

MEDICINE

Introduction to osteoporosis

OBJECTIVES :

- 1/ Understanding the definition of osteoporosis
- 2/ Causes of osteoporosis
- 3/ Impact of osteoporosis
- 4/ Diagnosis of osteoporosis
- 5/ Treatment of osteoporosis

IMPORTANT

NOTES

EXTRA

[Editing file](#)



MEDICINE
KING SAUD UNIVERSITY



Introduction

we have a complete new skeleton every 9-10 year

Major functions of bone :

Provide rigid support to extremities and body cavities containing vital organs.

Provide efficient levers and sites of attachment of muscles which are all crucial to locomotion.

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.

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

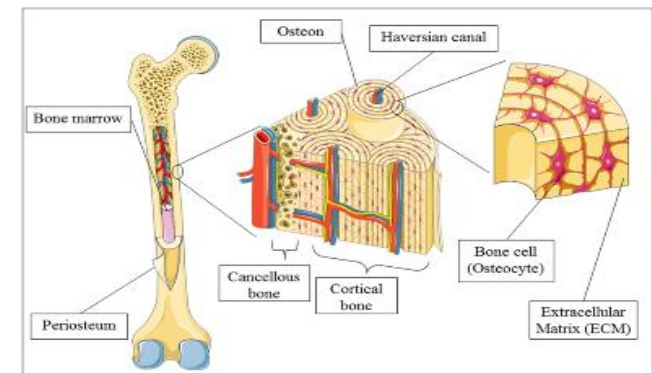
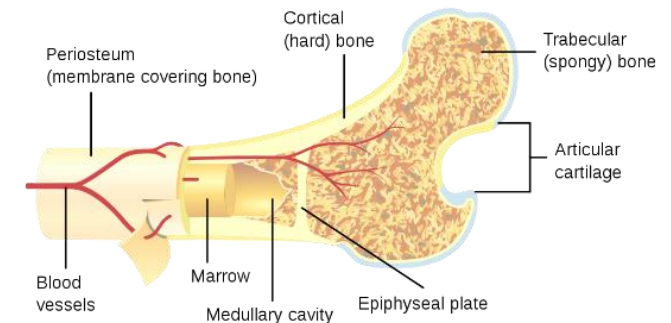
" bone consider as endocrine organ and bone marrow is a factory of bone cells "

Type of bones

Cortical bone	the compact bone of Haversian systems such as in the shaft of long bones
Trabecular bone	The lattice – like network of bone found in the vertebrae and the ends of long bones

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

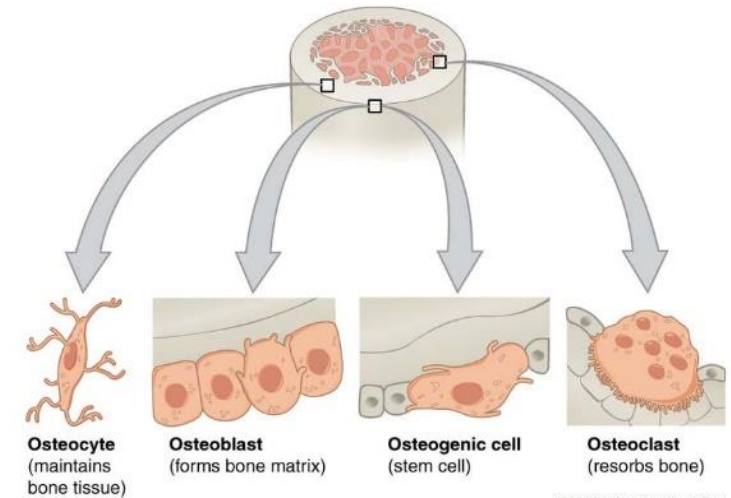


Bone cells :

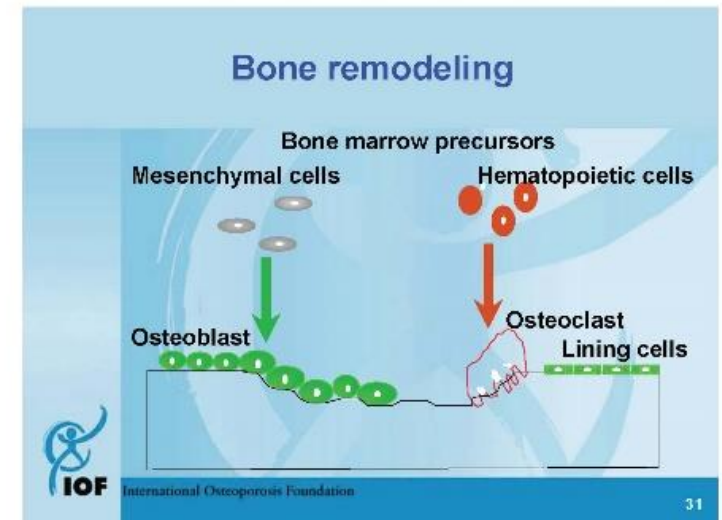
" these cells is important in bone remodeling "

OSTEOBLAST	OSTEOCYTE	OSTEOCLAST
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	They are believed to act as a cellular syncytium that permits translocation of mineral in and out of regions of bone removed from surfaces. has branches called dendritic branches	The bone resorption cells

" bone consider as endocrine organ and bone marrow is a factory of bone cells "



Original author: OpenStax College



International Osteoporosis Foundation

Osteoporosis " THE SILENT PAIN "

Mostly in elderly people

تعني نخر **por**

Definition :

1 in woman and 1 in 5 men over 50 will experience osteoporosis fracture

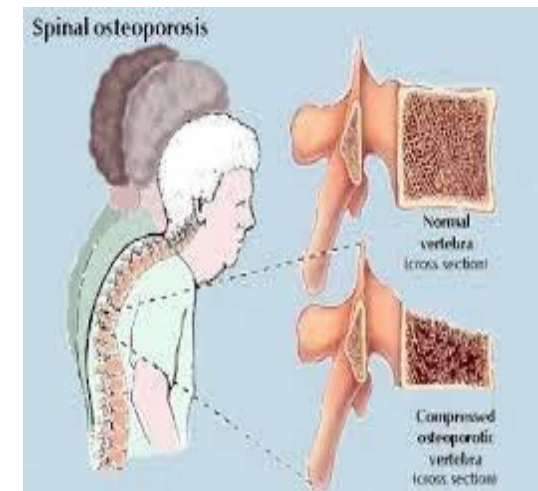
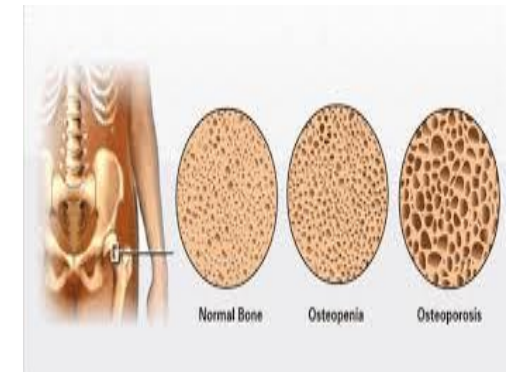
Decrease in **bone mass** and strength associated with an **increased tendency to fractures**. (less scientific straight forward definition)

Clinical features :

- 1/ It is usually an **asymptomatic** disease - patients are asymptomatic even with very low bone densities- until fractures occur. "no pain with osteoporosis". Pain is associated rheumatoid arthritis .
- 2/ Subsequent vertebral fractures may contribute to chronic back pain.
- 3/ In well established osteoporosis dorsal Kyphosis and loss of height occurs.
- 4/ Hip fractures with its fatal complications also occur commonly as osteoporosis become more severe.
- 5/ Atraumatic or low impact fractures.

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.

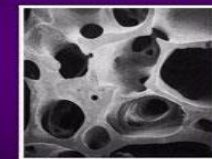
the early stage of osteoporosis → fracture



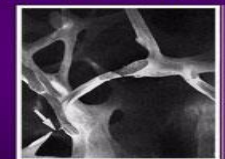
Osteoporosis Definition NIH Consensus Conference

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

Bone strength = Bone density + Bone quality



Normal



Osteoporosis

Common sites of fractures :

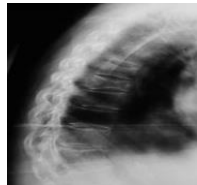
1/ SPINE

2/ FOREARM

" radius "

3/ HIP

" Neck of femur "



Difference in the two type of involutinal Osteoporosis

	51 : 75 Type I	>70 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)2D to 1,25(OH)2d	Secondary	Primary
Main causes	Decreased	Decreased
	Factors related to menopause	Factors related to aging

Types of osteoporosis :

may come without any symptoms just kyphosis

Type I Osteoporosis (Post-Menopausal) :

Fractures of bones composed mainly of Trabecular bone.

Distal radius → colle's fracture
vertebra → wedge & crush fractures

Usually affects woman within 15 years of menopause.

No estrogen → decrease density of bone

Type II Osteoporosis (Senile) :

Fractures of bones composed of both cortical & trabecular bone.

Hip → femur neck fracture

Usually affects individual over age of 70 years.

even when she loses her menstruation after 30's or 40's she will have osteoporosis at this age

Risk factors :

Non-modifiable:

- Age (increasing)
- Low BMI (small, low weight;< 58 kg)
- Ethnicity: Caucasian > Asian/Latino > African American
- Family History of Fracture

Modifiable:

- Sex Hormones (low estrogen/testosterone)
- Low calcium and vitamin D
- Inactive lifestyle
- Excessive alcohol
- Cigarette smoking
- Rheumatoid arthritis
- Hyperparathyroidism (primary or secondary)
الجسم شغال بزيادة عشان كذا يزيد التدمير
- Hyperthyroidism
- GI conditions which impair adequate nutrition
- **Steroids** or Cushing's
- Proton pump inhibitors

Laboratory & radiological finding :

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.**

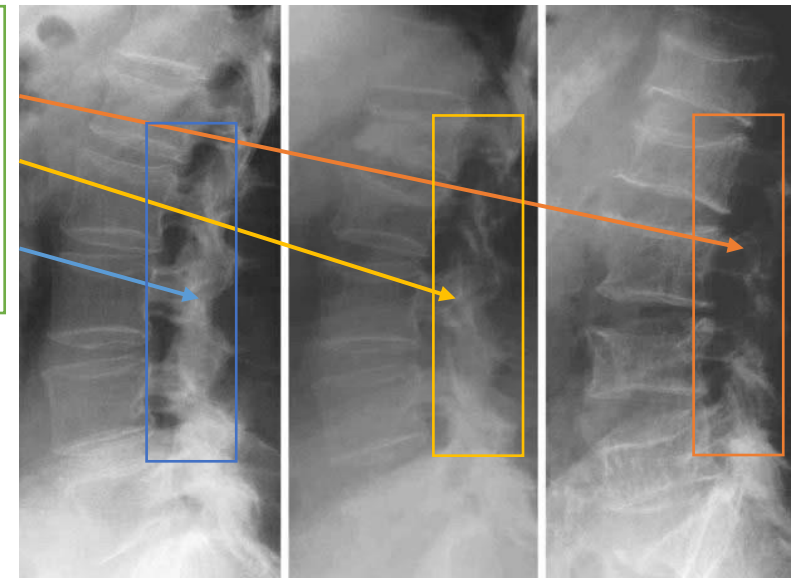
وش الفائدة تعرف فجأة حسابك نقص ٣٠% ، تبي تعرف اول ما يبدأ ينقص

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.

Pathogenesis of decrease in bone density especially in the vertebrae



Assessment of bone mass available method :

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 anti-epileptic'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.

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.

1/DXA is the machine used .

Measure spine L1 – L4 and Hip (neck of femur)

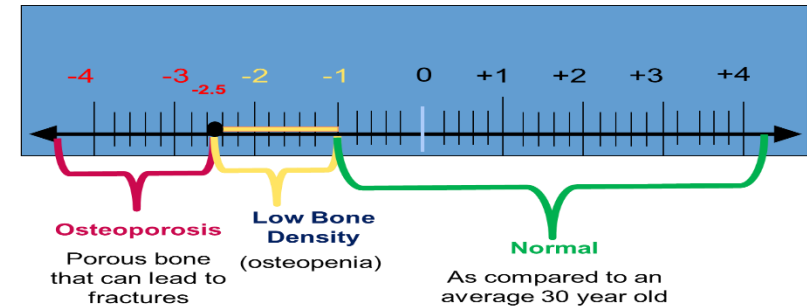
2/SPA 3/DPA 4/CT

Single-Photon absorptiometry

Dual-Photon absorptiometry

Computed Tomography

Dual-Energy X-ray Absorptiometry



The picture above explains the T- score and the numbers reflect a **standard deviation (SD)**.

-1 means there is a loss of about 10-12% of bone density. Therefore, individuals with -1 to 2.5 have osteopenia – they have lost from 10 – 25 % of their bone density.

In young individuals -Children- the Z score is used which is a comparison to age-matched norms- with an old individual. If ≤ 2 (below expected range for age)

Peak bone mass is between 20-30

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

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

Hip fracture :

- 1/ Hip fractures are bad (serious condition that can cause death).
- 2/ 20% patients with hip fracture die within the year
- 3/ 25-30% need placement in skilled nursing facility
- 4/ Cause serious disability and excess mortality
- 5/ Highest incidence in Scandinavian and N American countries.
- 6/ Women who have sustained fracture have a 10-20 % higher mortality than would be expected for their age.
- 7/ Above 50 years of age, female to male ratio is 2: 1.
- 8/ Mortality is higher in men, greater with co existent diseases
- 9/ 1-year mortality: 31 % in men and 17% in women
- 10/ Risk of death is greatest immediately post fracture

Strategy for management of osteoporosis :

Limit disability and provide rehabilitation •

Prevent Osteoporosis •

Detect and treat early to decrease further progression •

When to screen with DXA scan :

DXA scan

VERY CONTROVERSIAL

مثير للجدل

WOMEN \geq 65 YEARS

MEN \geq 70 YEARS

INDIVIDUALS WITH RISK FACTORS e.g. STEROIDS

asses how much the bone absorb x-ray and reflected back

Osteomalacia

لين العظام

Definition :

the most common metabolic bone disease are osteoporosis and osteomlasia

Failure of organic matrix (osteoid) **of bone to mineralize normally** and the commonest cause is vitamin D deficiency .

Calcium and vitamin D

1/ At least 1000 mg /day for men \leq 65 or younger

2/ 1500 mg /day for older men. Ca citrate vs. Ca carbonate.

Vitamin D : check 25 (OH) vit. D level. If very low, you need to "replete" the stores first.

Maintenance dose is 800 IU for men younger than 50 and 800-1000 IU for men older than 50 .

1000 IU or more for all patients with osteoporosis or reduced bone mass regardless of their age.

Prevention :

1/ Adequate nutrition, particularly calcium and vitamin D

2/ Calcium: 1000 – 1200 mg daily (diet plus supplementation)

3/ Vitamin D: **goal level above 50-75 nmol/l**

" **Less than 20 nmol/l is Vit D deficiency** "

4/ Weight bearing exercise

5/ Discourage smoking

6/ Reduction of risks for falling: consider OT evaluation for home hazards, minimize sedating medications.

7/ Hip protectors: can be useful if worn

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

Management :

- 1/ **Nonpharmacologic**
- 2/ Modification of life style measures
- 3/ Exercise
- 4/ Prevention of falls
- 5/ Adequate calcium and vitamin D intake
- 6/ Stopping smoking v More sun exposure

Treatment :

The Adolescent Group

(Peak bone mass attainment)

“Senile Osteoporosis is a pediatric disease”.

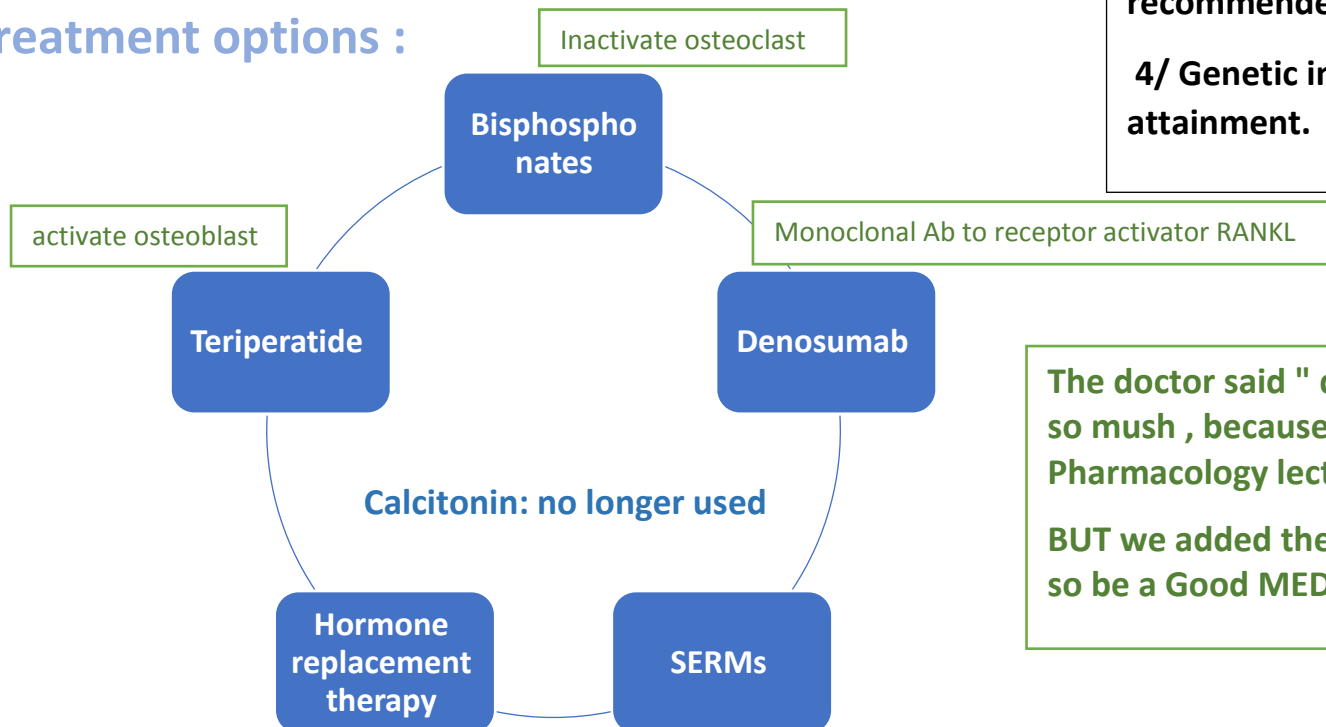
1/ A calcium intake of 1200 mg/day is recommended.

2/ Adequate sun exposure or vit D supplementation to ensure adequate level.

3/ A reasonable exercise program is recommended.

4/ Genetic influence on peak bone mass attainment.

Treatment options :



The doctor said " don't worry about the treatment so much , because it will be covered in Pharmacology lecture "

BUT we added them in the **next 2 pages** any way , so be a Good MEDICAL STUDENT and read them .

The Premenopausal Female (Maintenance of bone mass) :

Adequate calcium intake; 1000-1500 mg/day disease.

Adequate sun exposure or vit D supplementation

A reasonable exercise program is recommended, but not to the point of amenorrhea.

Avoidance of osteopenia-producing conditions/medications/lifestyle:

Smoking & excessive alcohol intake, excessive caffeine/protein intake.

Amenorrhea/oligomenorrhea.

Cortisone, excessive thyroid hormone replacement (?), loop diuretics, prolonged heparin exposure.

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

Adequate calcium intake: 1000-1500 mg/day

A reasonable exercise program with physical therapy instruction in para-spinous muscle group strengthening exercise.

Avoidance of osteopenia-producing conditions/medications/lifestyle:

Smoking & excessive alcohol intake, excessive caffeine/protein intake.

Cortisone, excessive thyroid hormone replacement (?), loop diuretics, prolonged heparin exposure.

Adequate supplementation with vitamin D

Consideration of Hormone replacement therapy

Other modalities of therapy : Bisphosphonates , SERMS , Anabolic Hormones e.g. PTH

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

Other modalities of therapy:

Bisphosphonates

SERMS (e.g., Evista)

Anabolic hormones e.g.PTH

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

Adequate calcium intake; 1000-1500 mg/day disease.

A careful exercise program with physical therapy instruction in para-spinous muscle group strengthening exercises

Consideration of short-term back bracing (non-rigid brace)

Avoidance of osteopenia-producing conditions/medications/lifestyle:

Smoking & excessive alcohol intake, excessive caffeine/protein intake.

Cortisone, excessive thyroid hormone replacement (?), loop diuretics, prolonged heparin exposure.

Adequate supplementation with vitamin D

Consideration of Hormone replacement therapy

Other modalities of therapy

Bisphosphonates , SERMS , Anabolic Hormones e.g. PTH

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 program of reasonable calcium intake (1000-1500 mg daily), exercise, short term back bracing and avoidance of osteopenia-producing situation is indicated.

Consideration of testosterone therapy if total and free testosterone levels are low.

Prostate concerns

Cholesterol concerns

Other modalities of therapy

1. Bisphosphonates

2. Anabolic Hormones e.g. PTH

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

General measures; decrease exercise if appropriate, regain body weight, adequate calcium intake (1000-1500 mg/day) and avoidance of other osteopenia-producing situations.

Regain menses

Other modalities of therapy

Estrogen replacement

Bisphosphonates

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), exercise, & avoidance of other osteopenia-producing situations is indicated.

Adequate supplementation with vitamin D

Other modalities of therapy

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

Table

Prescription Agents for Osteoporosis		
Medication	Prevention Dose	Treatment Dose
Bisphosphonates		
Alendronate sodium (Fosamax)—Merck	5 mg po daily 35 mg po weekly	10 mg po daily 70 mg po weekly
Risedronate sodium (Actonel)—Procter & Gamble/Aventis	5 mg po daily 35 mg po weekly	5 mg po daily 35 mg po weekly
Estrogens (various)	Equivalent to 0.3-0.625 mg conjugated equine estrogen daily	Not indicated
SERMs		
Raloxifene (Evista)—Lilly	60 mg po daily	60 mg po daily
Calcitonin-Salmon		
(Miacalcin)—Novartis	Not indicated	200 IUs intranasally daily
Parathyroid Hormone		
Teriparatide (Forteo)—Lilly	Not indicated	20 mcg sq daily

Pe = by mouth; SERMs = selective estrogen receptor modulators; IUs = international units; sq = subcutaneously.

Summary

1. Screening

All women > 65 years

Men > 70

Women 50-64 with risk factors

Patients on **steroids** or anti-estrogen/anti-testosterone treatment

2. Prevention

with adequate calcium/vitamin D, weight bearing exercise should be advised for all.

3. DXA scan

is the **primary** screening tool

4. Aggressive therapy should be offered to patients with atraumatic/low-impact fractures and those with osteoporosis, osteopenia with multiple risk factors, patients on **steroids**, anti-estrogen, and anti-testosterone therapy with abnormal bone densities (T score <-1).

Questions

1- Which of these statements about osteoporosis is correct:

- A Fractures in type 1 osteoporosis occur in cortical bones
- B Fractures in type 2 osteoporosis occur in trabecular bones
- C Type 1 osteoporosis usually affects women within 15 years of menopause
- D Type 2 osteoporosis is also called post-menopausal osteoporosis

2- All of the following are risk factors for osteoporosis except:

- A Low Calcium intake
- B Obesity
- C Alcohol
- D Turner's syndrome pt. have low Estrogen levels

3- Which of the following is a non-modifiable risk factor for osteoporosis:

- A Low BMI
- B Oral steroids
- C Proton pump inhibitors
- D Thyrotoxicosis

4- All of the following are factors Associated with Decreased Bone density EXCEPT:

- A Hemiplegia
- B Chronic obstructive lung disease
- C Anticonvulsants (Phenytoin, Phenobarbitone)
- D Liver disease

5- General clinical presentation of a patient with osteoporosis:

- A Asymptomatic
- B Osteodynia
- C Ostealgia
- D Osteoarthritis

6- All of the following are common sites of fracture in osteoporosis EXCEPT:

- A Spine
- B Radius
- C Hip
- D Tibia

1/ C

2/ B

3/ A

4/ E

5/ A

6/ D

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THANK YOU

FOR CHECKING OUR TEAMWORK



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Male & Female slides

