INTRODUCTION TO OSTEOPOROSIS

Mona Fouda Neel MBBS,FRCPEdin.,
Professor of Medicine
Consultant Endocrinologist , Diabetes, and Metabolism

OBJECTIVES

>Definition

>Anatomy and biologu of Bones

>Presentation and different types

>Investigations

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

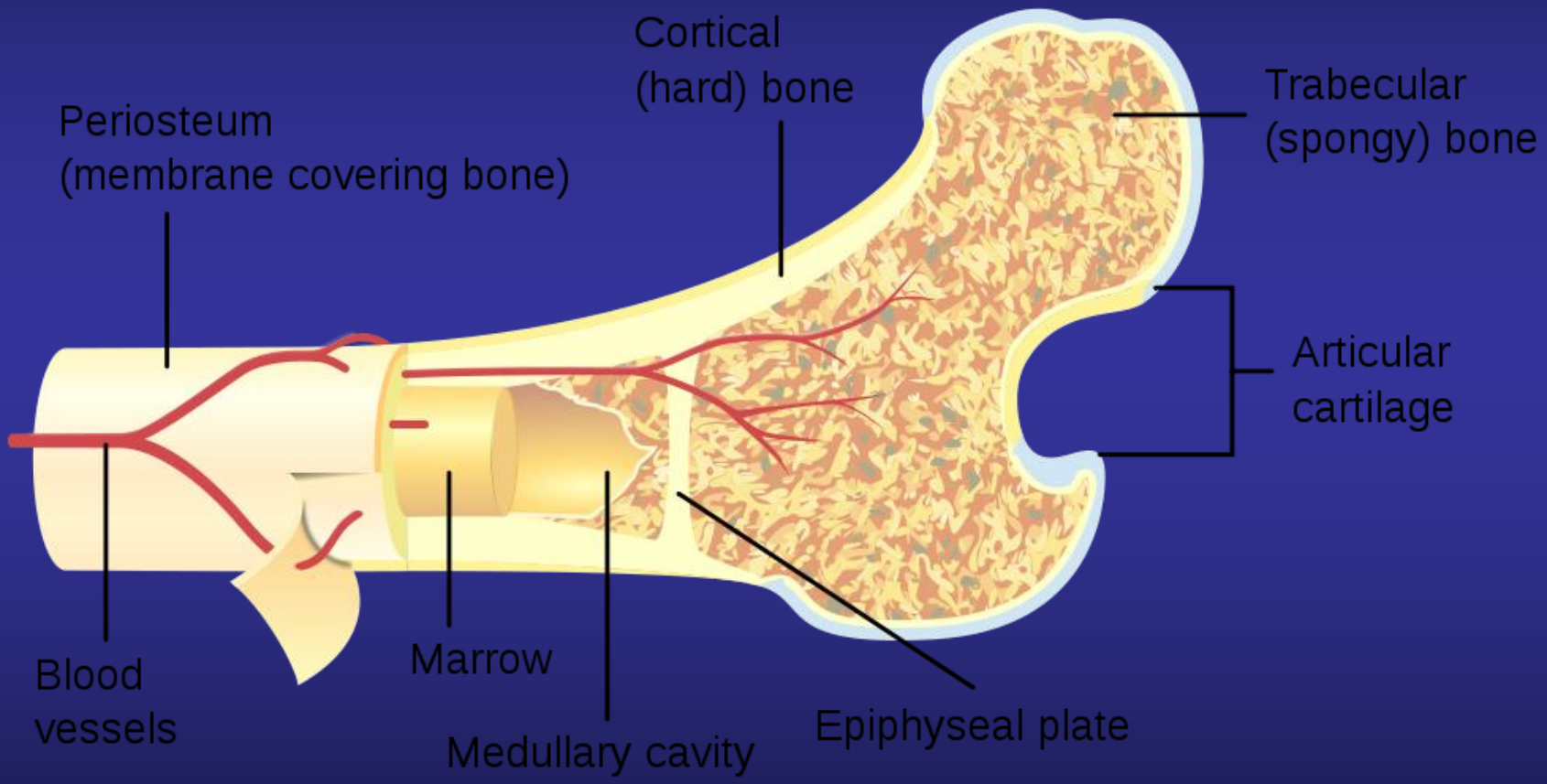
I. Cortical Bone:

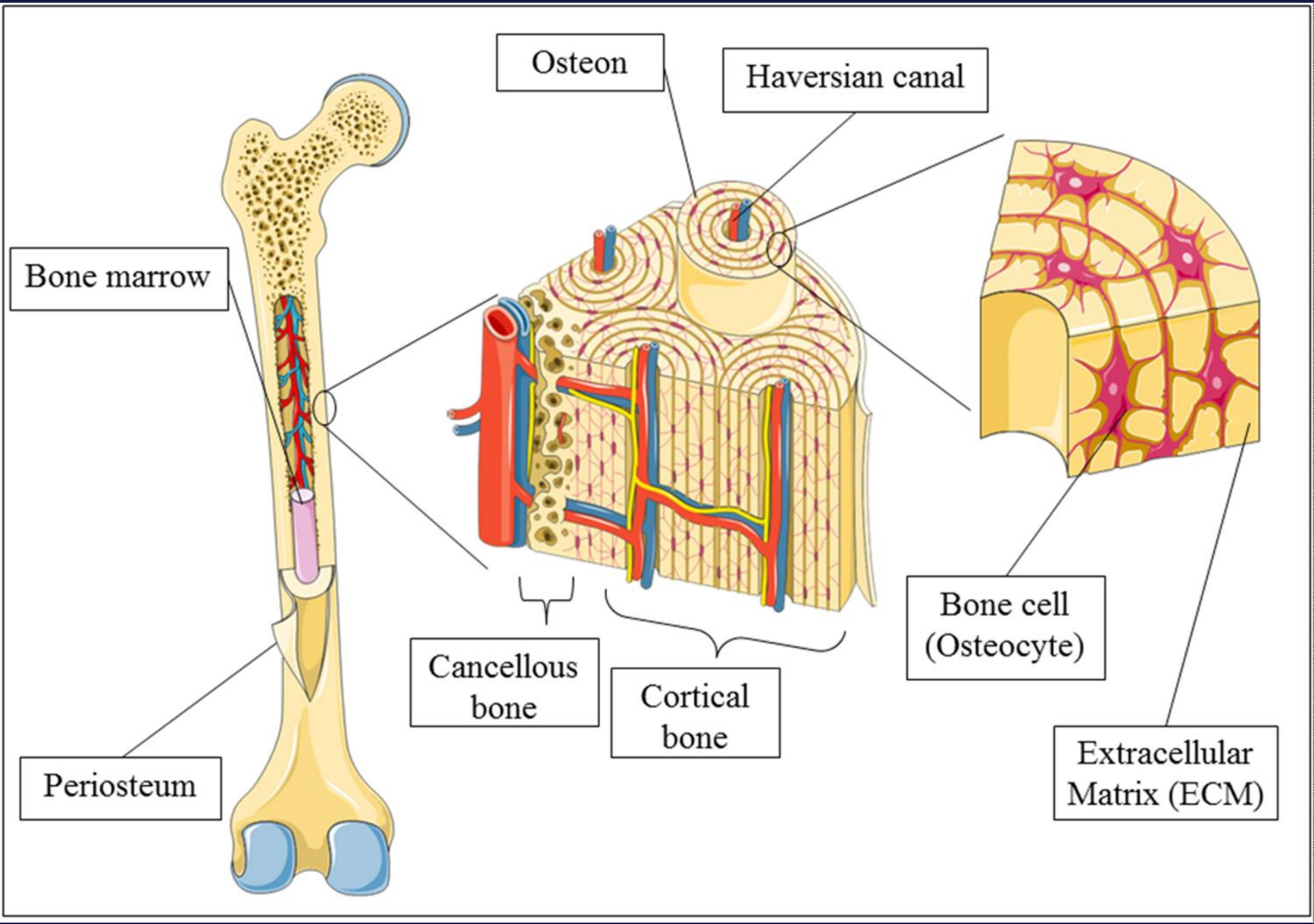
The compact bone of Haversian systems such as in the shaft of long bones.

II. Trabecular Bone:

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

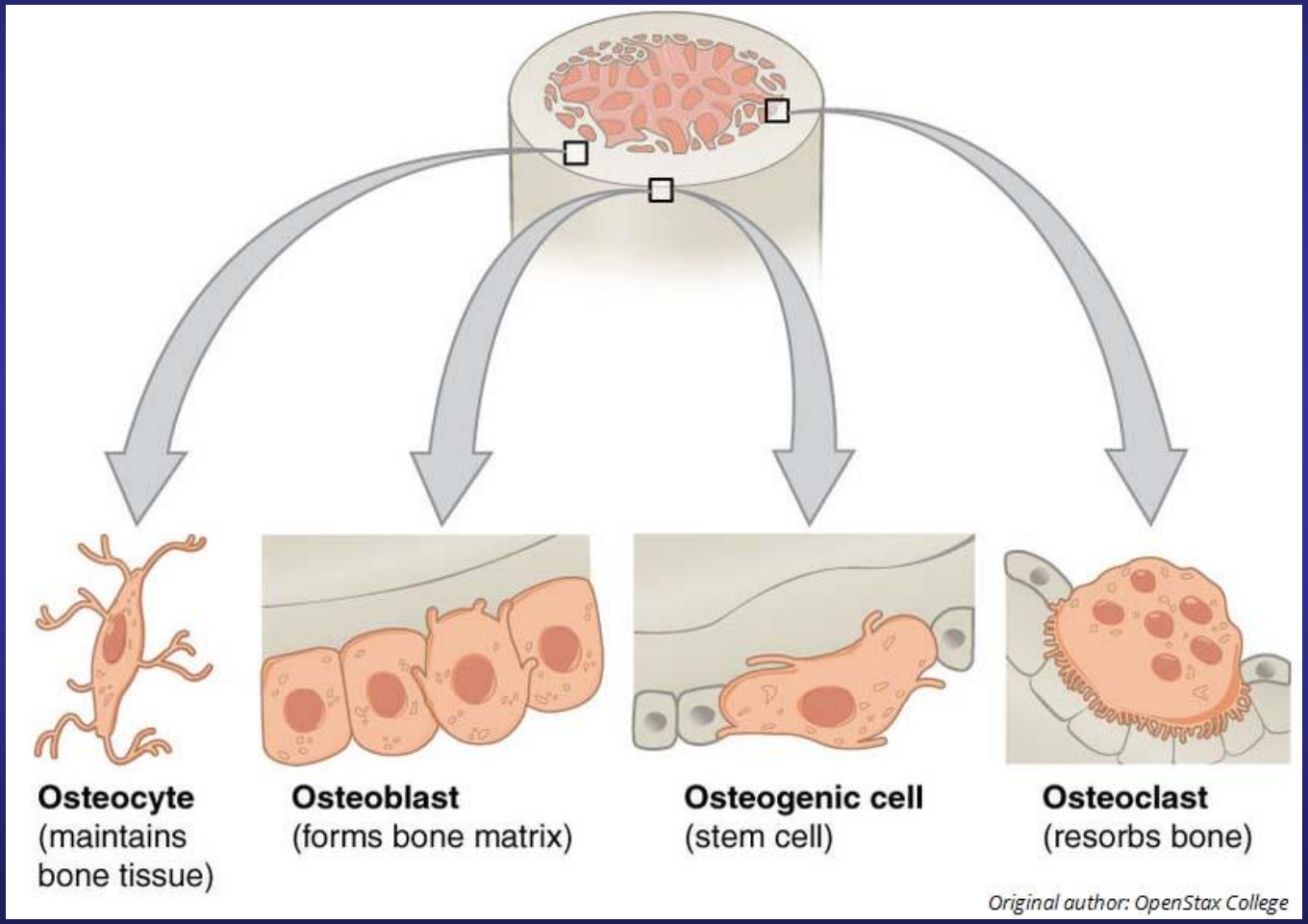
The difference pattern of bone loss affecting trabecular and cortical bone results in two different fracture syndrome.


Periosteum
(membrane covering bone)
Cortical
(hard) bone
Trabecular
(spongy) bone
Articular
cartilage
Blood
vessels
Marrow
Medullary cavity
Epiphyseal plate


Osteon
Haversian canal
Bone marrow
Bone cell (Osteocyte)
Cancellous bone
Cortical bone
Periosteum
Extracellular Matrix (ECM)

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.


Osteocyte
(maintains
bone tissue)
Osteoblast
(forms bone matrix)
Osteogenic cell
(stem cell)
Osteoclast
(resorbs bone)
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.

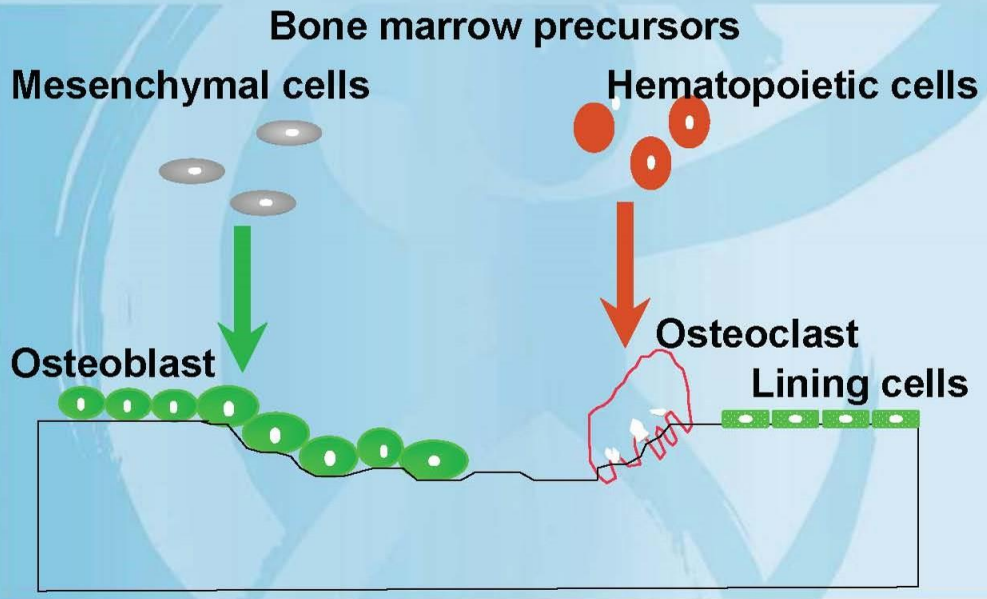
II. Osteocytes:

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”

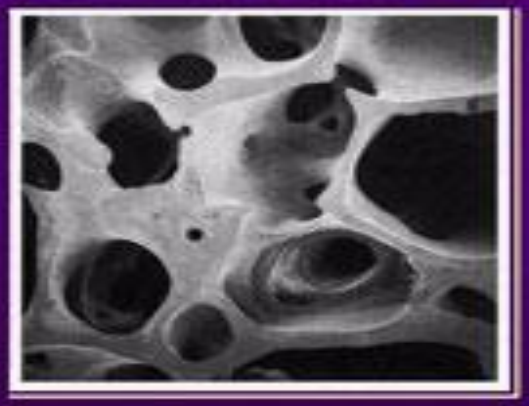
Definition

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

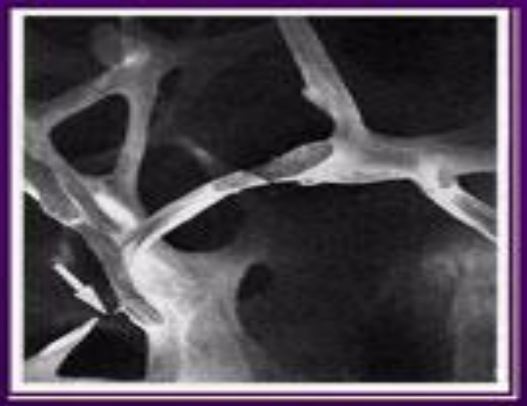
Osteoporosis Definition
NIH Consensus Conference

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

Bone strength = Bone density + Bone quality

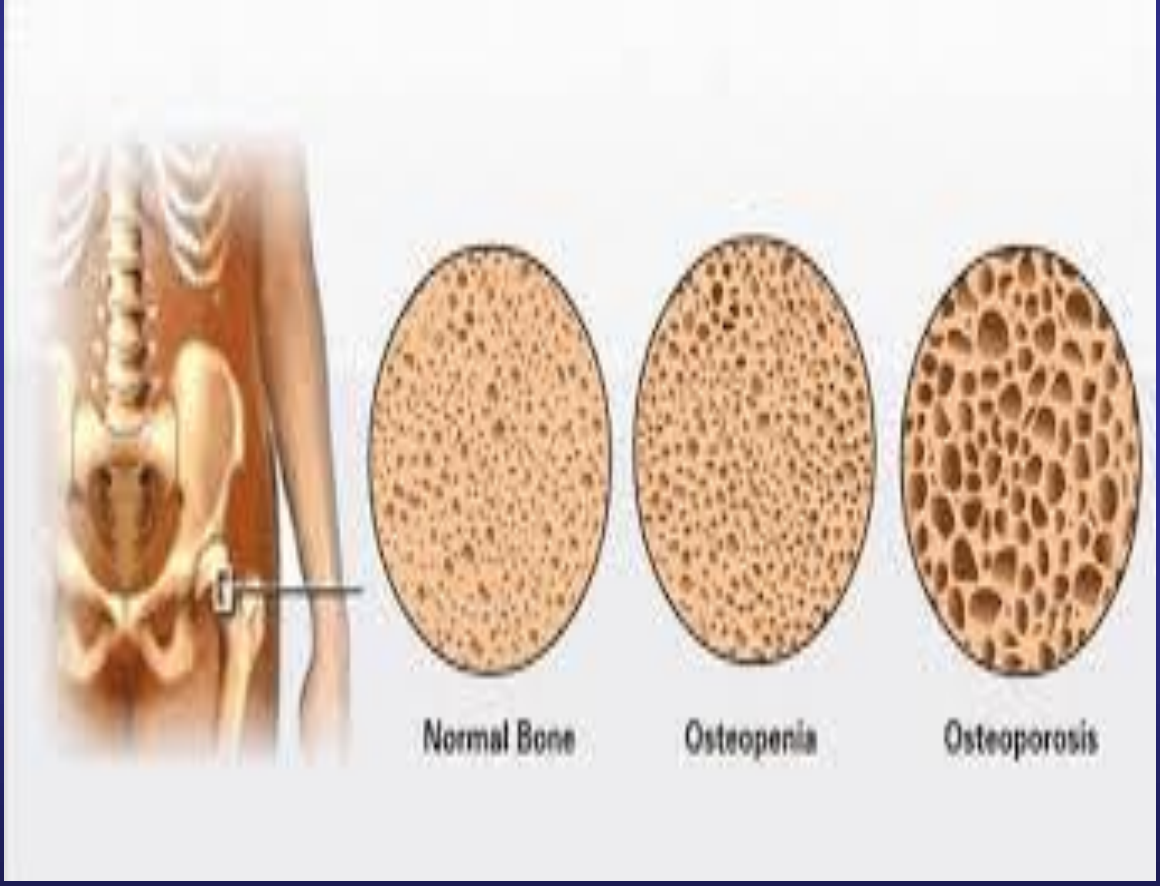


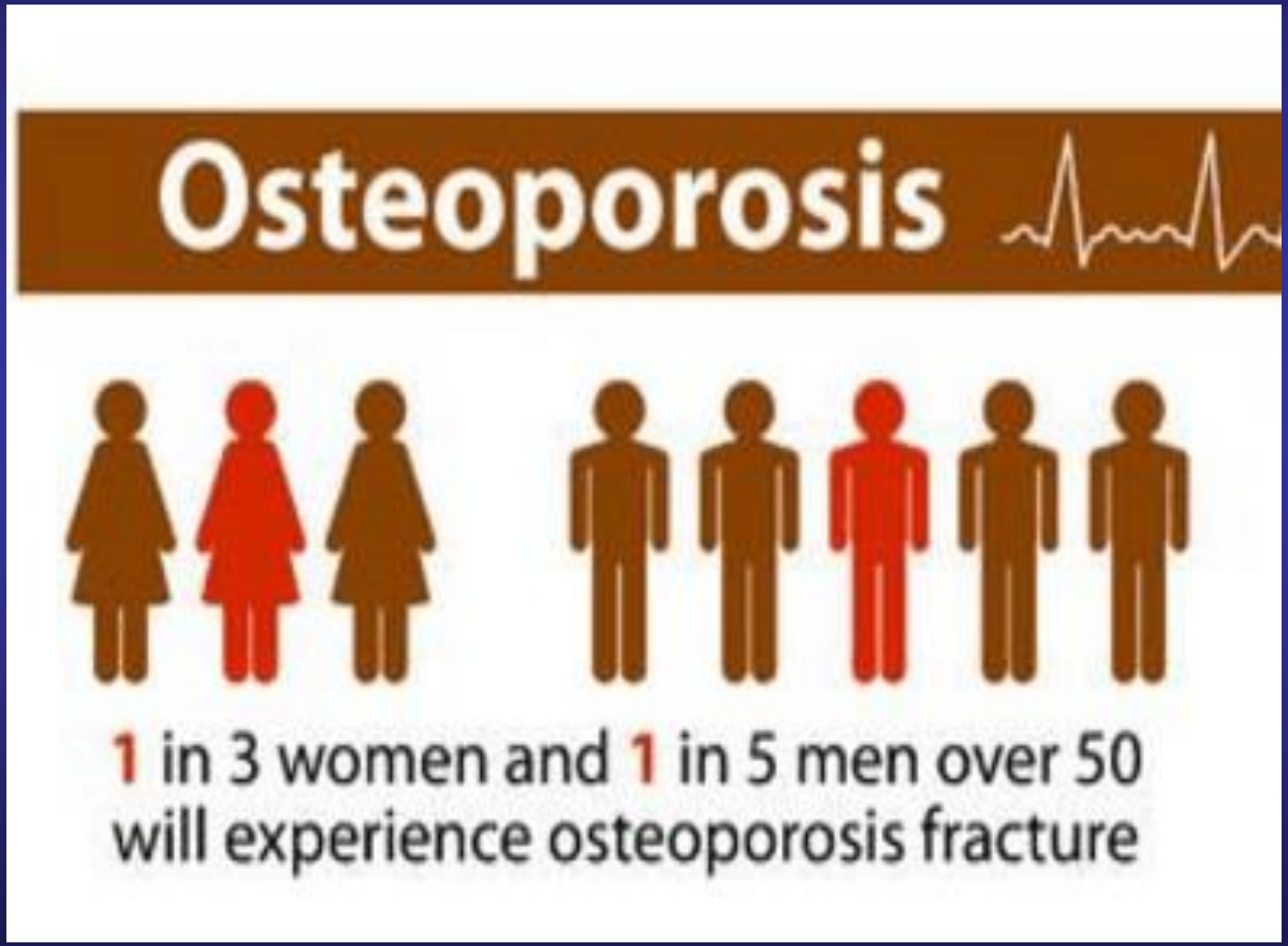
Normal

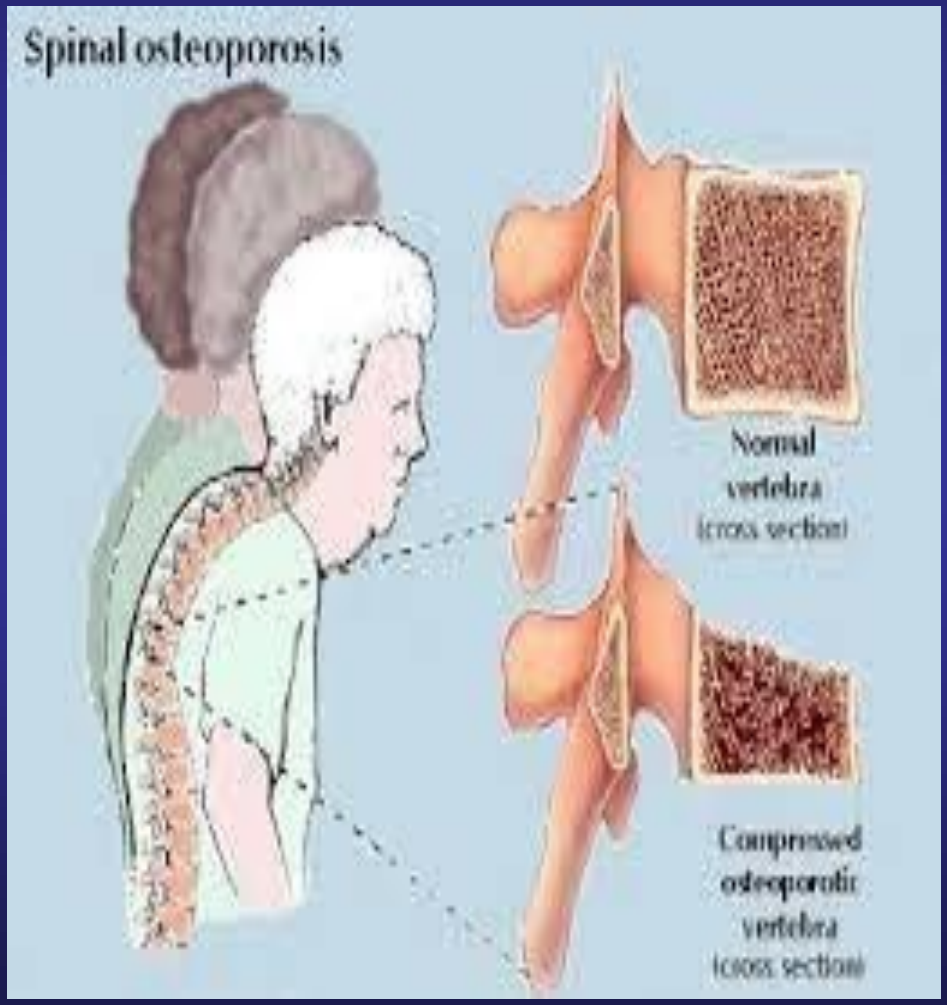


Osteoporosis

NIH Consensus Conference, 2000. Available at: http://consensus.nih.gov/2000/2000Osteoporosis111html.htm Accessed 12-16-05.


Normal Bone
Osteopenia
Osteoporosis


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


Spinal osteoporosis
Normal vertebra (cross section)
Compressed osteoporotic vertebra (cross section)

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	-	Collie'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 - Femur neck fracture

Usually affects individual over age of 70 years.

Difference in the two type of primary Osteoporosis

	Type I	Type II
Age (Yr.)	50 - 70	>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)2D to 1,25(OH)2d	Secondary Decreased	Primary Decreased
Main causes	Factors related to menopause	Factors related to aging

Secondary Factors causing Bone Loss

Factors Associated with Decreased Bone desity

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.


LEFT

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

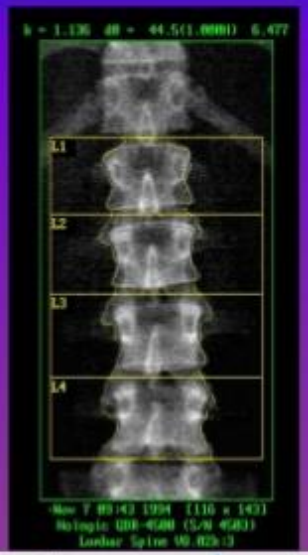
They measure bone mass by the ability of the tissue to absorb the photons emitted from the radionuclide source or the X-ray tube.

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

BMD (g/cm^2) = Bone mineral content (g) / area (cm^2)



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

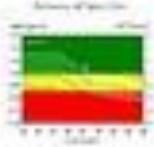
WHO criteria for diagnosis of osteoporosis

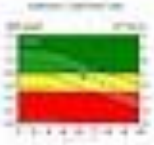
T-score: Difference expressed as standard deviation compared to young (20's) reference population

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

Kanis et al. J Bone Miner Res 1994; 9:1137-41

Norwalk Radiology & Mammography Center





Region	BMD gm/cm²	Young Adult T-Score	Age Matched Z-Score	WHO Classification
AP Spine L2-L4	1.120	-0.5	1.1	Normal
DualFemur Total				
Left	0.900	-0.5	0.6	Normal
Right	0.840	-1.0	-0.1	Osteopenia
Mean	0.870	-1.1	-0.1	Osteopenia
Difference	0.050	0.4	0.8	

Anatomical Deformations None

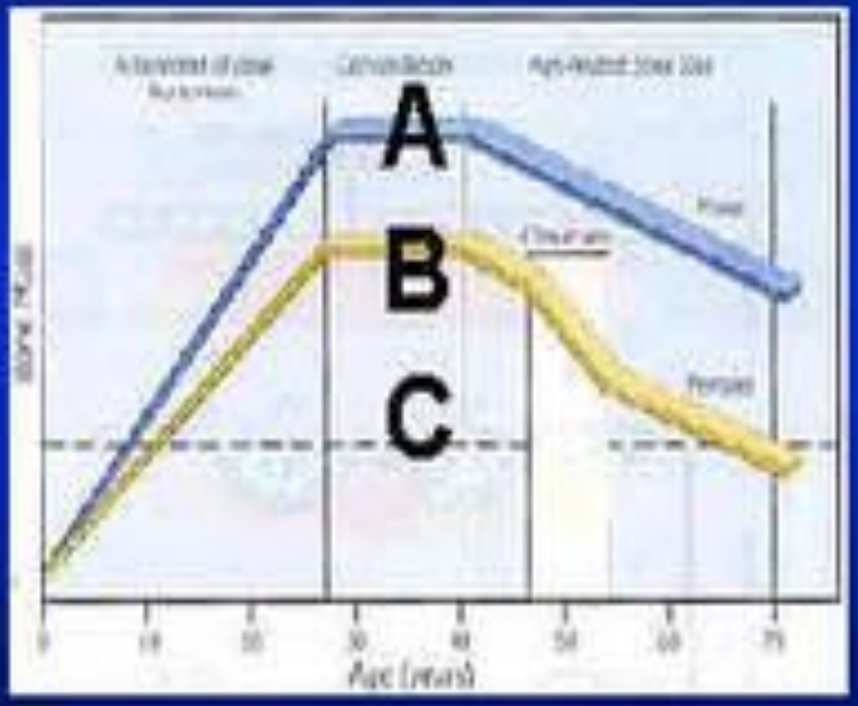
GE Medical Systems
Lunar

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.

골다공증의 예방 : 최대골량의 형성



Strategy for Management of Osteoporosis

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