

Pencegahan dan Pengobatan Patah Tulang pada Osteoporosis

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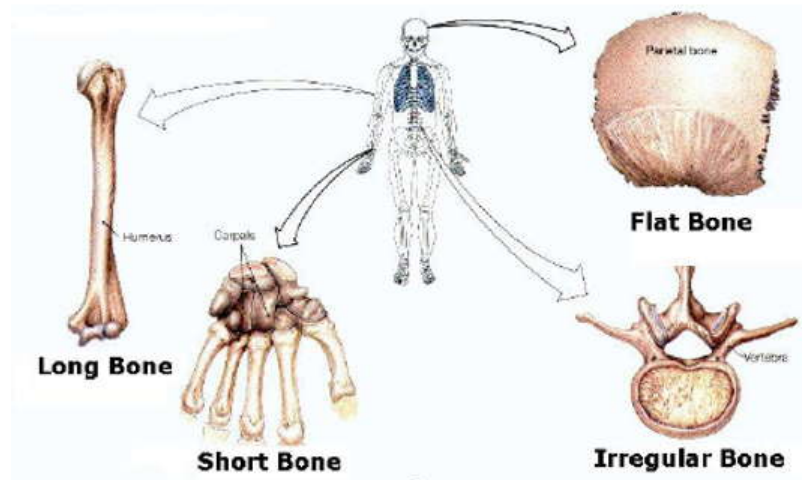


Introduction to Bone

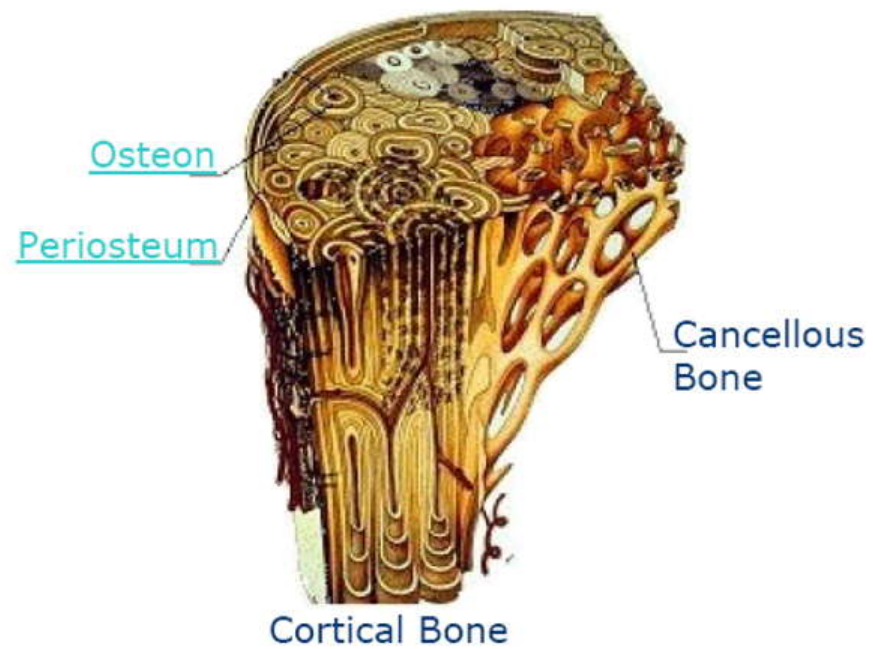
- Structural support of the body.
- Connective tissue that has the potential to repair and regenerate
- Comprised of a rigid matrix of calcium salts deposited around protein fibers
 - Minerals Provide rigidity
 - Proteins provide elasticity and strength

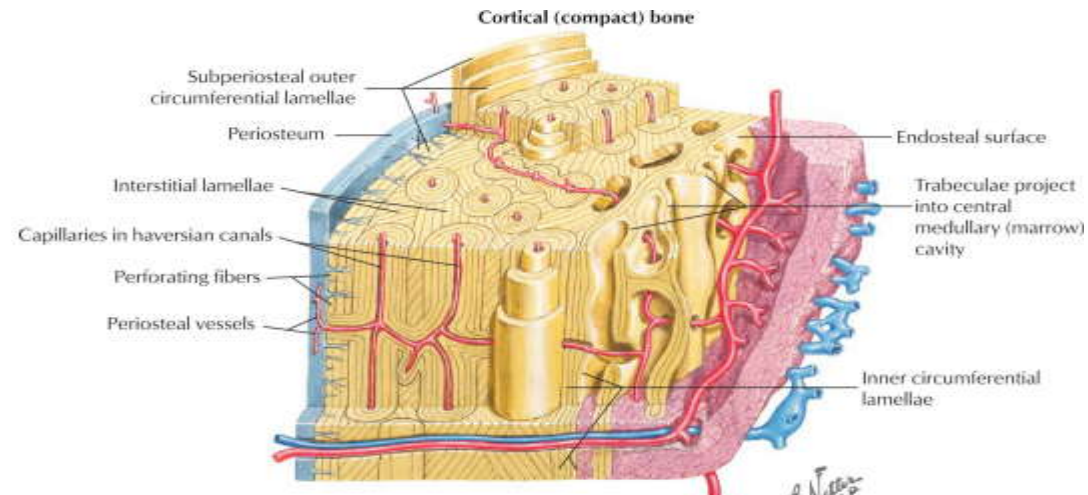
Shape

- Shapes include long, short, flat, and Irregular
 - Long bones are cylindrical and “Hollow” to achieve strength and minimize weight



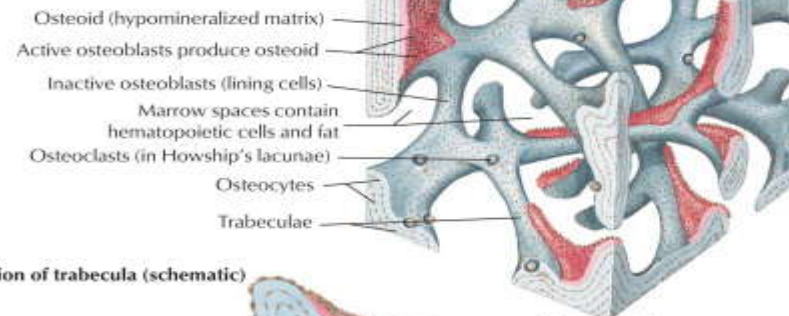
Global Organization





Trabecular bone (schematic)

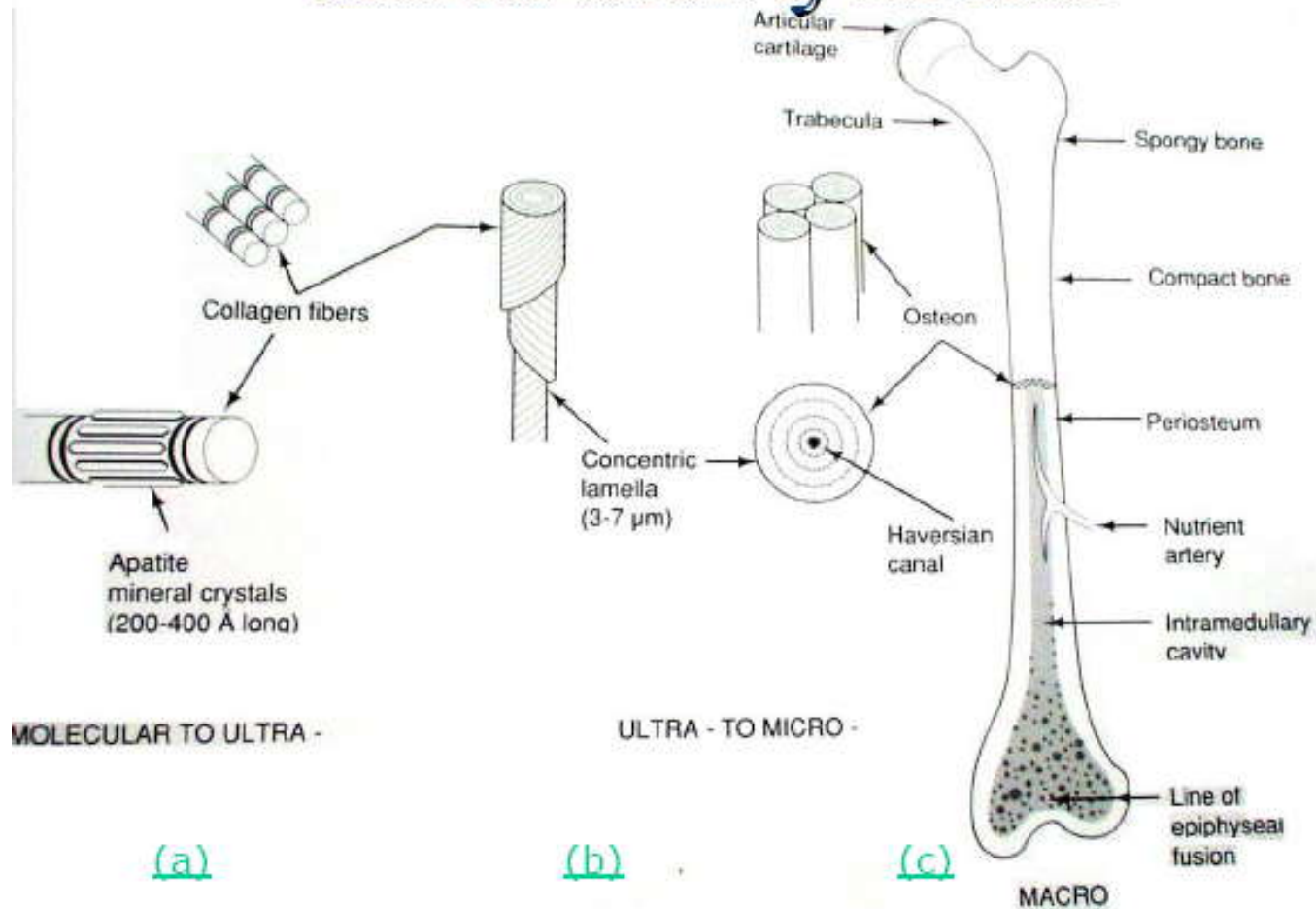
On cut surfaces (as in sections), trabeculae may appear as discontinuous spicules



Section of trabecula (schematic)



Microstructure of the Bone



Composition of Bone : Cells

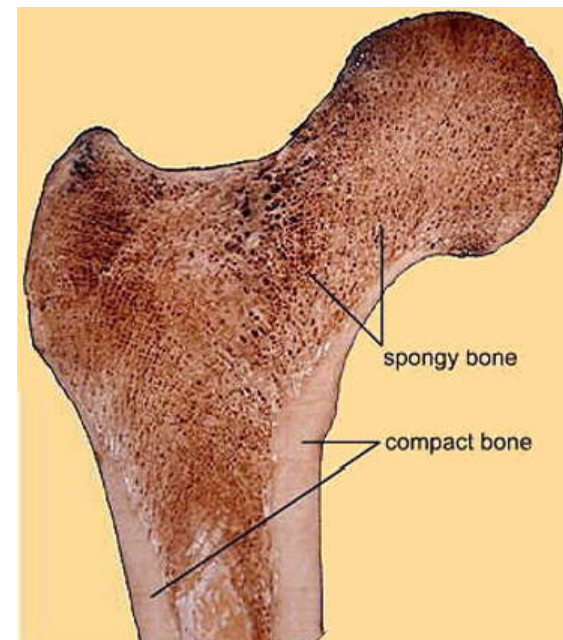
- Osteocytes
- Osteoblasts
- Osteoclasts

Controlling Factors of osteoclasts and osteoblasts

- Hormones
 - Estrogen
 - Testosterone
- Cytokines
 - Growth Factors
 - Interleukins (1, 6, and 11)
 - Transforming growth factor- β
 - Tumor necrosis Factor- α

Composition of Bone : Matrix

- Cortical/ Compact Bone
- Cancellous/ Trabecular/ Spongy Bone



	<i>Cortical</i>	<i>Cancellous</i>
Physical Description	Dense protective shell	Rigid lattice designed for strength; Interstices are filled with marrow
Location	Around all bones, beneath periosteum; Primarily in the shafts of long bones	In vertebrae, flat bones (e.g. pelvis) and the ends of long bones
% of Skeletal Mass	80%	20%
First Level Structure	Osteons	Trabeculae
Porosity	5-10%	50-90%
Circulation	Slow circulation of nutrients and waste	Haversian system allows diffusion of nutrients and waste between blood vessels and cells; Cells are close to the blood supply in lacunae

	<i>Cortical</i>	<i>Cancellous</i>
Strength	Withstand greater <i>stress</i>	Withstand greater <i>strain</i>
Direction of Strength	Bending and torsion, e.g. in the middle of long bones	Compression; Young's modulus is much greater in the longitudinal direction
Stiffness	Higher	Lower
Fracture Point	Strain>2%	Strain>75%

Load Characteristics of Bone

- Load Characteristics of a bone include :
- Direction of the applied force
 - Tension
 - Compression
 - Bending
 - Torsion
 - Shear
- Magnitude of the load
- Rate of load application

Material Properties Comparison

Material	Compressive Strength (MPa)	Modulus (GPa)
Cortical	10-160	4-27
Trabelcular	7-180	1-11
Concrete	~ 4	30
Steel	400-1500	200
Wood	100	13

Function of Bones

- Mechanical Support
- Hematopoiesis
- Protection of vital structures
- Mineral Homeostasis

Mechanical Support

- Provides Strength and Stiffness
- Hollow Cylinder : Strong and light
- Have mechanisms for avoiding fatigue fracture

Hematopoiesis

- Development of blood cells
 - Occurs in the marrow of bone
- These regions are mainly composed of trabecular bone
 - (e.g. The iliac crest, vertebral body, proximal and distal femur)

Mineral Homeostatis

- Primary storehouse of calcium and phosphorus
- Trabecular bone are rapidly formed or destroyed
 - In response to shifts in calcium stasis without serious mechanical consequences

Osteoporosis

Metabolic bone disorder characterized by decreased amount of normal-quality bone resulting in an increased susceptibility to fracture

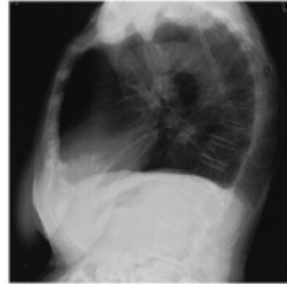
To develop osteoporosis, certain risk factors must exist and environmental conditions must occur.

Risk Factors :

- Estrogen Withdrawal
- Long-term calcium deficiency
- Secondary Hyperparathyroidism
- Decreased physical activity

Cont. Osteoporosis

- Certain genetic predisposition (individuals who are fair skinned, slim, have hypermobile joint, Northern European ancestry, or who have scoliosis)
- Cigarette smoking → increased bone loss, hip & vertebral
- Alcoholism → calcium diuresis or depressive osteoblast function.



Lateral radiograph of the chest of a patient who had severe osteoporosis, showing kyphosis due to multiple vertebral wedge fractures.



Anteroposterior radiograph of the proximal part of the femur of a patient who had osteoporosis, showing a fracture of the femoral neck.



- Osteoporosis have 2 forms :
 - Primary osteoporosis
 - Secondary osteoporosis

Primary Osteoporosis

Involutional or idiopathic osteoporosis occurs in certain individuals as they age or they go through menopause.

Unrelated to any specific endocrinopathy or other disease state, but linked to the estrogen level of post menopause.

Primary osteoporosis has been categorized into two distinct syndromes

Type I → postmenopausal osteoporosis, occurs most commonly in women within 5 to 10 year after menopause

Affects mostly trabecular bone and clinically associated with vertebral compression, intertrochanteric hip, and distal radius.

Cont. Primary Osteoporosis

- Type II →
 - known as senile osteoporosis.
 - Woman and men over 70 years old
 - Women : men = 2 :1
 - Affects cortical and trabecular equally and associated with multiple vertebral wedge, femoral neck, pelvic, proximal humeral and proximal tibial.
 - In type I osteoporosis, estrogen deficiency plays a primary role whereas in type II osteoporosis aging and long-term calcium deficiency are more important.
 - Osteoporosis is a silent and progressive disorder that comes to the attention of the patient or physician only after an acute, painful has occurred
 - No single strategy is curative for this condition → especially primary osteoporosis

How to delay osteoporosis

- Active in daily life
- More movement
- Doing sport regularly



Secondary Osteoporosis

Cause by:

Endocrinopathy	Mechanical disorder
Neplastic disease	Biochemical collagen disturbance
Hematologic disorder	Nutritional aberration

Secondary Osteoporosis → underlying disease must be identified before agents were administered

e.g : Hyperthyroidism, primary hyperparathyroidism, iatrogenic steroid- include osteoporosis and exercise induced amenorrhea.

- Most Patients have attain their level of peak bone mass between age 16 and 25
- The greatest amount of bone that individual will ever have in their lifetime. The higher this value is, the less chance that they will develop osteoporosis.

thank you!

