

УНИВЕРЗИТЕТ  
У КРАГУЈЕВЦУ



# ► RADIOLOGY OF BONE AND JOINT SYSTEM

ASSISTANT PROFESSOR *BILJANA GEORGIEVSKI-  
BRKIĆ*

# DIAGNOSTIC MODALITIES

- ▶ **Conventional radiography** → trauma, tumors (bone integrity, fracture type and dislocation)
- ▶ **Ultrasound** → in the diagnosis of soft tissues and joints
- ▶ **CT** → has better spatial and contrast resolution than radiography
- ▶ **MP** → excellent results in the evaluation of bone and joint diseases

# DIAGNOSTIC MODALITIES

**CONVENTIONAL X-ray** - the first imaging technique for suspected bone lesions

**CT** - to determine the nature of the lesion (precise localization, matrix, details of the cortex, detection of cystic and fatty lesions)

**MRI** - a superior method for determining the pathology of the bone marrow and connections with neurovascular structures

**SCINTIGRAPHY** - a highly sensitive but non-specific technique that helps in the detection of metastases

# COMPUTED TOMOGRAPHY (CT) IN DISEASES OF THE MUSCULOSKELETAL SYSTEM

- Herniated disc
- Spinal stenosis
- Trauma
- Complex bones (spine, pelvis)
- Tumor extension



# CT DIAGNOSTICS


## CT ADVANTAGE

Non-invasive method, good contrast resolution  
the ability to measure the density of tissues  
reduced radiation

## DISADVANTAGES OF CT

Limited field of view  
Artifacts made of metal foreign bodies

# MAGNETIC RESONANCE IMAGING (MRI) IN DISEASES OF THE MUSCULOSKELETAL SYSTEM

- Herniated disc
  - Compression of the spinal cord
  - Extension of bone tumors
  - Imaging of soft tissue tumors
  - To show injuries to articular cartilage, ligaments and other soft tissues
  - Diagnose avascular necrosis and other pathologies of the joints
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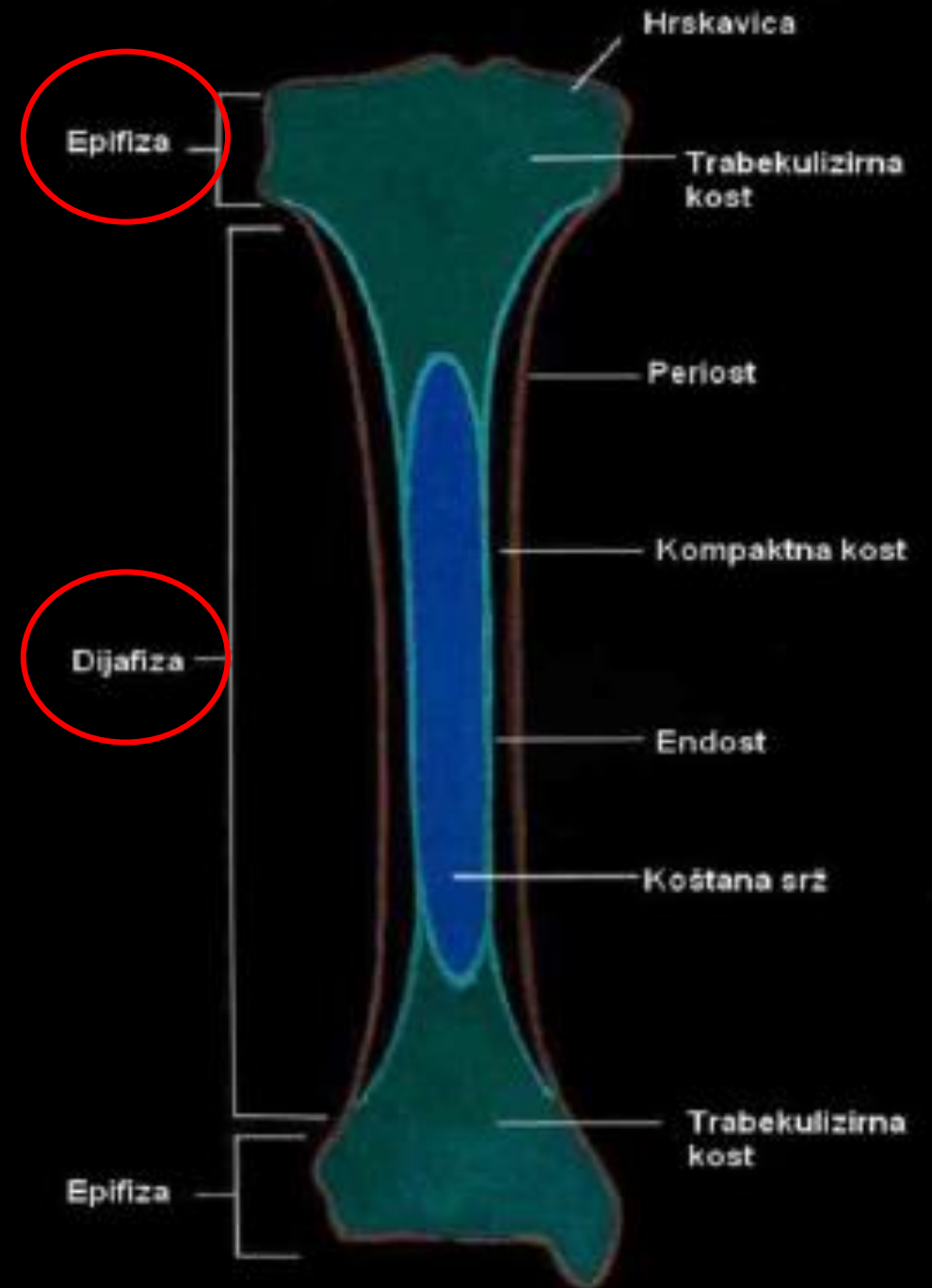
# BONE STRUCTURE

Histologically, there are 2 types of bone

1. Trabecular bone - chaotically arranged trabeculae between which there is bone marrow (margins of long bones and flat bones)
2. Compact bone - the basis of the structure is an osteon (in the shape of a cylinder) made of concentric lamellae and layers of bone matrix. In the center of the osteon passes the Haversian canal, which contains an artery, a vein and a nerve. It is isolated by the periosteum and endostome.

By form:

1. Long
2. Short
3. Flattened
4. Incorrect

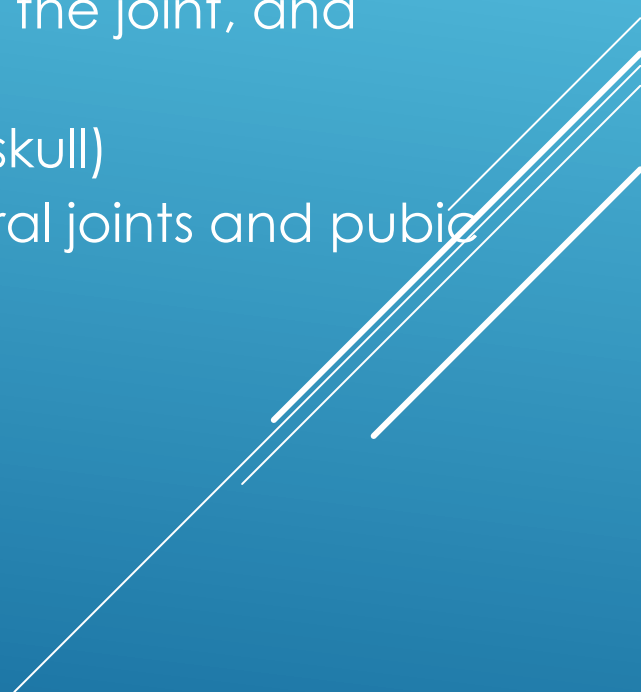


# TYPES OF BONES

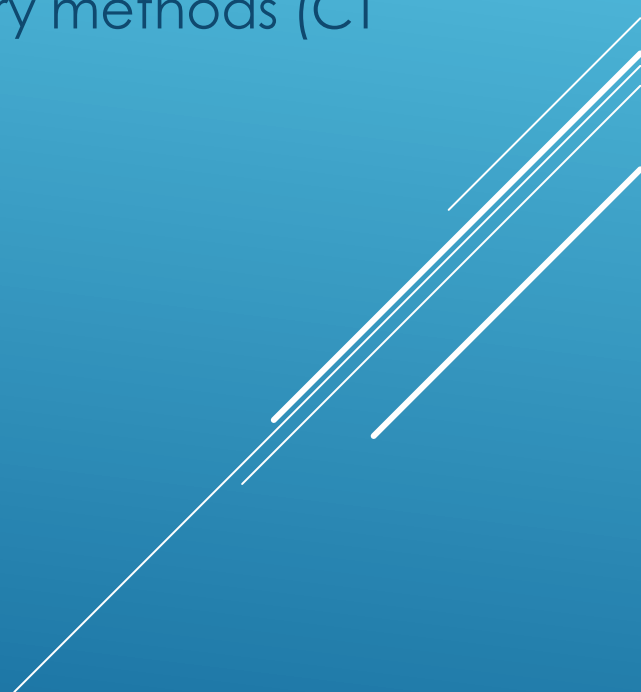
- ↓ In the case of **long bones**, one dimension is larger than the other two. They are characteristic of the extremities (tibia, femur, ulna). The basic parts of long bones are the body (corpus, diaphysis), the two margins, and the metaphysis. In the part of the metaphysis, the end and the edge are joined. This part of the bone grows during the period of growth.
- ↓ All three dimensions of **short bones** are similar in size. Short bones are most often found in the areas of the hands and feet
- ↓ In **flat bones**, one dimension is much smaller than the other two. Flat bones include the bones of the cranial vault, sternum, scapula, ribs, and pelvic bone
- ↓ By their shape, **irregular bones** (ossa irregularia) do not belong to any of these groups. In this group, for example, the vertebra of spine, the bones of the base of the skull and the bones of the face.



# TYPE OF JOINTS

1. Synovial around the cartilage is the articular capsule that isolates the joint, and inside there is synovial fluid (hip, shoulder, elbow, knee)
  2. Fibrous junction of 2 bones without articular space (suture of the skull)
  3. Cartilage inserted cartilage between bony surfaces (intervertebral joints and pubic bone)
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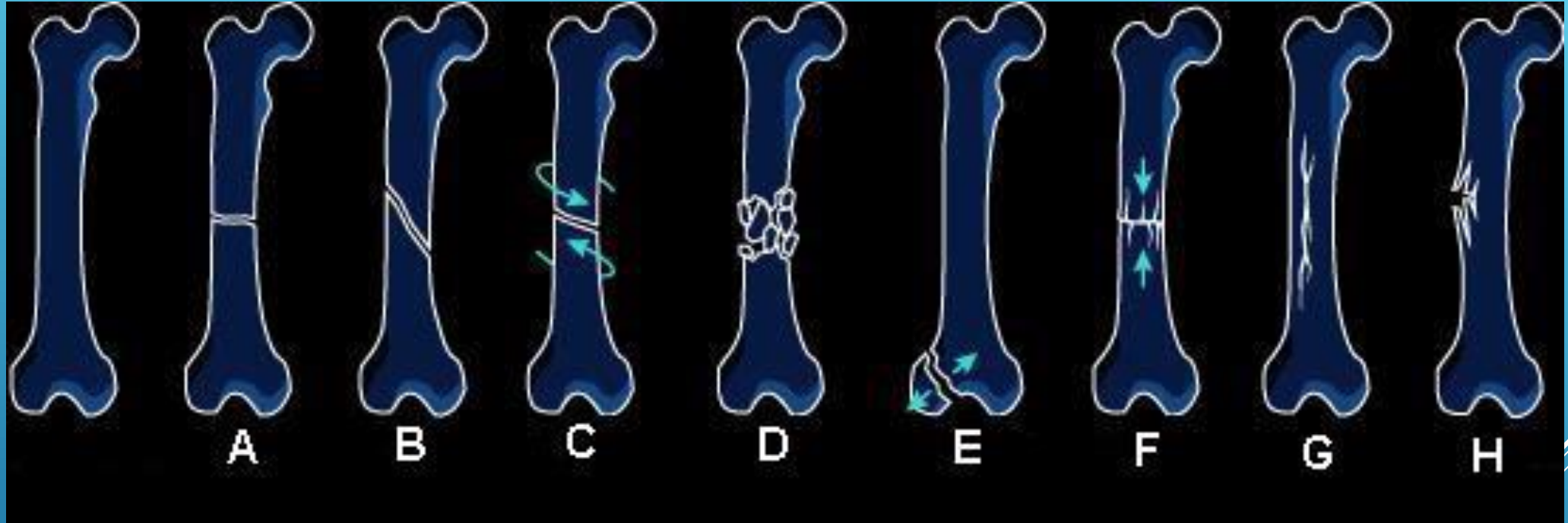
# TRAUMA OF THE SKELETON

- ↓ **BONE FRACTURE** = break in bone continuity
  - ↓ **Radiography in 2 projections** (PA and profile) and complementary methods (CT and MRI)
  - ↓ Anamnesis is important!
  - ↓ Trauma data
  - ↓ Deformity of the injured part of the body
  - ↓ Pain in that region
  - ↓ Loss of function
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# TRAUMA OF THE SKELETON

- ↓ **Fracture Description:**
  - ↓ Which bone is injured and which part (epiphysis, metaphysis, diaphysis)
  - ↓ The existence of a fractured fissure
  - ↓ The relative position of fracture fragments (always the proximal fragment is seen as fixed, relative to the distal one that is dislocated).
- 
- ↓ **Dislocation** with contraction (overlap) due to muscle contraction.
  - ↓ There are 2 types of dislocations along the length: **with distraction** (separate fragments) and **compact fracture** (imprinted fragments)

# TRAUMA OF THE SKELETON



Various forms of bone fracture (fractured fissures). A . Transverse B. Oblique C. Spiral D. Communitive E. Avulsion F. Compact fracture G. Fissure H. Fracture of the appearance of "green branches".

# TRAUMA OF THE SKELETON


- ↓ Special types of fractures:
- ↓ **Avulsion** → Fracture of a part of the bone at the attachment of tendons or ligaments under extreme exertion or weakness of the bone at the attachments
- ↓ **Stress fracture** → due to long-term, repeated effects of small trauma to the bone (in athletes and soldiers). They are manifested by a periosteal and sclerotic reaction of the bone
- ↓ **Pathologic fracture** → due to a decrease in bone strength (osteoporosis, bone tumors, metastases)
- ↓ **Intraarticular fracture** → They occur when a fractured fissure enters the joint. They are more difficult to fix, heal and the frequency of complications is higher (knee, hip, and shoulder)

# TRAUMA OF THE SKELETON

- ↓ Typical fracture:
- ↓ **Fractura radii loco typico** (Coles) → It is caused by falling on the hand in flexion. The fractured fissure affects the distal diaphysis with a radius of 1 inch from the radiocarpal joint
- ↓ **Fractura colli femoris** → in elderly people with osteoporosis (hip pain, shortened leg with external rotation)



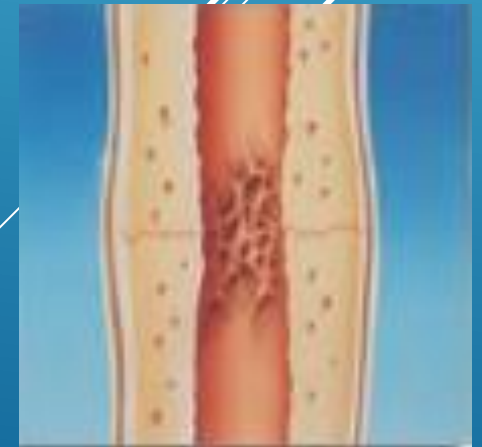
# TRAUMA OF THE SKELETON

- ↓ If the first X-ray does not show a fractured fracture, a follow-up is scheduled in 7-10 days, if there is a suspicion of a fracture.
  - ↓ When healing, decalcification of the edges of the fracture occurs, so it is better noticed. If you can't wait 2 weeks, then you can go to MRI.
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# TRAUMA OF THE SKELETON

- ↓ Bone healing:
  - ↓ 1. After trauma, a **hematoma** is formed in and around the fractured fissure with macrophages and inflammatory leukocytes
  - ↓ 2. In this mass, chondrocytes are formed, which secrete collagen, forming a **"soft" callus (fibrous cartilaginous structure)**
  - ↓ 3. In the soft callus, osteoblasts differentiate and a **"hard" callus** is formed
  - ↓ 4. Further osteoblasts and osteoclasts under the influence of load forces **remodel the bone**
- 1-2 weeks                      3-4 Weeks                      4 -16 weeks                      17 weeks





# TRAUMA OF THE SKELETON

- ↓ Joint fracture → A **luxation** is a complete loss of contact (usually the shoulder, hip and elbow), and a **subluxation** is a partial loss of contact



# SKELETAL TRAUMA

## AXIAL

- ↓ The cervical spine is particularly important because of the mobility and vulnerability of the cervical spinal cord

Graphia of the cervical spine

- Vertebral bodies
- Paravertebral soft tissue
- Line

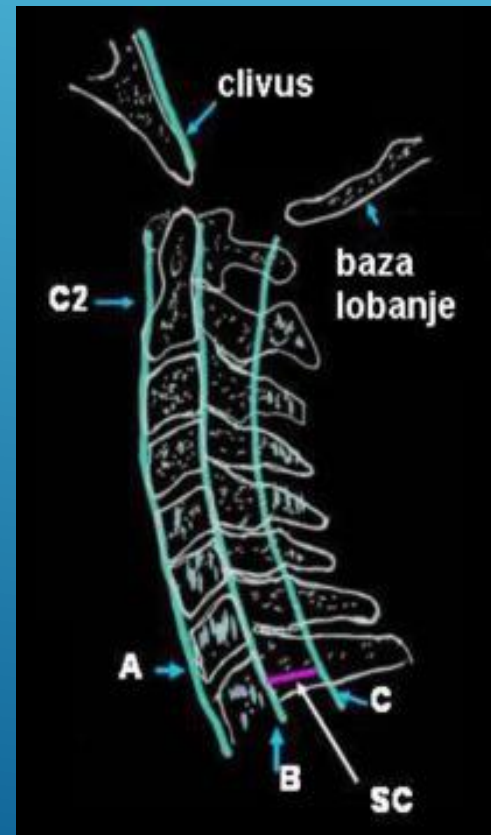
Anterior vertebral line

Posterior vertebral line

Spino-laminar line

-Intravertebral joint

-Intervertebral space



A. anterior vertebral line,  
B. posterior vertebral line,  
C. spino-lamellar line,  
SC. spinal canal.

# SKELETAL TRAUMA

## AXIAL

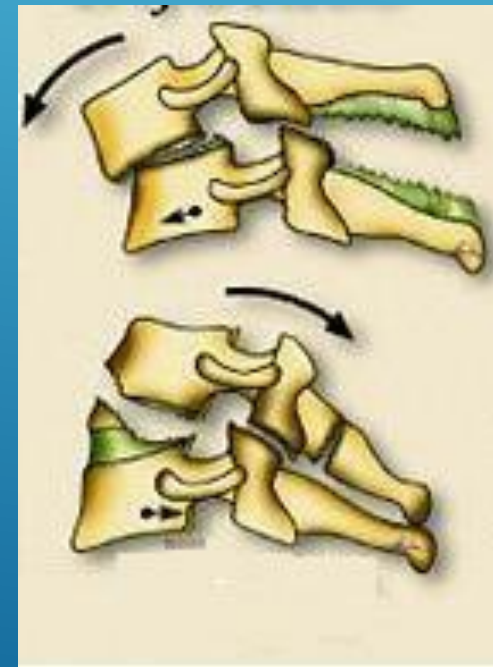
- ↓ The cervical spine is examined in a PA and LL projection (special images are also used - a "dance" image through an open mouth and an "oblique" image of the cervical spine).
- ↓ The method of choice is a CT scan
- ↓ TIME! It is necessary to diagnose the cervical spine injury as soon as possible, in order to immobilize as soon as possible

# SKELETAL TRAUMA

## AXIAL

- ↓ According to the prognosis, injuries of the cervical spine can be:
- ↓ **Stable** → there are no lesions of the nerve structures or there is no possibility that they develop as a result of a fracture (they affect only bone elements)
- ↓ **Unstable** → there is damage to the spinal cord or there is a likelihood of

According to the mechanism of occurrence, they can be **flexion** (possible quadriplegia due to damage to the corticospinal pathway in the anterior parts of the spinal cord) and **extensive**



# SKELETAL TRAUMA

## AXIAL

Compressive fracture of the vertebral body of the thoracic spine





# SKELETAL TRAUMA

## AXIAL

Fracture of os ischii

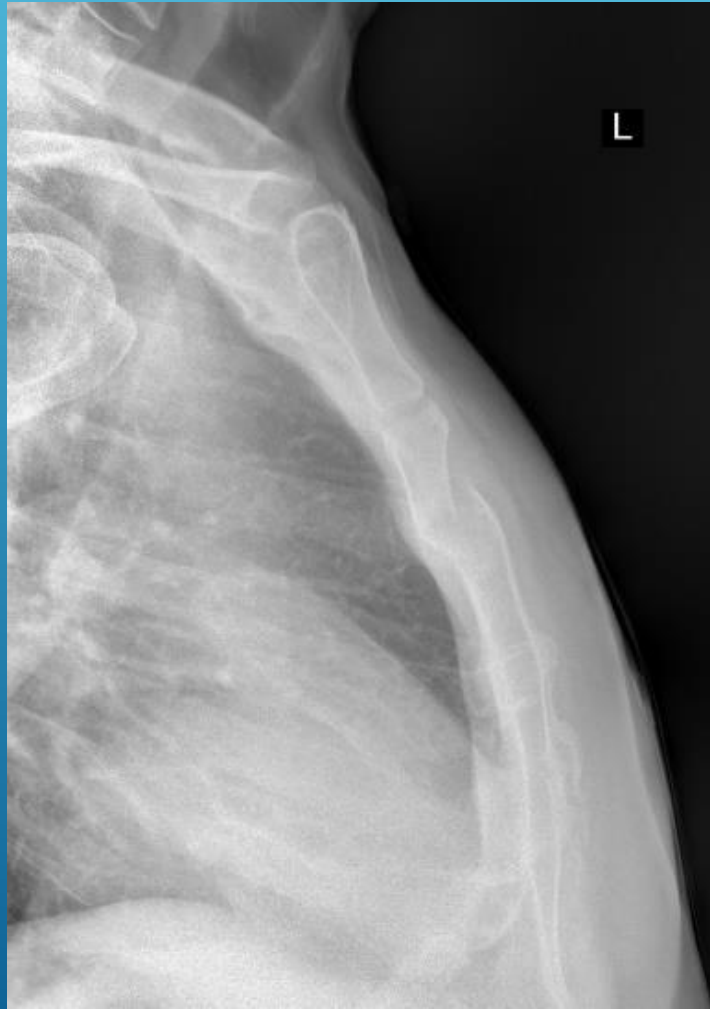
Fracture of the pubic bone



# SKELETAL TRAUMA

## AXIAL

Fracture of the sternum bone

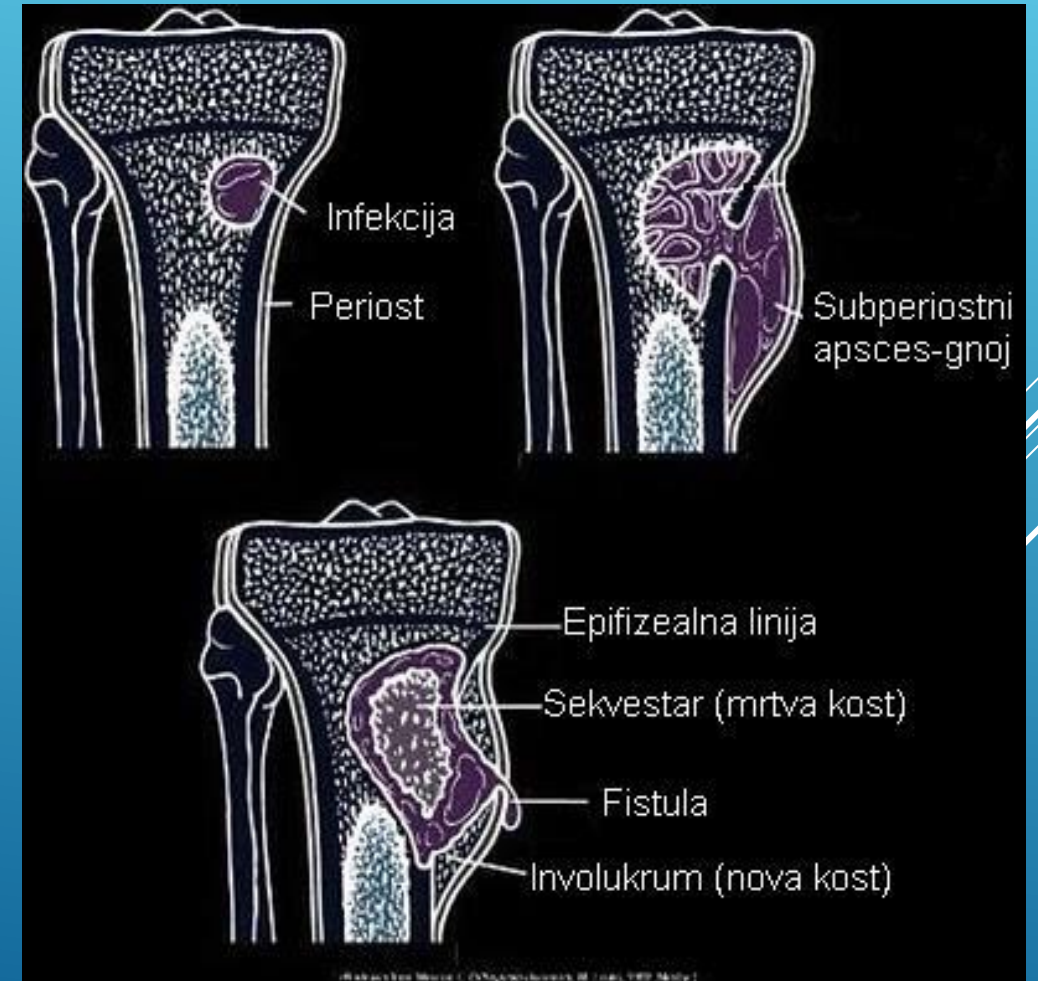


# OSTEOMYELITIS

- ▶ 3 ways of expansion:
- ▶ directly through the injury
- ▶ from soft tissues
- ▶ hematogenous (most common)

## MAGNETIC RESONANCE IMAGING

There are 2 forms:  
ACUTE  
CHRONIC





# OSTEOMYELITIS ACUTE

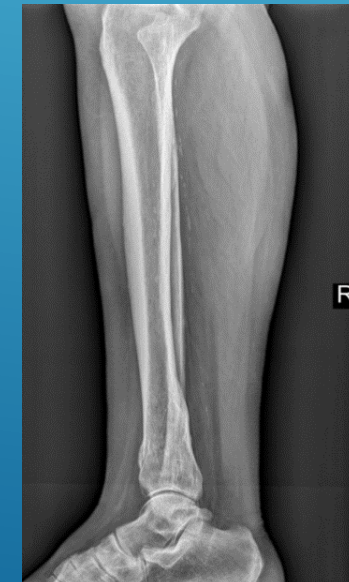
- ↓ It does not give radiologically visible signs for 1-2 weeks from the onset of symptoms
- ↓ In adults, it begins with an inflammatory reaction on the metaphysis of the bone and does not spread toward the epiphysis and joint, since there are no blood vessels, in children this obstacle does not exist and the process expands rapidly
- ↓ Repair begins with the formation of **the INVOLUCRUM** (a new sclerotic bone around the inflammatory process), and in the center of the purulent process there is an old, dead bone **CEKBECTAP**

# OSTEOMYELITIS ACUTE

- ▶ In further development, spontaneous drainage of purulent contents with a breakthrough of the periosteum and the formation of an abscess in the soft tissues, which descends down the muscles and fascia under the influence of gravity.
- ▶ Later, it drains spontaneously over the skin, creating fistulas

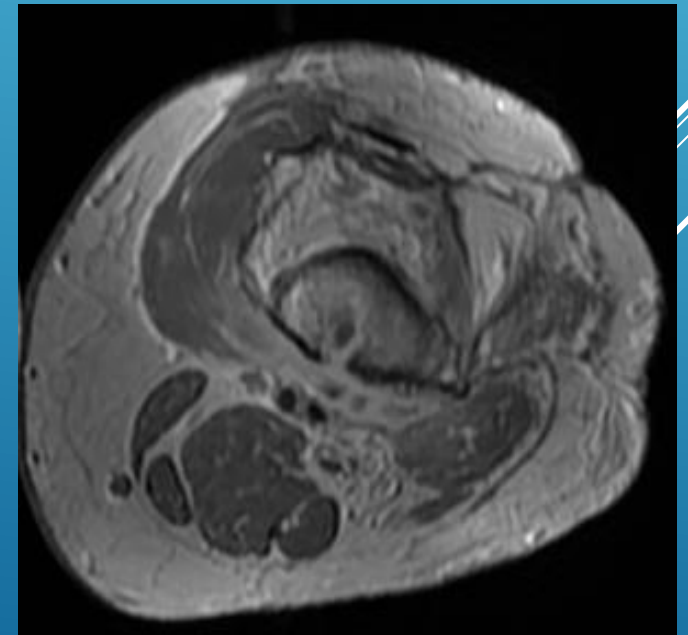
## Radiological signs:

- Swelling of soft tissues
- Periosteal reaction
- Zones of osteolysis
- Reactive zones of sclerosis
- Sequestrum and involucrum (chronic forms)
- Soft tissue abscesses
- Fistula



# OSTEOMYELITIS CHRONIC

- ▶ It most often develops on long bones (humerus, femur and tibia)
- ▶ In adults, infection of the body of the spinal vertebrae is common (**nonspecific spondylitis**) → deformation of the vertebrae and possible spread through soft tissues, as well as an abscess paravertebral



# TUBERCULOSIS OF BONES AND JOINTS

- ▶ Inflammation of the joint and surrounding bones, as it spreads rapidly
- ▶ Hematogenous spread from the primary focus (usually the lungs)
- ▶ Decalcination, narrowing of the articular space, erosions and pseudocysts, bone sequestrars
- ▶ Later comes the repair with ankylosis
- ▶ **Cold abscess** - tbc spondylitis - homogeneous clearly delimited shadow paravertebrally with lesion of the psoas muscle
- ▶ **Spina ventosa** – a large periosteal reaction is formed around the focus with spindle-shaped bone deposits



# ARTHRITIS

- ↓ It may be a consequence of a local inflammatory reaction of one joint or more often synovium of several joints as part of systemic disease

PAIN

EDEMA

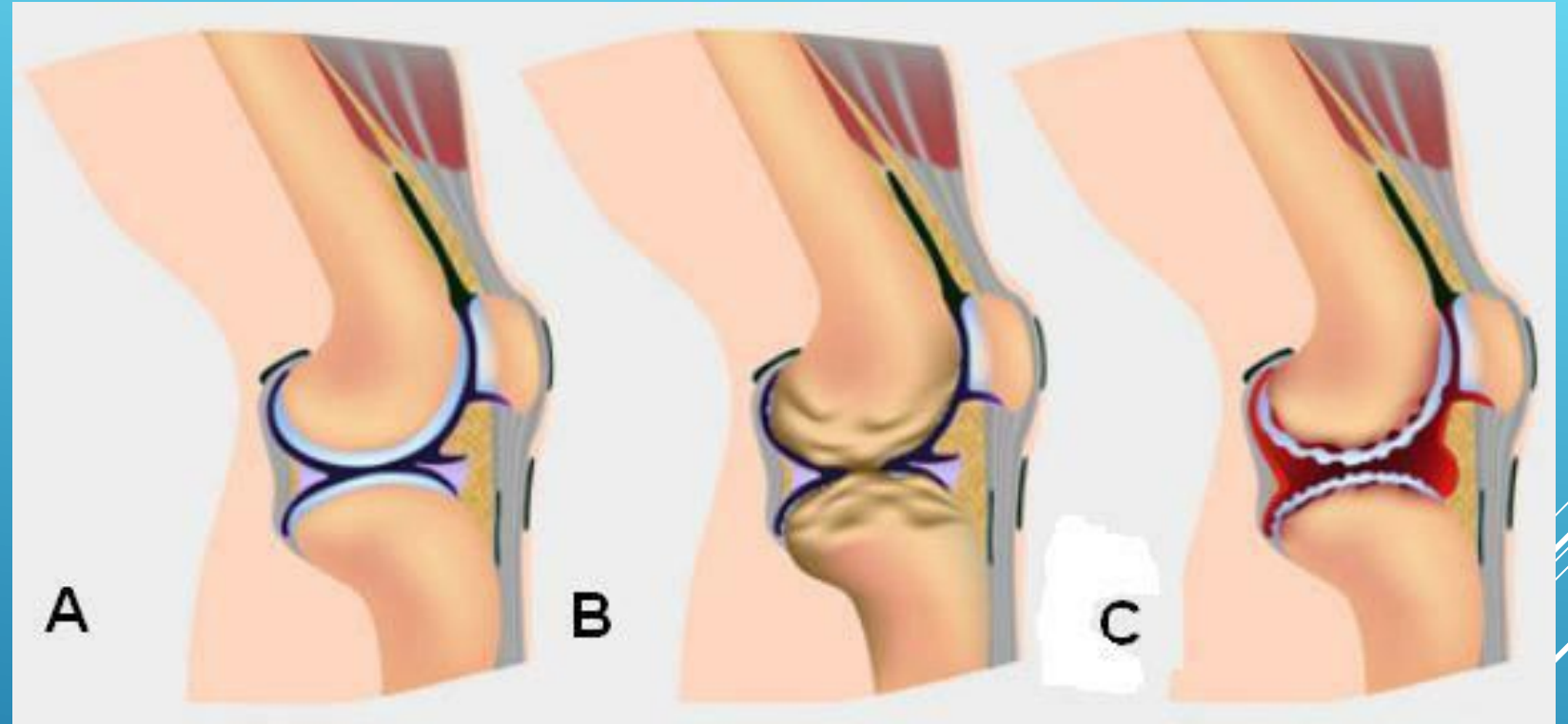
DECREASED PHYSIOLOGICAL  
MOVEMENT

## Division of arthritis

- Osteoarthritis
- Rheumatoid arthritis
- Gout
- Septic arthritis
- Ankylosing spondylitis - Bechterev
- Juvenile arthritis
- Seronegative arthritis

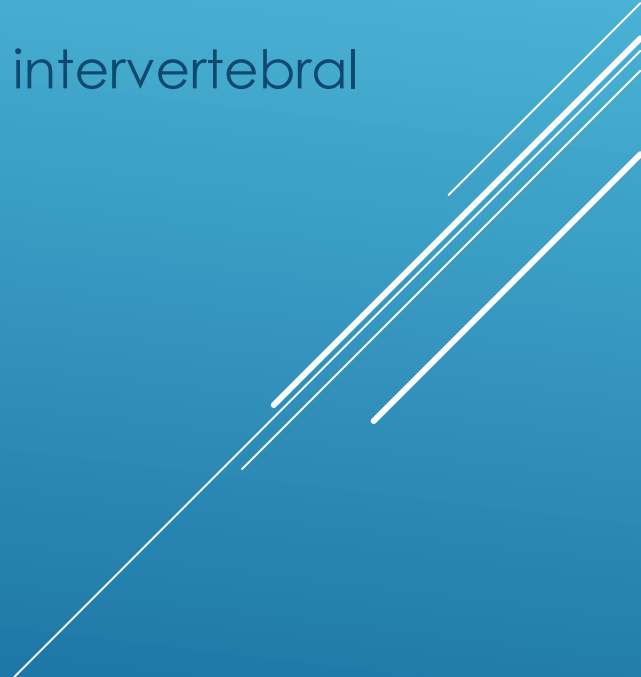


# ARTHRITIS



- (A). Morphological characteristics of a normal joint.  
(B ). Osteoarthritis, destruction of cartilage and subchondral bone, narrowing of the articular space.  
(C). Rheumatoid arthritis, inflammation of the synovium of the pannus at the junction synovium and cartilage.

# ARTHRITIS OSTEOARTHRITIS

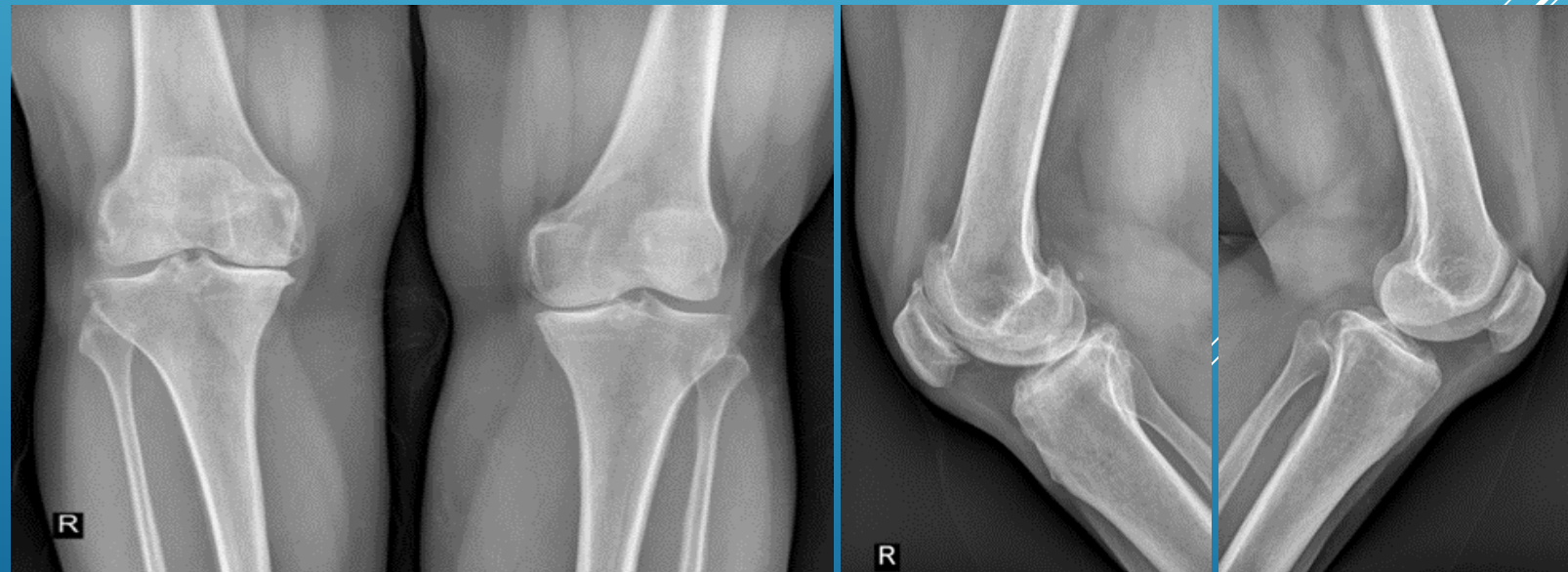
- ↓ The most common form occurs later in life
  - ↓ It is caused by degenerative changes in the cartilage of the joint
  - ↓ Affects large joints (knee, hip), small joints (hands and feet), small intervertebral joints
  - ↓ It is often associated with osteoporosis
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# ARTHRITIS

## OSTEOARTHRITIS

- ↓ Initially, there is an erosion of the cartilage and contact of the bare parts of the bone, pain and reduction of movements
- ↓ Osteophytes are formed

X-ray:  
Narrowing of the joint space  
Osteoporosis  
Subchondral sclerosis  
Osteophytes (fix the joint)





# ARTHRITIS

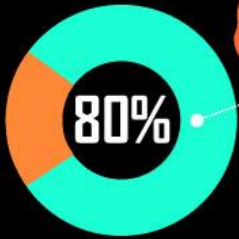
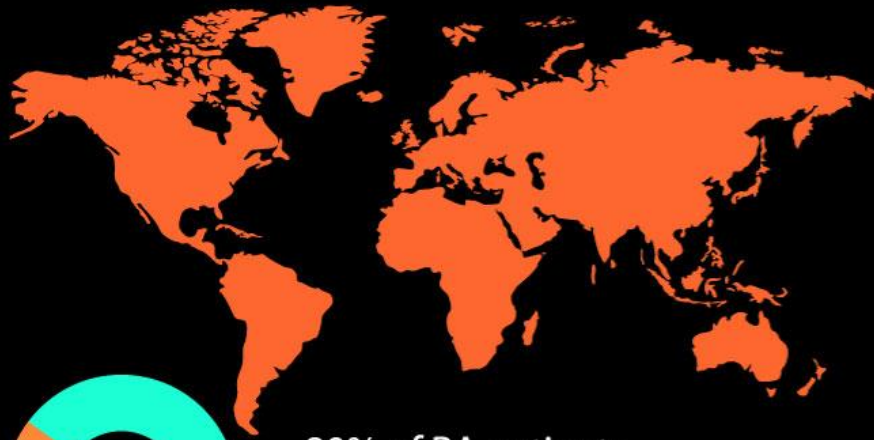
## RHEUMATOID ARTHRITIS

- ↓ Systemic autoimmune disease of the synovium of the joint, affecting first the interphalangeal, metacarpal joints and wrist
- ↓ Occurs after the age of 20, the changes are symmetrical

MRI especially good at an early stage

PAIN  
REDNESS  
EDEM

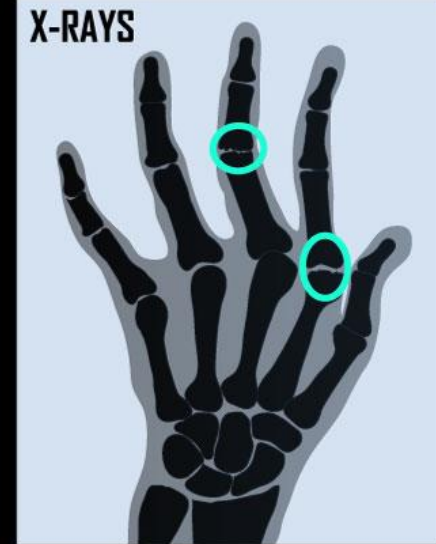
# Rheumatoid arthritis



80% of RA patients  
between the ages of 35-50



Women are 3 times more  
likely to develop  
RA than men



X-RAYS

## Risk



Heredity



Age



Lifestyle



Pollution

## Complications



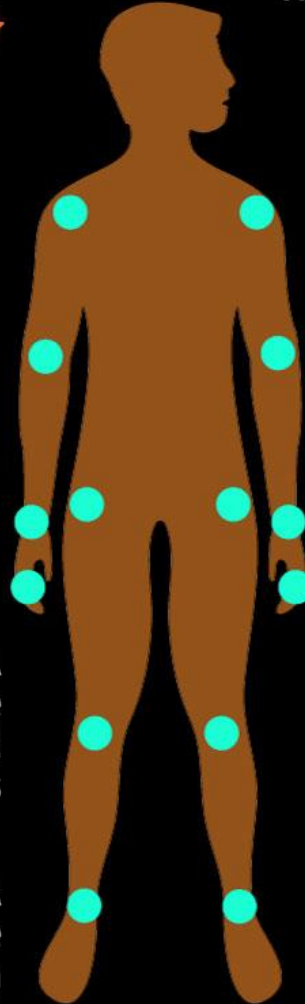
Heart attack



Stroke

70% of RA  
patients have  
wrist and hand  
problems

90% of RA  
patients have  
symptoms in  
the foot



Vaccination

## Management



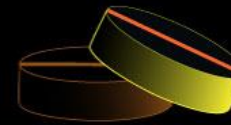
Exercise



Surgery



Dietary  
supplements



Antirheumatic  
drugs



Stop  
smoking



Limit  
alcohol

# ARTHRITIS

## RHEUMATOID ARTHRITIS

- ↓ It begins with the formation of a **rheumatoid pannus** (fibrous nodule) at the attachments of the synovium and articular cartilage, which with its growth erodes the cartilage and thickens the synovium
- ↓
- ↓ Later, there is a narrowing of the joint space, subchondral sclerosis, and periarticular osteoporosis, with the development of erosions on the cartilage
- ↓ In the last stage, luxation and **ankylosis** develop (the joint is fixed and immobile)



# RHEUMATOID ARTHRITIS

- ▶ Stage 1 - narrowing of the articular spaces with pseudocysts
- ▶ Stage 2 - erosions
- ▶ Stage 3 - subluxations and luxations
- ▶ Stage 4 - ankylosis

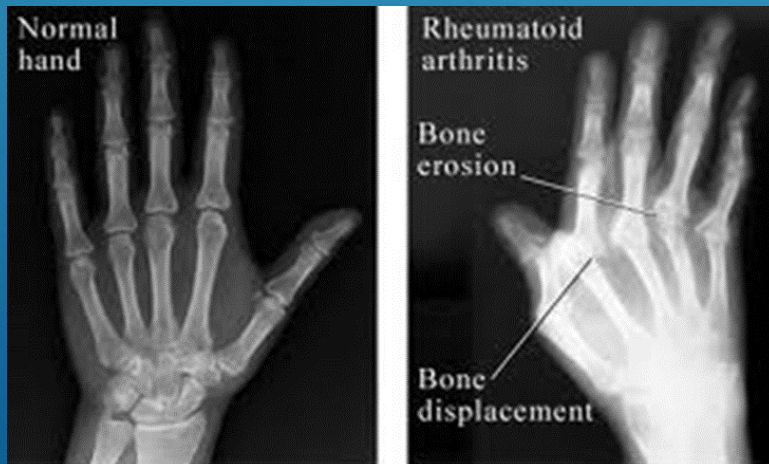
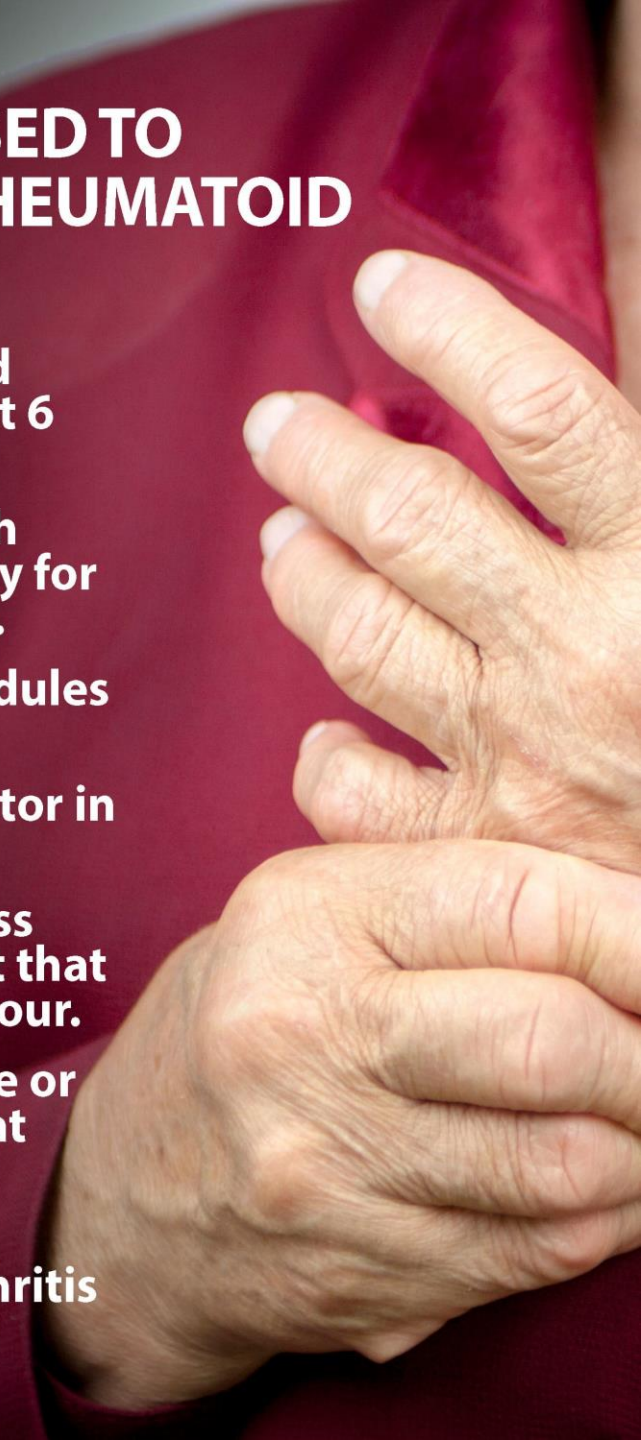


Figure 1

Figure 2

## CRITERIA USED TO CONFIRM RHEUMATOID ARTHRITIS

- Arthritis of hand joints for at least 6 weeks.
- Arthritis on both sides of the body for at least 6 weeks.
- Rheumatoid nodules under the skin.
- Rheumatoid factor in blood testing.
- Morning stiffness around the joint that lasts at least 1 hour.
- Arthritis of three or more joints for at least 6 weeks.
- Evidence of rheumatoid arthritis on X-rays.



# OSTEOARTHRITIS


## GOUT

- ↓ It begins at the first metatarsophalangeal joint
- ↓ Severe pain, redness and swelling, and as a result of disorders of urate metabolism that are deposited in the joint capsule

X-ray:  
Clearly limited erosion  
Sclerotic reaction  
Soft tissue shadow (urate crystals) -  
tofi urici



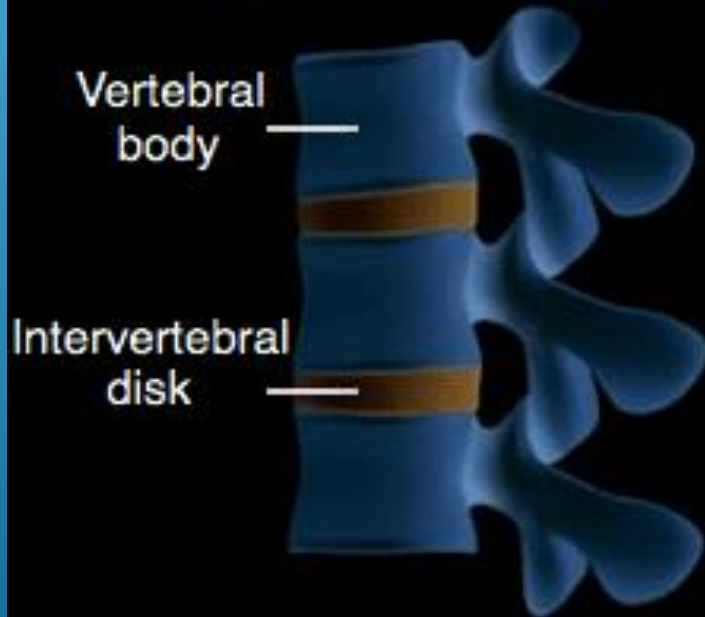
# BECHTEREW'S DISEASE

- ↓ Seronegative arthritis affecting the spinal column, affecting the ligaments
  - ↓
  - ↓ It begins with inflammation at the junction of the annulus fibrosus of the intervertebral disc with the **anterior and posterior longitudinal ligaments**, spreads into the ligaments and continues with fibrosis and ossification of the ligaments
  - ↓
  - ↓ Finally leads to **kyphosis and fixation** of the spinal column
  - ↓
  - ↓ X-ray description of the spinal cord: the appearance of a "**bamboo stick**"
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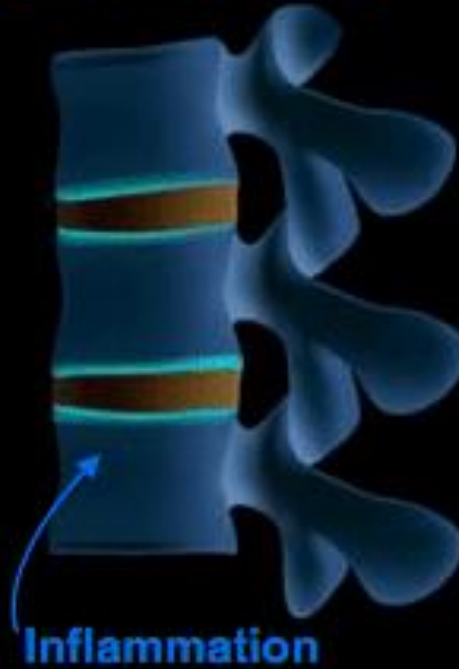


# Ankylosing Spondylitis

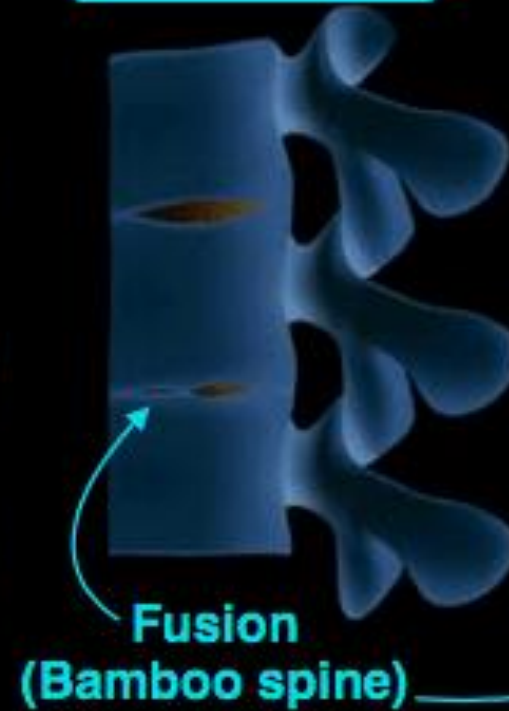
**Normal Spine**



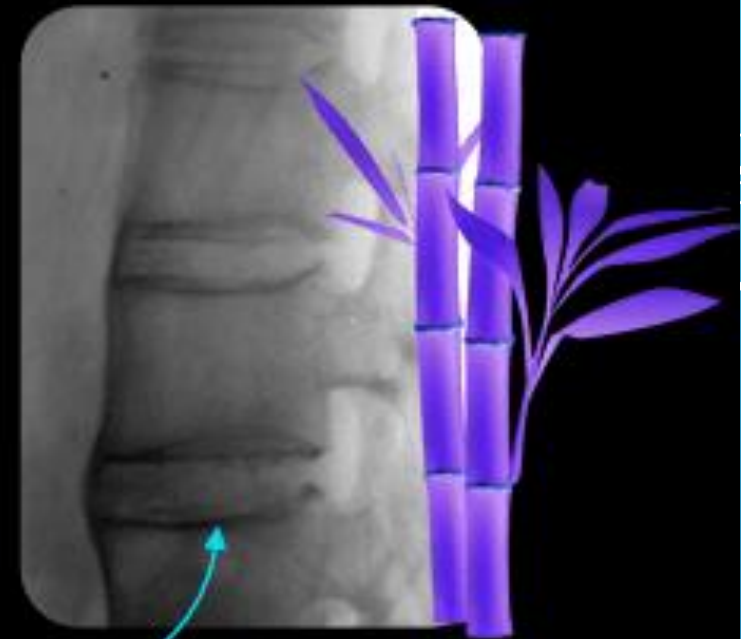
**Early Ankylosing Spondylitis**



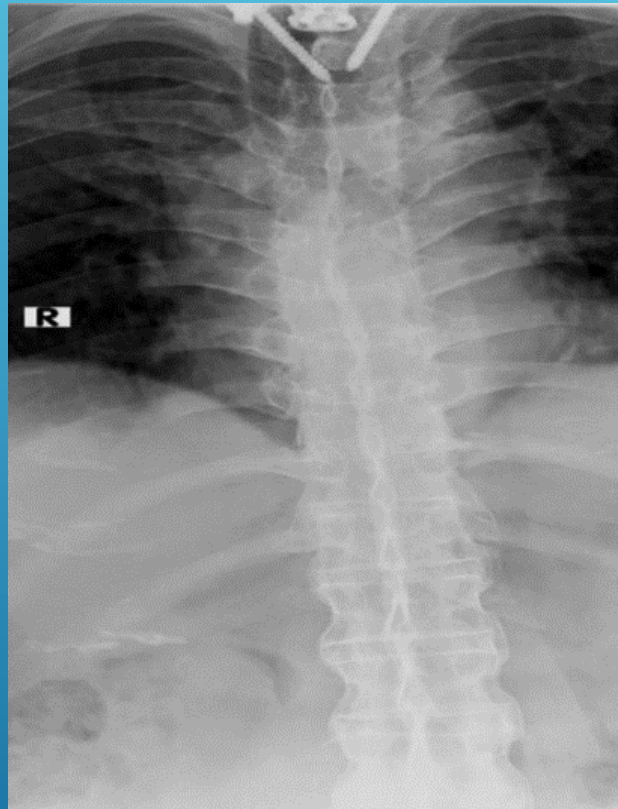
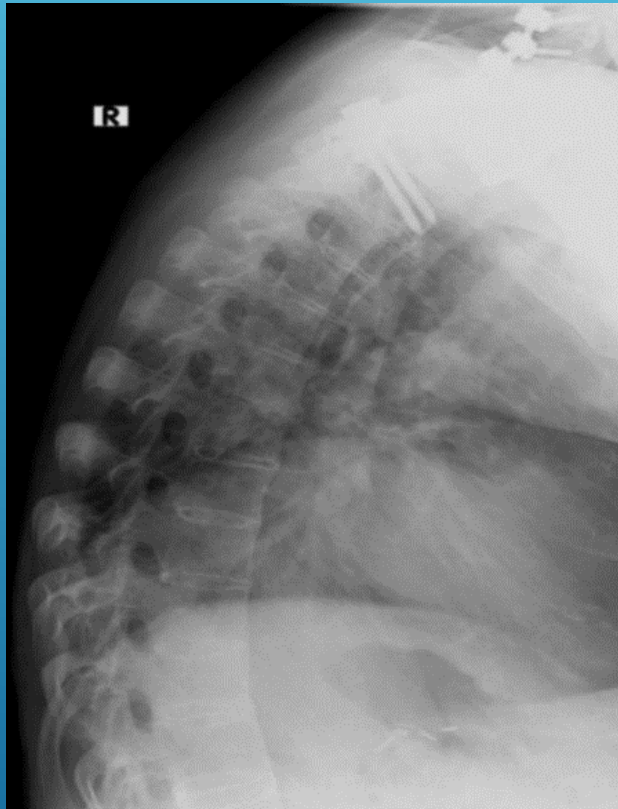
**Ankylosing Spondylitis**



**HLA-B27**



# BECHTEREW'S DISEASE



Classification of tumors	Benign	Maligant
Bone origin	Osteomas	Osteosarcoma
Cartilage origin	Chondroblastoma	Chondrosarcoma
	Enchondroma	Osteoblastoma
Origin of bone marrow		Myeloma
		Ewing sarcoma
Vascular tumor	Hemangioma	
Other connective tissue tumors	Lipoma	
	Fibroma	
Undifferentiated sarcomas	Chondroma	
	Adamantinoma	
Tumor-like lesions	Solitary bone cyst	
	Aneurysmal bone cyst	

# BONE TUMORS

## ↓ A periosteal reaction that attempts to limit the lesion

- ↓ Benign - continuous, homogeneous, discrete
- ↓ Malignant - discontinuous
- ↓ Spicular type (osteosarcoma)
- ↓ Kodman's triangle
- ↓ The appearance of "bulbs" (Ewing's sarcoma)

## Bone zone

- ↓ Epiphyseal - chondroblastoma and giant cell tumor
- ↓ Metaphysis - osteosarcoma
- ↓ Diaphysis - Ewing's sarcoma

## Ages of patients

- ↓ Before the age of 30, malignancies are more common - osteosarcoma, Ewing's sarcoma
- ↓ After the age of 30 - metastases, giant cell tumor, chondrosarcoma





- ▶ CT and MRI determine the localization and spread of the neoplasm, and may also indicate a specific diagnosis. If metastatic or multicentric tumors are suspected, radioisotope scintigraphy examines the entire skeleton.
- ▶ As a rule, a biopsy is the basis of diagnosis. The pathologist should be presented with relevant information from the medical history and radiological findings. Histopathological diagnosis is not always easy, so it is necessary to biopsy enough tissue from a representative part of the tumor.

## Differential diagnosis between Benign and Malignant Bone Tumor

items	Benign	Malignant
<b>growth</b>	Slow, compressing neightbouring tissue, no metastasis	Quick, neightbouring tissue invading, metastasis
<b>Signs of the Lesion</b>	Expansive, well-defined, thin but continue tissue	Invading, ill-defined, irregular destruction of cortex, tumor bone formation
<b>Periosteal reaction</b>	most of time (-), can be shown after pathological fracture, but no bony destruction	Different forms of periosteal reaction, can be destructed by the tumor
<b>Surrounding soft tissue</b>	No mass, well-defined if there is	Mass formation, indistinct demarcation with surrounding tissue

# BONE TUMORS

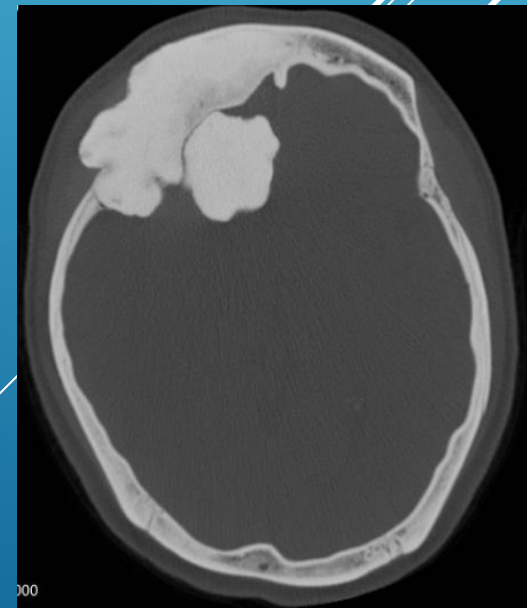
## Describing the tumor change

- ❖ The change must be compared with the normal structure
  - ❖ **Osteolytic (less intense)**- osteosarcoma, giantocellular, metastases
  - ❖ **Osteosclerotic (higher intensity)** - osteosarcoma, chondrosarcoma, fibrous bone dysplasia
- 
- ↓ Analysis of the **"transition zone"** between normal bone and change
  - ↓ Clear, thin, like a pencil drawn most likely benign
  - ↓ Broad, unclear, probably malignant
  - ↓ If sclerotic changes are described, chronic disease



# OSTEOMA

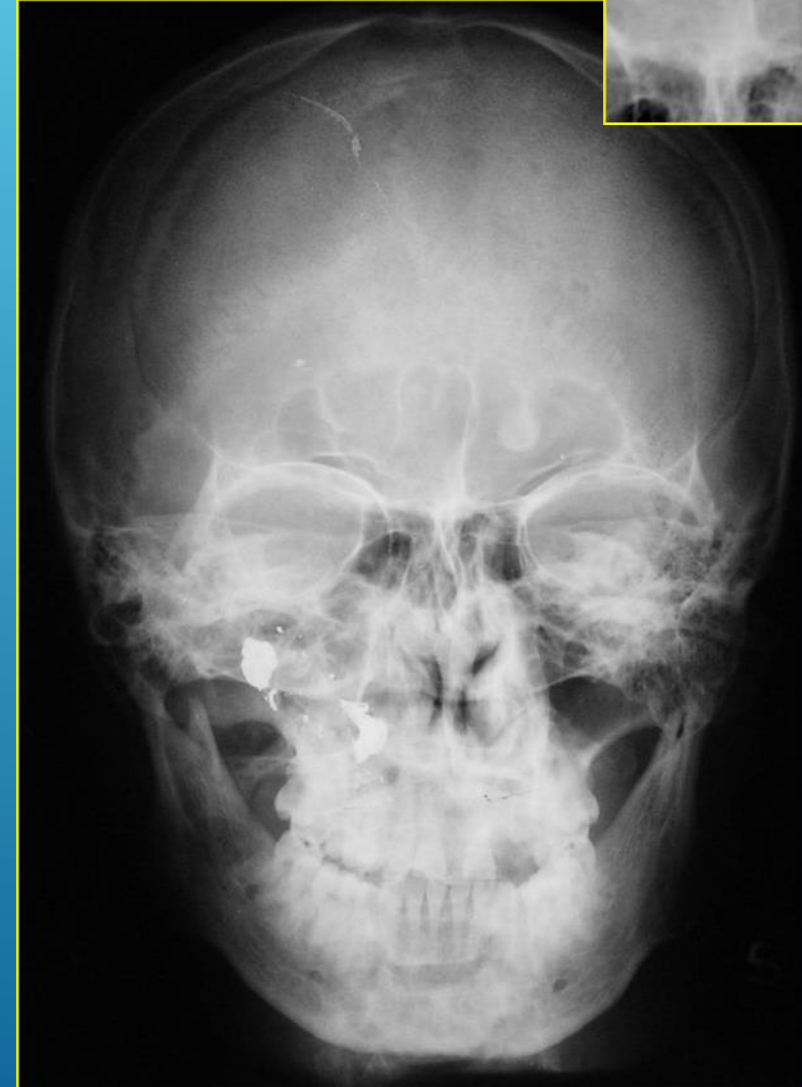
- ❖ Benign tumor of bone tissue - slow growth
- ❖ Periosteal deposition of reactive bone caused by trauma
- ❖ It doesn't recur, there's no malignant alteration
- ❖ It is formed on the surface of the bone, most often on the craniofacial bones (towards the orbit, sinuses - frontal and ethmoid, oral cavity, pelvic and pelvic area, long bones of the extremities)
- ❖ Small - asymptomatic
- ❖ Major – symptoms due to local growth: painful swelling, headache, sinusitis, exophthalmos, visual disturbance



## OSTEOMA

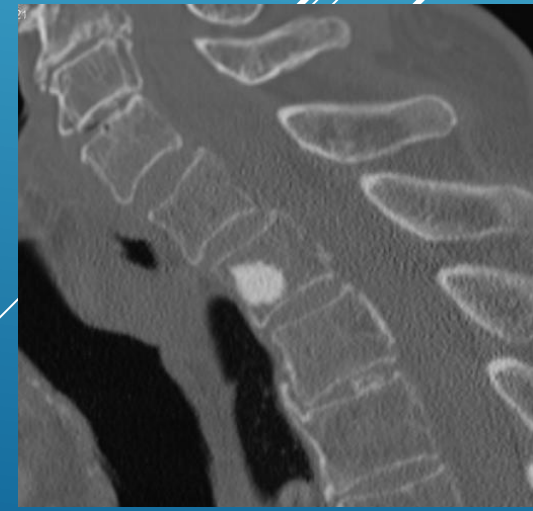
The lesion is confined to the parts of the bone produced by the periosteum.

- ❑ Radiography :
- ❑ Solitary or multiple foci of **osteosclerosis** - protrusion into the sinus or rising from the edge of the bone from which they originated.
- ❑ contours smooth or lobulated, homogeneous in structure appearance – stationary for years
- ❑ periosteal osteomas - on the cortical surface of the clavicle, scapula and tubular bones



# ENOSTOSIS (*INSULA COMPACTA*, BONE ISLAND)

- ↓ Equally in men and women of all ages
- ↓ It occurs predominantly on the **pelvis, proximal femur and ribs**
- ↓ Radiography: solitary or multiple **sclerotic zones** with a discrete margin, round or oval in shape.
- ↓ Differential diagnosis: osteoma, osteoid osteoma, enchondroma, bone infarction, fibrous dysplasia



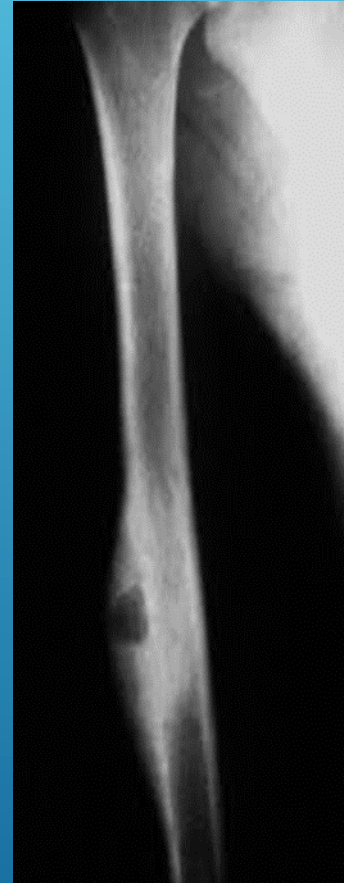
# OSTEOID OSTEOMA

- ◉ Benign osteoblastic tumor with a histological abnormality that manifests as a central nucleus of vascular osteoid tissue and the peripheral zone of sclerotic bone.
- ◉ M > F, age: 10-30 years
- ◉ Predilection site: diaphysis of long tubular bones
- ◉ Clinical finding:
  - ◉ - localized pain, intense, especially at night, passes to salicylates (aspirin) because the tumor is increasingly synthesized prostaglandins;
  - ◉ - Developing skeleton: bone hypoplasia – shorter limb, deformation of the skeleton in the form of torticollis and scoliosis, muscle atrophy, and slow growth



# OSTEOID OSTEOM

- 
- Radiography: centrally localized oval or round zone of reduced bone density, less than 1 cm in diameter, surrounded by a zone of homogeneous sclerotic bone
- TH: monitoring of change; radical surgical excision
- Recurrences: rare after surgical treatment, no malignant alteration





# NONOSSIFYNG FIBROMA

- Age: 10 -20 years
- Predilection sites:
- **bones of the facial massif (face and jaw)** – a slow-growing tumor, well limited, covering a larger area;
- Clinical finding - painless expansive change at the site of the tooth root in the mandible, less often in the maxilla.
- X-ray - well-defined uni or multilocular zone of osteolysis with varying degrees of calcification.

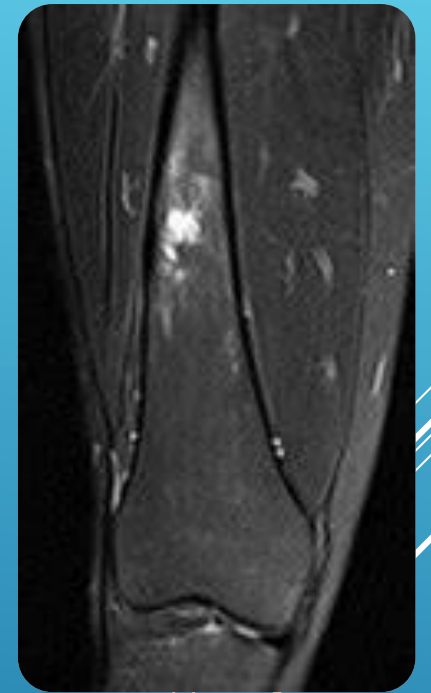


Ossifying fibroma, axial CT images obtained in two different patients show well-defined, locally expansile, sharply margined lesions with predominantly ground-glass attenuation, the presence of a narrow zone of transition (arrows) helps differentiate ossifying fibroma from fibrous dysplasia



# NONOSSIFYING FIBROMA

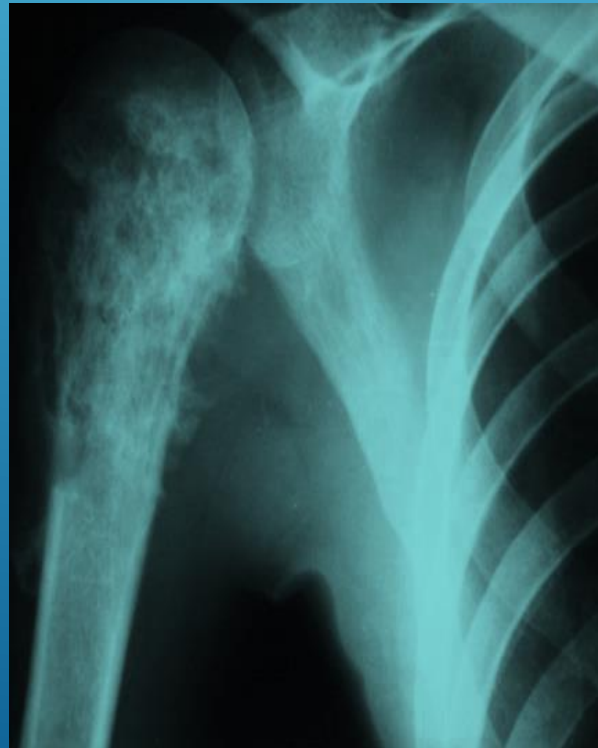
- ⦿ Long tubular bone-localization on the diaphysis is typical, the middle third of the anterior side of the bone.
- ⦿ Sometimes the first symptom is a pathological fracture / pseudoarthrosis.
- ⦿ Radiography : intracortical osteolytic lesion, well delimited by sclerotic bone, appearance of multiple bubbles ("bubble-like areas")
- ⦿ Diagnosis : radiological
- ⦿ Good prognosis, possible spontaneous regression



# BONES TUMOR OSTEOSARCOMA

- ↓ The most common bone malignancy
- ↓ It usually occurs by the age of 30, and the second peak is in the sixth decade
- ↓ Predilection sites are the metaphysis of the tibia, femur and humerus
- ↓ There is pain that intensifies at night and swelling

- OSTEOLYSIS
- SCLEROSIS ZONE
- PERIOSTEAL REACTION (SPICULES, KODMAN'S TRIANGLE)



# BONE TUMOR

## CHONDROSARCOMA

- ↓ It occurs in the 4th and 5th decade, on any cartilaginous localization, most often on the extremities and pelvis
- ↓ It is not aggressive, swelling and deformation can persist for years
- ↓ The tumor mass deforms the bone and grows extrasensory with "pop corn" calcifications



# BONE TUMORS

## EWING'S SARCOMA

- ↓ In **younger people**, more often **men**
- ↓ The predilection site is the diaphysis of long bones, histologically it is made of tiny round cells
- ↓ It is characterized by pain and swelling
- ↓ Difficult to distinguish from osteomyelitis

- OSTEOLYSIS
- PRELIMINARY REACTION BY BULB TYPE



# BONE TUMORS

## OSTEOCLAST

- ↓ A gigantic cell tumor, occurs in childhood, benign in nature, but can malignantly alter
- ↓ Pain, swelling and frequent pathological fractures
- ↓ Localization is mainly around the knee, distal radius and sacrum

- Osteolysis zone, directly adjacent to articular cartilage - metaphysis
- There is no transition zone





# BONE TUMOR METASTASIS

- ↓ The most common primary tumors are from the prostate, breast and lungs
- ↓
- ↓ Pain, swelling and pathological fractures
- ↓
- ↓ Axial skeletal metastases are more common
- ↓
- ↓ They can be osteolytic and osteoblastic (prostate cancer)
- ↓
- ↓ 90% of osteolytic changes are metastases
- ↓ Skeletal scintigraphy (SPECT) is the method of choice



# METASTASIS

- ◉ In third place, after the lungs and liver.
- ◉ Most often in the bone metastasize - Ca breast, prostate, kidney, lung and thyroid gland.
- ◉ They are spread by the hematogenous route
- ◉ 1 . Through the vena cava (cavalry type) – the primary filter is the lungs;
- ◉ 2 . Through the portal vein (primary filter liver; others are the lungs; Tu GIT);
- ◉ 3 . Through the pulmonary veins (filters, capillaries of the large bloodstream)
- ◉ 4. or, more rarely, per continuity, by the direct propagation of the process from the surrounding

# SECONDARY MALIGNANT BONE TUMORS

- ◉
- ◉ They are not in the bones of the hands and feet
- ◉ Radiological division:
  - ◉ Osteolytic (Ca, kidney, adrenal, thyroid, Ewing's sarcoma)
  - ◉ Osteoblastic (Ca prostate)
  - ◉ Mixed (Ca lung and breast)
- ◉ In children – retinoblastoma, neuroblastoma, rhabdomyosarcoma

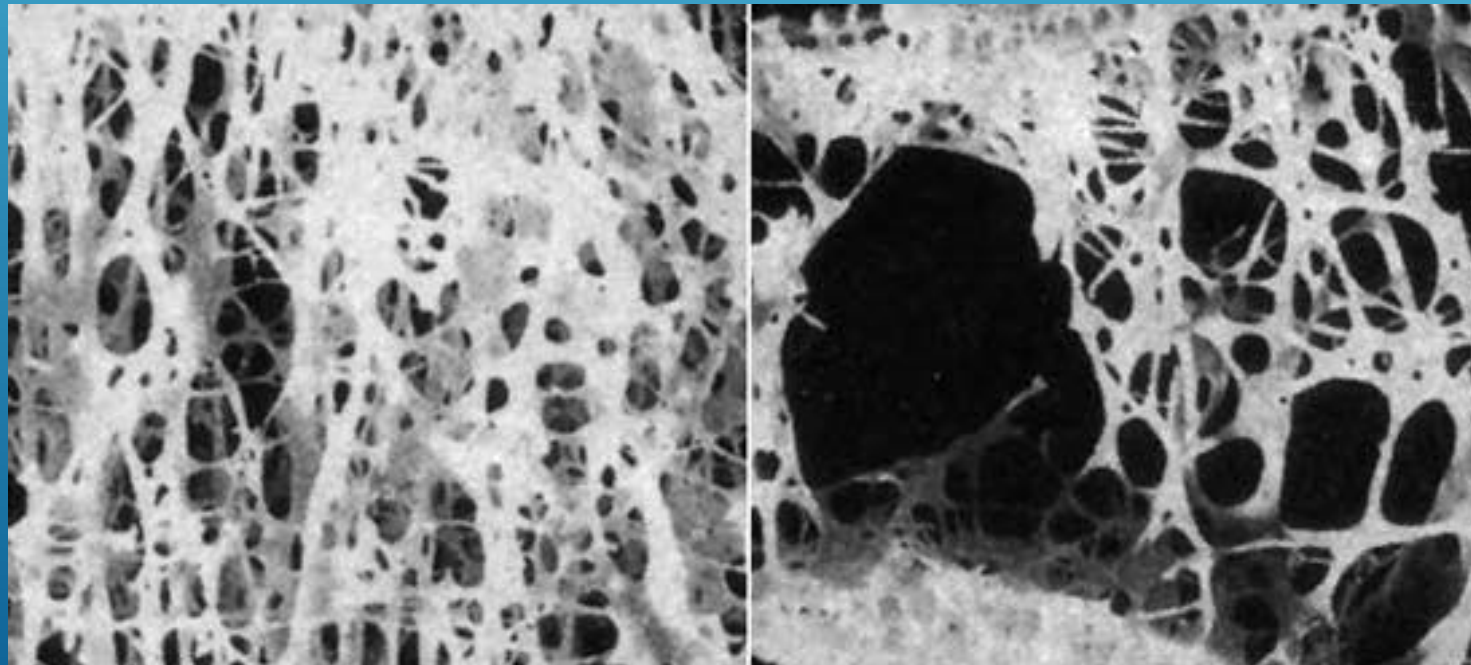


# METASTASIS



# METABOLIC DISEASES OF THE BONE

- ▶ They are related to osteogenesis and the metabolism of calcium and phosphorus, which are regulated by the parathyroid gland, vitamin D and kidney



# METABOLIC DISEASES OF THE BONE

## OSTEOPOROSIS

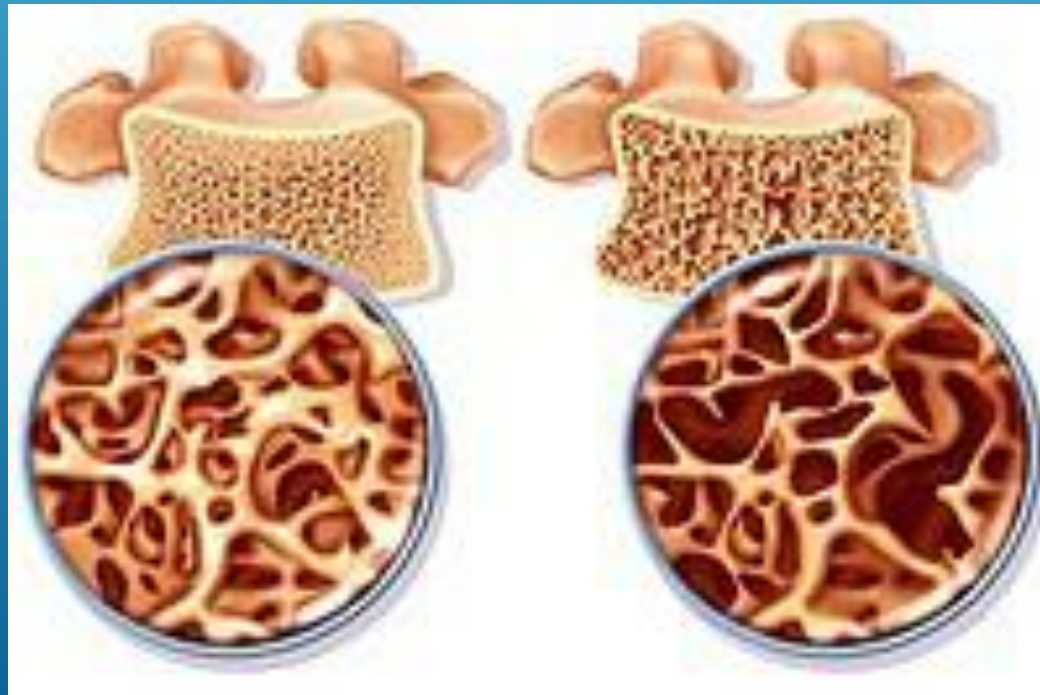
- ▶ Reduction of bone (matrix and calcium) in proportional relation
- ▶ Usually in menopausal women and men in later years
- ▶ Densimetry of 2.5 SD less than normal bone density in healthy adults of the same age
- ▶ Bones are weak, porous, prone to fractures



# METABOLIC DISEASES OF THE BONE

## OSTEOPOROSIS

- ▶ Most often, the consequences are seen on the spinal column, a decrease in the vertical diameter of the vertebral body with fractures
- ▶ The most common cause of fracture of the neck of the femur and humerus is

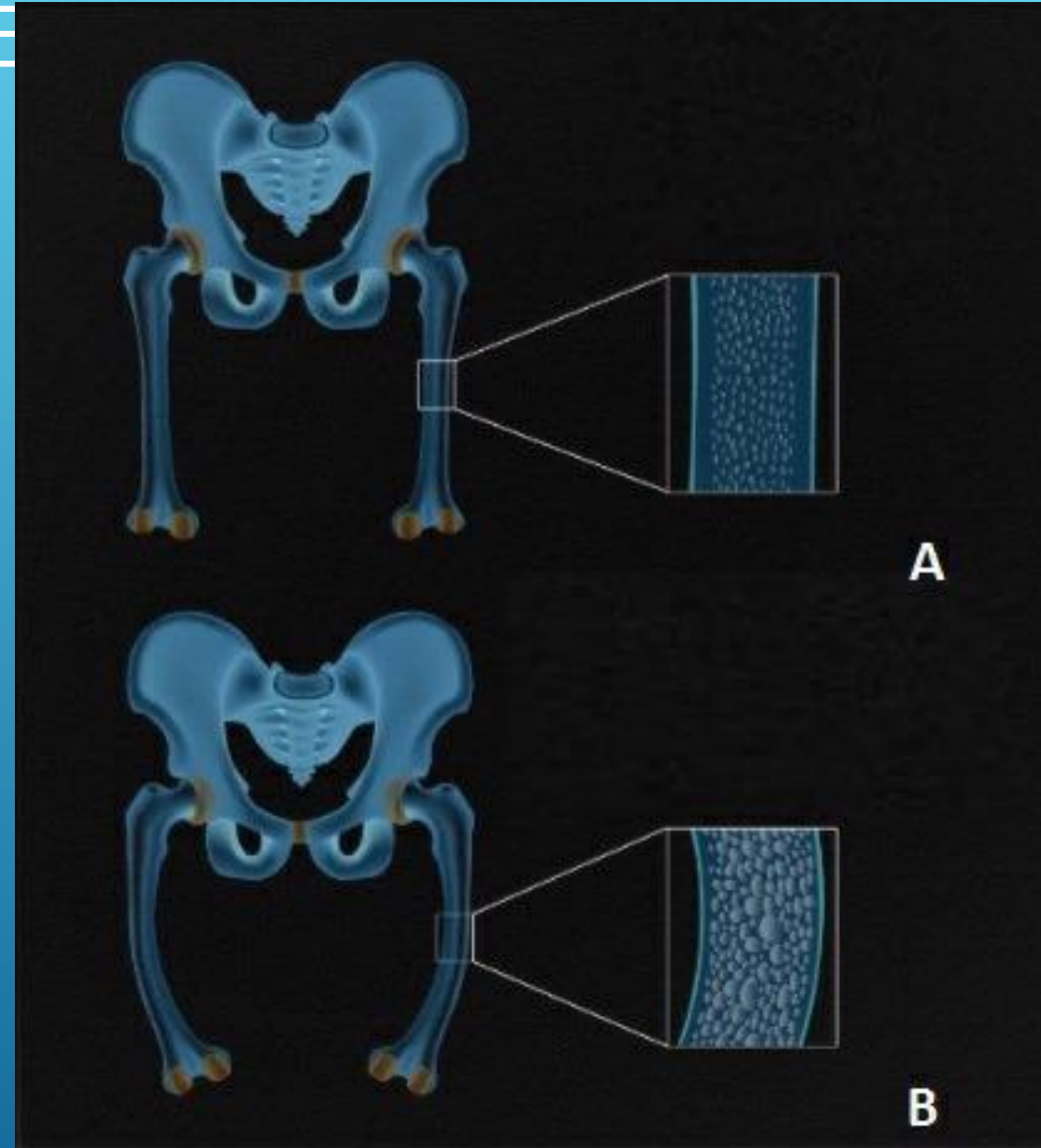


Loss of trabecular structure

# METABOLIC DISEASES OF THE BONE










## OSTEOMALACIA

- ▶ Osteomalacia occurs due to defective mineralization of bones during formation, or the release of calcium from formed bones. The bone matrix is normally created and maintained in both cases. **SOFTENING BONES**
- ▶ It occurs in extreme malnutrition (reduced calcium intake and bone mineralization), pregnancy, renal weakness, hyperparathyroidism



# METABOLIC DISEASES OF THE BONE

- ▶ Osteoporosis loss of both bone matrix and calcium in the elderly population.
- ▶ Osteomalacia is the inability to store calcium in the bones. Normally, a matrix of bone is formed. A lack of vitamin D causes it.
- ▶ -Children rickets
- ▶ -Adult osteomalacia

		Osteoporosis	Osteomalacia
Definition	 <p>Normal</p>	 <p>Bone mass decreased, mineralization normal</p>	 <p>Bone mass variable, mineralization decreased</p>
Age at onset	 <p>Generally elderly, postmenopause</p>	 <p>Any age</p>	
Etiology	Endocrine abnormality, age, idiopathic, inactivity, disuse, alcoholism, calcium deficiency	Vitamin D deficiency, abnormality of vitamin D pathway, hypophosphatemic syndromes, renal tubular acidosis, hypophosphatasia	
Symptomatology	 <p>Pain referable to fracture site</p>	 <p>Generalized bone pain</p>	
Signs	Tenderness at fracture site	Tenderness at fracture site and generalized tenderness	
Radiographic features	 <p>Axial predominance</p>	 <p>Often symmetric, pseudofractures, or completed fractures</p> <p>Appendicular predominance</p>	
Laboratory findings	Serum $\text{Ca}^{++}$ Serum $\text{P}_i$ Alkaline phosphatase Urinary $\text{Ca}^{++}$ Bone biopsy	Normal Normal $\text{Ca}^{++} \times \text{P}_i > 30$ Normal High or normal Tetracycline labels normal	Low or normal (high in hypophosphatasia) Low or normal $\text{Ca}^{++} \times \text{P}_i > 30$ if albumin normal (high in renal osteodystrophy) Elevated, except in hypophosphatasia Normal or low (high in hypophosphatasia) Tetracycline labels abnormal

# METABOLIC DISEASES OF THE BONE

## RICKETS

- ▶ Osteomalacia in children (4-18 months of age) due to a lack of vitamin D, which regulates the absorption of calcium from the digestive tract and its deposition in the bones
- ▶ Bones become soft and pliable
- ▶ The Disease of Lower Social Conditions
- ▶ It develops on the fastest-growing joints: the knee, elbow and the anterior edges of the ribs

ENLARGED EPIPHYSEAL PLATES  
DECREASED BONE INTENSITY  
BONE BENDING  
OSTEOPHYTIC THORNS





# METABOLIC DISEASES OF THE BONE

## PAGET'S DISEASE

- ▶ Unknown etiology, more common in Europe
- ▶ Defective bone regeneration, uncontrolled osteoblastic activity, which is not manifested by the lamellar arrangement of the beds, but are chaotic
- ▶ Fractures and arthritis of the surrounding joints

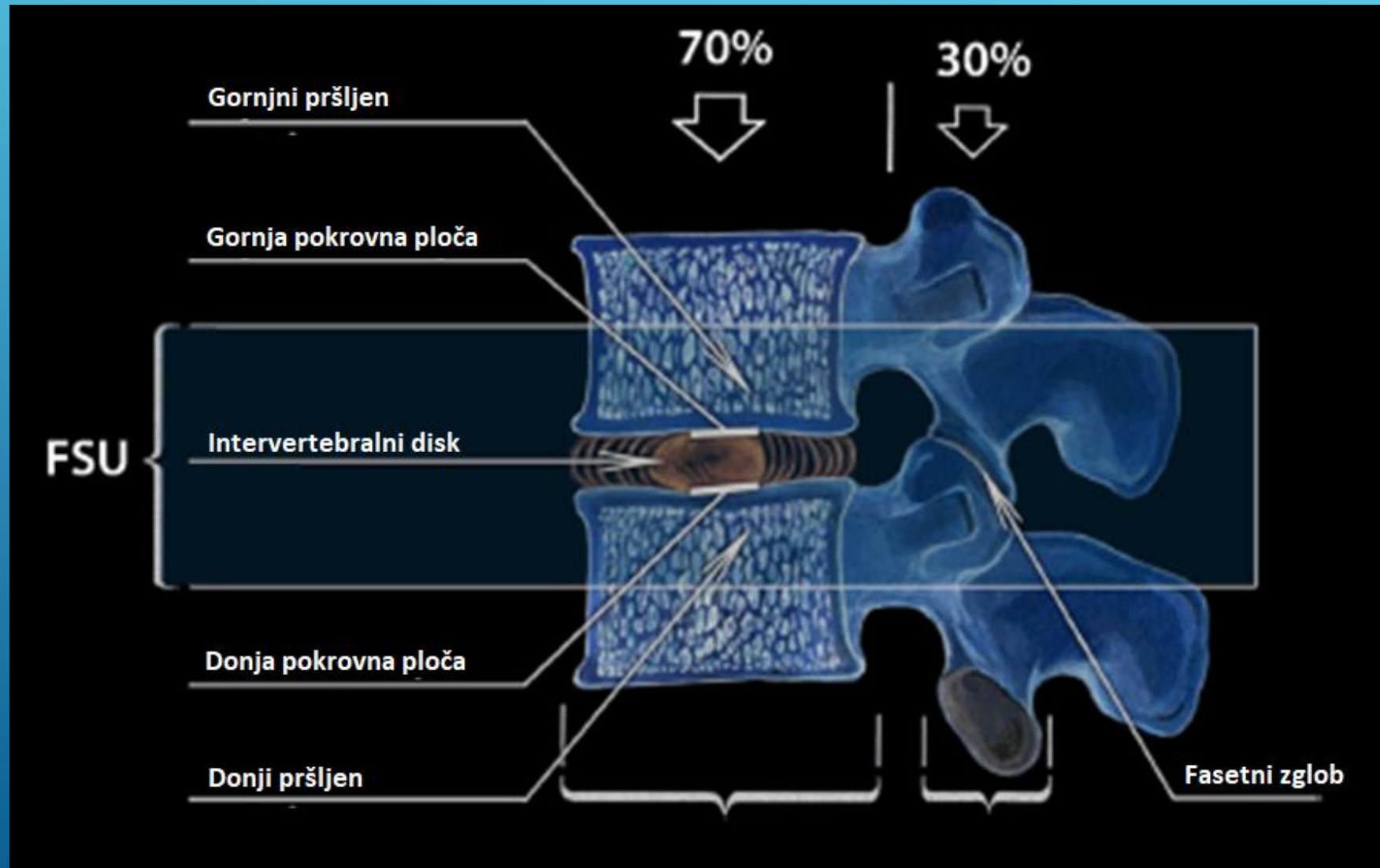


- BONE THICKENING
- ZONES OF OSTEOLYSIS AND OSTEOLASTIC ACTIVITY ALTERNATE

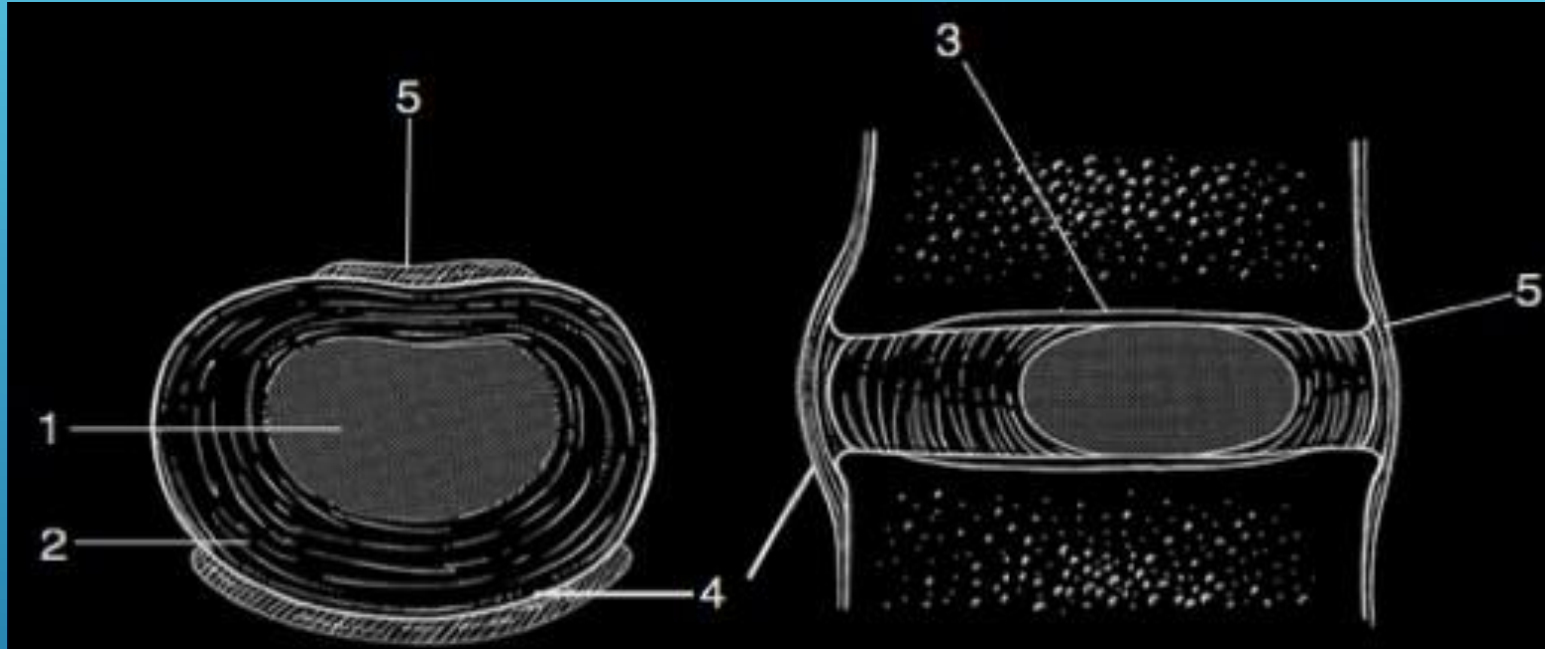




# DEGENERATIVE CHANGES OF SPINE



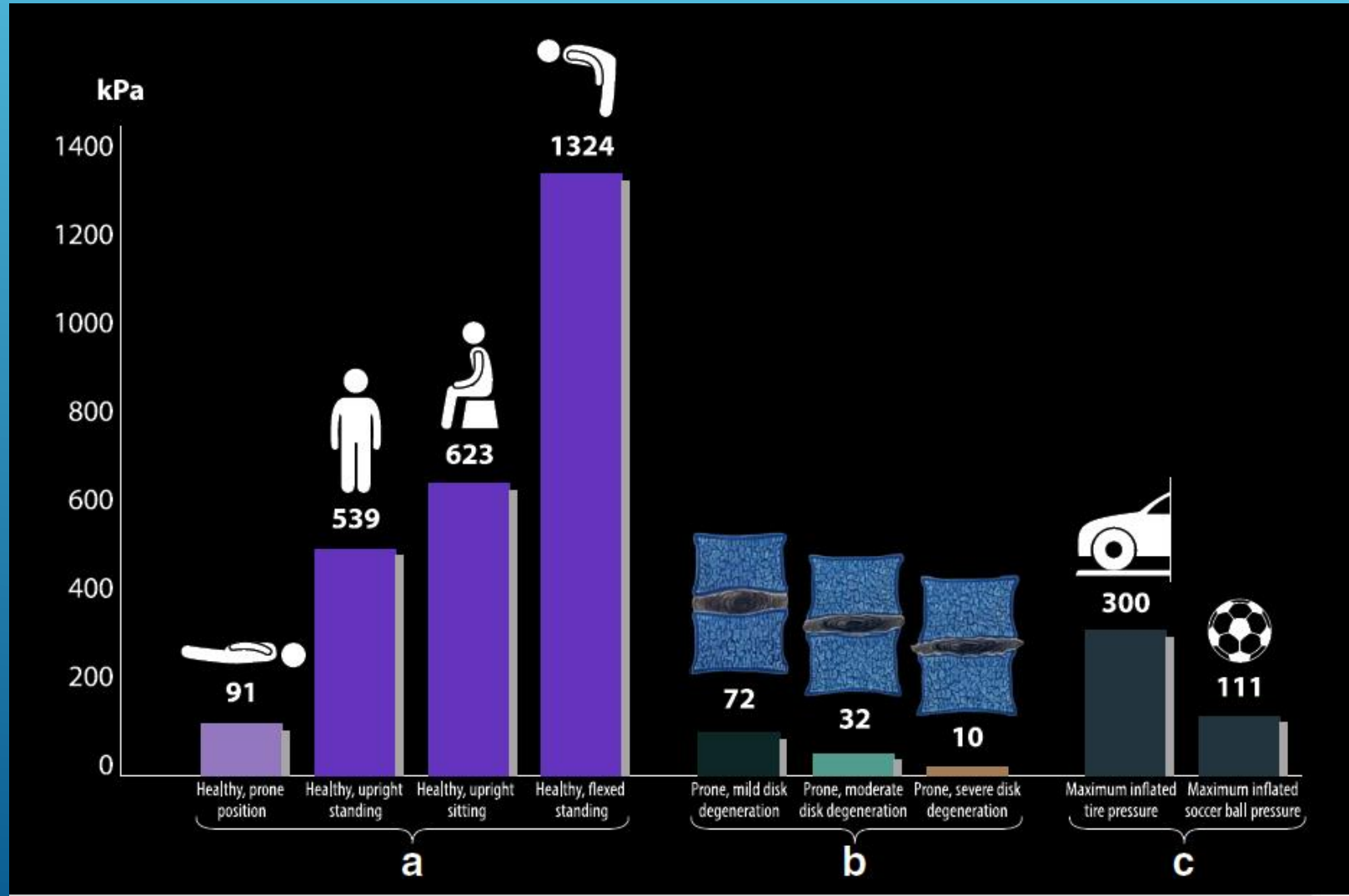
# DEGENERATIVE CHANGES OF SPINE



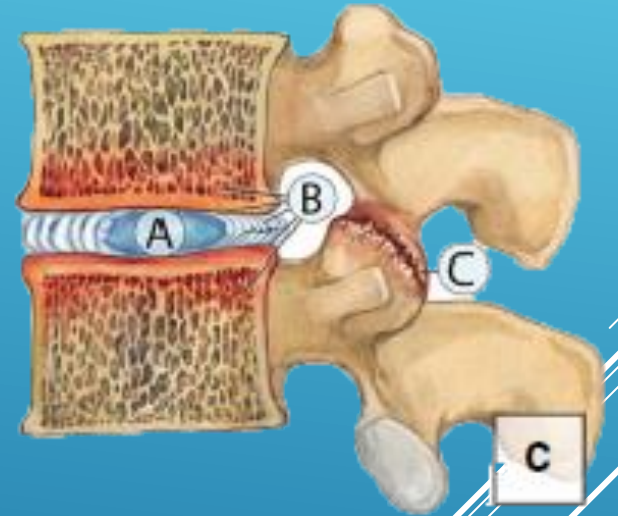
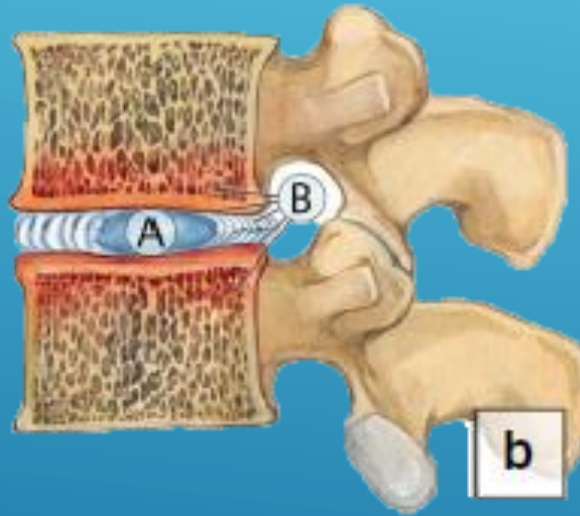
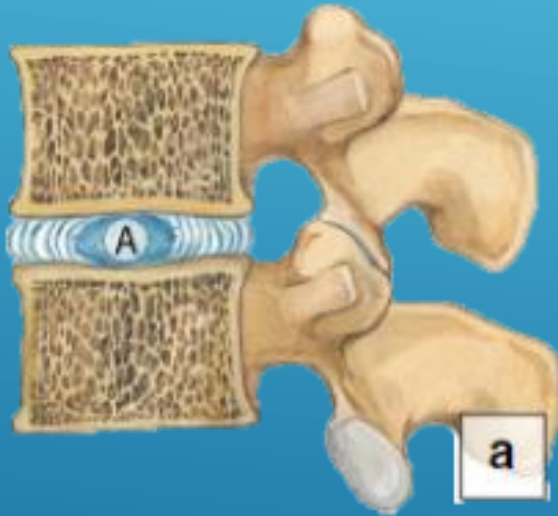
Intervertebral disc:

- 1 . Nucleus
- 2 . Annulus
- 3 . Cartilage cover plate
- 4 . Anterior longitudinal ligament
- 5 . Last longitudinal ligament

# DEGENERATIVE CHANGES OF SPINE



# DEGENERATIVE CHANGES OF SPINE



Due to abnormal mechanical axial stress combined with heredity, age, inadequate metabolic transport, and trauma



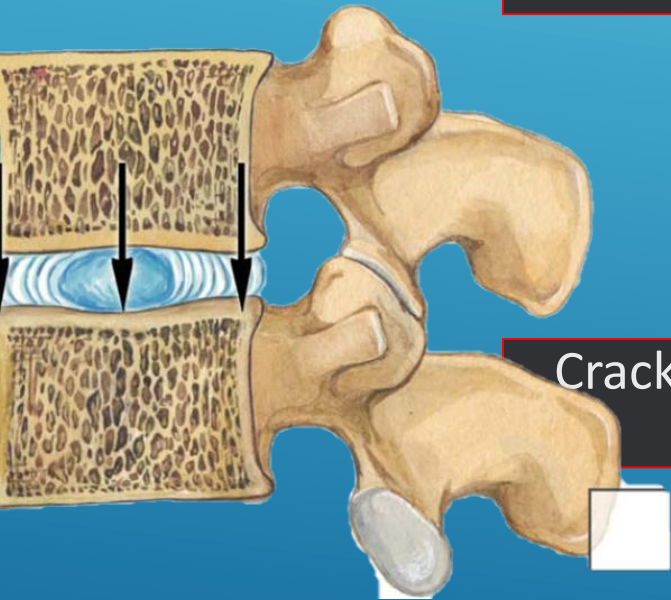
Degeneration of chondrocytes and pulposus nuclei



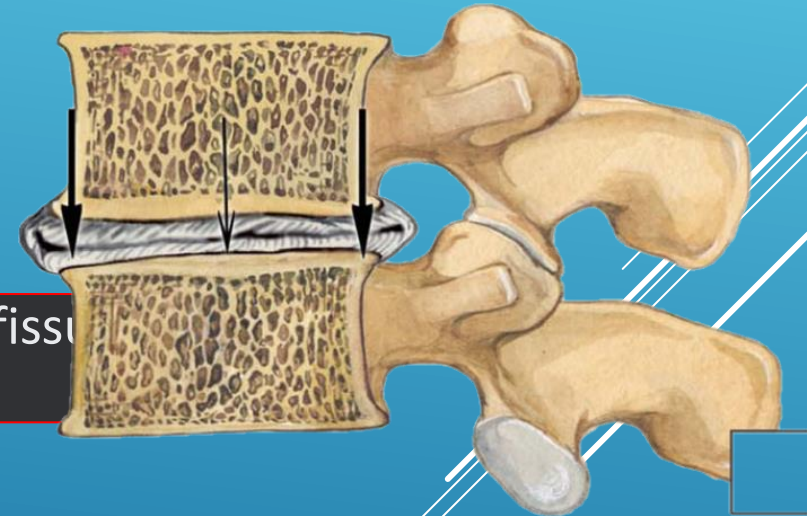
With the progression of degeneration, the interdiscal pressure decreases, shifting the load to the annulus fibrosus



With the progression of degeneration, the interdiscal pressure decreases, shifting the load to the annulus fibrosus



Cracks and cavitations develop, gradually leading to fissures and clefts



Herniated disc

Instability and/or  
spondylolisthesis

