

جَائِزَةُ الْحُسَيْنِ
بْنِ عَبْدِ اللَّهِ الثَّانِي
لِلْعَمَلِ التَّطَوُّعِيِّ

AL HUSSEIN BIN ABDULLAH II
AWARD FOR VOLUNTARY WORK



النادي الطبي
Medical Club



Radiology

Subject: MUSCULOSKELETAL SYSTEM

Group no: D11

Done by: Hala Yaseen



هَذَا خَلَقَ اللَّهُ فَأَرْوَاهُ مَاذَا خَلَقَ الذِّينَ مِنْ دُونِهِ بَلِ الظَّالِمُونَ فِي ضَلَالٍ مُبِينٍ

MUSCULOSKELETAL SYSTEM



رَبِّ الشَّح لِي مَدْرَب
وَيَسَّرْ لِي أَمْرِي

Dr Bilal Al-Badayneh, MBBS, JBR
Neuro and MSK radiologist

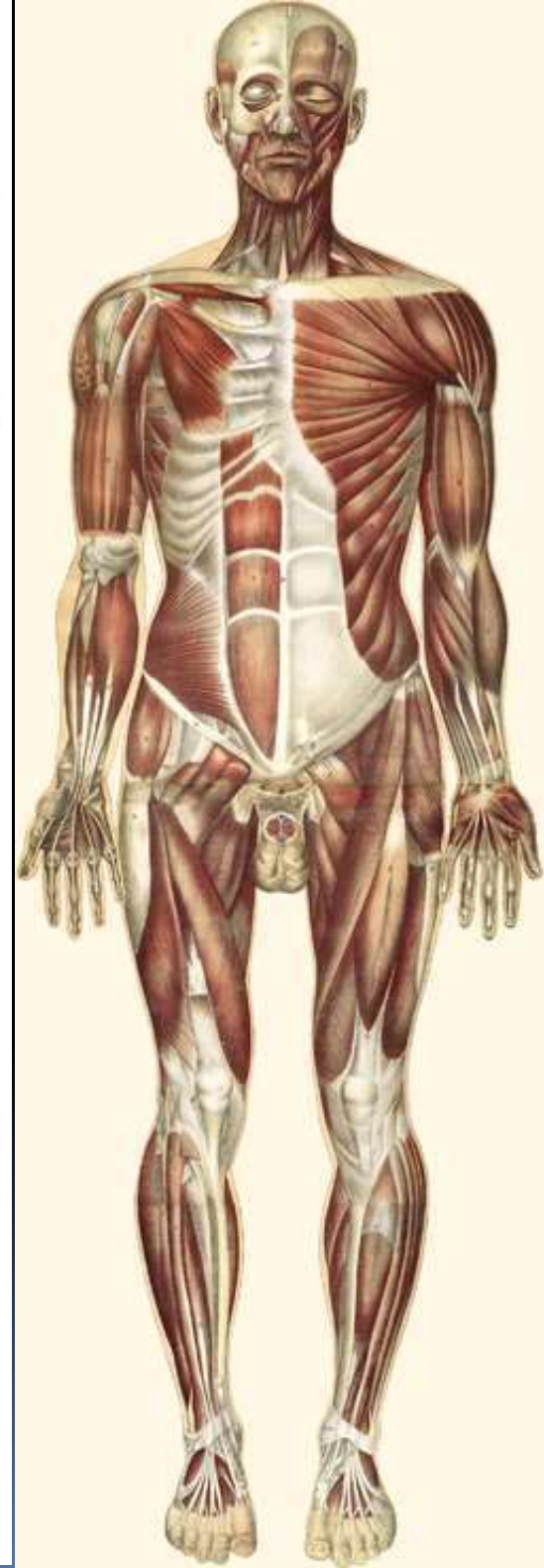
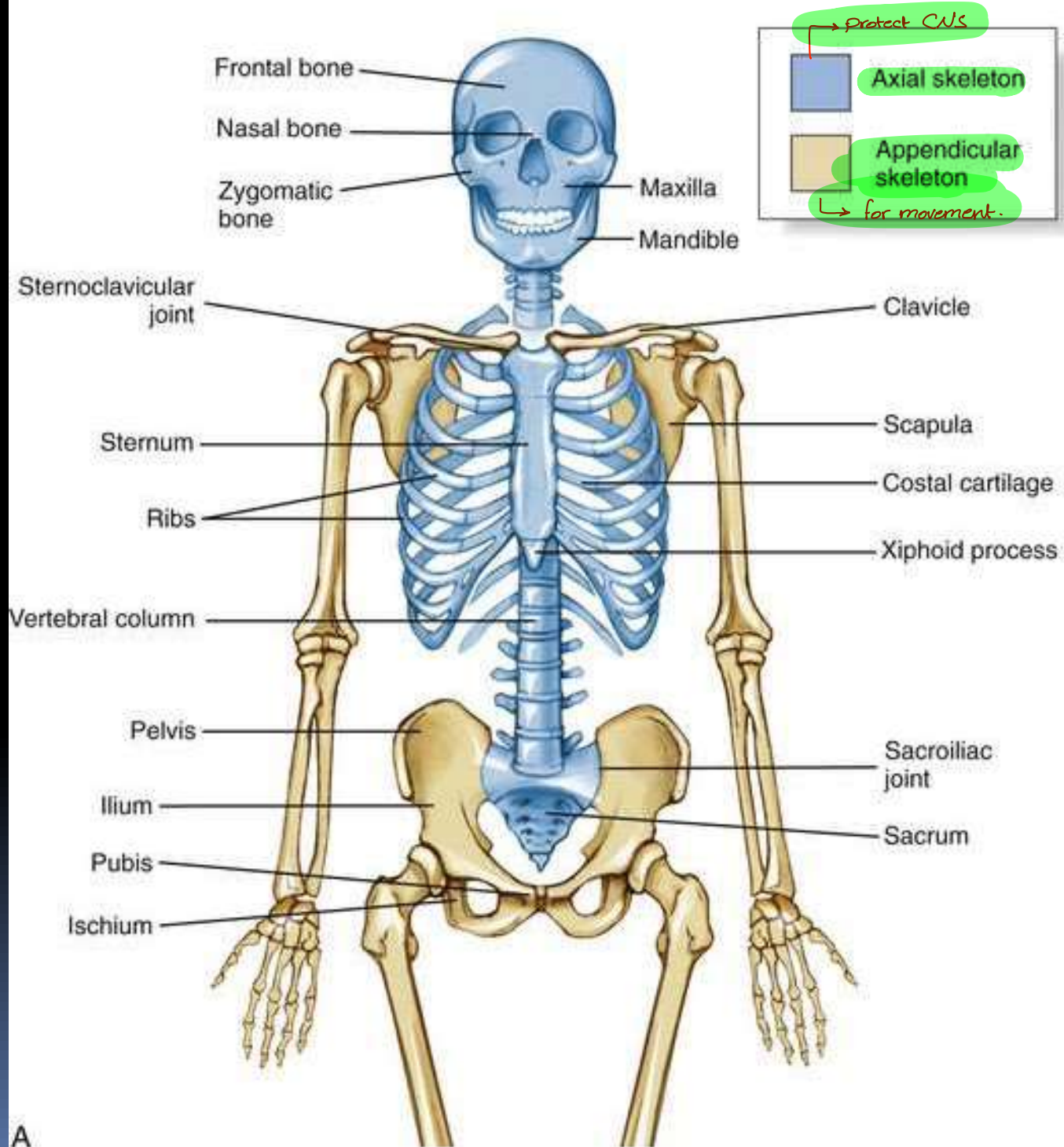
❑ What is the musculoskeletal system ?

→ skin + SC fat

Is all of the bones in the body and the associated tissues such as muscles, tendons, ligaments and cartilage that connect them.

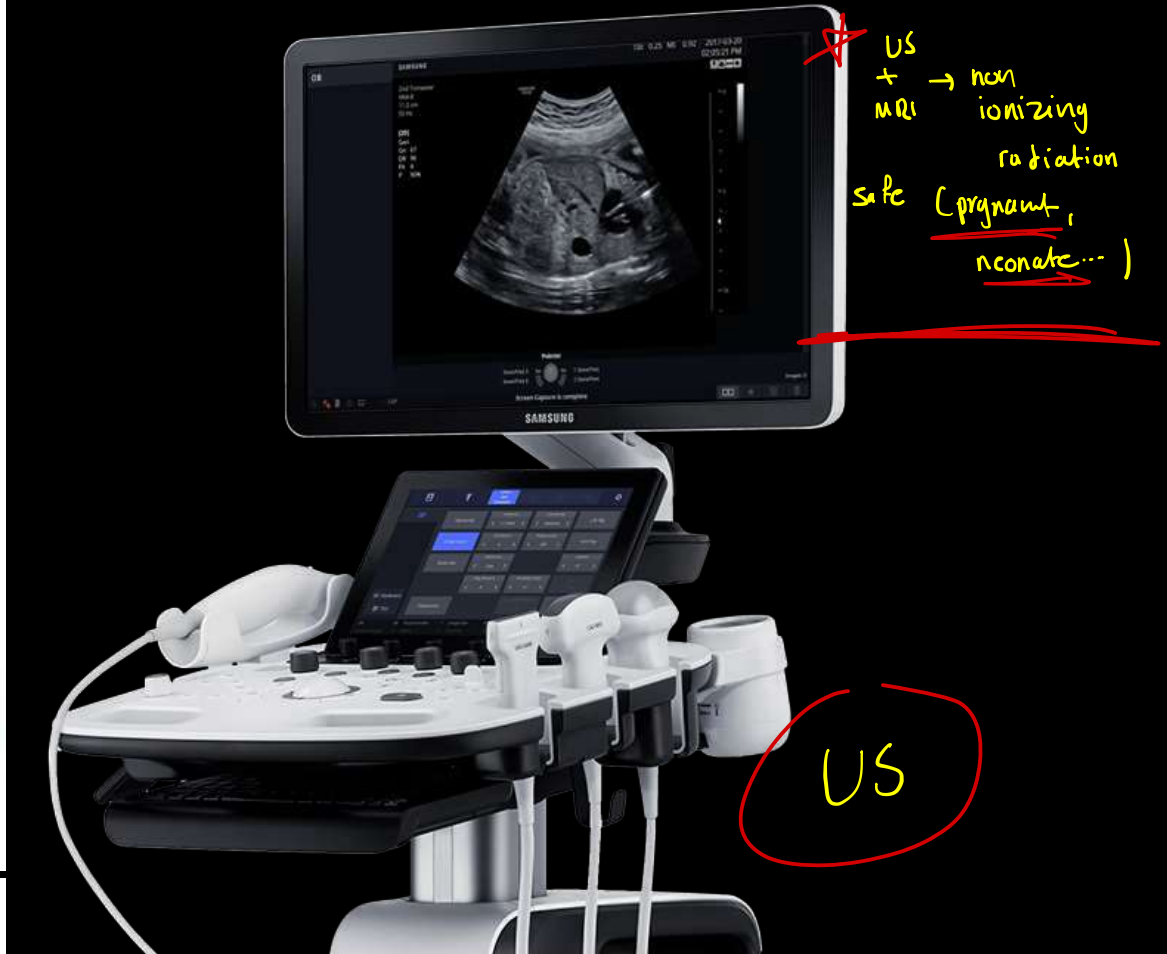
❑ The average adult human skeleton has around 206 bones.

206





x-ray



US
+ MRI → non ionizing
safe radiation
(pregnant,
neonate...)

US



CT scan

CT scanner



MRI

it has major rule in appendicular system but minor rule in axial system bc: ✱

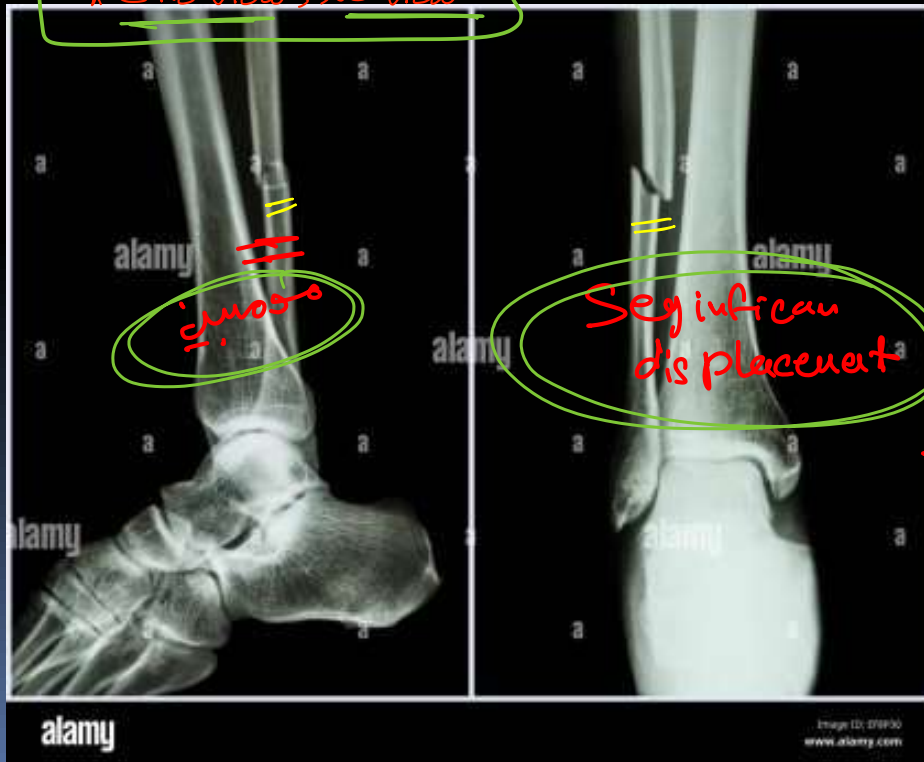
Imaging modalities

Plain film: (fracture, bony lesion, Calcification) + deformity. ✱

- ↑ overlap ✓
 - Complex bone ✓
 - it covers vital organ (brain, spinal cord) ✓
- واضحة لدرجة التعرف على عضو حيوي لو فيه
Fracture، الونى مثلا Hemorrhage
قد يكون غير واضح X-ray

- ✱ Plain films still remain the mainstay of radiological investigation of the skeletal system.
- ✱ views should always be obtained in two projections.

✱ One view, No view.



✱ take 2 adjacent Joints
✱ Take 2 views.
✱ (view no view)



* using linear Probe

Ultrasound : minor rule

DDH
خلع الورك

(X-ray after 3 month)

✓ neonatal hip for congenital dislocation

✓ soft tissue lesions and abscesses.

✓ joint effusions

Muscular and tendinous tears

Femoral head

Still

US
Cartilaginous

2week

Ossification of Femoral head

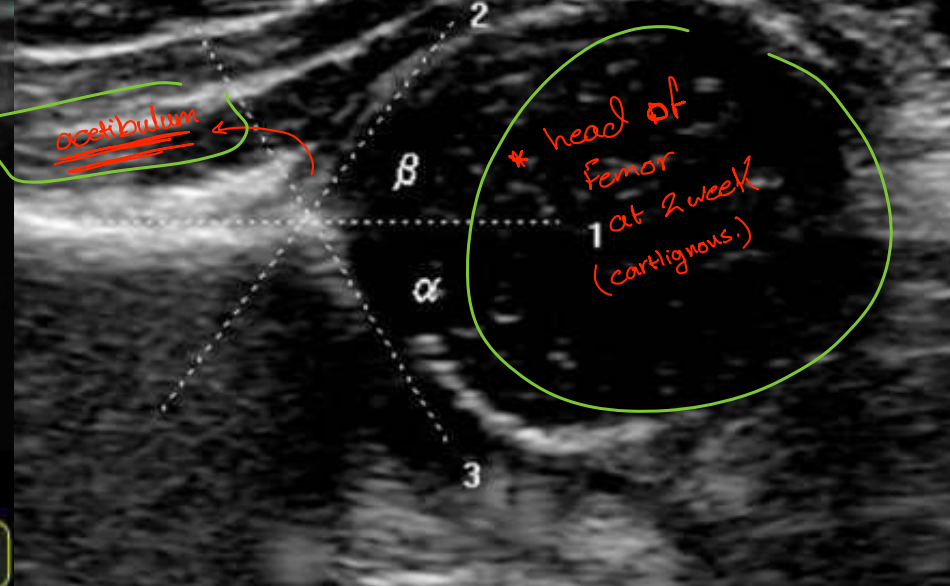
قبل بقاء العظم بنسخته

الحالة بعد 1 year ← بعد سنة السجيرة

DDH خلع ورك
* كل طفل لازم
* Pelvis x ray

1 Rt Beta 55 deg
Rt Alpha 60 deg

فترة بتعطيل
حالة الخلع
Conservative
باستخدام الطريقت
المعروف



HGHED US

* for bony assessment
CT is the best in both axial + appendicular.

CT is very helpful in :

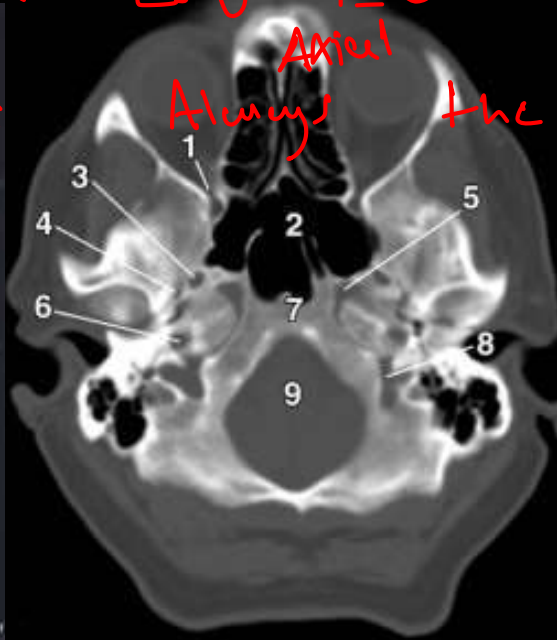
- CT is the best, but in appendicular skeleton, x-ray is enough.
- in axial skeleton, CT is mandatory.

- Assessment of bone tumours prior to surgery.
- evaluation of certain fractures, such as the acetabulum, spine and calcaneus.
- study of the vertebral column.

⌘ back pain + filling down → x-ray (-) is (no enough, Lb)
A x-ray skeleton

X ray → enough ✓

CT is always the best ✓



∴ bone marrow edema → best via MRI STIR.

The best
for soft
tissue.

MRI / Skeletal system ⇒ Major / Soft

❖ MRI assists the investigation of bone tumours, soft tissue masses and joint.

appears like
Soft tissue
component.

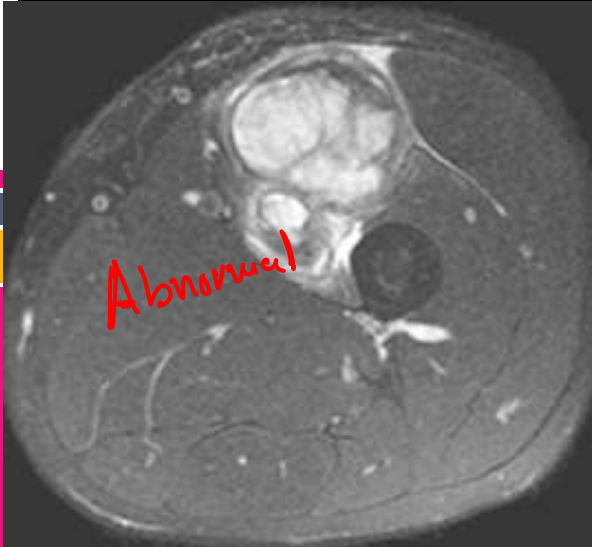
→ MRI

❖ MRI is extremely sensitive in injuries to cartilage, muscle, ligaments, menisci and tendons.

most pathology
↓
Soft tissue
↓
most
↓
MRI

bone

✓ Bone marrow → soft tissue → MRI
✓ (Joints) → MRI best modalities.



X ray
bone

[]

Osteoarthritis

Weight bearing joints

Primary:
* aging process
life style حسب ال
في ناس بيش قبل
80 - 60

(degenerative joint disease)

- Is a degenerative condition affecting the articular cartilages and subchondral bone. hip ✓ knee
- Is part of the normal aging process. كناز = طبيعي
- (Secondary osteoarthritis) results from previous trauma and joint infection.
- Any joint may be affected, but the knees, hips, and shoulders are frequently involved. ↓
Weight bearing (Abbiad)



Osteoarthritis / 2

Weight bearing
X-ray

best initial
modality.

The
best
&
CT

(Osteophytes)

إذا فلتت عن العظم
بغير أسسها

* loose body

bone
over
growth

إذا العظم بزيادة
ال load

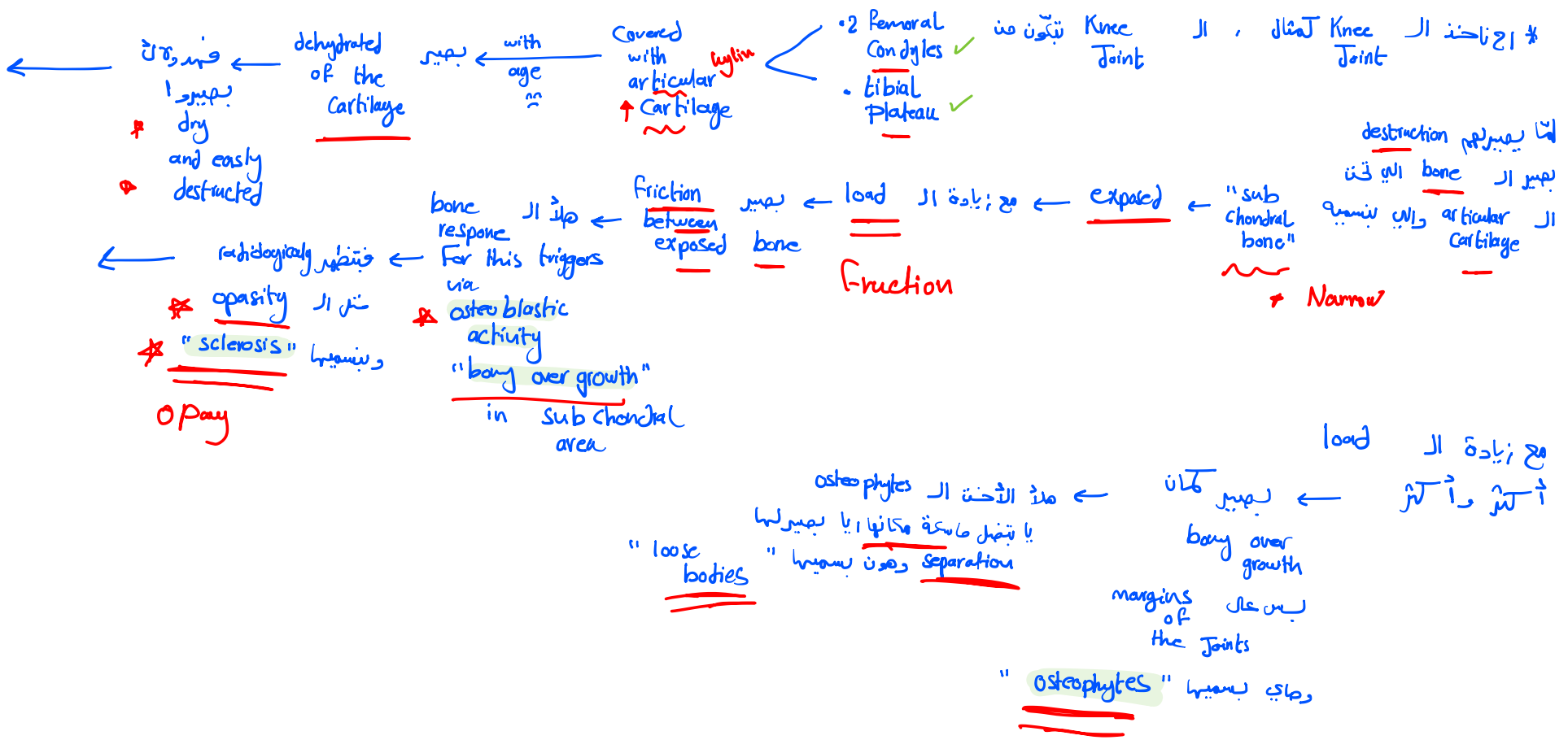
margin
of
Joint

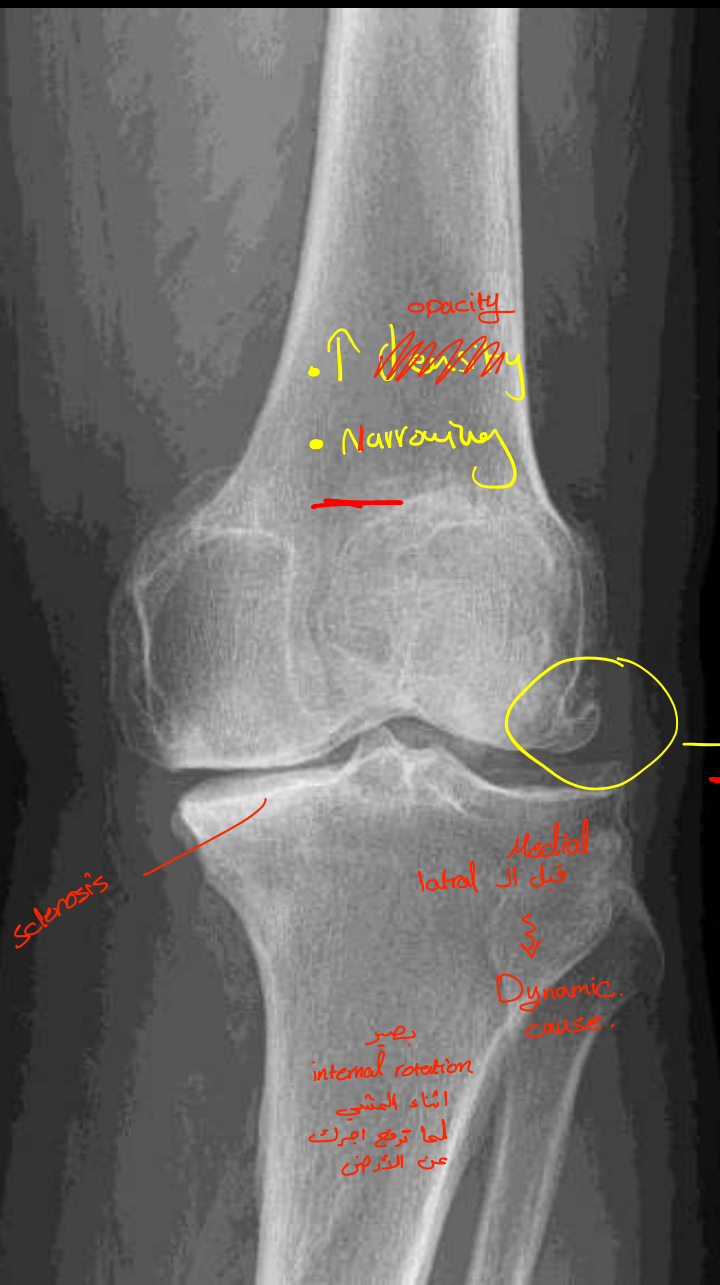
in
sub chondral
bone
(العظم البيني)

* sclerosis
as fibrosis
but in bone.

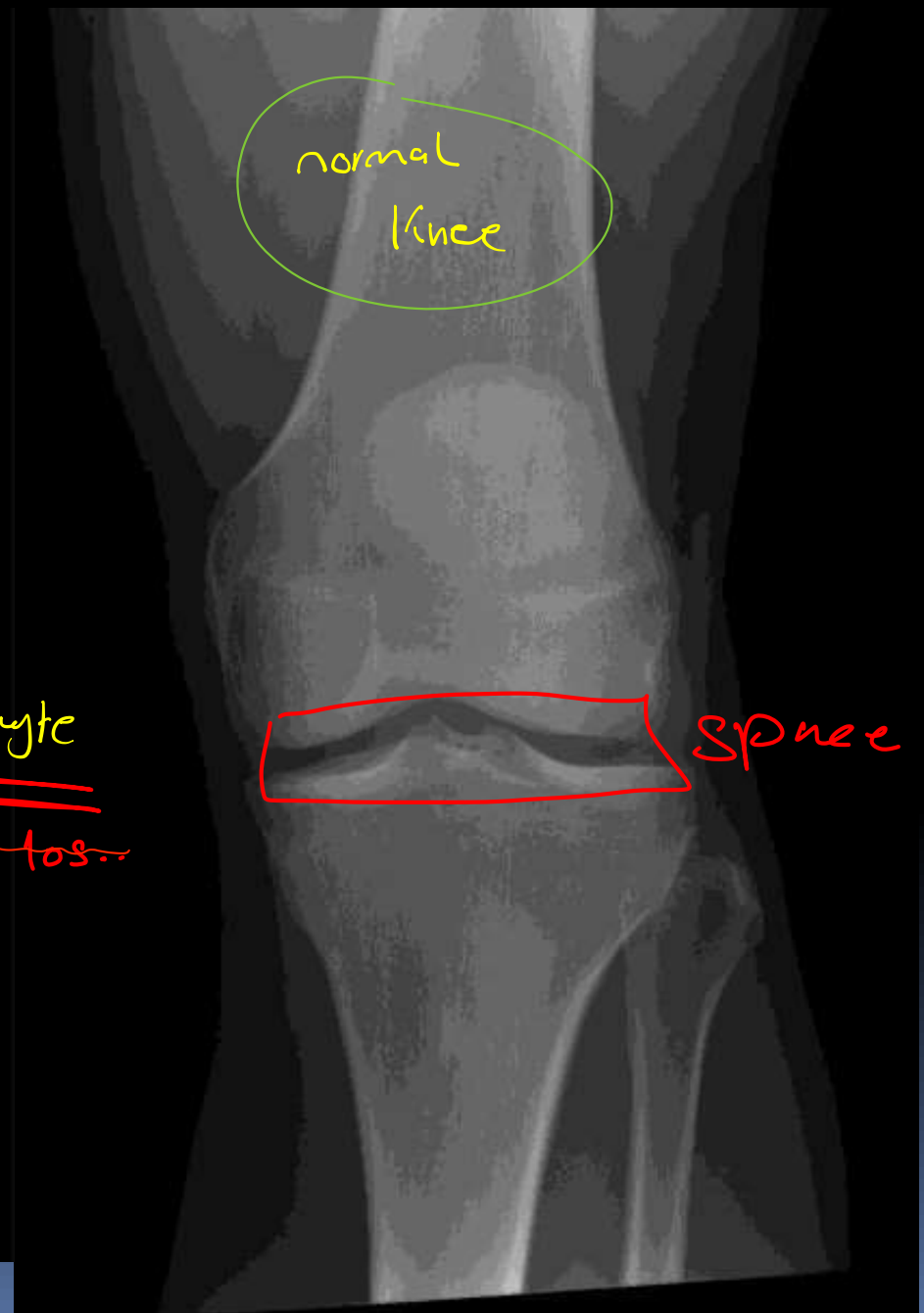
Radiological features:

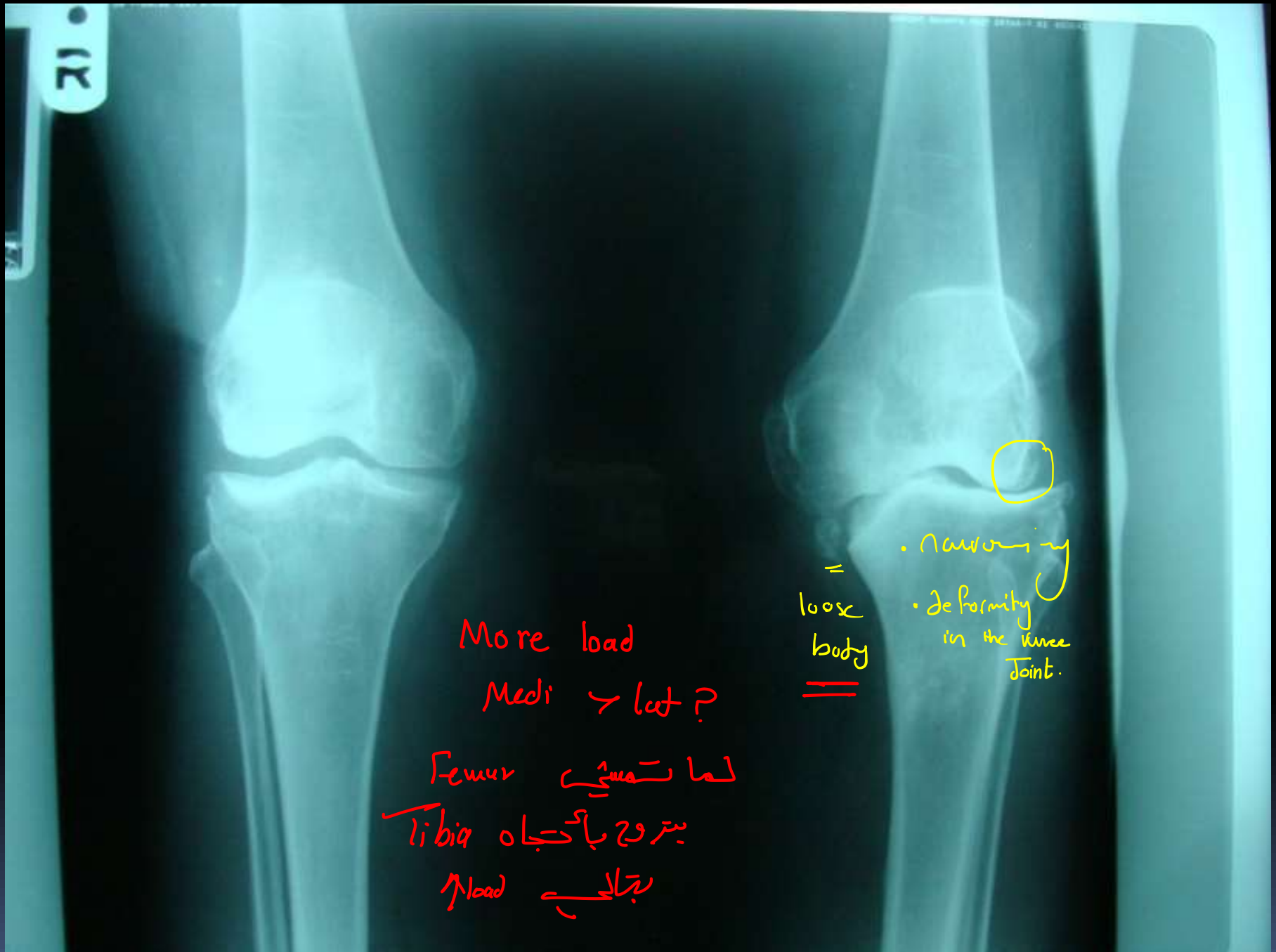
- ❖ Osteophytes formation: are spurs of bone which forms at joint margin.
- ❖ Joint space narrowing.
- ❖ Sclerosis with Secondary degenerative cysts formation.
- ❖ Loose bodies: result from separation of cartilage and osteophytes.
- ❖ Articular chondral loss or thinning.





→ osteophyte
body to...





More load
Medi > lat ?

لما تمشي
تروح باتجاه
Femur
Tibia
Load

=
loose
body
==

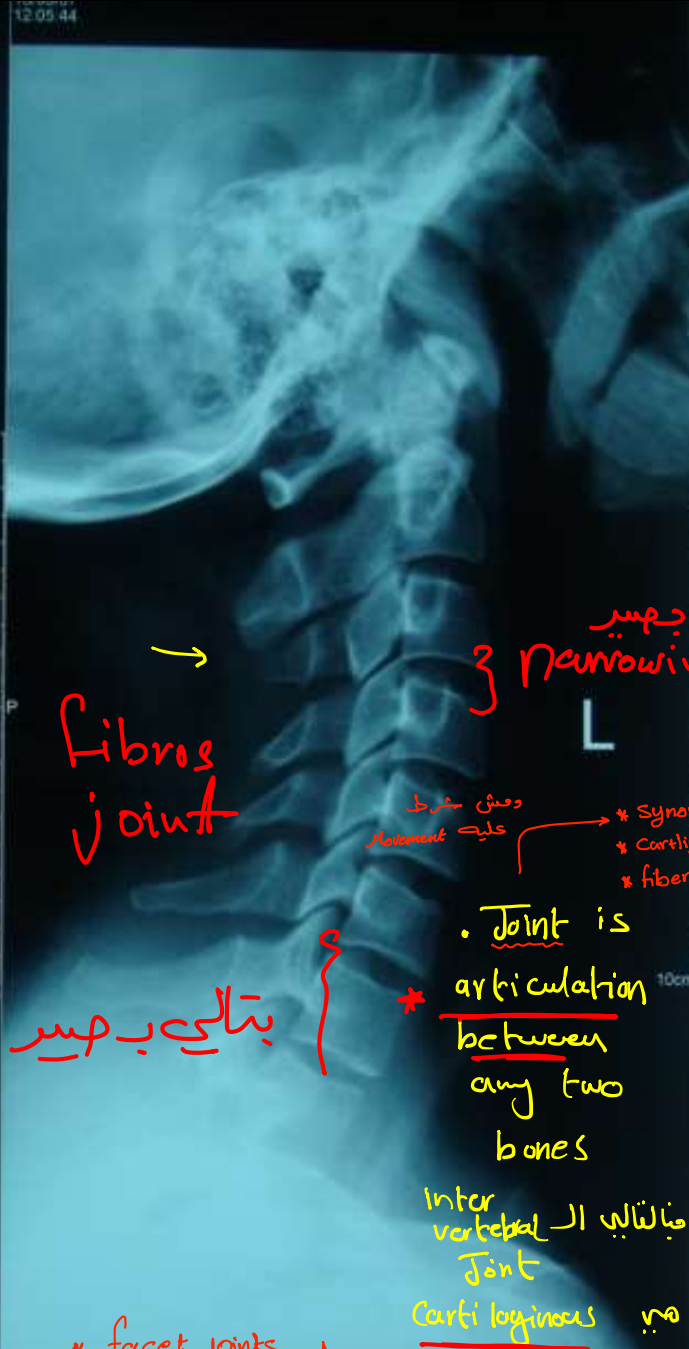
• narrowing
• deformity
in the knee
Joint.

يارب، نصبر على الذي وعدت ☺

- osteoarthritis in spine
↓
called degenerative spine dz

normal

R



fibros joint

3 narrowing

دوسری شرط
Movement علی

- * Synovial → ex: Knee ✓
- * Cartilaginous → ex: ribs. ✓
- * fibrous → ex: sutures in skull. ✓

• Joint is articulation between any two bones

inter vertebral joint

Cartilaginous Joints

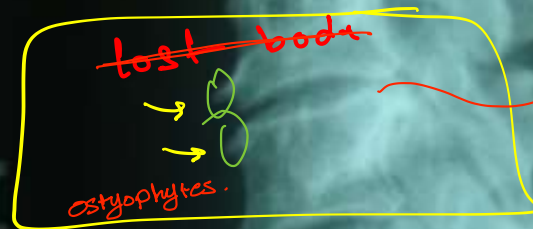
بٹالائی بھیر osteoarthritis

* facet joints

vertebral column

ایک مینر ال
movement
anterior and posterior

محول دہ قوۃ اے بالہ



- narrowing
- sclerosis
- osteophytes

anterior ←
or posterior

اسود

Spine ال osteophytes بار

اسودان آبی مکان سینی

Compressing آندە مەن نەخل

nerve
roots

✓ narrowing →

✓ sclerosis →

✓ osteophytes

✓

Osteomyelitis



Infection of bone tissue ✓

* Hematogenous vs direct spread. ✓

inflammation of soft tissue
then spread to underlying bone.

* ^{Most ↑} Staphylococcus Aureus is responsible for the majority of cases.

neonates: metaphysis and/or epiphysis

children: metaphysis

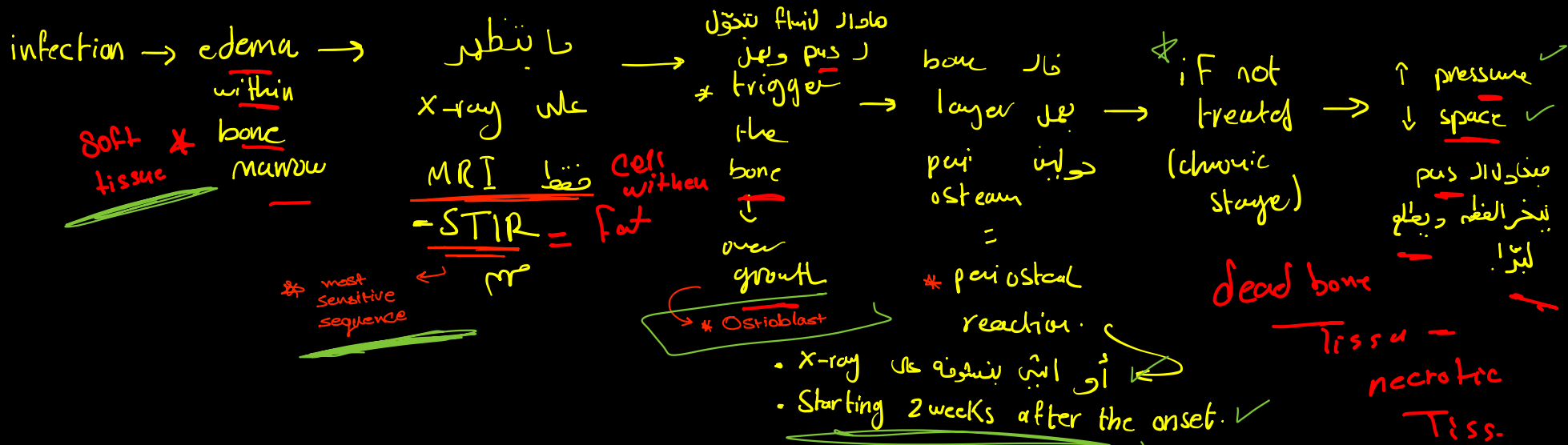
↑ 18 mm then ossified

adults: epiphyses and subchondral regions

• if it
hematogenous

→ Septic arthritis

vessels ?
↓
الدم الزن
الغشاء الزنوية
عند دم هون
اكتر عشان
مير



Conventional Radiological features: ■

- ① May be normal in the first 10 days or two weeks.
- ② The earliest sign is soft tissue swelling due to edema. Bone marrow
- ③ Periosteal reaction
- ④ Bone destruction

* if suspected clinically
 → treat as soon as possible.
 → then go for imaging confirm.

infection → sequestrum → involucrum → Cloaca

(draining
Sinus)

Thick cortex

Chronic
osteomy

■ MRI

علائق بنفاز من
reinfection ۛ

التهاب عظمي مزمن

★ Bone marrow edema is the earliest sign.

The cloaca is an opening in an involucrum which allows drainage of purulent and necrotic material out of the dead bone.

★ Involucrum is a complication of osteomyelitis and represents a thick sheath of periosteal new bone surrounding a sequestrum.

★ Sequestrum is defined as a piece of devitalised bone that has been separated from its surrounding bone during the process of necrosis.

* Bone marrow mostly fats (hypointense)

MRI

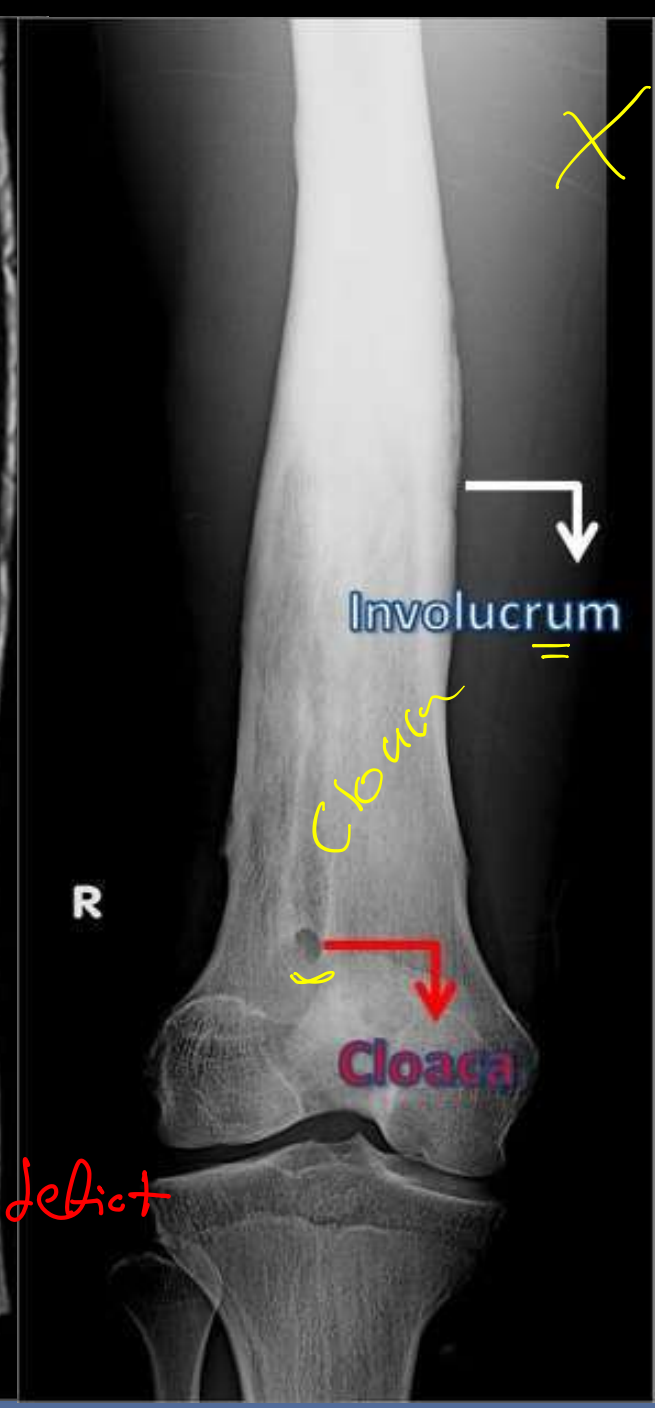
Sequestrum →

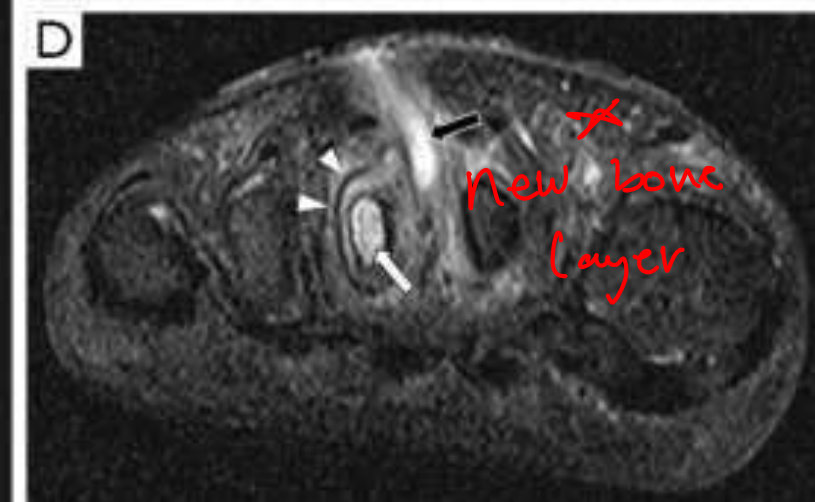
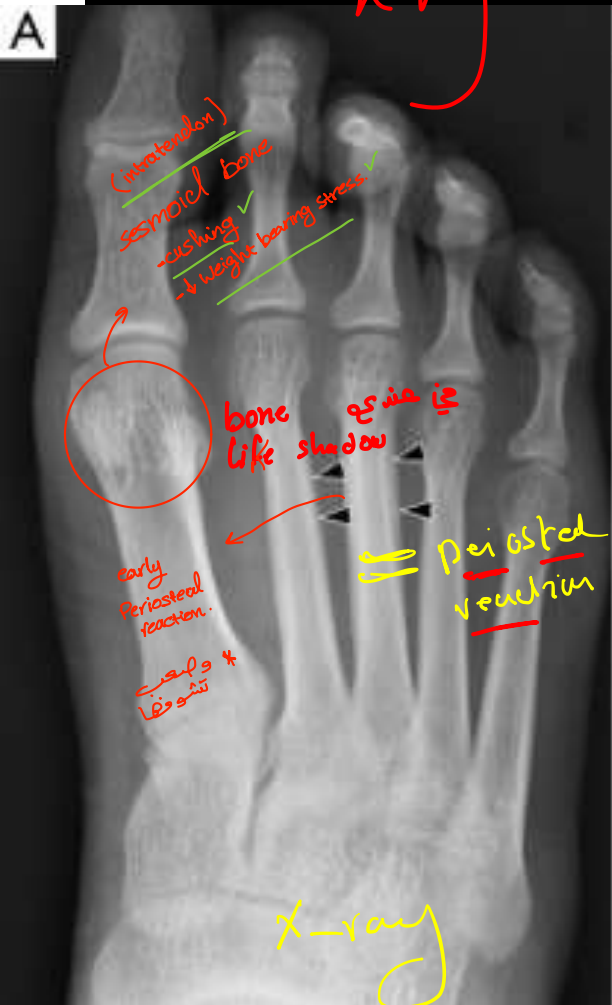
Involucrum →

pus = fluid

Cloaca

(focal bony defect)





* MRI initial modality
by STIR

✓

Multiple Myeloma



MM

* Bone marrow disease

→ MRI Best modality.

ممکنہ ہے سب سے

★ ■ Is a tumor of plasma cells (malignant proliferation). ★ ★

↑ 70 older panzil protein

↓
specif for it

★ ■ The most common bones involved are:
the skull, spine, pelvis and ribs.

■ The disease may occur in a disseminated form, or as a localized solitary mass
(**Plasmacytoma**).

A X-ray

★ whole body → MRI

The most common bones involved are the skull, spine, pelvis and ribs → so if we suspect a multiple myeloma in a Pt, we need to make a lateral skull, chest, spine, pelvis x-ray → lytic lesion (black) → if single called "plasmacytoma"

but also affect appendicular?
?

Multiple Myeloma / 2

* negative X-ray not excluding
MM need 40% destruction to appear
lytic lucent *

• very specific clinical test → bence Jones protein
+

Radiological features:

- At time of presentation 80% have skeletal abnormalities.

Plain films reveal:

- ✓ - Generalized **osteoporosis**.
- ✓ - **Scattered** lytic lesions with **well defined** margins
- ✓ - **Compression fractures of the vertebral bodies.**

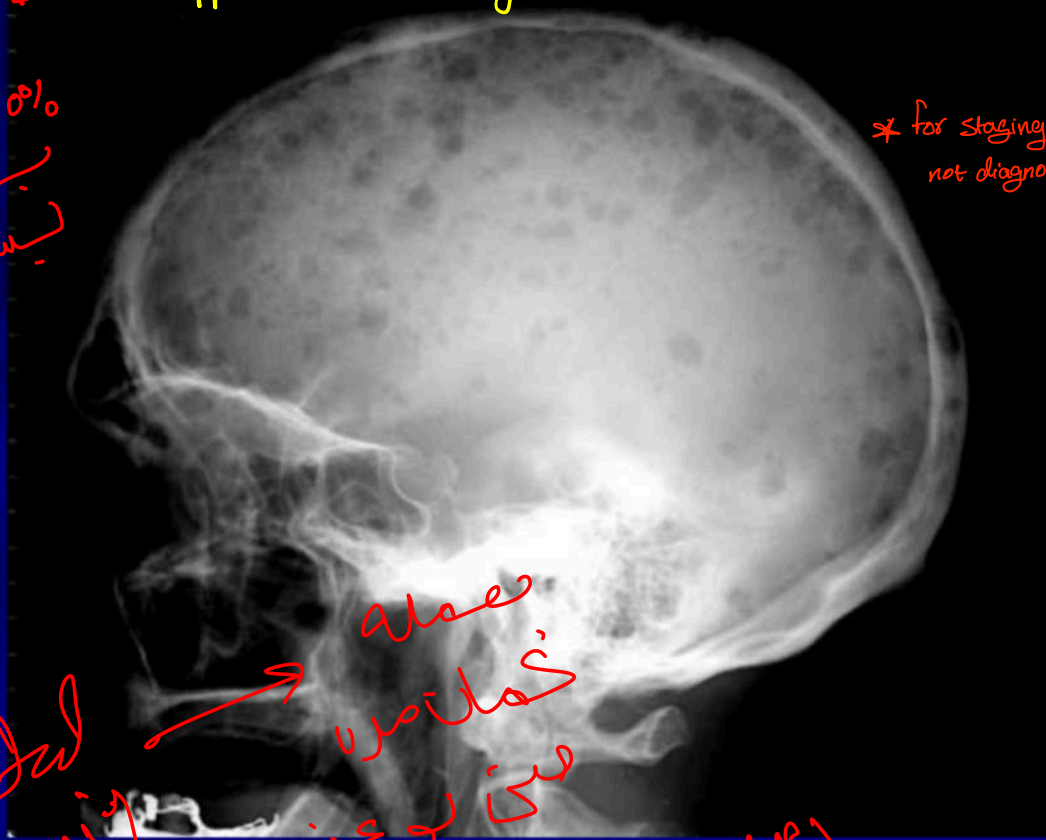
Osteoporosis is a bone disease that occurs when the body loses too much bone, makes too little bone, or both. As a result, bones become weak and may break from a fall or, in serious cases, from sneezing or minor bumps

pushed out lesions with sharp edges
through cortex

- * MM need to destroy 40% of bone cortex to appear on the x-ray!

positive Benne + bone pain
Jones Test
نحوه بنی + درد استخوان
- زمان کافی بگذارد x-ray برای whole body
بنی ضعیف negative x-ray
یعنی عدم وجود multiple myeloma
والسبب این

Multiple lytic lesions



* X ray → 40%
بسیار کم

* for staging
not diagnosis.

* پس حالا ما می بینیم
از MRI جیا
whole body MRI

فهرست رفرنس MRI

* well defined
osteolytic
lesion

(x-ray)
Skeletal survey
شماره
می توانی
whole MRI
body

* Skeleton Survey: is a whole body x-ray

if I don't have a whole MRI Imaging

→ each one has its

staging technique.

عشان میله لو مشیت بطریق
restaging: عمل فیها او عمل

T1W



STIR T2W



في كل ايامنا
العتير مار
boney lesion

Bone metastasis

Mostly to ... ?

Vertebral

Most vasculariz...

□ Are the most common malignant bone tumors.

□ Any primary tumor may metastasize to bone, but the most frequent are:

★ **Breast:** usually lytic in nature but may be sclerotic or mixed.

★ **Prostate:** the vast majority are sclerotic.

★ **Lung, Kidney, thyroid:** lytic lesions

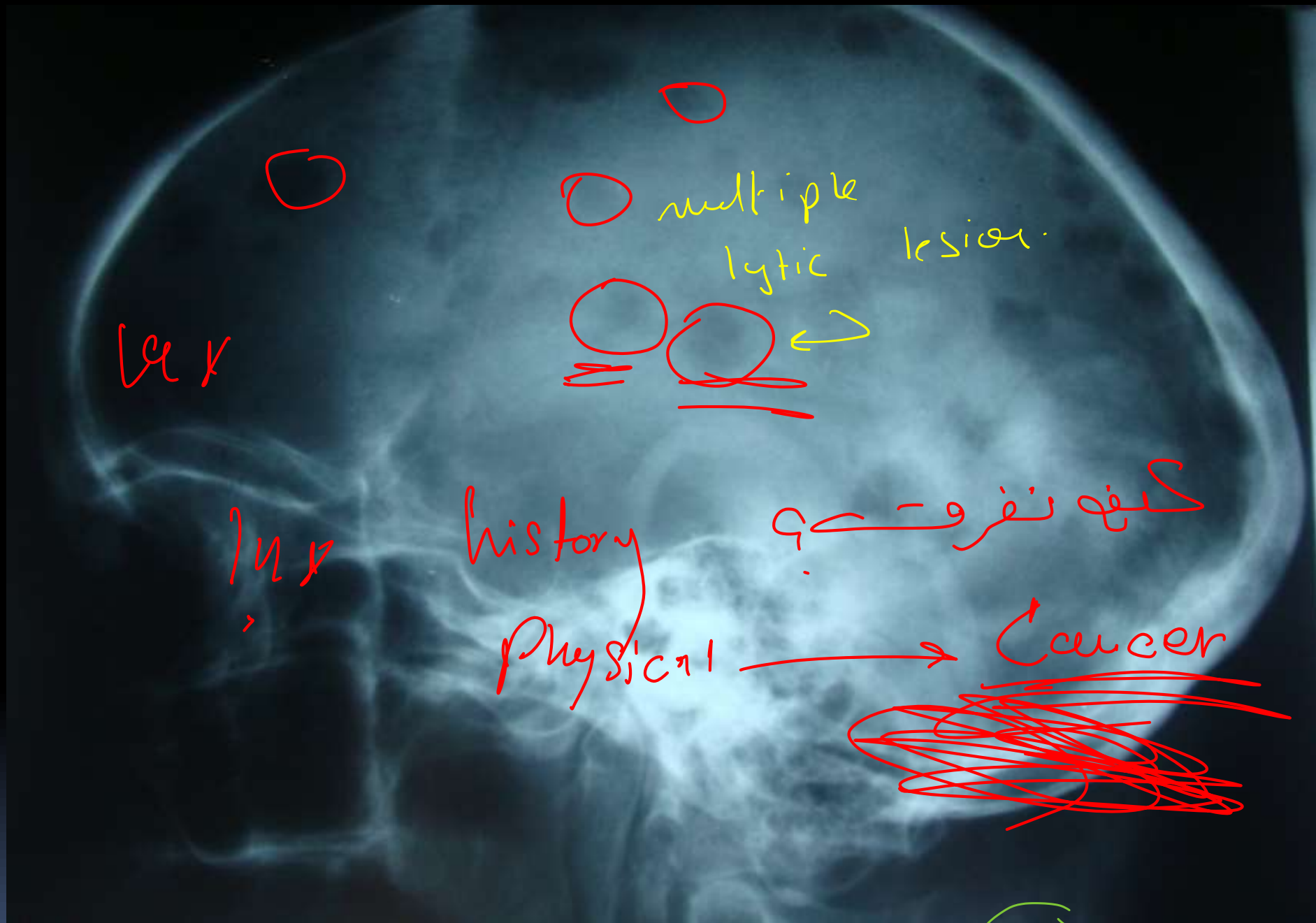
Adrenal gland: predominantly lytic.

Ratio opaque

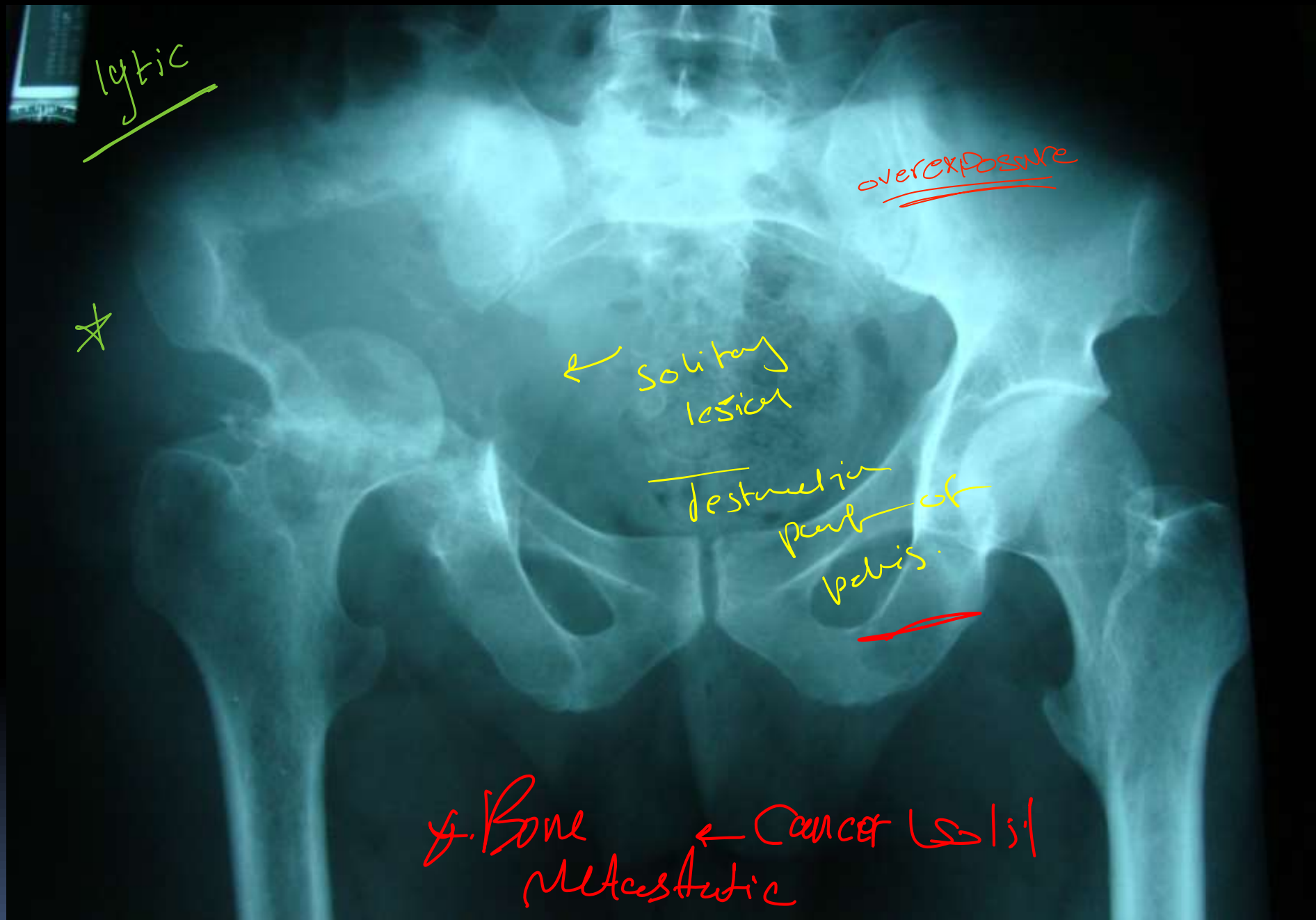
is - is

Pure

lytic



بفرقه عن MM من خلال
Clinical Features
It



lytic

overexposure

★

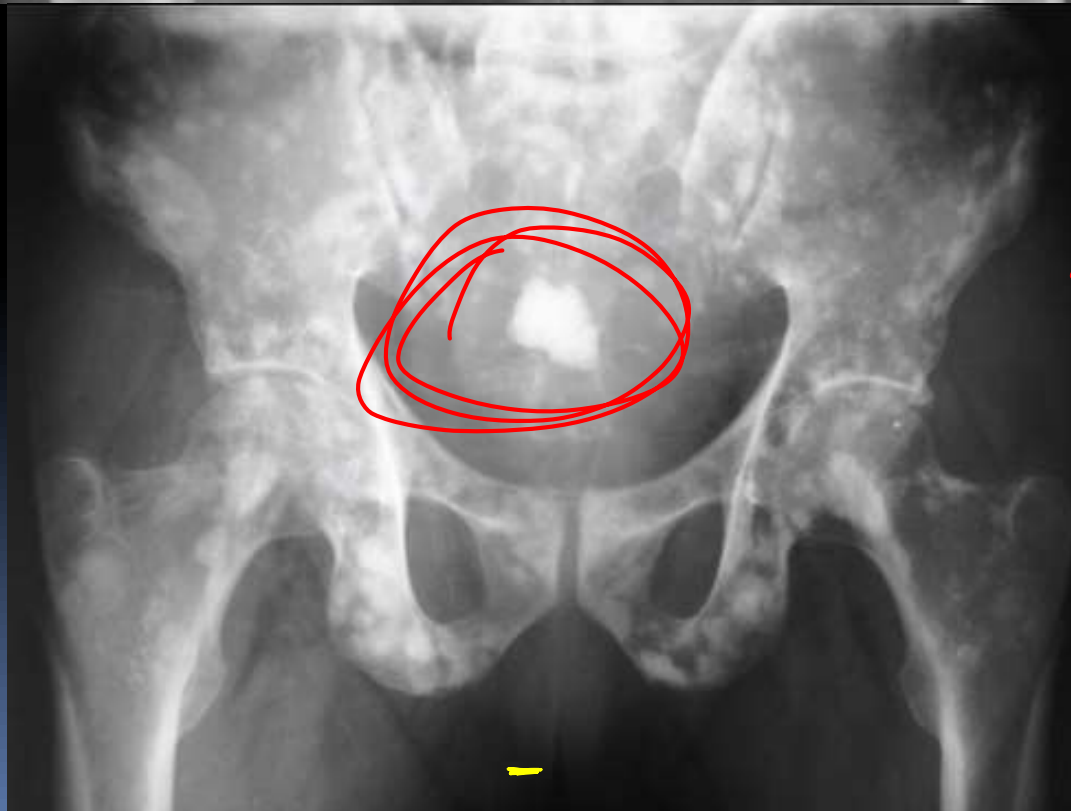
← solitary lesion

destruction part of pelvis

g. Bone Metastatic ← Cancer Lesion



normal



→ From Prostate Cancer

Sclerotic metastasis

Skeletal trauma

- ✓ ❖ Plain films are the initial evaluation of a patient with suspected skeletal trauma.
- ✓ ❖ At least two views (A.p, and lateral) should always be obtained.
- ✓ ❖ In any significant head or spine injury, CT scan is the initial investigation.
- ✓ ❖ CT will detect fractures as well as underlying intracerebral hemorrhage or contusions.

FRACTURES

✧ Fracture: is a break in the continuity of bone.

✧ Closed fracture: Fracture with intact skin.

✧ Open fracture: Fracture with skin and soft tissue wound connecting the fracture to the external environment. → exposed

→ infection

Ab

Types of fracture ⇒

normal fracture → normal bone exposed to over load.

➤ Linear fracture. (radio lucent line)

بعض النقر
عن شكله
ex: spiral.

3

➤ Comminuted fracture: a fracture with multiple fragments

التفتت

➤ Avulsion fracture: a fragment of bone is detached from the site of a ligament or tendon insertion.

مزل

مثال ال tendon
ال رابط في ال
5th metatarsal
bone.

➤ Pathological fracture: a fracture through diseased bone.

على خلاف
ال

①* usual fracture
(ordinary ...)



abnormal bone exposed to normal load

Musc → tendon → bone
بشدة بشفاع

Types of fractures /2

- ☆ ➤ Greenstick fracture: ^{طفلي} Incomplete fracture that usually occurs in children. The bone may also buckle without an actual break.
linear incomplete Fracture
- ☆ ➤ Compression fracture: force is applied in the longitudinal axis of bone, usually occurs in the spine.
بسن Cortex و كسور مكسورة intact. الثاني
- ☆ ➤ Depressed fracture: usually occurs in the skull.
(Flat bone)

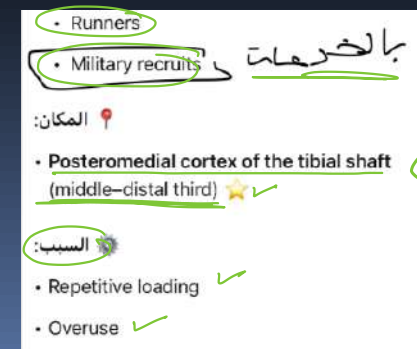
Types of fractures /3

Accidents running → *stress* { *normal bone exposed normal load for long time*

- ③ ➤ Stress fracture: Is incomplete fracture caused by repeated stress, or over-use to bone, in the form of a fine crack.

most common in the proximal shaft of the tibia and fibula (long distance runners and ballet dancers).

- March fracture: is a type of stress fracture, also known as fatigue fracture of second and third metatarsal bones caused by recurrent overstress, is more common in soldiers.

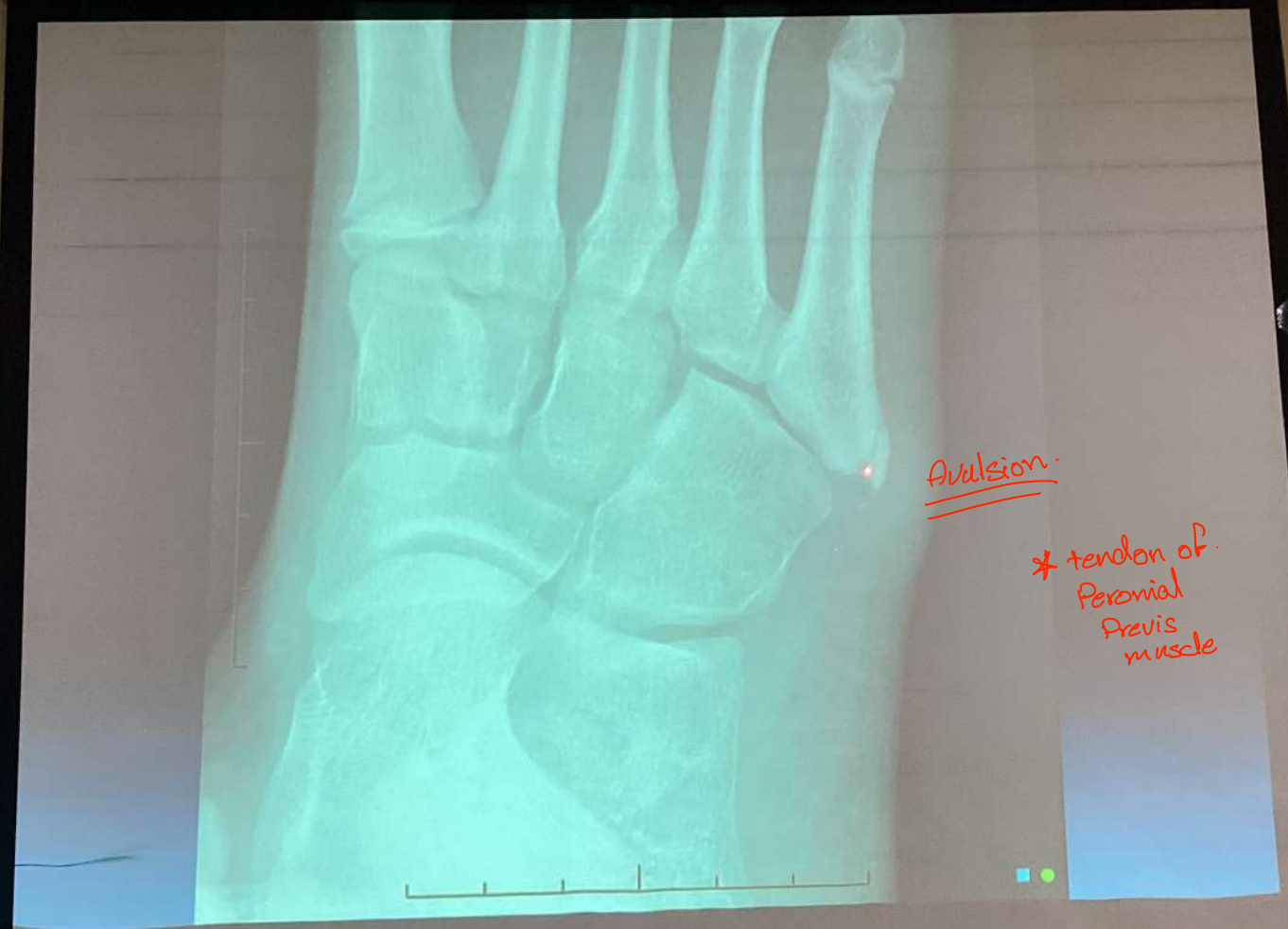




linear fracture along parietal bone.

to check if there is hemorrhage , CT check

هائي قاسية
تفاجت على
axial fracture



Avulsion.

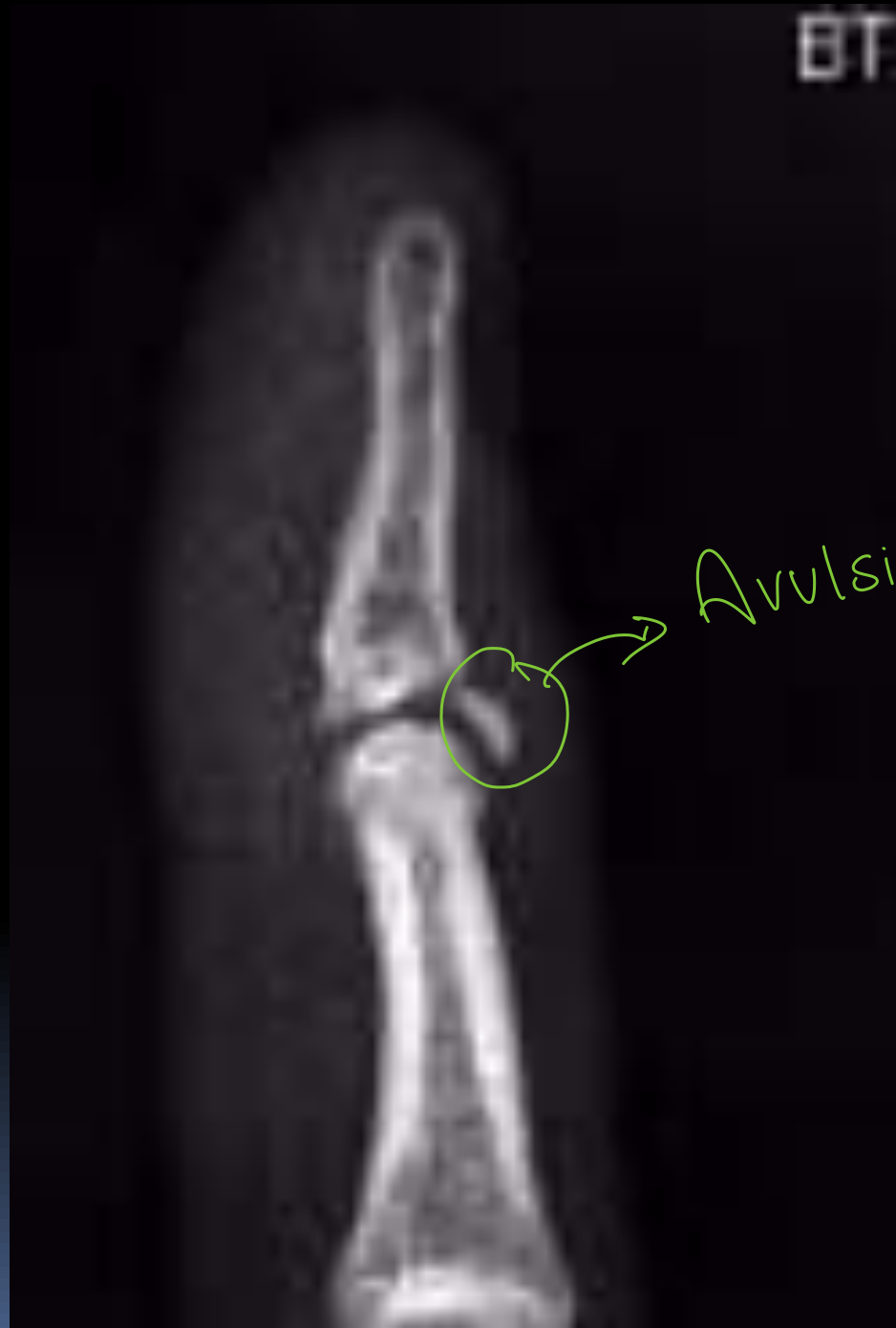
* tendon of.
Peroneal
Acris
muscle

1



oblique
linear
fracture.

child



Avulsion.

Fracture.

Avulsion.

Fracture

+

dislocation



drhueso

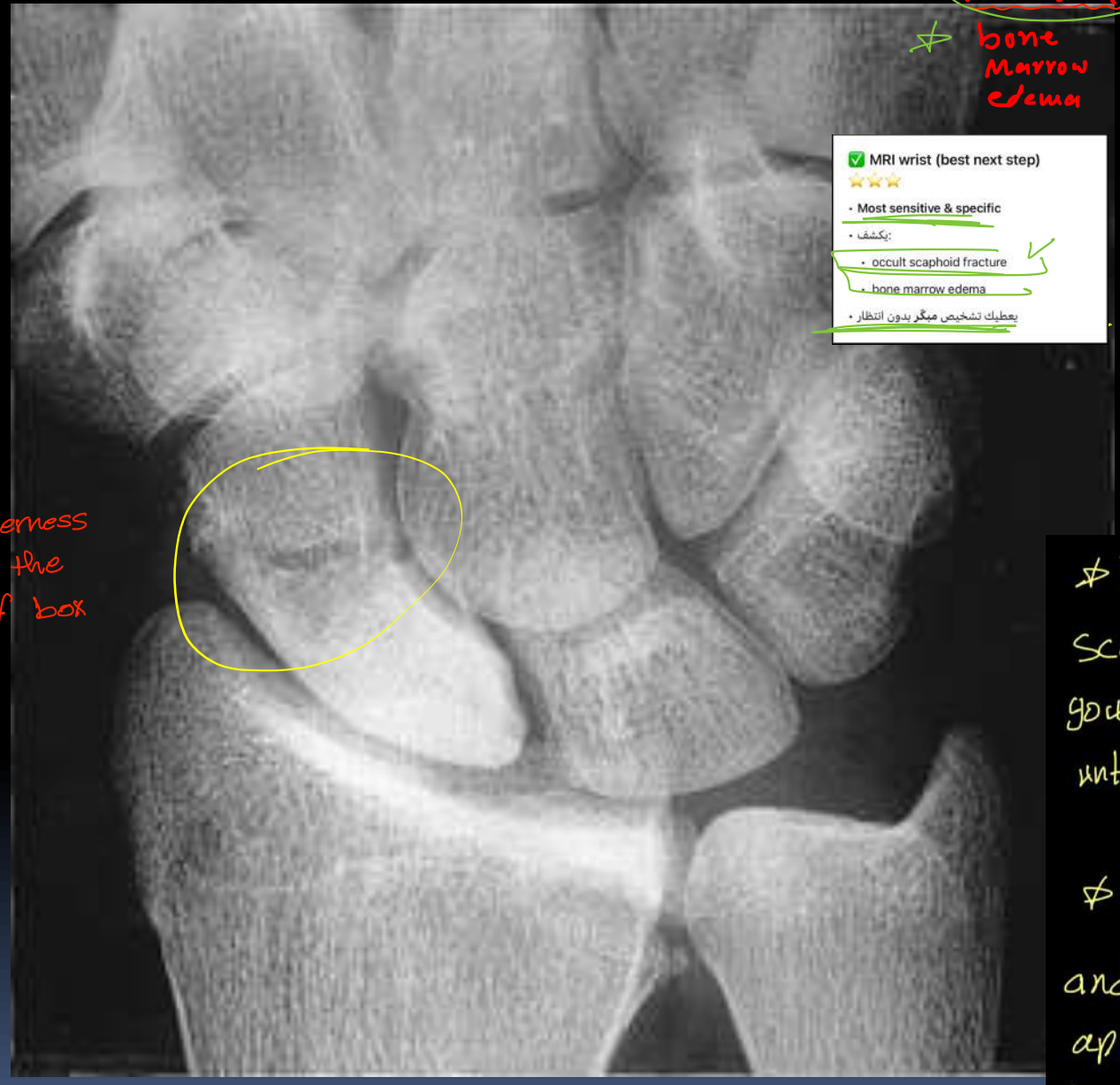


أو بهيئة آخر من ← Scaphoid بار normal X-ray
 Fracture ← Scaphoid بار Core ما بين 10 - 2 weeks) رحت يوصل ال Cortex
 X-ray

MRI

bone marrow edema

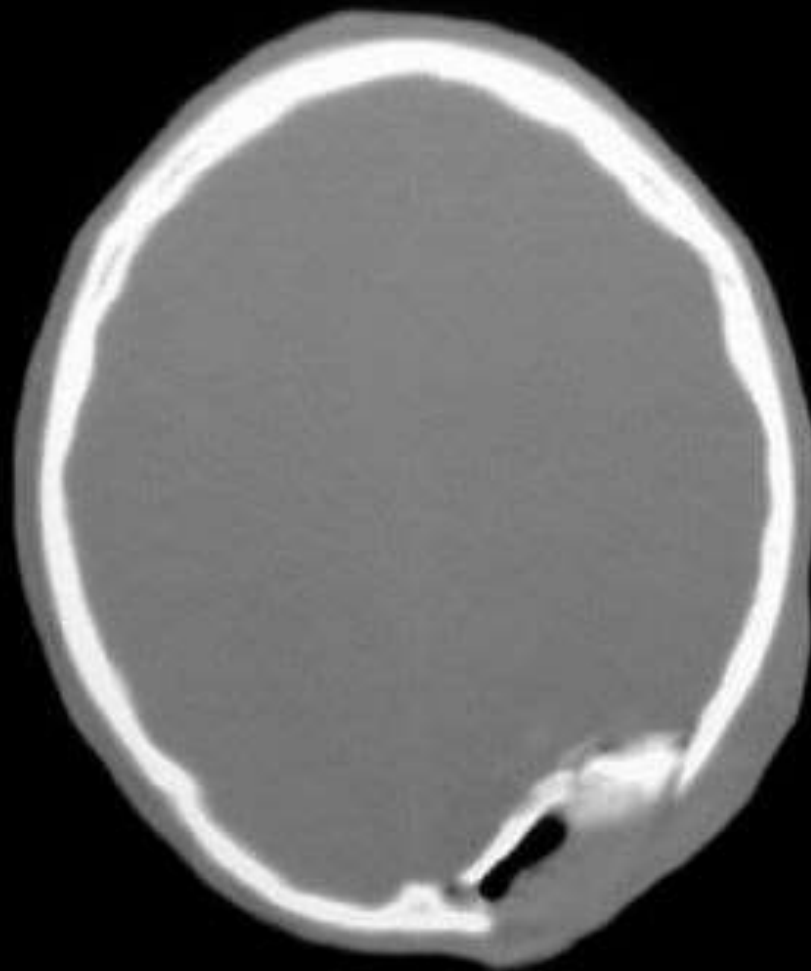
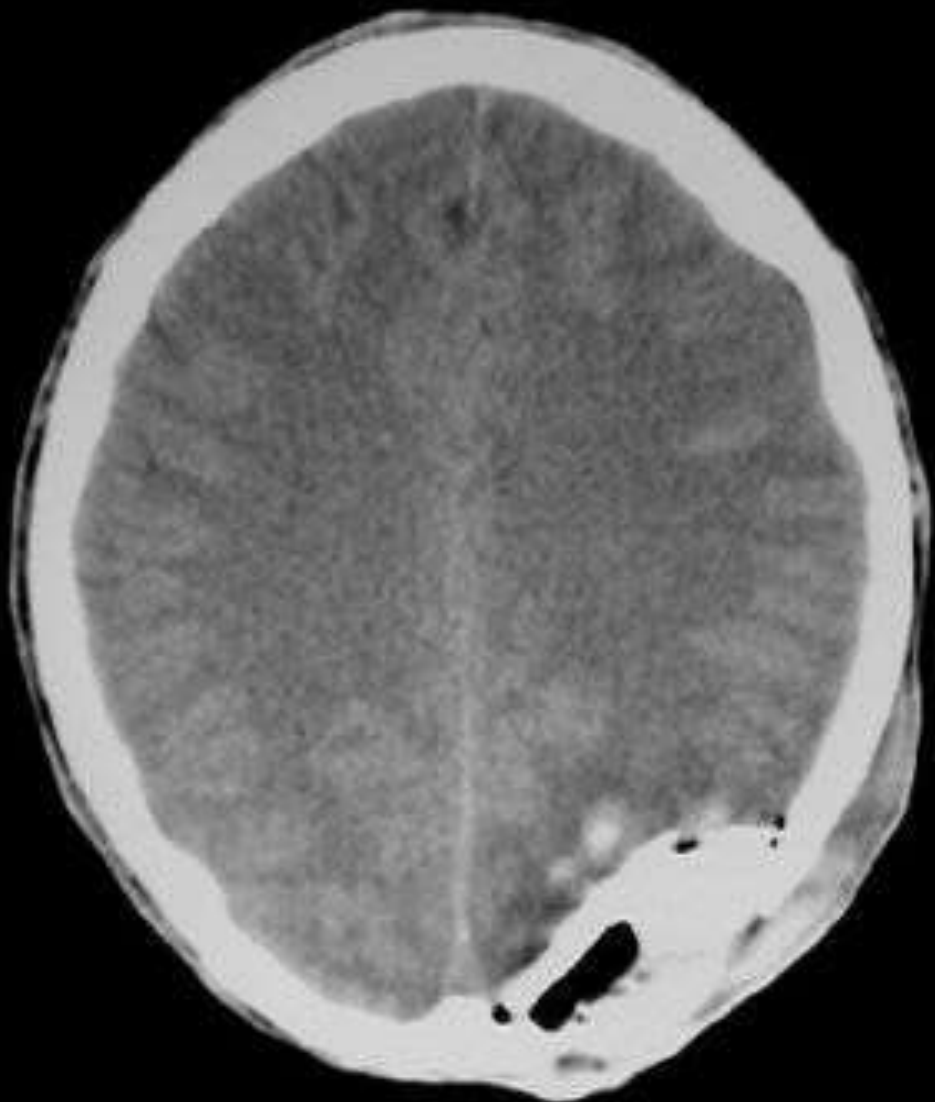
مبتدئي يا
 further imaging
 أو
 treat him as a fracture
 إذا إذا لم يشف fracture
 cut off the blood supply
 osteo-necrosis
 =



دليل على كسر
 هالعظم
 *
 Tenderness over the snuff box
 *

* if you suspect Scaphoid fracture → you treat as fracture until proven otherwise
 * usually fatal and carpal bone appear late fractures.

depressed.
Fracture



Distal radial fracture
+
displacement.



Comminuted
Fracture.





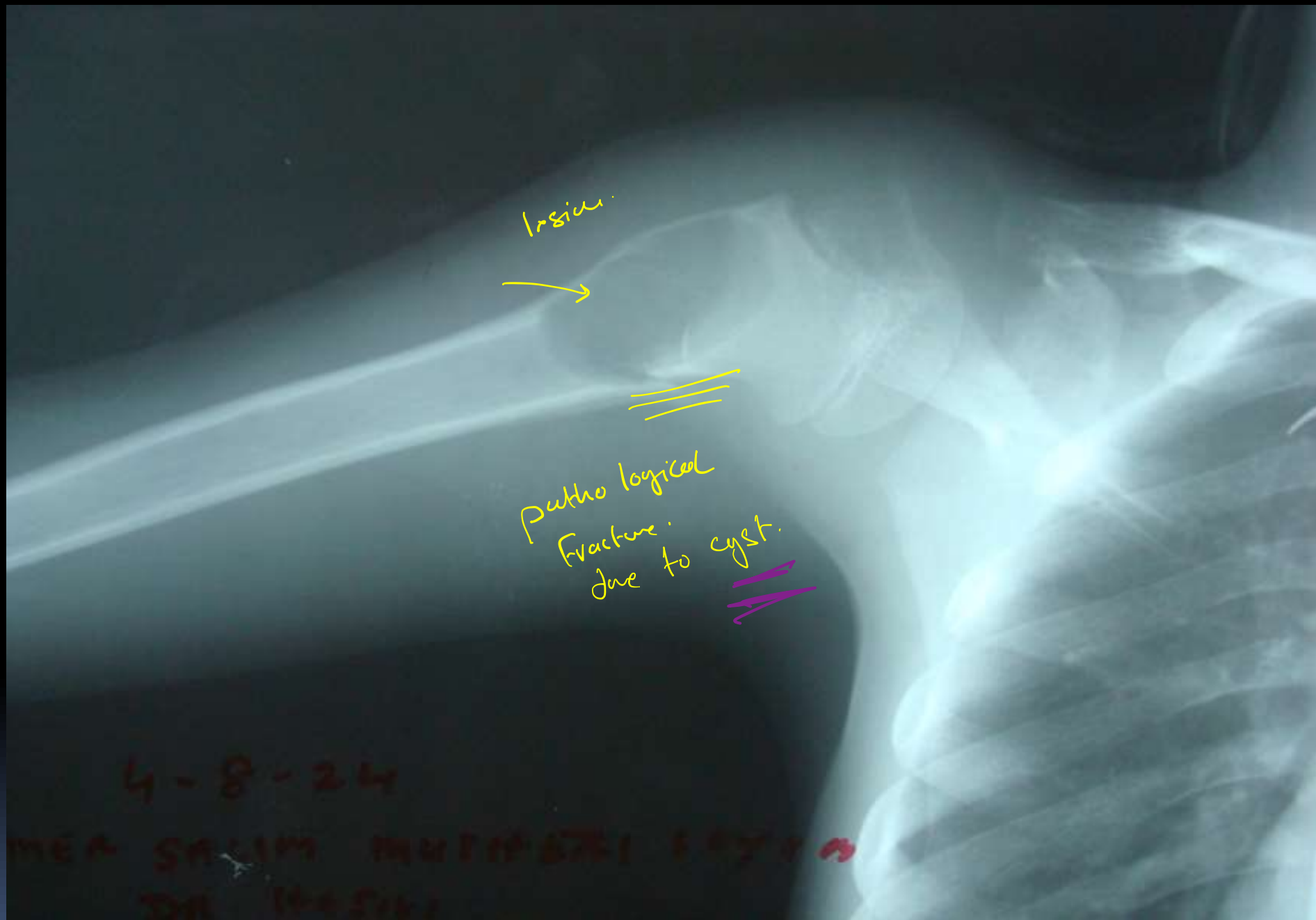
Green
Stick
Fracture.

Green
Stick

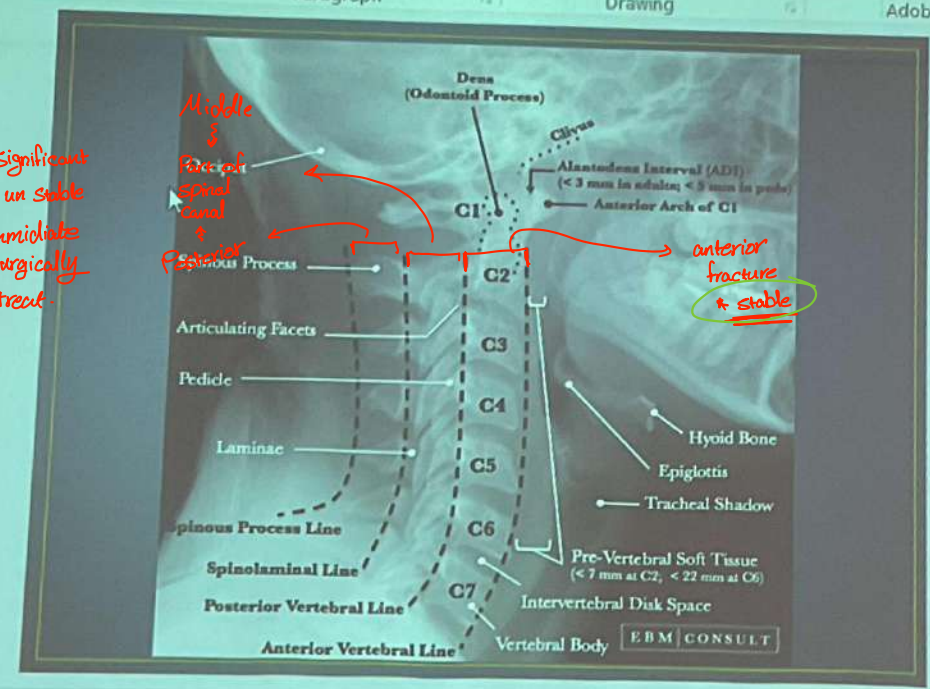
افئال

Buckling fracture : pediatric age group.





Significant
unstable
immobilize
surgically
treat.



anterior
fracture
+ stable

Click to add notes

- Neck
Cervical
X-ray.

Lat. view

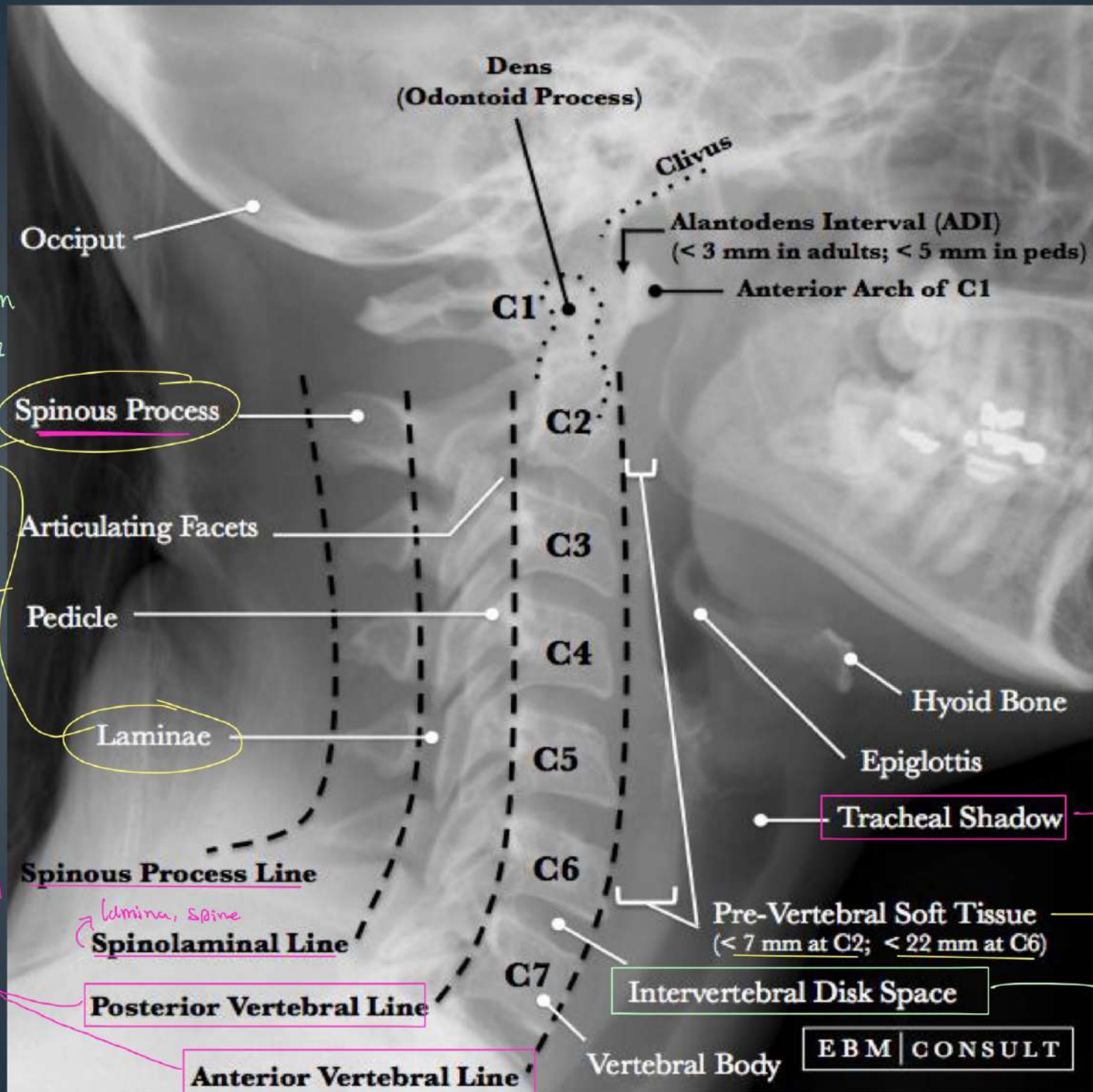
↳ begin
counting from
C2, since C1
only appear
at post.

unstable

fracture
(surgical)

significant
+ middle

المفروض هو في
C1, انه ان كان
لا يوجد شيء على
الlevel



→ lucent line
= air = Trachea

→ ان طفلان ممكن
يبي فيه abscess

→ Best
diagnosed
by MRI

SPINAL INJURIES

The spinal injury can be classified in three types:

- 1 - Compression fracture.
- 2 - Burst fracture. RTA
- 3 - Fracture-Dislocation.

over load it but axial load
usually affect anterior (stable)



Cervical — Thoracic

in 2 facet At same lv

spinal

dislocation.

فاسيت

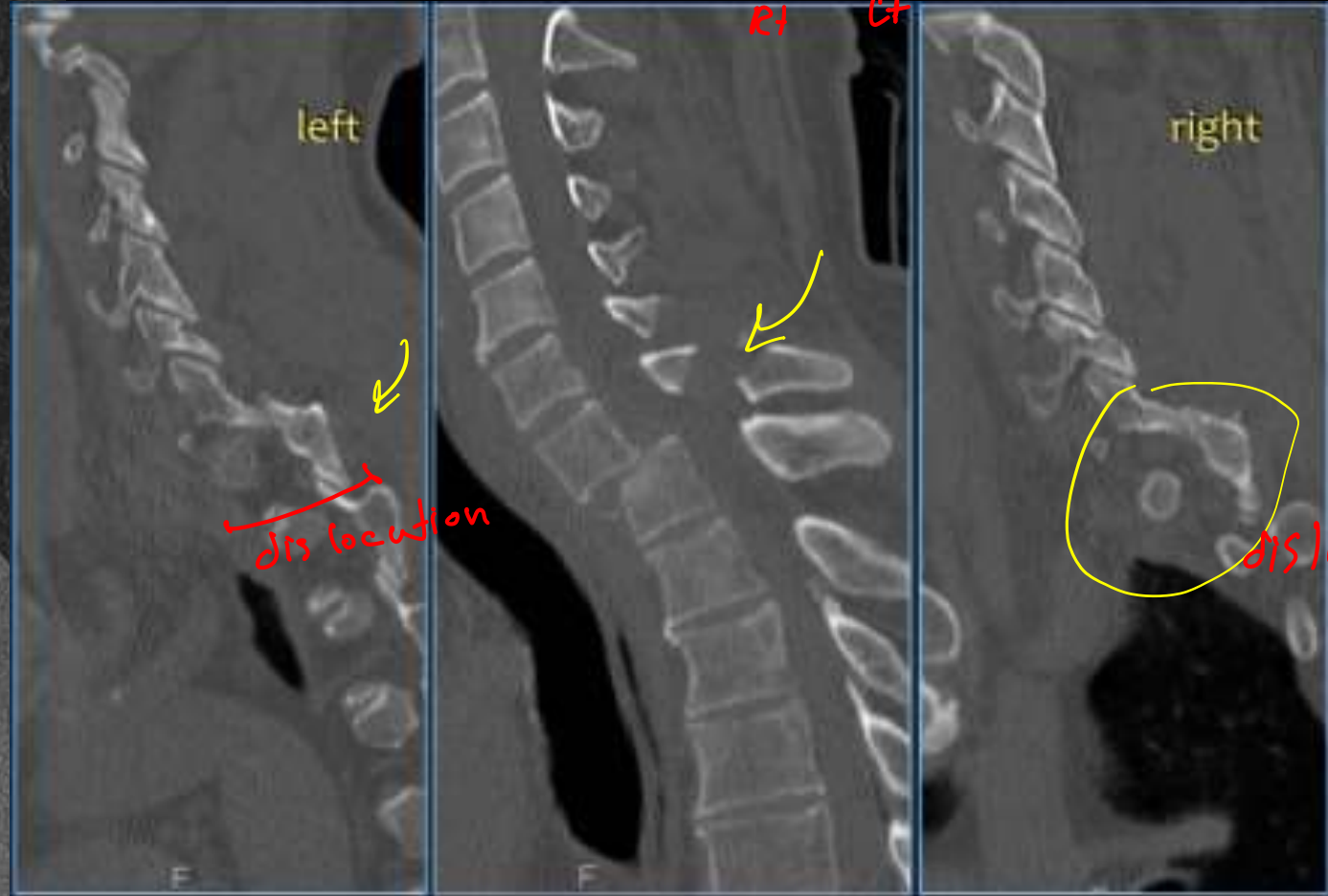
Facet

Joint

تفجيد
Antero-posterior
movement.

كسور في

Rt Lt



left

right

dislocation

dislocation

صدأ كبد في Cord injury

في Cord injury ليس ما يجلد عليه
MRI لا تعمل

bilateral facet Joint dislocation

vertebral C. move anteriorly.

unstable Burst Fracture.
انتجبار

Ant + mid & post.

unstable Fracture

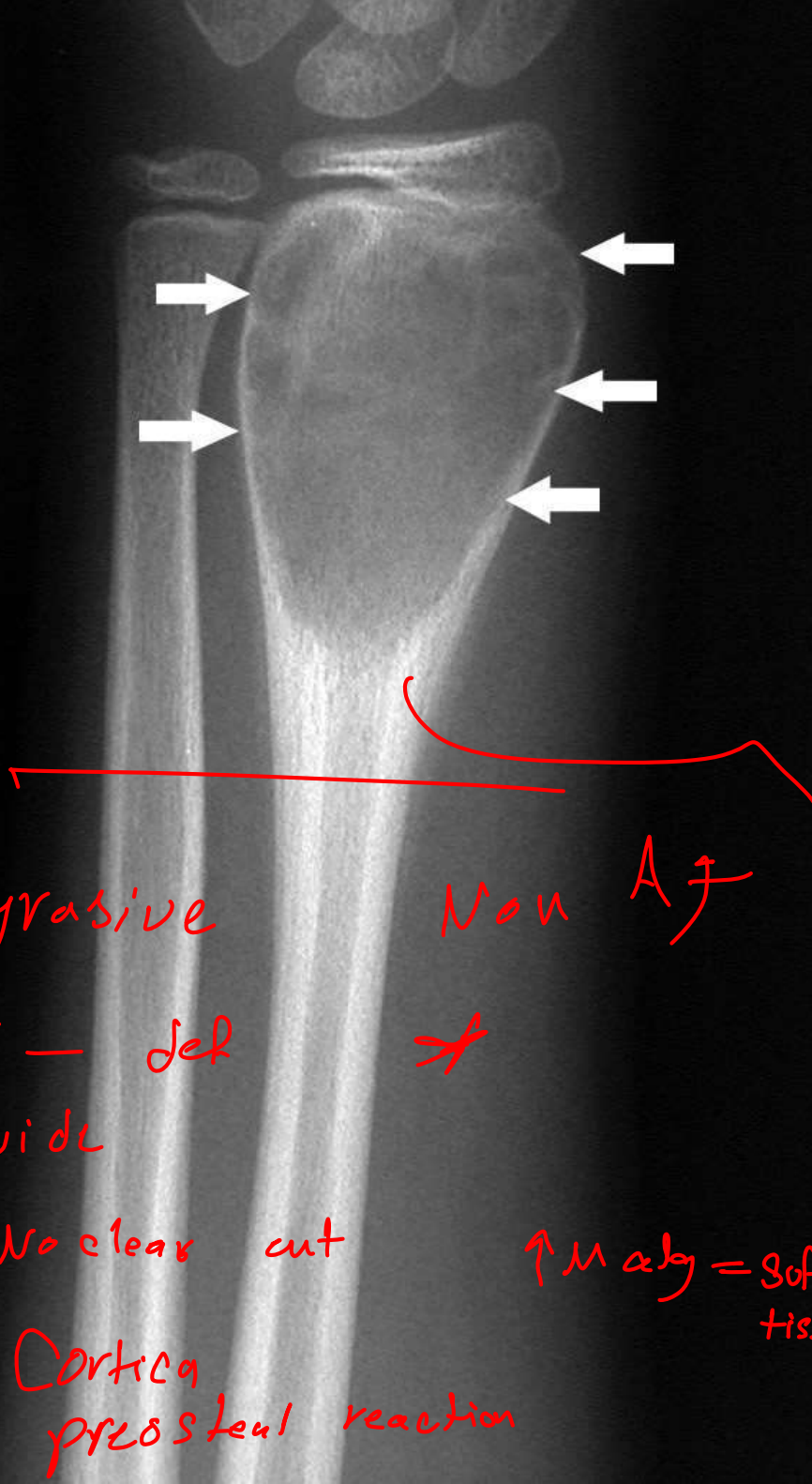
Non-aggressive bony lesion

→ I can draw the lesion.

- ✱ ■ Are generally well defined and have a sharp narrow zone of transition between normal and abnormal bone . (where in malignant tumour is ill-defined)
- ✱ ■ Benign lesions sometimes cause thinning of the adjacent cortex, however cortical destruction is more typical of malignant lesions .
- ✱ ■ A well defined sclerotic margin is in favour of benign lesions and rare in malignant lesions .
 - Periosteal reaction: lamellated (onion), sun-burst and codman triangle (interrupted).
mildly aggressive very aggressive



یارب صبر



osteolytic

or

osteosclerotic

= well defined

with

narrow

zone

transition.

- no perosteal

reaction

Agressive

Non Ag

III — Jer
wide

*

No clear cut

↑ Maly = soft
tissue

Cortical
prostatic reaction



- no periosteal reaction
- no cortical destruction
- narrow zone transition
- well defined
- mixed lytic + sclerotic



Benign في مفاصل

Aggressive bony lesion

85% → X ray

(ill-defined)

(soft tissue opacity?)

with soft tissue component

↓
↑ Probability of Malignant.

- Are destructive lesions, often associated with periosteal reaction, wide zone of transition between normal and abnormal tissue and cortical destruction.
- Periosteal reaction: lamellated (onion), sunburst and codman triangle (interrupted).
- The most common malignant bone tumor is metastasis and it's often solitary.

primary → osteosarcoma

Aggressive bony lesion

Radiological features :

- Plain film: shows an area of bone destruction
- CT and MRI are the best imaging modalities to evaluate tumours and determine bone and soft tissue involvement
- Features that may be verified by CT / MRI:
 - tumour vascularity ✓
 - infiltration of surrounding tissue ✓
 - relationship to nerves and vessels ✓

Malignant bone tumours / 3

The most common primary malignant bone tumors are:

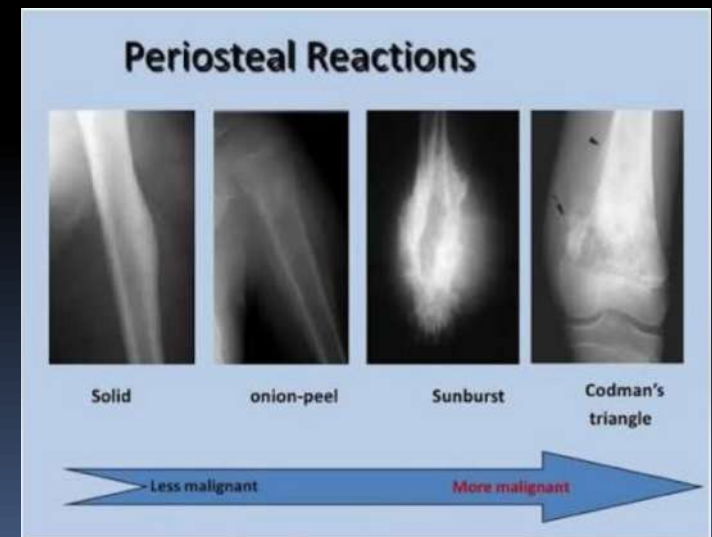
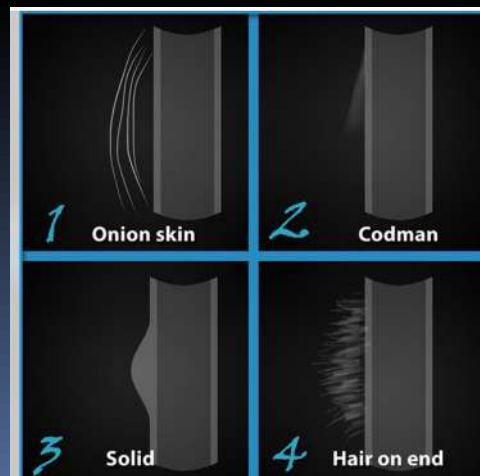
❖ *Osteogenic sarcoma* ✓✓

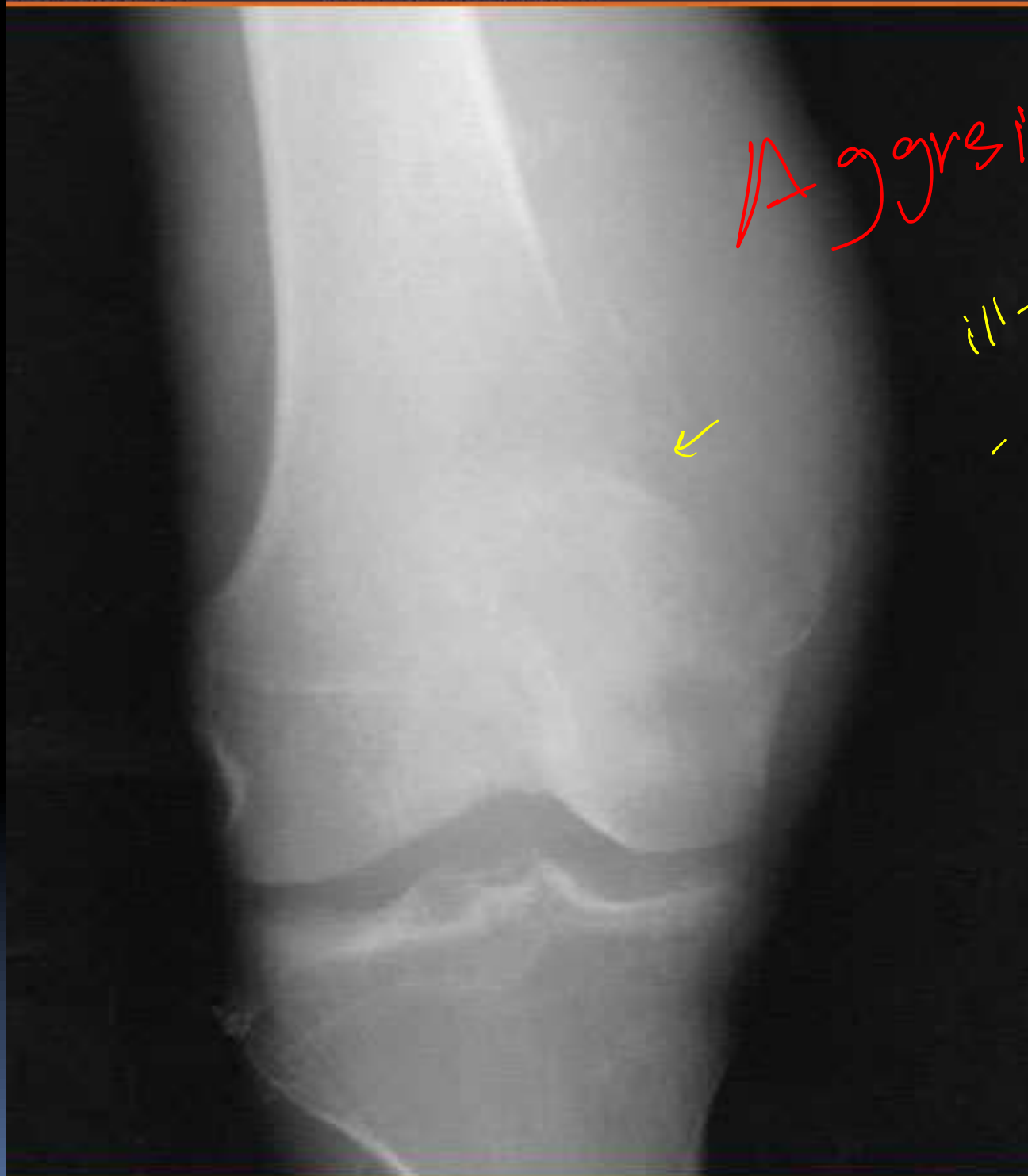
❖ *Ewings tumour* ✓✓

❖ *Chondrosarcoma* ✓✓

❖ *Fibro sarcoma* ✓✓

most





Aggressive

ill-defined

- wide

zone

of transition

- periosteal

reaction

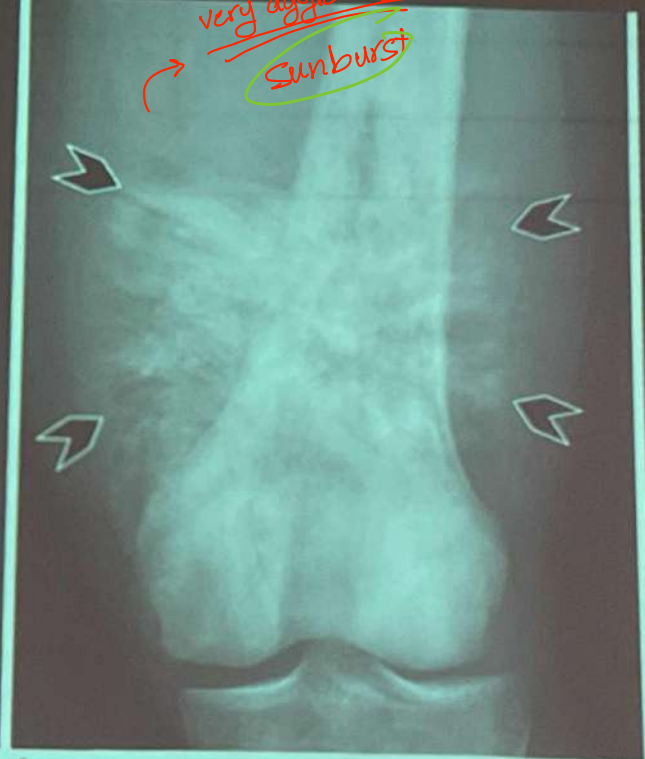
- cortical
destruction



aggressive
ill defined

Periosteal
reaction

onion shaped
layers



very aggressive
sunburst

b

c

Good luck