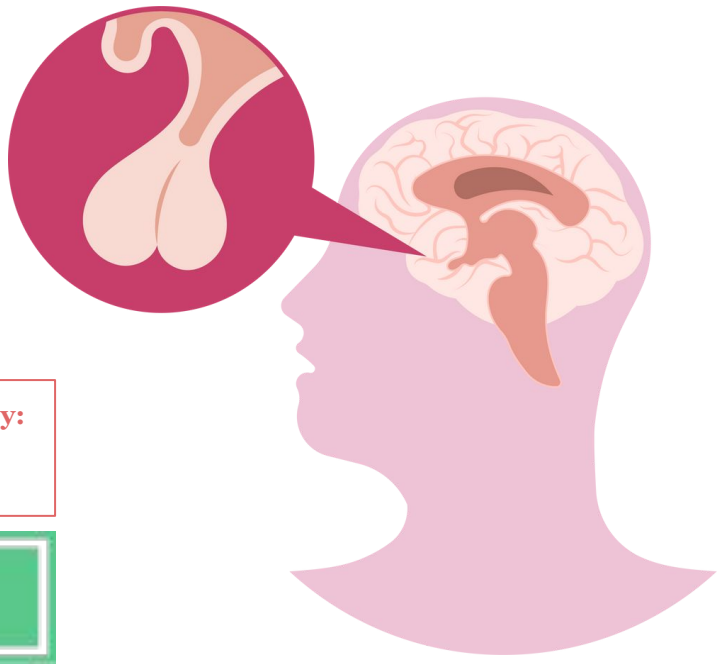
Introduction to osteoporosis



This lecture was explained by:
Dr. Mona fouda.
Prof. Riad sulimani.

Editing file

Color index :

Main text (Black)

Female slides (Pink)

Male slides (Blue)

Important things (Red)

Dr's notes (Green)

Extra information (Grey)

OBJECTIVES

Understanding the definition of osteoporosis.

Causes of osteoporosis.

Impact of osteoporosis.

Diagnosis of osteoporosis.

Treatment of osteoporosis.

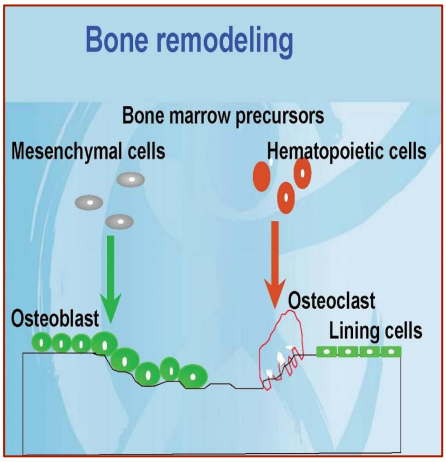
Introduction

Bone has three major functions:

1-Provide rigid support to extremities & 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.



4-Also a place that stores hormones & proteins interacting with other organs, that's why the bone is considered an endocrine organ. (441 team)

Type of bone:

1

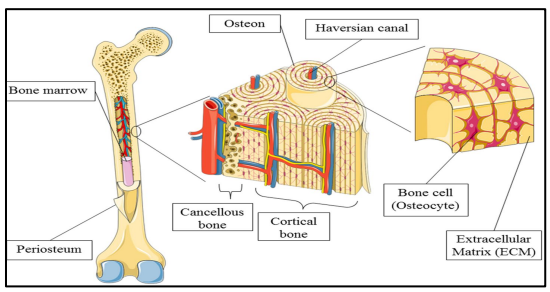
- **Cortical bone:** The compact bone of Haversian systems (The canals and the surrounding lamellae are called a Haversian system or an osteon) such as in the shaft of long bones.
- **Disorders** in which **cortical bone** is **scanty** or defective lead to **fractures of long bones and Hip.**

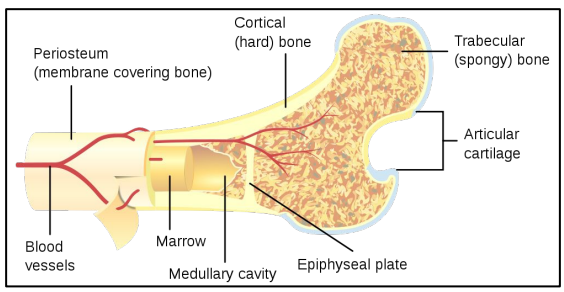
2

- **Trabecular Bone (Cancellous):** lattice like network of bone found in the vertebrae and the ends of long bones.
- **Disorders** in which **Trabecular Bone** is **scanty** or defective lead to **vertebral fractures** (most common in KSA) and also may help in fractures of long bones because of the loss of reinforcement.

Q: give me an example of trabecular bone?
The femur.

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





Bone cells and Osteoporosis

Bone cell

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

Bone cell:

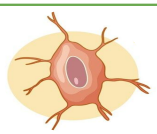
Osteoclasts

The bone resorption cells.

It is important to remember that the cells come from different origins:
1-Precursor of osteoblasts: mesenchymal cells
2-Precursor of osteoclast: hematopoietic cells

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.
(maintains bone tissue)



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.
(forms bone matrix)

Osteoporosis (The silent thief)

- **Decrease** in **bone mass** (Density) and **strength** (Quality) associated with an **increased tendency** to **fractures**.
- Skeletal disorder characterized by compromised bone strength predisposing to increased risk of fracture.
- Bone strength reflects the integration of bone density and **bone quality (Bone strength= Bone density + Bone quality).**
- 1 in 3 women and 1 in 5 men over 50 will experience osteoporosis fracture.

Clinical feature

It is usually an **asymptomatic** 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 Acute or chronic back pain.

In well established osteoporosis dorsal **Kyphosis** & **loss** of **height** occurs.

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

Click the icon for pictures from slides which is related to this topic.

Primary Osteoporosis

Types of primary Osteoporosis

Type 1 Osteoporosis (Post Menopausal)

Fractures of bones composed mainly of **trabecular bone.**

Example:

- **Distal radius → Colles fracture.**
- **Vertebra → Crush and wedge fractures.**
- Usually affects woman within 15 years of menopause.

Questions from the doctor

(very important) !!!

Q1/ a patient with osteoporosis had fracture in distal radius, what is the type? Type 1.

Q2/ What is it called? Colles fracture.

Q3/ what is the most common place for type 2 osteoporosis fracture? Hip.

Type 2 Osteoporosis (Senile, very old)

Fractures of bones composed of **both cortical and trabecular bone**.

Example:

- **Hip → Femur neck fracture.**
- Usually affects individual over age of 70 years.

Dr said: don't memorize it, this table just for extra information.

Difference in the two type of involutional Osteoporosis		
–	Type 1	Type 2
Age (Year)	51 : 75	>70
Sex ratio (F:M)	6:1 (high ratio)	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 $25(OH)D_2$ to $1,25(OH)D_2$	Secondary Decreased	Primary Decreased
Main cause	Factors related to menopause	Factors related to aging

Secondary factors and Radiology

Very important !!

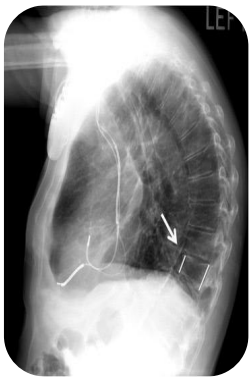
Secondary Factors associated with decreased bone density	
Medical Conditions	Premature menopause, Hypogonadism (in men), Liver disease, Hyperthyroidism, Hyperparathyroidism, Hemiplegia, Chronic obstructive lung diseases (COPD).
Drug Therapy	Glucocorticoids, Anticonvulsants (Phenytoin, Phenobarbitone), steroids.
Behavioral factors	Smoking (tobacco) and Alcohol abuse.
Nutrition	• Low calcium & Vitamin D intake. • High phosphorus (carbonated drinks), protein, sodium, caffeine intake. (Vitamin D deficiency could be coexisting, not the direct cause)

Laboratory & radiological findings

- Bone profile, ALP & PTH are within normal in patients with osteoporosis due to sex hormones deficiency & aging.
- X-rays of skeleton do not show a decrease in osseous density until at least 30% of bone mass has been lost.

Q3/ How much bone density to be lost before it is detected in X-ray? 30%

Normal | Mid Crush vertebral fractures | Last stage



- X-ray of spine show **prominent trabeculae** & 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 & calculating the risk for hip fracture.
- Dowager's hump: kyphotic spine, in elderly ladies especially, leading to shortened height.
- Kyphotic posture is not only cosmetically bad, it affects the internal organ function.

5 Diagnosis and T-score

Click the icon for pictures from slides which is related to this topic.

Methods of bone mass assessment

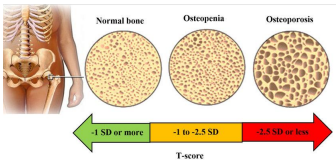
- Single-photon Absorptiometry (SPA)
- Double-photon Absorptiometry (DPA)
- Computed tomography (CT)
- **Dual-Energy X-ray Absorptiometry (DXA/DEXA)**

These methods (DXA/DEXA)

- They measure bone mass by the ability of the tissue to absorb the photons emitted from the radionuclide source or X-ray tube.
- Age related bone loss particularly trabecular bone in the spine begins in women before menopause.
- Current golden standard for diagnosis of osteoporosis is BMD (g/cm2) = bone mineral content (g) / area (cm2).
- Diagnosis based on comparing patients BMD **(bone mineral density)** to that of young, healthy individuals of same sex.
- Measure the quantity of bone by assessing the absorption of X-rays.
- Usually done in three areas: hip, spine, and wrist joint. (most common sites of osteoporosis and fracture)

WHO criteria for diagnosis of osteoporosis

T-score: Difference expressed as standard deviation (SD) compared to young (20s) reference population.



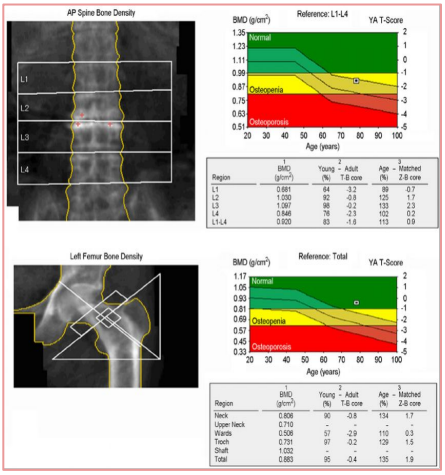
Very important always come in the exam !

Classification	T-score
Normal	-1.0 and above
Osteopenia	-1.0 to -2.5
Osteoporosis	-2.5 and below
Sever (established) osteoporosis (Clinical osteoporosis)	-2.5 and below, plus one or more osteoporotic fracture

Example of a question from the table

a patient T-score is -1.3 what is the classification?

Osteopenia



In younger individuals:

- Use Z SCORE
- If ≤ 2 (below expected range of age)
- Peak bone mass: best bone mass, often between ages 20-30
- T score is comparing one's bone density with the younger (peak bone mass)
- Z score is comparing one's bone density with the older
- Exam lumbar vertebrae(L1-L4) & femoral neck if one of them is 2.5 or lower means the patient have osteoporosis.

Assessment of bone mass

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.

High risk groups

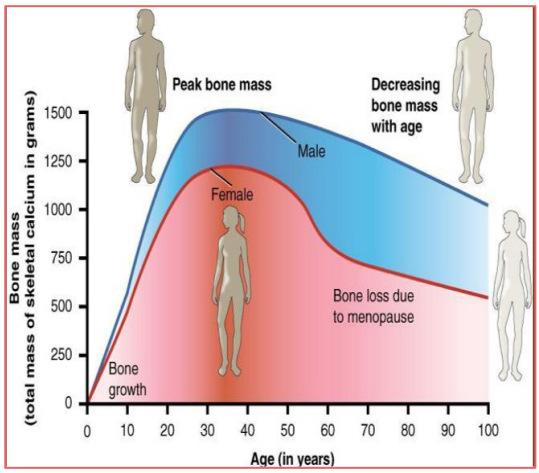
High risk groups (in the presence of one or more of such risk factors measurement of BMD provides further information to the risk of fractures) :

1-80% of bone mass is genetic.
2-Asian women have genetically lower mass than Americans/Africans.

1. Women with thin light frame
2. History of low calcium intake
3. Decreased physical activity
4. Smoking
5. High alcohol or caffeine consumption
6. family history of osteoporosis
7. History of prior menstrual disturbances
8. History of drugs like antiepileptics or steroids

Strategy for management of osteoporosis

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



Treatment

Senile osteoporosis is a pediatric disease this means if you don't achieve best peak bone mass as possible in your twenties and thirties you always start at a lower level than the normal and then you are more likely to have osteoporosis when you get old and more likely lead to fracture so the best way to prevent osteoporosis is starting from a young age! from a pediatric age group by optimizing calcium intake, vitamin D exposure, nutrition and exercise all these stuff are very important. (team 439)

1-Adolescent group (peak bone mass attainment)	2-Premenopausal female (maintenance of bone mass)
A calcium intake of 1200 mg/day is recommended.	Adequate calcium intake; 1000-1500 mg/day.
Adequate sun exposure or vit D supplementation to ensure adequate level.	
A reasonable exercise program is recommended.	A reasonable exercise program is recommended, but not to the point of amenorrhea.
Genetic influence on peak bone mass attainment.	Avoidance of osteopenia-producing conditions/medications/lifestyle: 1. Smoking & excessive alcohol intake, excessive caffeine/protein intake and soft drinks (high phosphates). 1. Amenorrhea/oligomenorrhea. 1. Cortisone, excessive thyroid hormone replacement, loop diuretics, prolonged heparin exposure.

3-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.
Other modalities of therapy: (Discussed in pharma in details) 1. Bisphosphonates. 2. SERMS (Selective estrogen receptor modulators e.g., Evista). 3. Anabolic Hormones e.g. PTH. 4. Denosumab.

Treatment

4-The elderly (>62) postmenopausal		
Female		**Male**
with low bone mass but no compression fractures (Prevention of bone mass loss & restoration of bone mass previously lost).	With fragility fracture (Prevention of further fractures).	with low bone mass and/or fractures (Prevention of bone mass loss & restoration of bone mass previously lost; prevention of further fractures).
Adequate calcium intake; 1000-1500 mgm/day.		
A reasonable exercise program with physical therapy instruction in paraspinous muscle group strengthening exercise.	A careful exercise program with physical therapy instruction in paraspinous muscle group strengthening exercises.	Exercise.
Avoidance of osteopenia-producing conditions/medications/lifestyle: 1. Smoking and excessive alcohol intake, excessive caffeine/protein intake. 2. Cortisone, excessive thyroid hormone replacement, loop diuretics, prolonged heparin exposure.		
—	Consideration of short-term back bracing (non-rigid brace).	Consideration of short-term back bracing (non-rigid brace) and avoidance of osteopenia-producing situation is indicated.
Adequate supplementation with vitamin D.		—
Consideration of Hormone replacement therapy.		consideration of testosterone therapy if total and free testosterone levels are low. 1. Prostate concerns. 2. Cholesterol concerns.
Other modalities of therapy: 1. Bisphosphonates. 2. SERMS (Selective estrogen receptor modulators e.g. Evista). **(Only for female)** 3. Anabolic Hormones e.g. PTH. 4. Denosumab.		

Treatment

5-The amenorrheic female

Exercise induced amenorrhea, eating disorders,etc. (Prevention of bone loss)

01 **General measures;** decrease exercise if appropriate,regain body weight, adequate calcium intake 1000-1500 mg/day.

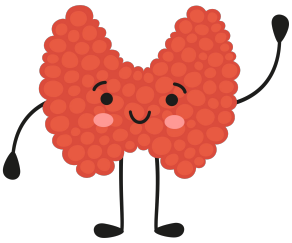
02 avoidance of other osteopenia-producing situations.

03 Regain menses.

04 **Other modalities of therapy:**
1. Estrogen replacement.
2. Bisphosphonates.

6. The male or female with corticosteroid induced osteopenia (Prevention of bone mass loss & restoration of bone mass previously lost)

- Bone mass measurement if possible to identify bone mass loss.
- Lowest possible dose of corticosteroids.
- A program of reasonable calcium intake (1000-1500 mg). (too much can lead to nephrocalcinosis)
- exercise, & avoidance of other osteopenia-producing situations is indicated.
- Adequate supplementation with vitamin D.
- Other modalities of therapy:
  1- Estrogen (Females).
  2- Testosterone (males).
  3- Bisphosphonates.
  4- PTH.



MCQs

Q1

Which of the following is a secondary cause of osteoporosis?

- A- Hyper-thyroidism.
- B- Hypo-parathyroidism.
- C- Hypo-aldosteronism.
- D- Rheumatoid arthritis.

Q2

a patient T-score is -1.3 what is the classification?

- A- Normal.
- B- Osteopenia.
- C- Osteoporosis.
- D- osteoporosis.

Q3

a patient with osteoporosis had fracture in distal radius, what is the type? and what is it called?

- A- Type 1, Crush and wedge fractures.
- B- Type 2, Colles fracture.
- C- Type 2, Crush and wedge fractures.
- D- Type 1, Colles fracture.

1-A 2-B 3-D

MEDICINE TEAM

Leader
يزن الأحمري

Leader
رغد المصلح

Member
عبدالله الضويحي

Member
رند أبا الخيل

Member
ريما المطيري

Member
فيصل الشويعر

Member
ريوف الأحمري

Member
ريما الزغيبي

Member
عبدالعزيز الحميدي

Member
محمد السلامة

Member
يزيد السليم

Member
عبدالله الزامل

Member
مشعل الدخيل