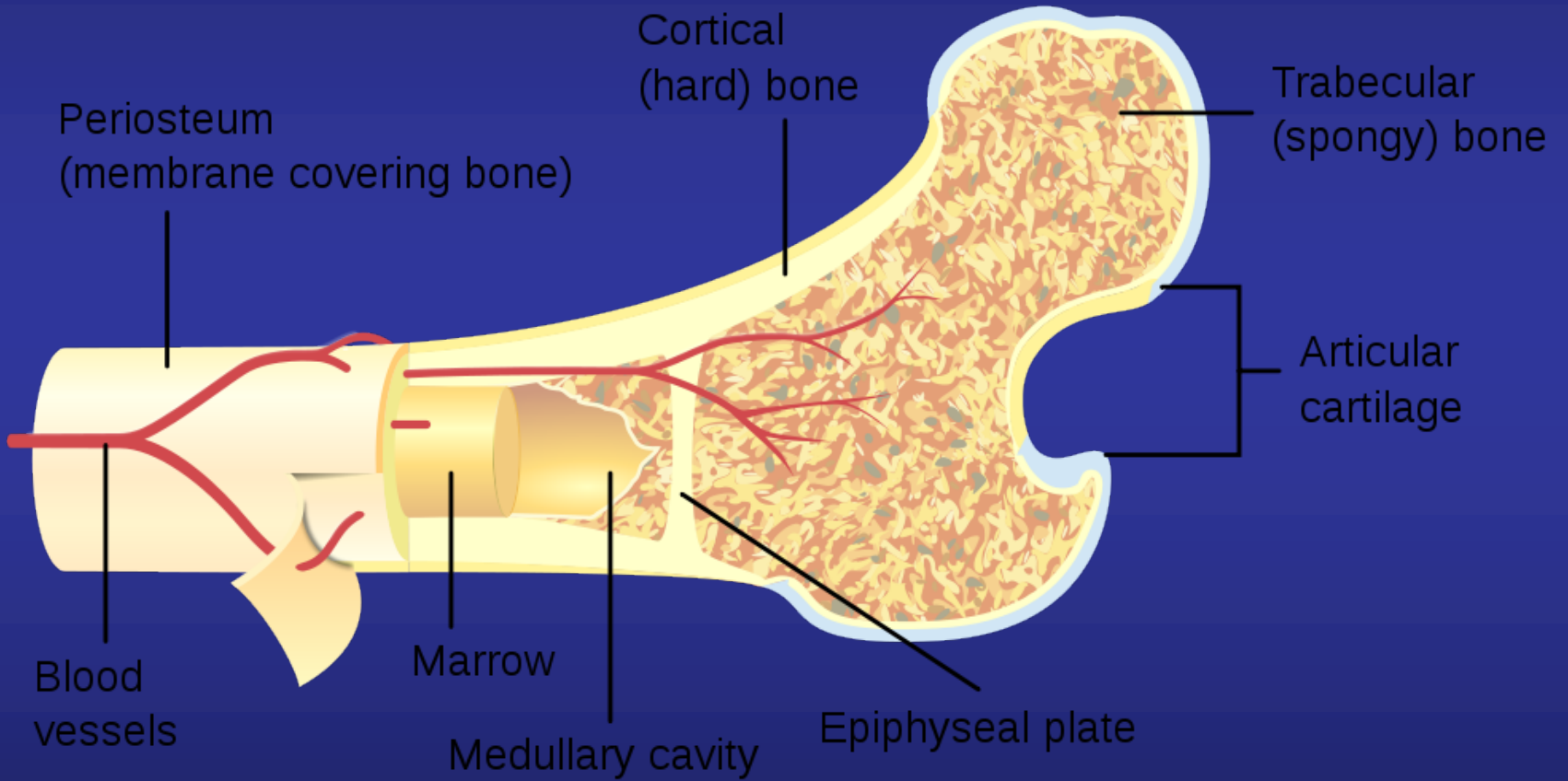
## I. Cortical Bone:

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

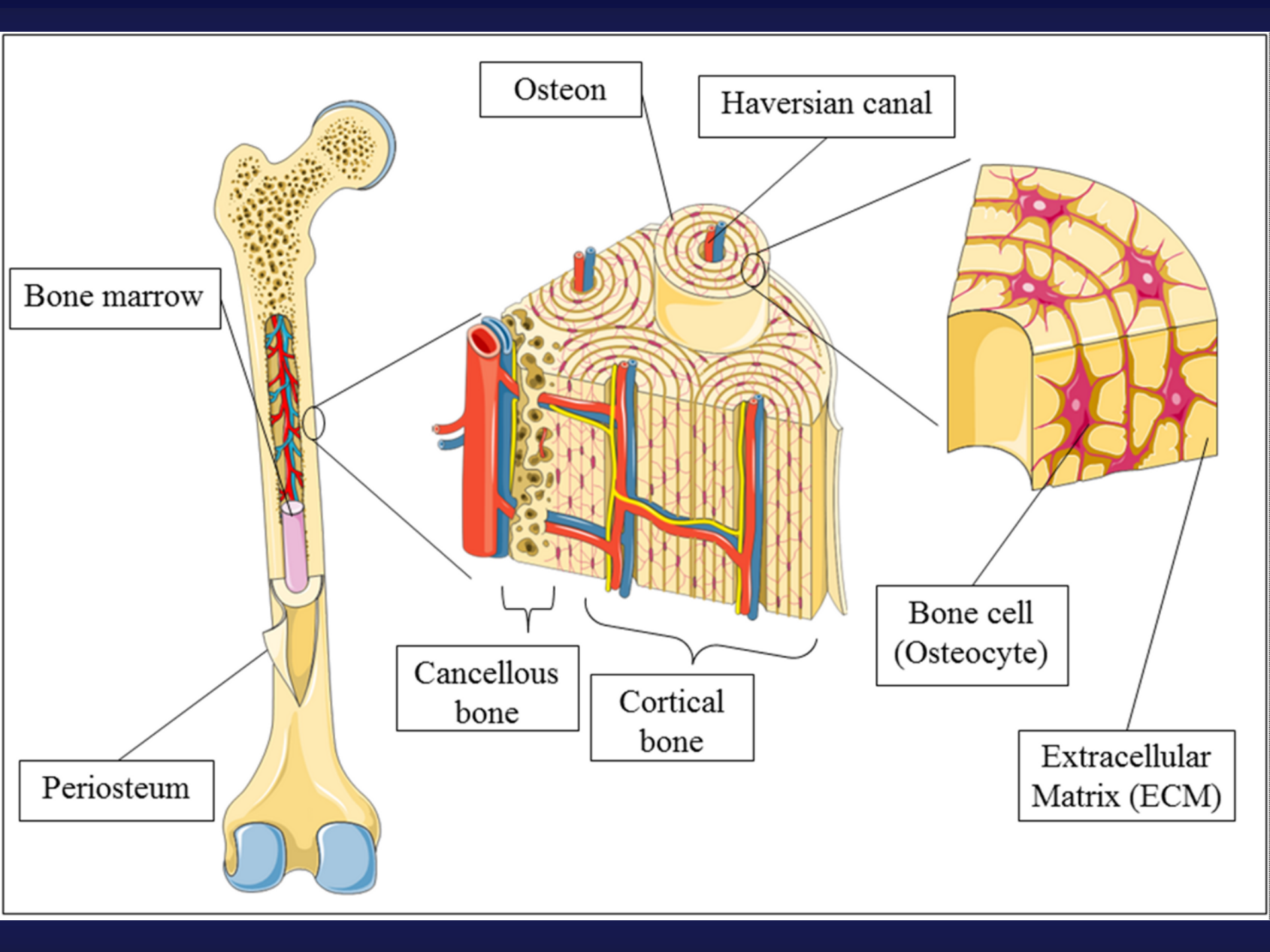
## II. Trabecular Bone:

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.

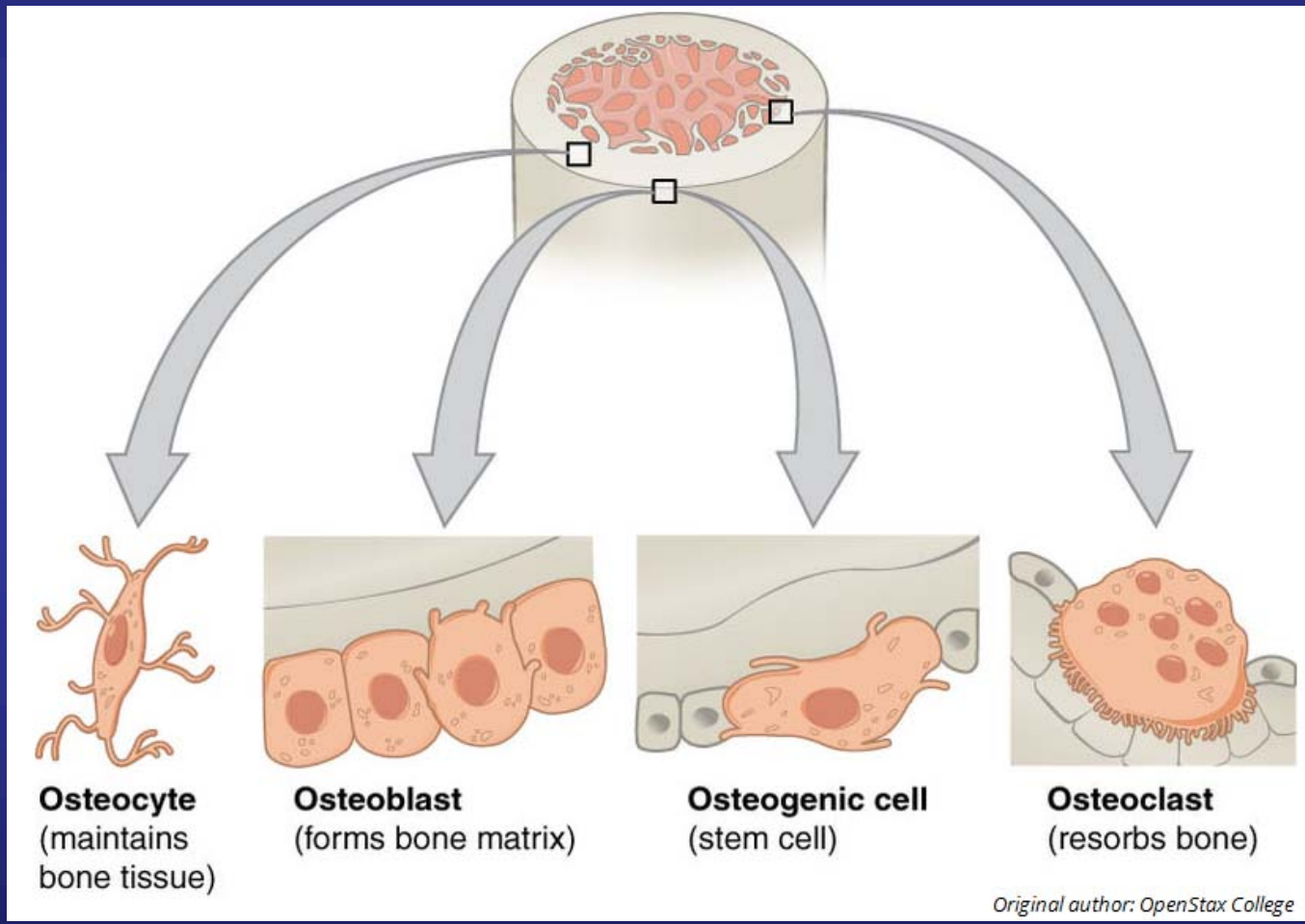






Disorders in which **cortical bone** is defective or scanty lead to **fractures of long bones** whereas disorders in which **trabecular bone** is defective or scanty lead to **vertebral fractures** and also may help in fractures of long bones because of the loss of reinforcement.

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



## 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.

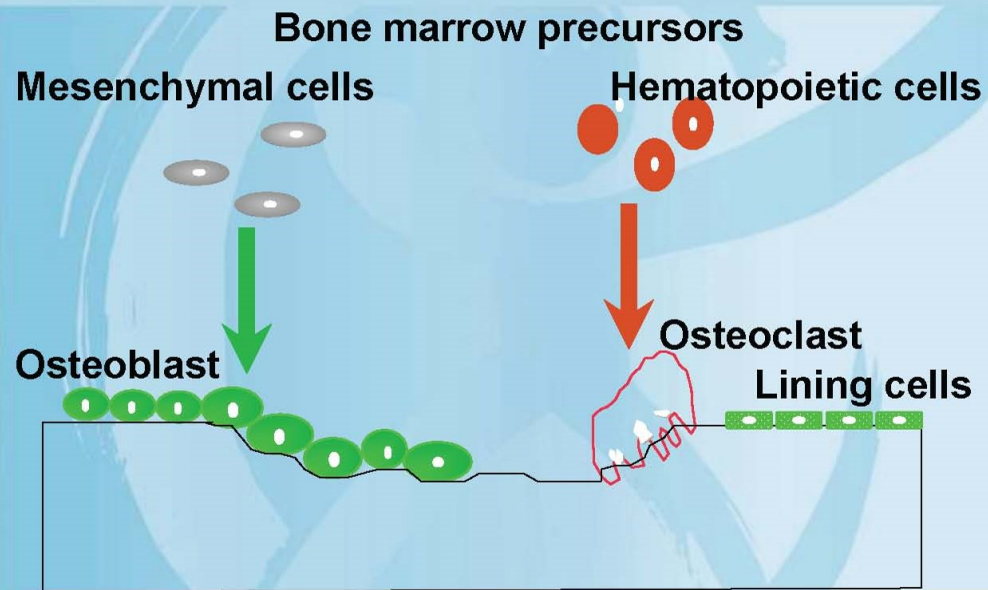
## II. Osteocytes:

They are believed to act as a cellular syncytium that permits translocation of mineral in and out of regions of bone removed from surfaces as well as signaling between cells

## 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**

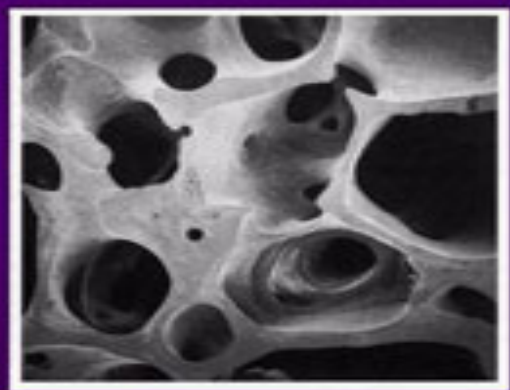


## Osteoporosis Definition

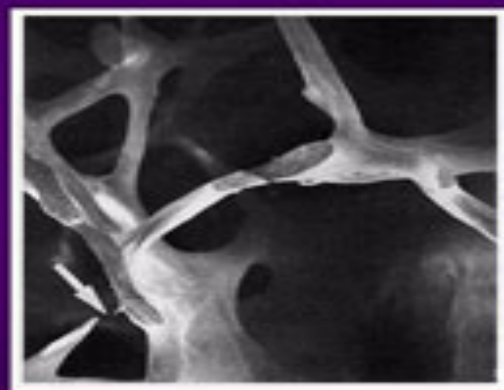
### NIH Consensus Conference

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

**Bone strength = Bone density + Bone quality**



**Normal**

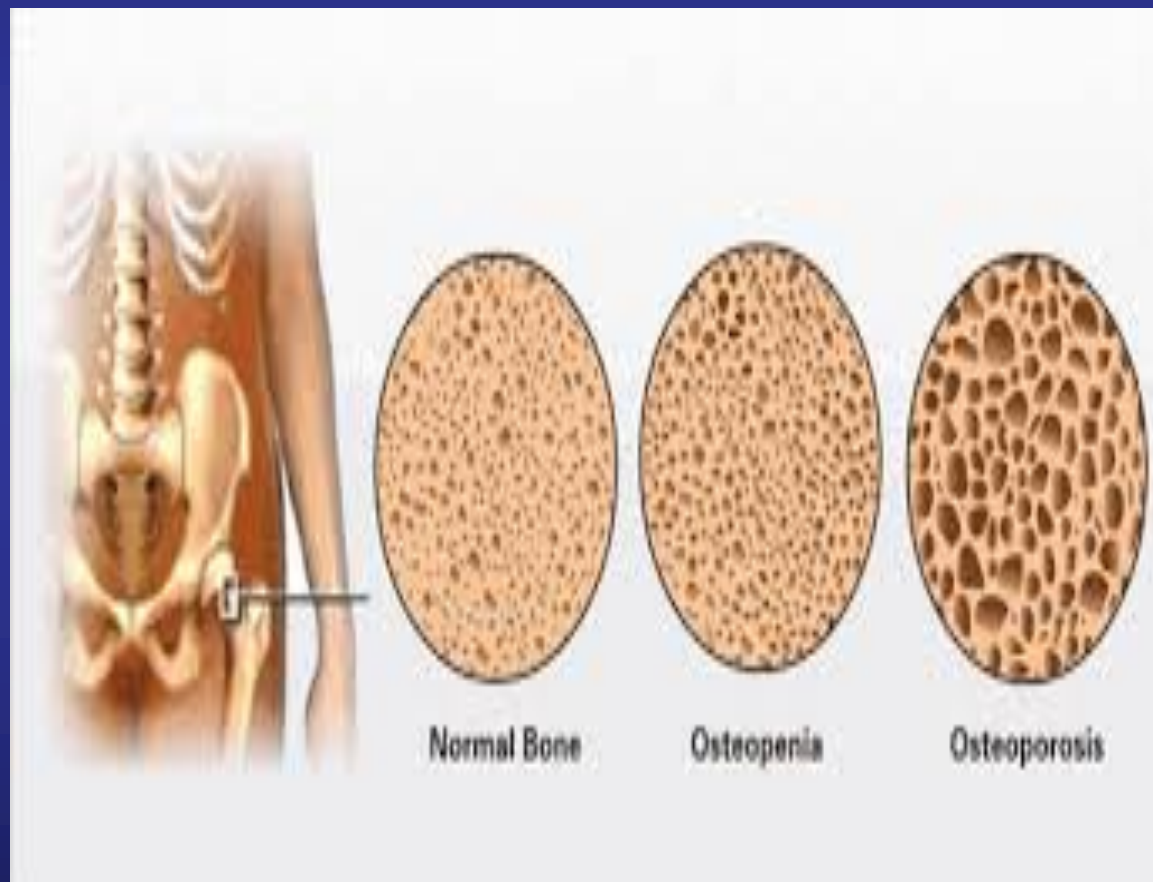


**Osteoporosis**

NIH Consensus Conference, 2000. Available at: <http://consensus.nih.gov/2000/2000Osteoporosis111.html.htm>  
Accessed 12-16-05.

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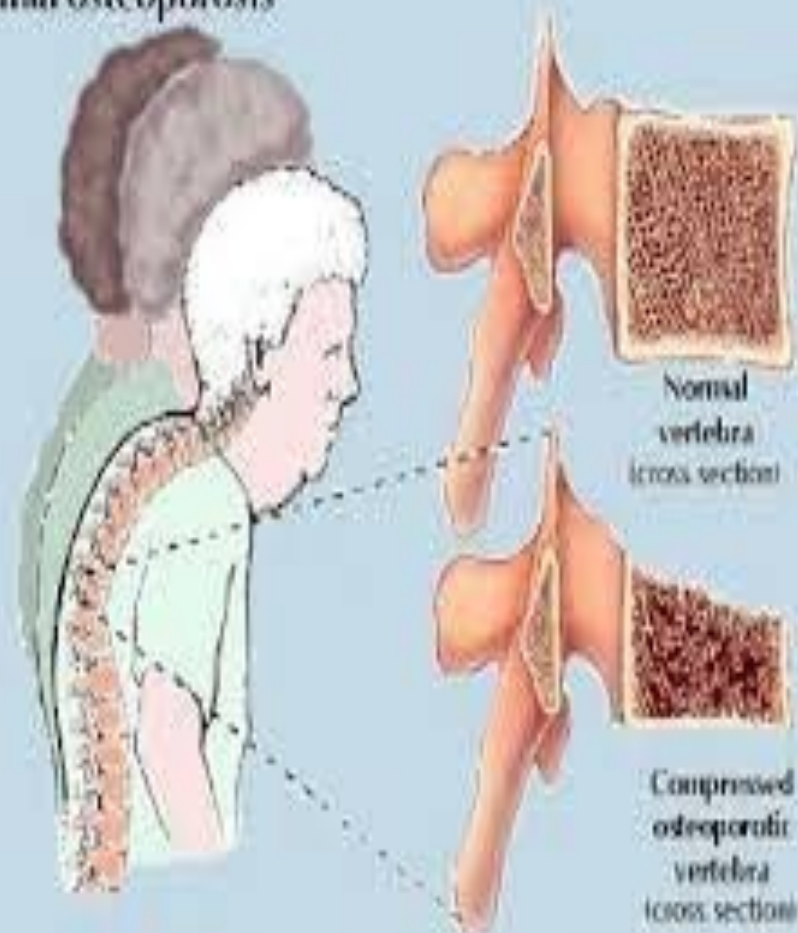


# Osteoporosis



**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 type of involutonal 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	Vertebrae (Crush) & distal radius	Vertebrae (Multiple wedge), hip, pelvis, 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	Primary
	Decreased	Decreased
Main causes	Factors related to menopause	Factors related to aging

# Secondary Factors causing Bone Loss

## Factors Associated with Decreased Bone density

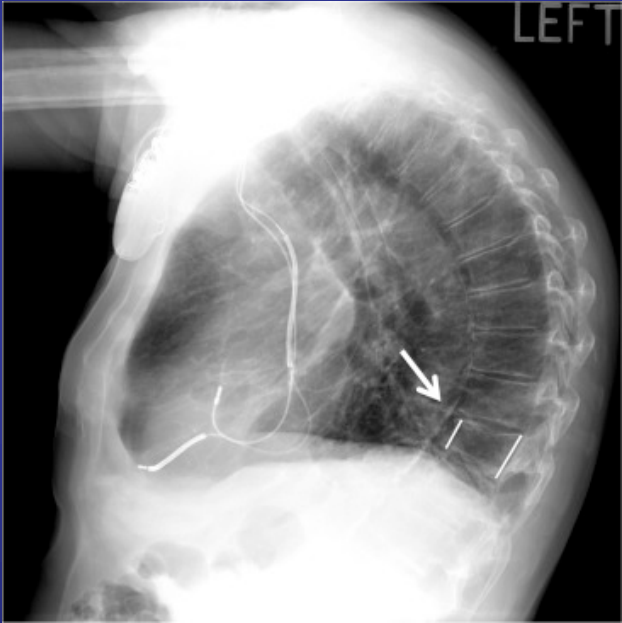
Medical Conditions	Premature menopause Hypogonadism (in men) Liver disease Hyperthyroidism Hyperparathyroidism Hemiplegia Chronic obstructive lung dis.
Drug Therapy	Glucocorticoids Anticonvulsants (Phenytoin, Phenobarbitone)
Nutrition	? Low calcium & Vit. D intake ? High phosphorus, protein, sodium, 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>

## Norwalk Radiology & Mammography Center

Patient:	Wright, Eric	Patient ID:	Eric Wright 124
Book Date:	08/11/2009 08:00am	Physician:	
Height/Weight:	68.00 / 180.0 lbs	Measure:	12/1/2009 08:00
Sex/DOB:	Female / 08/04	Age/Day:	25/09/2009 08:00



View to match anatomical position(s).

Region	BMD <sup>1</sup> g/cm <sup>2</sup>	Young Adult <sup>2</sup> T-Score	Age Matched <sup>3</sup> Z-Score	WHO Classification <sup>4</sup>
AP Spine (LRA)	1.026	-1.1	-1.1	Normal
Distal Forearm Total	0.890	0.0	0.0	Normal
Left	0.890	0.0	0.0	Normal
Right	0.890	0.0	0.0	Normal
Mean	0.890	0.0	0.0	Normal
Reference	0.950	0.0	0.0	-

Reference Information Table

1. BMD is the areal bone mineral density (areal bone mineral content divided by areal bone mineral density).
2. T score is the difference between the patient's BMD and the mean BMD of a young adult population of the same sex and race.
3. Z score is the difference between the patient's BMD and the mean BMD of a population of the same sex and race, and of the same age.
4. WHO Classification: Normal: T score  $\geq -1.0$ ; Osteopenia: T score  $< -1.0$  and  $\geq -2.5$ ; Osteoporosis: T score  $< -2.5$ .

# 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, high alcohol 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)

*“Senile Osteoporosis is a pediatric disease”.*

- 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.
- Genetic influence on peak bone mass attainment.

# 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, but not to the point of amenorrhea.
- D. Avoidance of osteopenia-producing conditions/medications/lifestyle:
  - 1. Smoking & excessive alcohol intake, 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 alcohol intake, 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 instruction in paraspinous muscle group strengthening exercises
- C. Consideration of short-term back bracing (non-rigid brace)
- D. Avoidance of osteopenia-producing conditions/medications/lifestyle:
  - 1. Smoking & excessive alcohol intake, 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