

جَائِزَةُ الْحُسَيْنِ
بْنِ عَبْدِ اللَّهِ الثَّانِي
لِلْعَمَلِ التَّطَوُّعِيِّ

AL HUSSEIN BIN ABDULLAH II
AWARD FOR VOLUNTARY WORK



النادي الطبي
Medical Club



Radiology

Subject: Spine Imaging

Group no: D11

Done by: Hala Yaseen

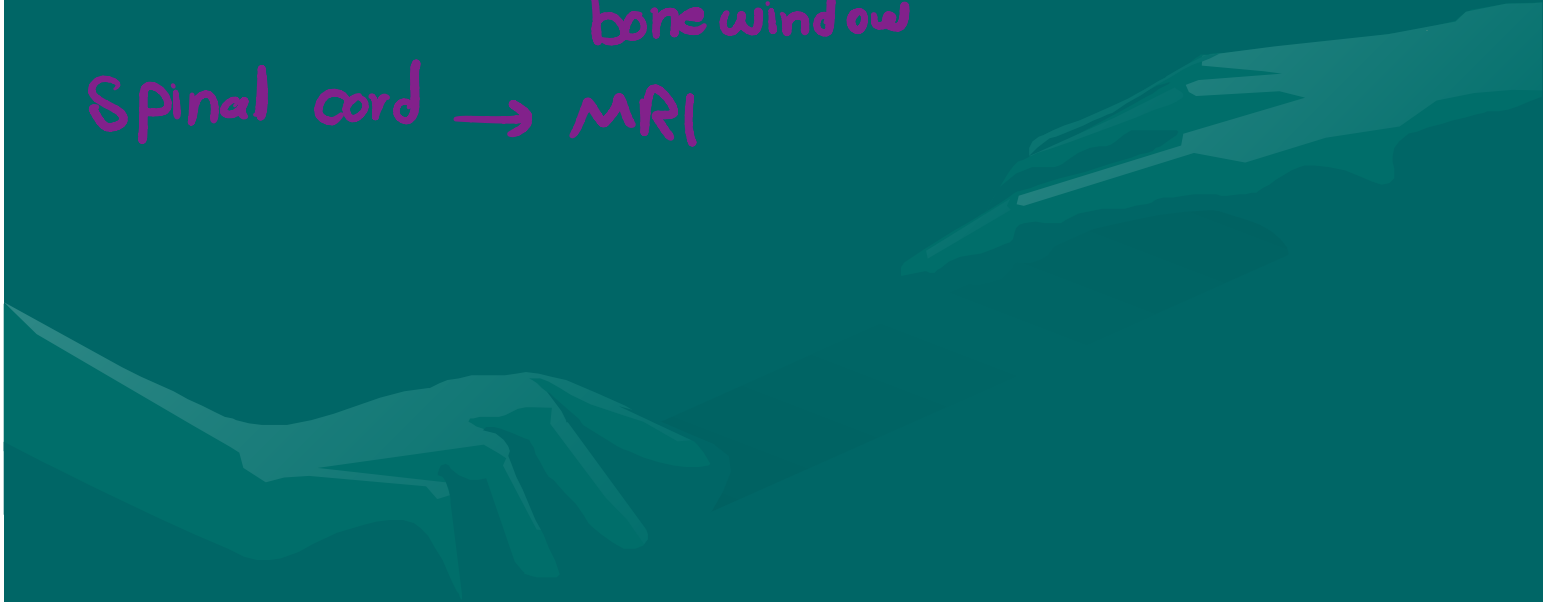


هَذَا خُلِقَ اللَّهُ فَأَرْوِيهِ مَاذَا خُلِقَ الذِّينَ مِنْ دُونِهِ بَلِ الظَّالِمُونَ فِي ضَلَالٍ مُبِينٍ

SPINE IMAGING

bone Assessment → CT Scan
bone window

Spinal cord → MRI



Spine anatomy

❖ The vertebral column forms the central bony axis of the spine, and is composed of 33 vertebrae.

- 7 Cervical vertebrae
- 12 Thoracic vertebrae
- 5 Lumbar vertebrae
- 5 Fused sacral segments
- 4 Fused coccygeal segments

They're separated from each other by disks

➡ اذا شفتنا L5 كانت fused مع ال sacral segment بنحكي عن هاي الحالة sacralization و هاي congenital anomaly

➡ لما تيجي تعد ال lumbar vertebrae راح تلاقيهم ٤

➡ و اذا شفتنا S1 كانت separated عن الباقي sacral segment يعني صارت free vertebra بنحكي عن هاي

الحالة lumbarization .. يعني بتيجي تعد ال lumbar vertebrae بتلاقيهم ٦

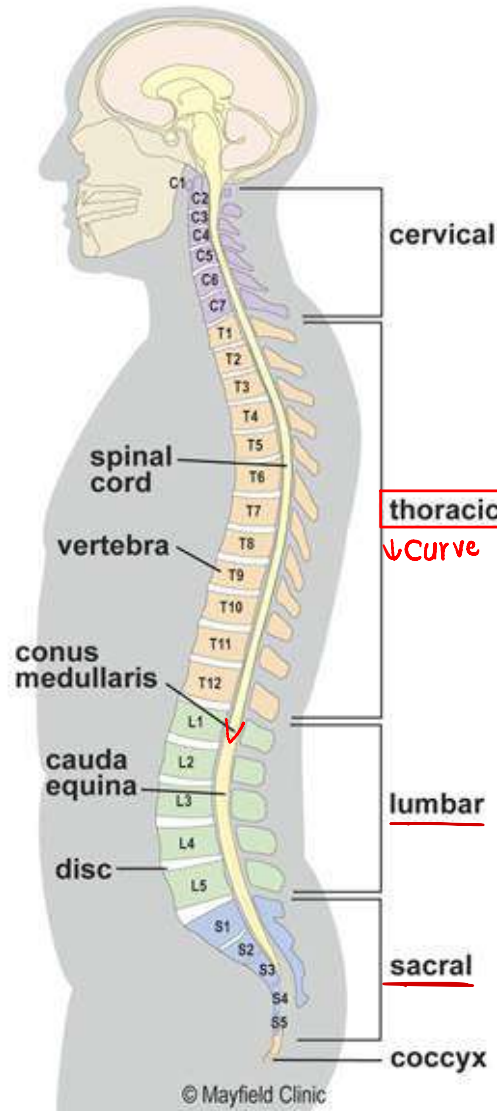
➡ احنا كيف بنعدهم؟ بنطلع على اخر vertebra ماسك

فيها rib بتكون هاي T12 و بعدها لازم تلاقي هـ

ممكن تأش على شكله وممكن ٤

كلهم ورأيتهم في
Frontal
Coronal

Sagittal = (L + S) curve
 (ما لولواو ستريه ←
 muscle spasm)



الي بالصورة هو ال normal alignment ال
 spine على ال frontal view يكونوا كلهم
 ورا بعض ما في curve .. اما على ال
sagittal view يكون بال cervical
lumbar vertebrae minimal lordosis \
 يعني متقدمين لقدام شوي اذا ما كان
 موجود هاد ال normal curvature ال
 spine بصير فيه straightening يكون
 بسبب muscle spasm بمونوا شادين و
 بتخليهم صف ورا بعض .. و normally
 كمان بشوف minimal kyphosis بال
sacral + thoracic vertebrae

- Lordosis = cervical + lumbar
- Kyphosis = thoracic + sacral
- These curves are normal & physiological
- Loss or exaggeration → pathology
- ↓ lordosis → muscle spasm, disc disease
- ↑ kyphosis → osteoporosis, Scheuermann disease

✓ Loss of the normal spinal curvature (lordosis or kyphosis) should first raise suspicion of muscle spasm.
 ⚠ However, it should always be considered a diagnosis of exclusion, and fractures, disc pathology, or fixed structural deformities must be ruled out.

Spine anatomy / 2

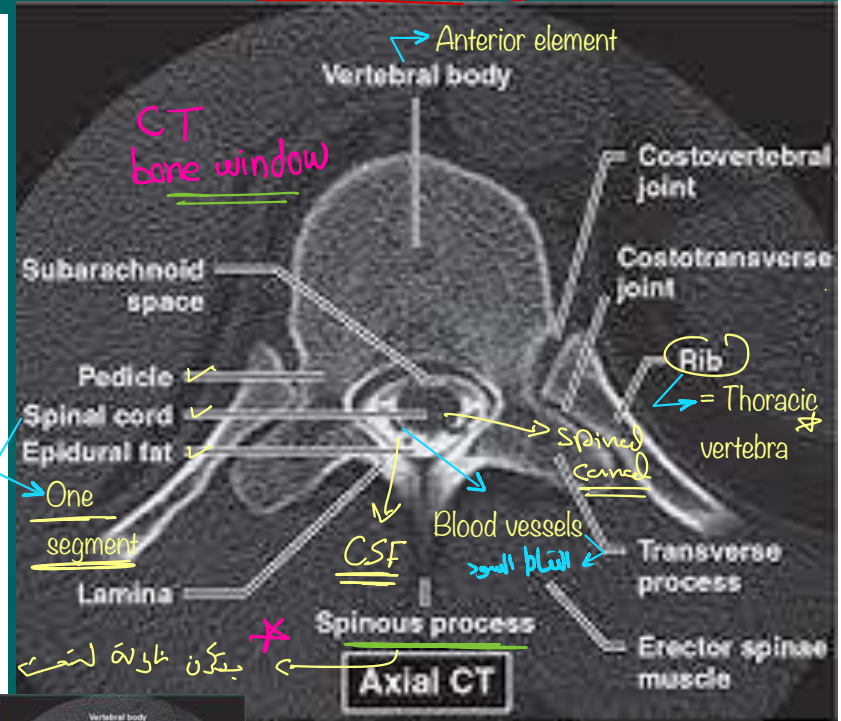
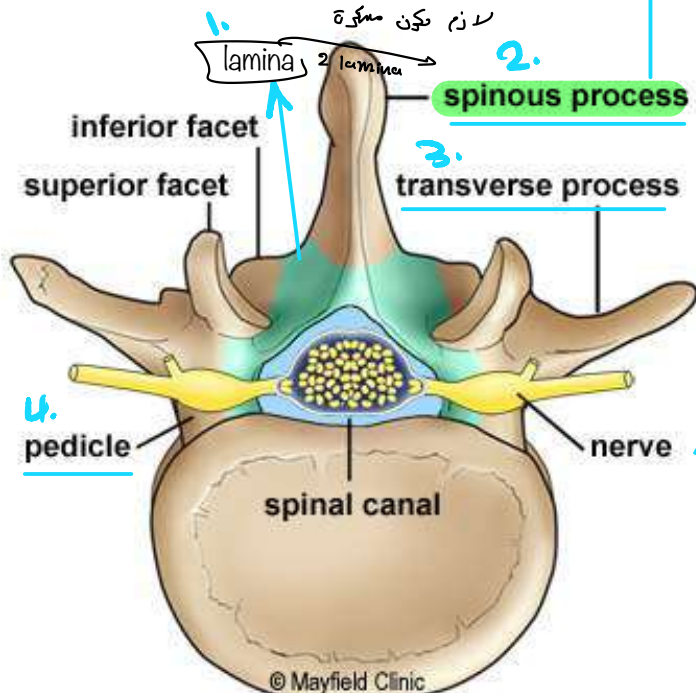
- A typical vertebra consist of two parts:
 - ✧ - Anterior (the body)
 - ✧ - Posterior (neural arch)
- The two parts of the vertebrae enclose the vertebral canal which contains:
 - ✧ - The spinal cord.
 - ✧ - The meninges.
 - ✧ - The associated vessels.

لازم تكون مسكرة اذا كان في defect فيها بتعمل spina bifida الي من خلالها
 ممكن يصير herniation و يعمل meningiocyte or mylomeningiocyte .. و
 بنشوفها على level لتحت من ال vertebral body بتكون نازلة نزول

Posterior element :

Bone window = pathology abnormality in bone

حوالين ال spinal cord لونه ابيض لانه ماخذ
 subarachnoid space بال intrathecal contrast



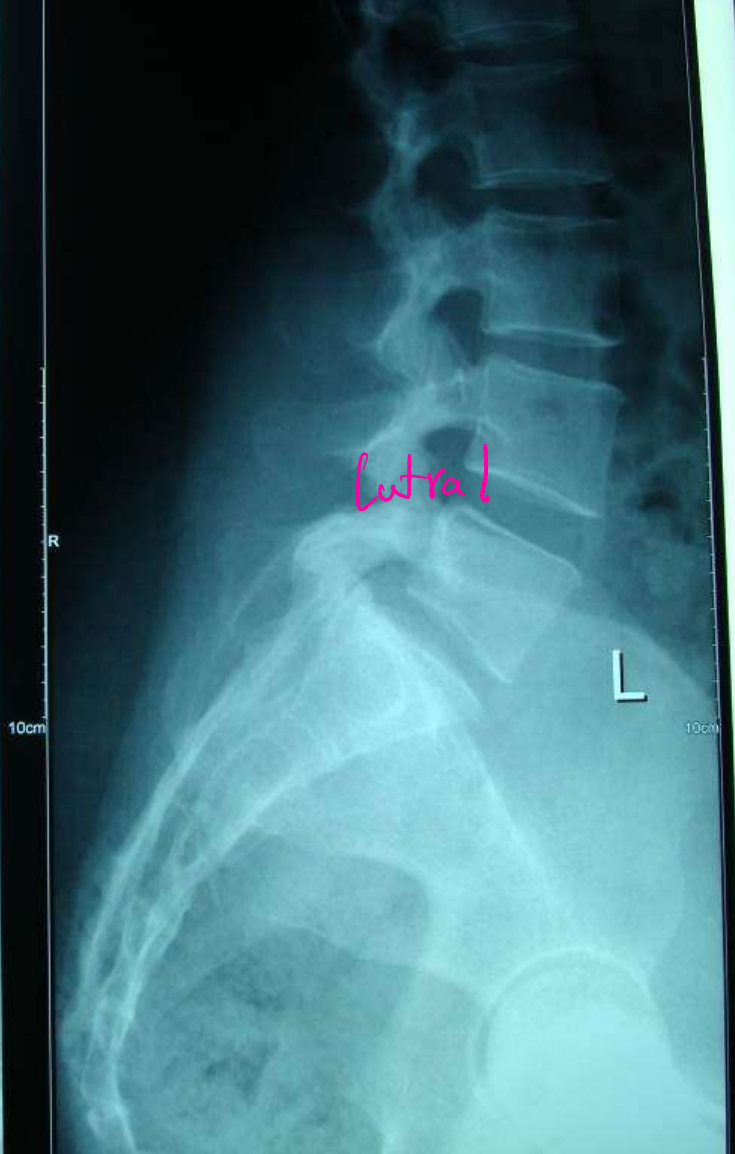
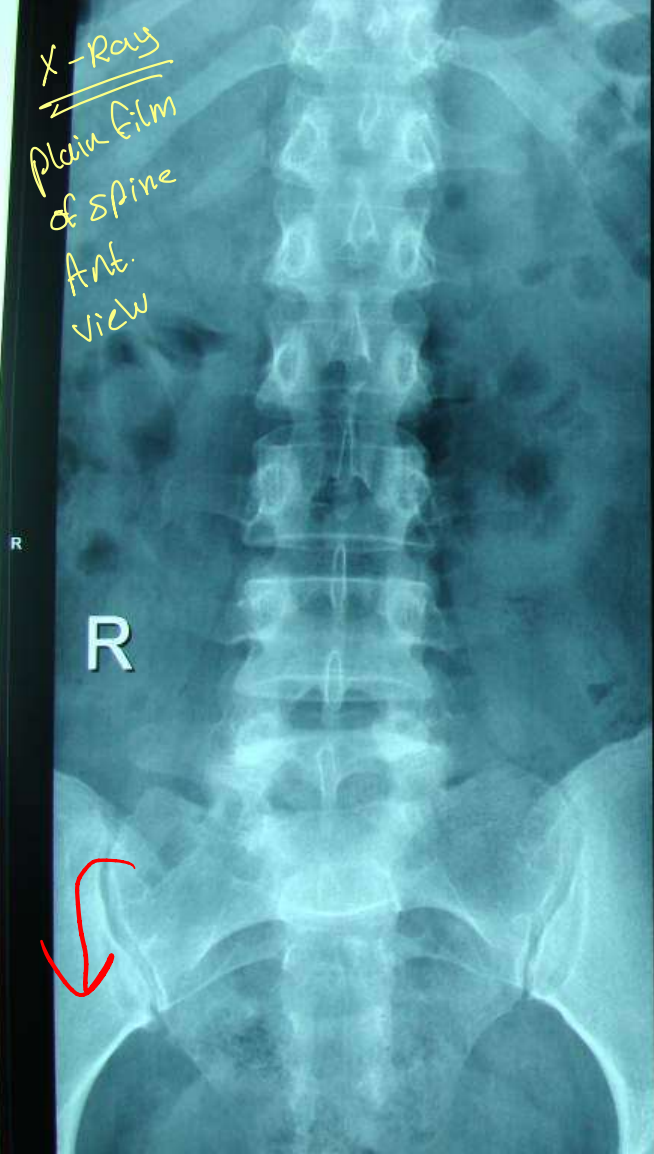
Between posterior and anterior elements

من برة فيها dura جواتها في CSF وجواتها spinal
cord الي حواليه في nerves, blood vessels



McKinnis: Fundamentals of
 Aging, 4th Edition:
 Section.com
 Davis Company. All rights reserved.

X-Ray
Plain Film
of Spine
Ant.
view



Lumbar sacral spine X-ray frontal view

+ بدي اطلع على ال vertebral body
 ولازم يكونوا preserved على كل ال
levels يعني لما اقارنها ب الي فوقها و
 تحتها يكونوا تقريبا the same .. لو
 صار في decrease بال vertebral
 hight معناها في pressure/fracture



Pedicle
 Rib 12
 Spinous process

(اخرومده مرتبعا مع Rib 12)
 ولازم اتأكد انه ال sacral bone موجودة
 لانه في anomalies زي ال sacral bone
 agenesia or dysgenesis يعني ما تكون
 موجود ابدأ او جزء منها موجود
 بتطلع على ال sacro-iliac joint لازم يكون
 preserved spaced و ال edges تعونه
 يكونوا smooth ما في irregularities ولا
 sclerosis الي هم signs of
 osteoarthritis يعني اليا من بزي

Lumbar sacral spine X-ray lateral view

Posterior element
 Vertebral body



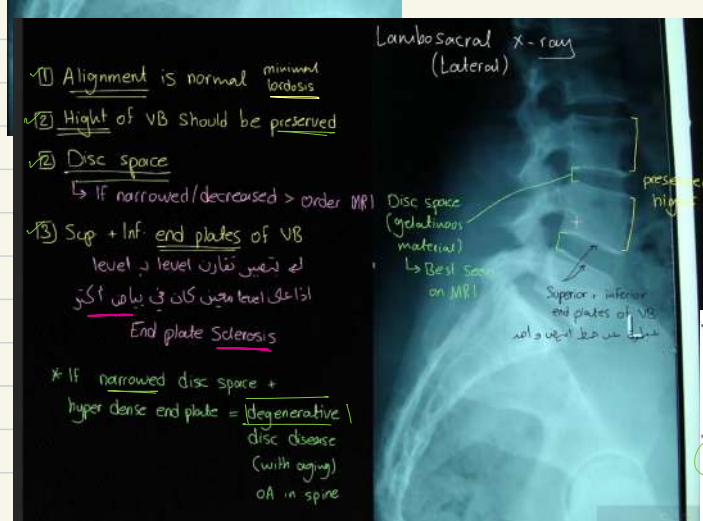
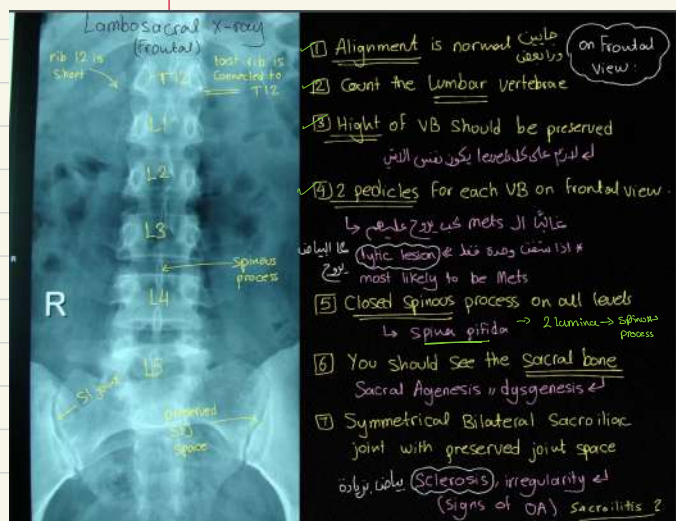
No metrial
 MRI
 Disc space

لازم اقرن ال levels ببعضشان
 نتأكد انه ما في space منهم decreased
 و بهاي الحالة بنطلب MRI

* To check for disc content
 -> by MRI, it is best for
 Soft tissue

لوحمار اقل مسافة
 8 زم اعلق

Space = MRI



- Compression fracture -> collapse of the vertebral body
- vertebral height (often anterior -> wedge fracture)
- Disc spaces are usually preserved
- Decreased disc space suggests disc pathology, not fracture:
- Degenerative disc disease
- Discitis / infection
- Severe chronic collapse

CC Ju ← MO
↓
spinal

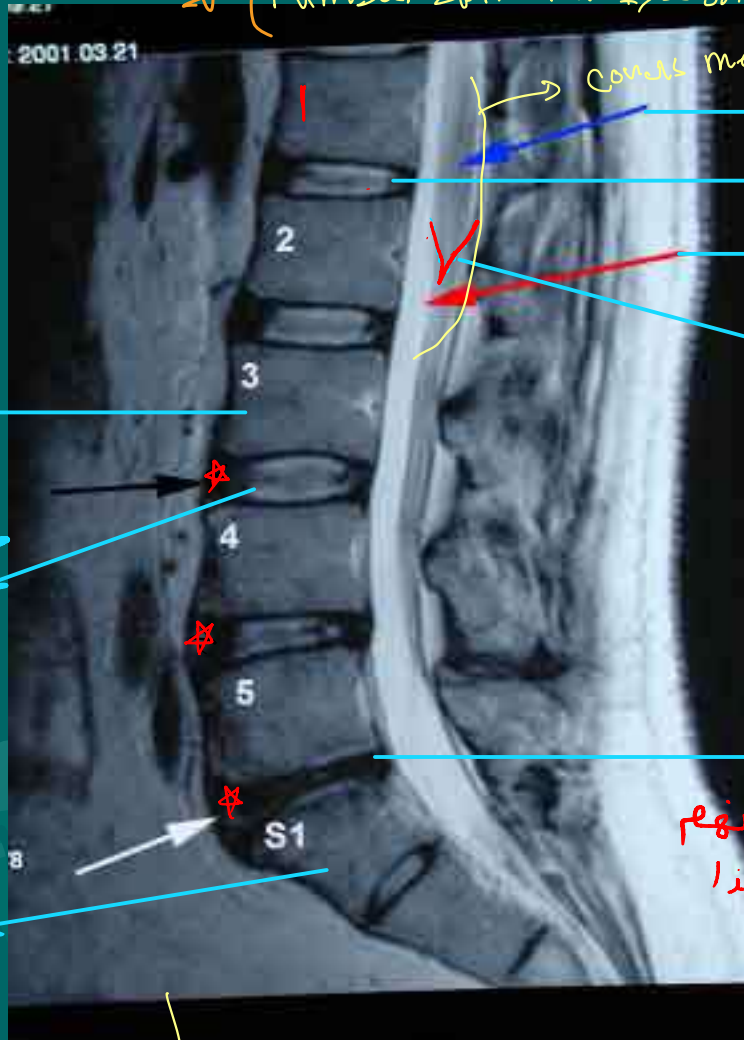
Spinal cord ⇒ MRI

- The spinal cord is approximately 45cm long and descends from the ^{from BS} medulla oblongata at the level of the foramen magnum and terminates at the conus medullaris between L1-L2.
 * Along its course the diameter is the same »
 * tapering occurs at level of L1-L2
- The ^{هذا} cauda equina is formed by the spinal nerves extending from the lowest portion of the spinal cord (conus medullaris).
 * هذا نفس الشيء ←
 * م = tapering end
- The spinal nerves lie free in the subarachnoid space.

* tethered cord يكون عند المريض level of L1-L2 اذا كانت ال conus medullaris بعد ال L2 → lower than L2
 ال spine يكون مشدود ← MRI ← T2 + T1 ← درجته اميليين

→ Lumbar-sacral
 Spinal MRI, sagittal cut, T2 image
 (hyperintense) White CSF
 T1 ← Black *
 لونيات

✱ (Lumbar spin MRI, sagittal, T2)



→ Conus medullaris

→ Spinal cord

→ Disc hyperintense = Fluid = T2

→ CSF

→ Tapering of the spinal cord » conus medullaris

→ lumbar vertebrae ال

بكون شكلها مربعة

→ ال vertebral disc يتكون من شغلتين ال

nucleus pulposus و nucleus anulus ال

يتكون بالنص و هاي مكونة من مني و

جيلاتين ف على ال T2 ببين لونها ابيض

ال تكون normal and healthy

hyperintense

→ ال sacral vertebrae بكون شكلها

زي المثلث و بتكون راجعة لورا

→ Dehydrated disc

* كل اقل فوق لونهم

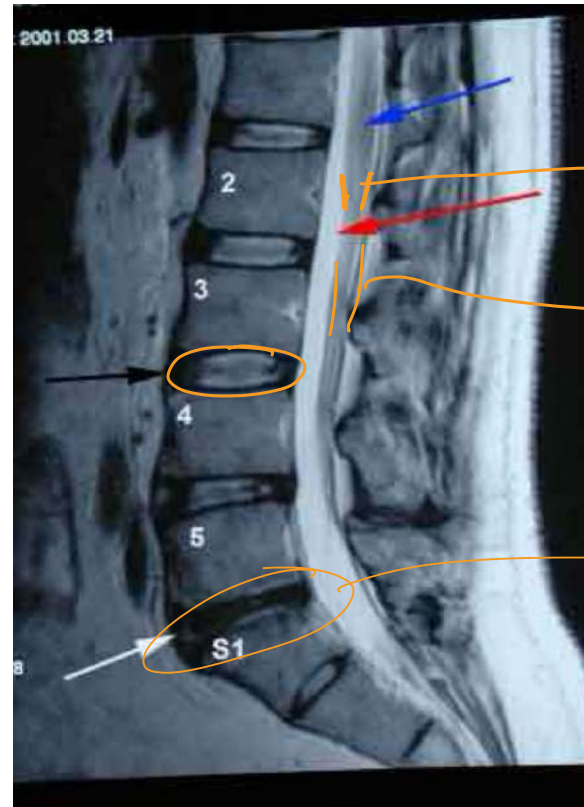
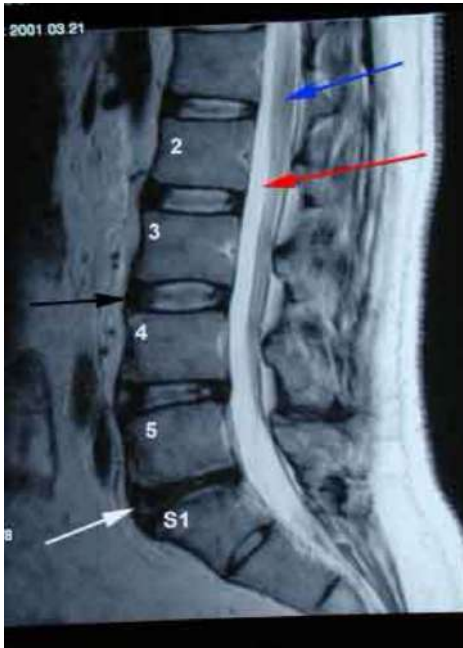
ابيض هذا

اسود

hypointense

Decreased space

✱ يمكن تبين ال UB



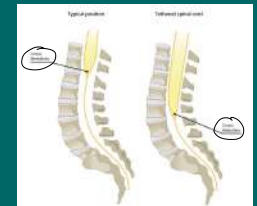
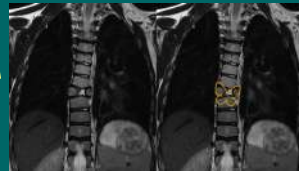
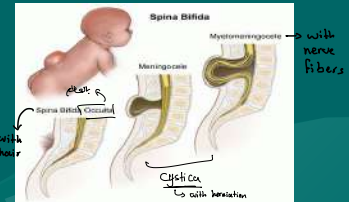
* MRI, T₂, lumbosacral sagittal.

DEVELOPMENTAL ANOMALIES OF THE LUMBAR SPINE

L=4
↑

L=6
↑

- 1 • Sacralization or Lumbarization.
- 2 • Spina bifida. ماسكرته $\square \square$ or $\diagup \square$
- 3 • Synostosis (Block vertebra). = narrow in disc space
- 4 • Hemivertebra. $\rightarrow$ فشل تكون ذبص
ال Vertebra
- 5 • Butterfly vertebra. $\rightarrow$ انقسمت
ال Vertebra الى نصفين
منه يتبعها عرق فقري
- 6 • Myelomeningocele. = bifide + nerve fibers
- 7 • Tethered cord. * ادراجات Conus بعد (L1-L2)
- 8 • Diastematomyelia. 2 spinal cord

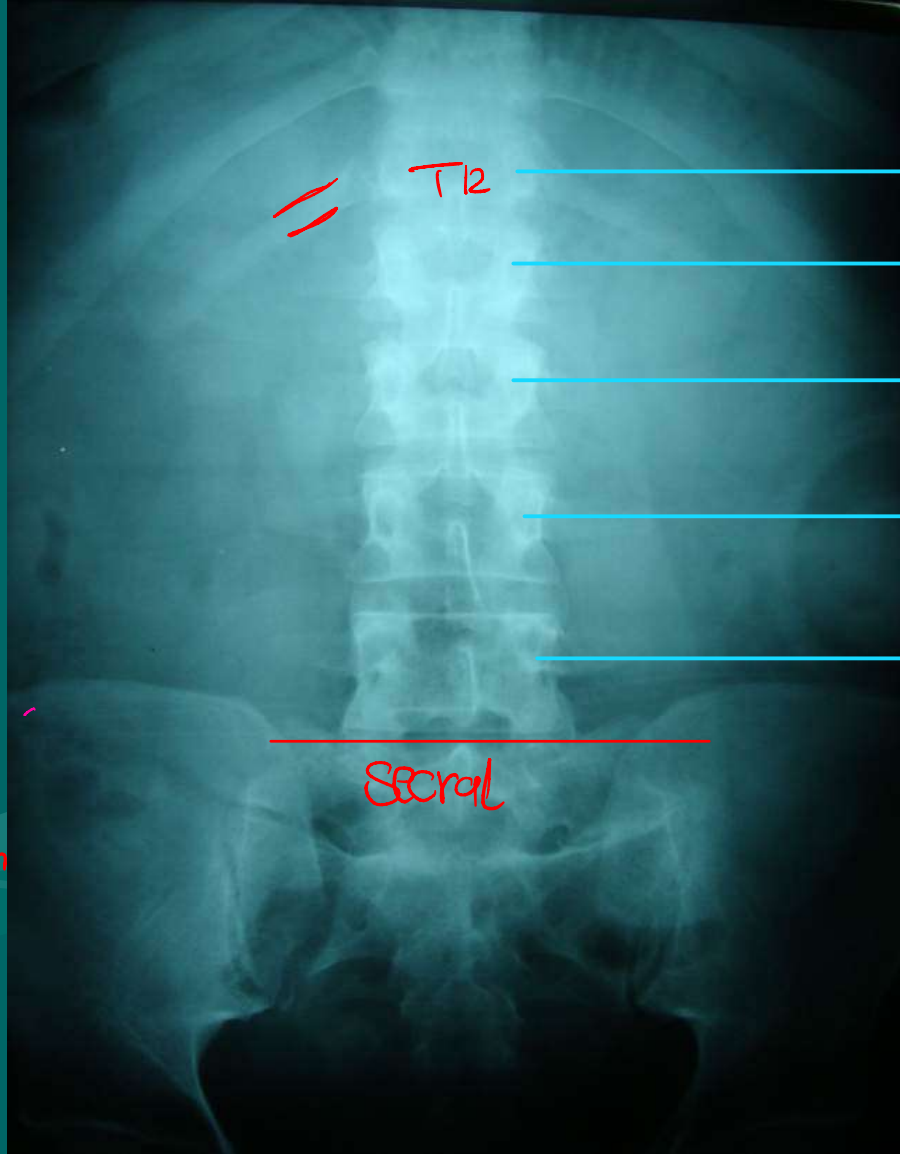


$\rightarrow$ Spinal cord
Split into two
halves



سببها عظم

↳ Lumbo-sacral spine X-ray,
frontal view

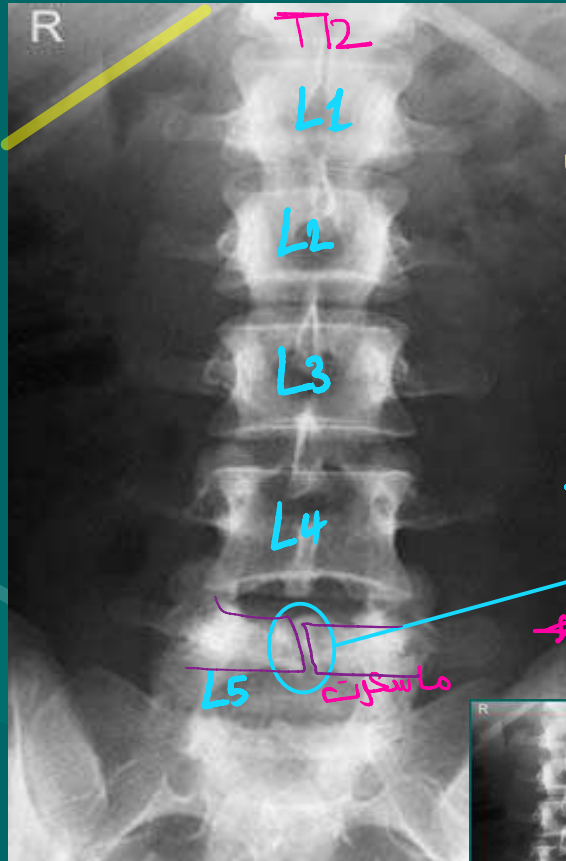


T12 = اصل از ریه
مع ریه
ribs

↳ Diagnosis » sacralization

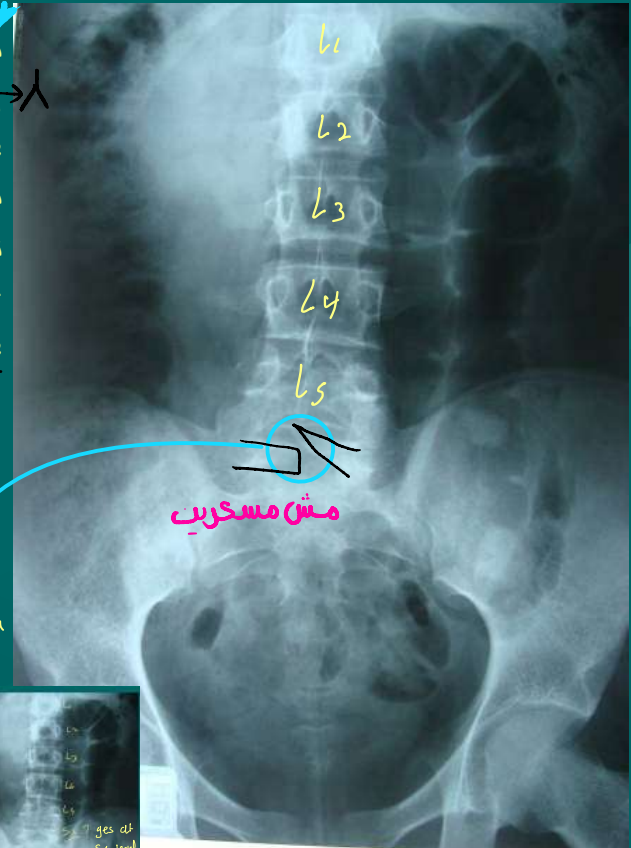
عدد 4 = L مع ریه
یعنی فاصله
ادایه
Sacralization

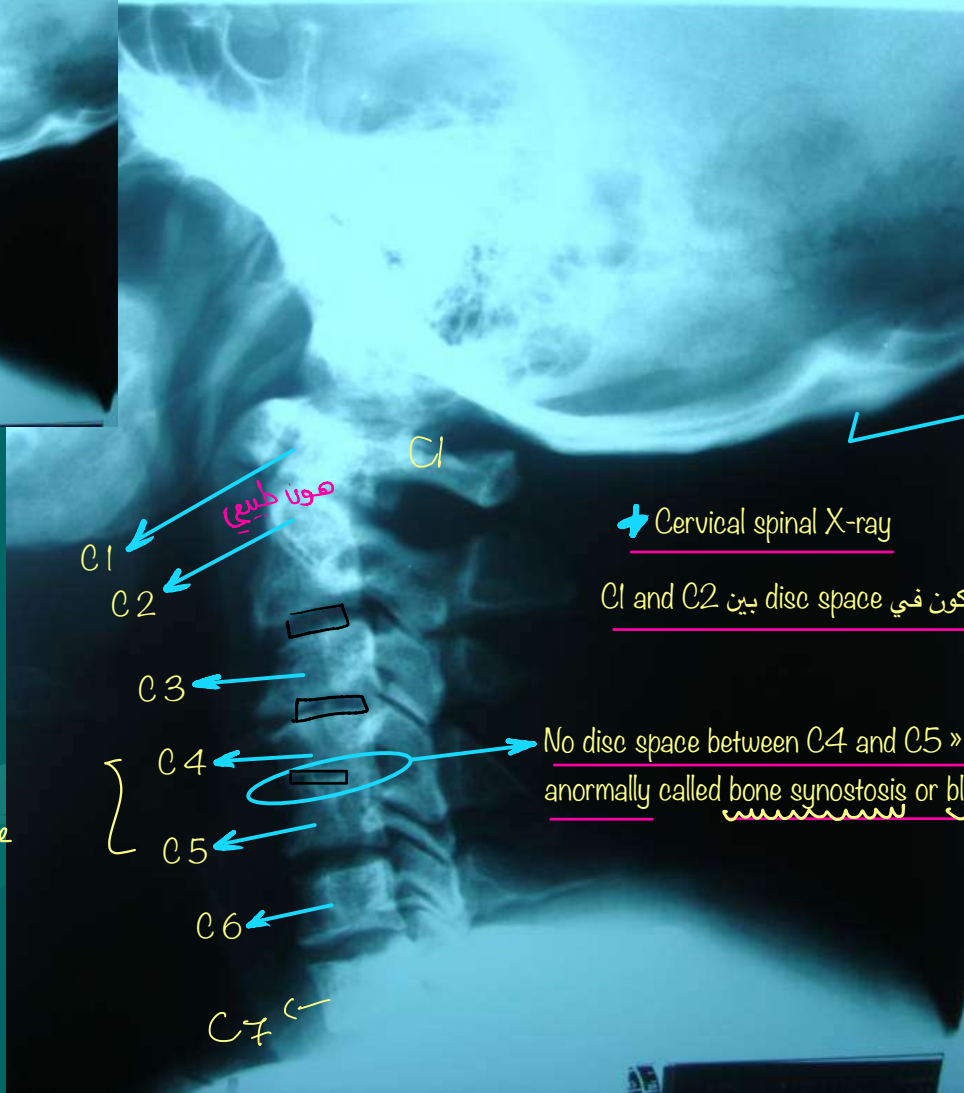
✦ Lumbo-sacral spine X-ray, frontal view



lower بكون عنده
limb weakness ,
urine incontinence
بطلبه MRI عشان
نشوف اذا في
meningiocele or
myelomeningocele

✦ Spinous process
defect » spina
bifida occulta





Occipital bone

➔ Cervical spinal X-ray

➔ طبيعي انه ما يكون في disc space بين C1 and C2

C1
C2
هونا طبيعي

C3

C4

C5

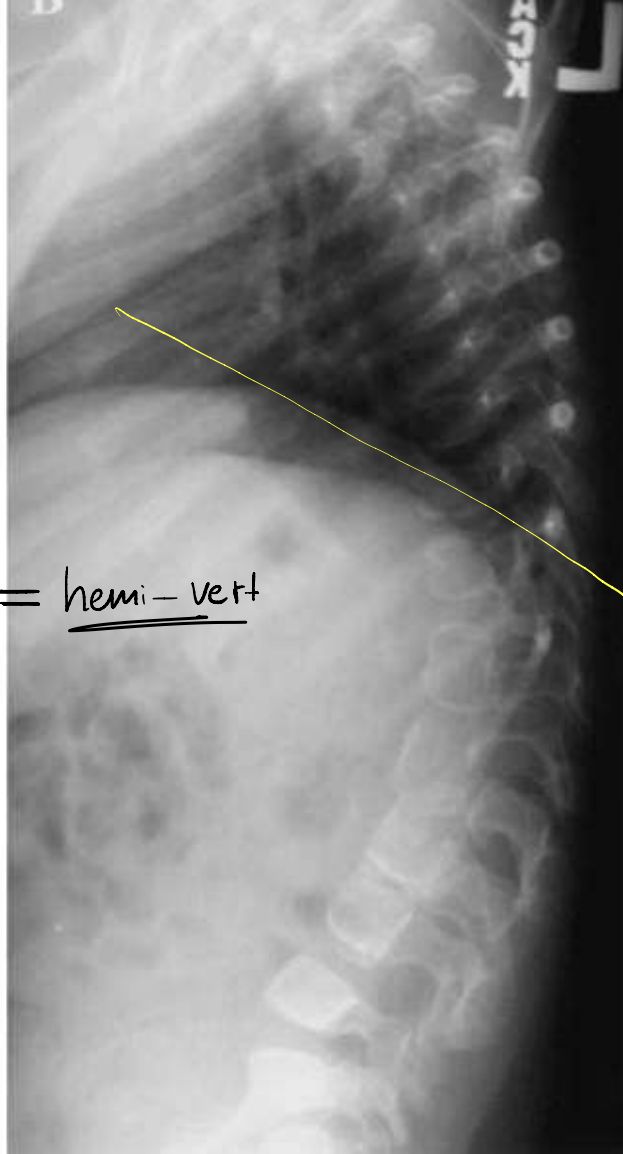
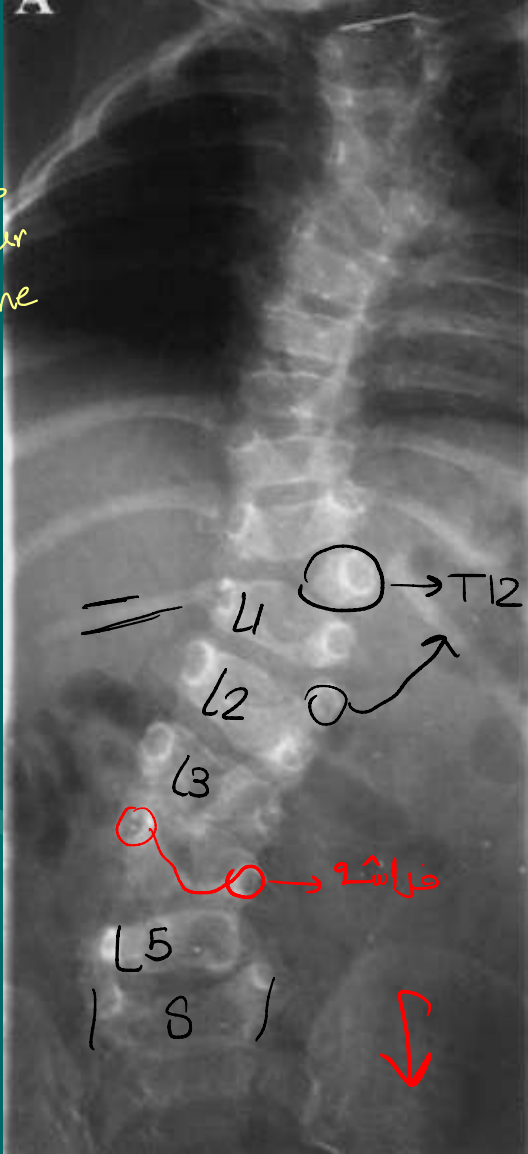
C6

C7

Block
vertebrae

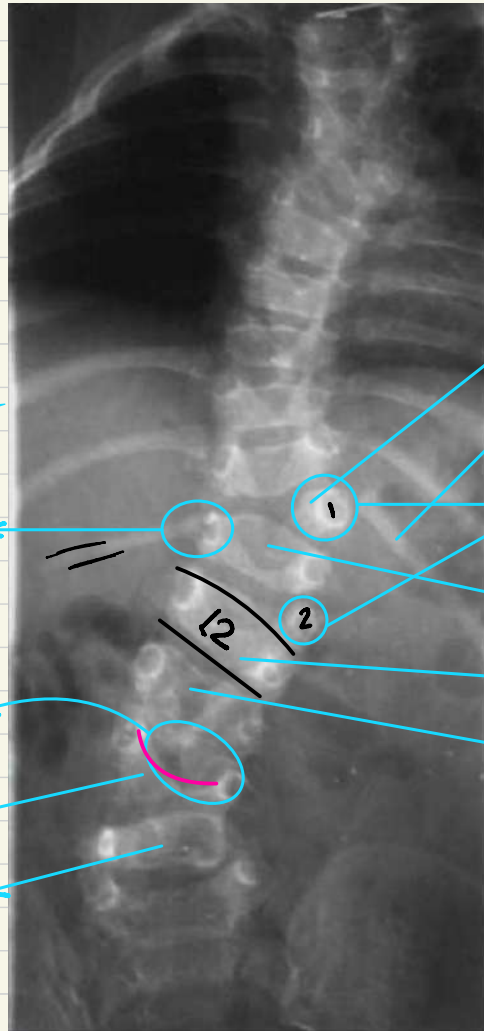
No disc space between C4 and C5 » congenital
anomaly called bone synostosis or block vertebrae

Thoraco
lumbar
Spine



Thoraco lumbar - xray

Lumbo sacral spine X-ray, frontal view



هون لانه T12 جاي hemi- (نص)

vertebra يعني نص وحدة ما

في T12 على الجهة اليمين ف

آخر rib على اليمين مسك ب L1

Butterfly vertebra

L4

L5

T12

Last rib

Hemi - vertebra

L1

L2

L3

1+2=T12

X ray or
CT bone
window

Abnormal alignment of vertebrae » scoliosis



انحراف

Most common cause of scoliosis » deformed shape of vertebral bodies

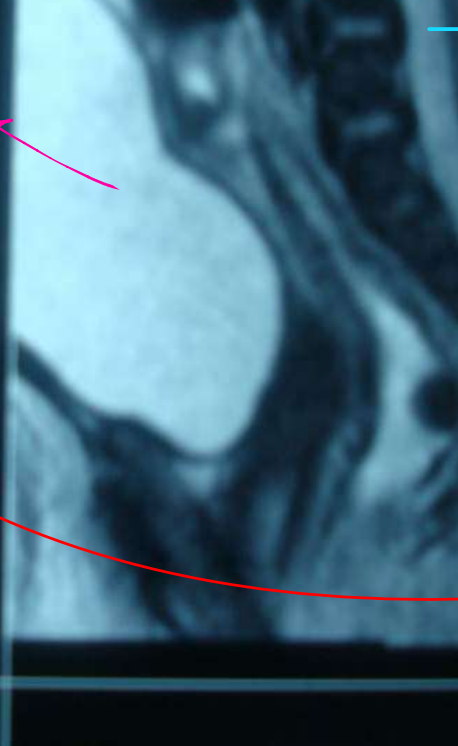
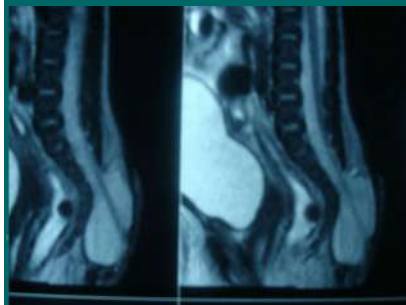
يعني لما يكون في انحراف جانبي للعمود الفقري (مش مستقيم، بيصير مائل لليمين أو اليسار)، هذا بنسميه scoliosis (الجنف).
• Most common cause of scoliosis → deformed shape of vertebral bodies
المقصود إن السبب الأكثر شيوعاً لظهور scoliosis هو وجود تشوه في شكل الفقرات نفسها (vertebral bodies).
مثال: إذا كانت الفقرة وحدة أكبر من الثانية أو مش متناظرة، هذا بخلي العمود الفقري ينعوج بدل ما يضل مستقيم



only one half
of vertebra

failure of two
halves become
together

butterfly
vertebra



→ Lumbo-sacral spine MRI,
sagittal cut, T2 image

CSF ⇒ hyper

→ Spinal cord

→ CSF » white

→ Posterior element
مش مغطي ال
spinal cord كامل

bladder
وتلته امينا T2

→ Herniation
→ due to spina
bifida »
defect in
posterior
element

→ Nerve » myelomeningocele

* Black lines » nerve fibers

Tethered Cord
 LL weakness ✓
 Urine incontinence ✓
 بيشي عاى عر صغرى ✓

L1 ← مربعة

Sacral → مثلثة

L2 ←

L3 ←

L4 ←

L5 ←

* S1 ←

A

بالش يمين

قونا مغروطين L1-L2

مثلثة

→ Lumbo-sacral spine MRI, sagittal cut, T2 image

CSF → ابيض

→ CSF » white

→ Tapering of the spinal cord

→ Diagnosis » tethered cord

لويحات اقدم من L2

Conus medullaris
 نهاية الـ
 →

copy



➡ Spinal MRI, axial cut, T1 image

Vertebral body

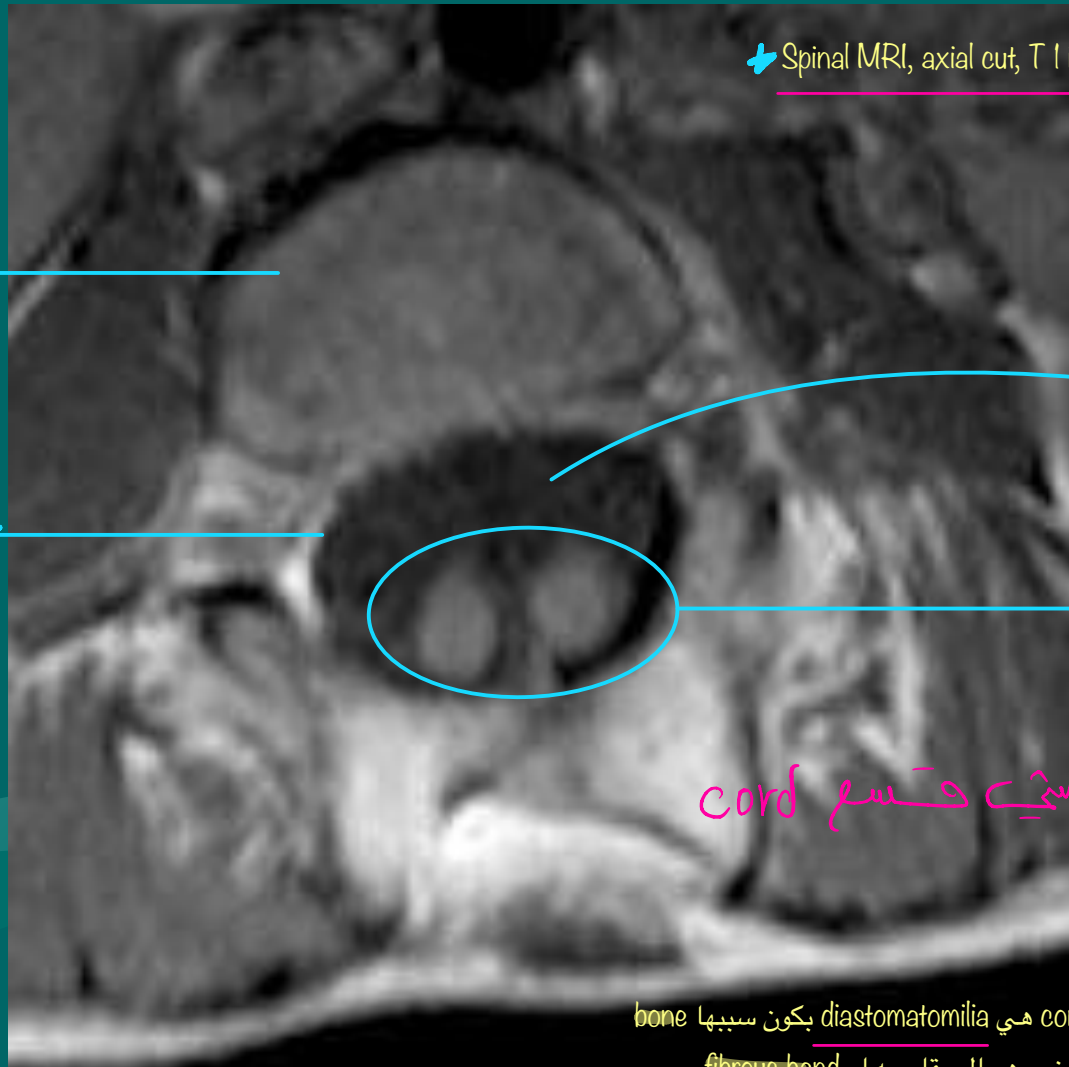
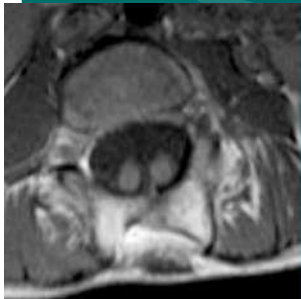
Spinal canal

✗
CSF » black

✗
2 spinal
cord
segments »
hemi-cords

استئصال قسَمِ cord

➡ اسم ال condition هي diastomatomilia بكون سببها bone
spare يعني العظم هو الي قاسمه او fibrous band



SPONDYLOLISIS AND SPONDYLOLISTHESIS

ما بييجي بالامتحان لانه صعب تميز كسر كتير صغير

كانو يدكوعنه
congenital
كسر

What is spondylolysis ?

- Is a defect in the region of the pars  pedicle  مكان قريب من ال interarticularis of a vertebra, most commonly at the fourth and fifth lumbar level.
- This defect which was considered to be a congenital abnormality, is now thought to be almost always the result of unhealed stress fracture.

?WHAT IS SPONDYLOLISTHESIS

بالاصحاح

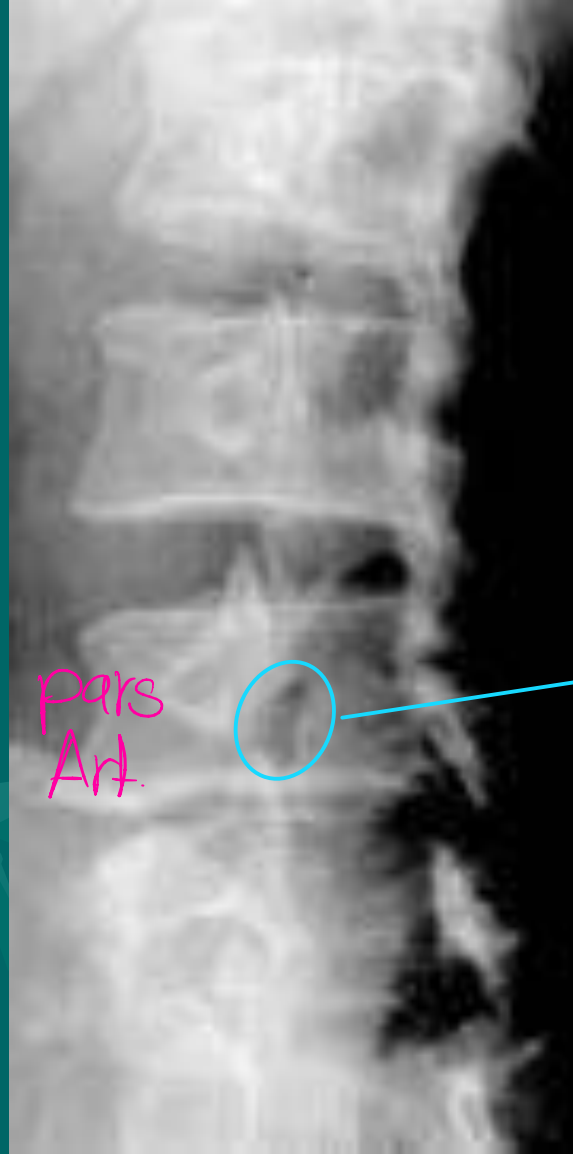
Fracture + زلزاله

Is anterior slipping or subluxation of a vertebra (or the spine above) in relation to the vertebrae below.

The main causes of spondylolisthesis are:

- Spondylolysis, is the most common cause
- Degenerative disc disease and osteoarthritis of the facet joints.
- Fracture of the posterior elements of the vertebra

* Btwn
pedicle and
vertebral body.



هاي الصورة مش true
oblique lateral
(zoomed photo)

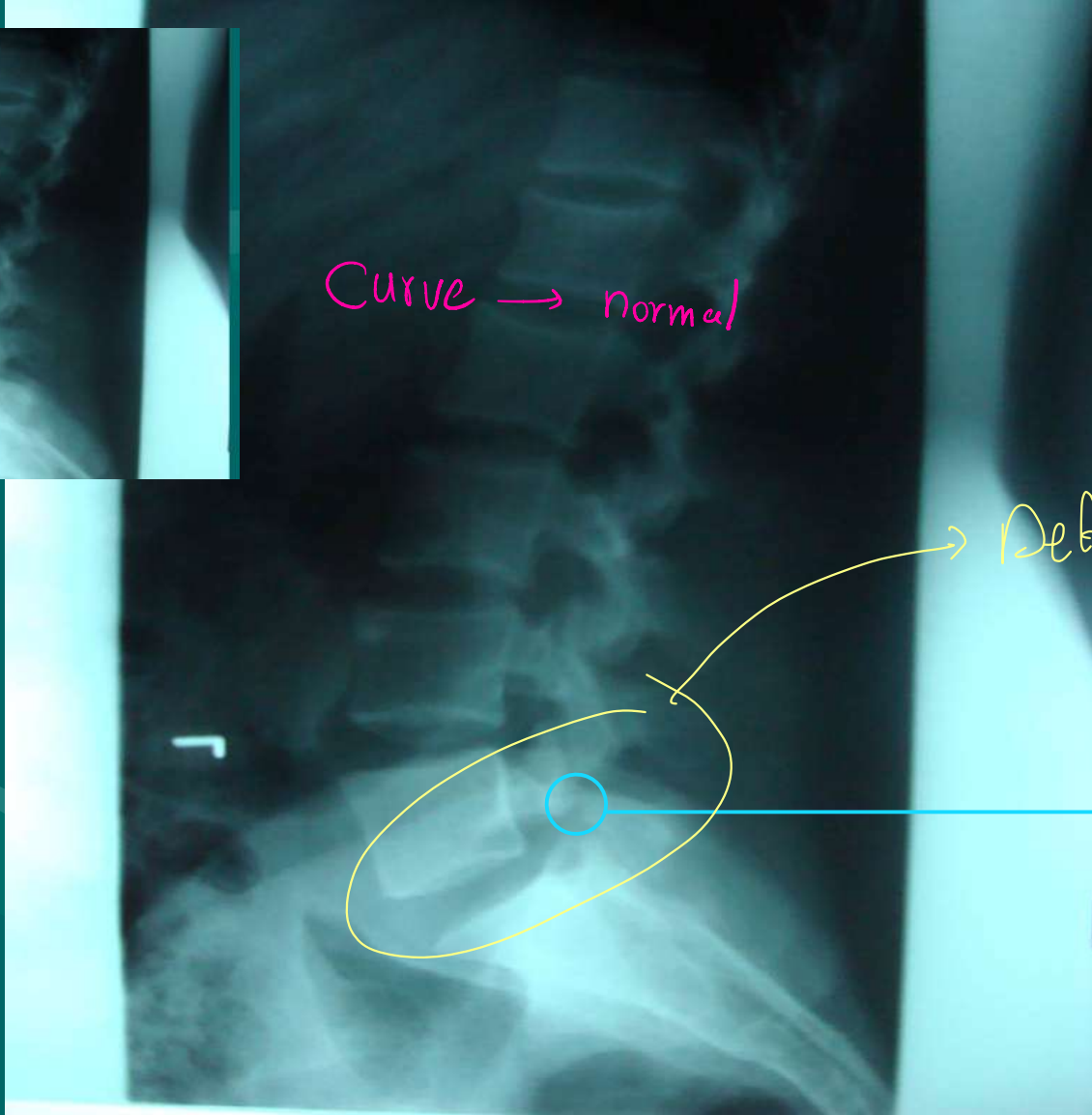
pars
Art.



Fracture » spondylolysis



Curve → normal



Defect

Fracture »
spondylolysis



Anterior displacement

متردد
الجزء
post

L1

L2

L3

L4

L5

S1

Fracture

L3-L4

Lith

5 80

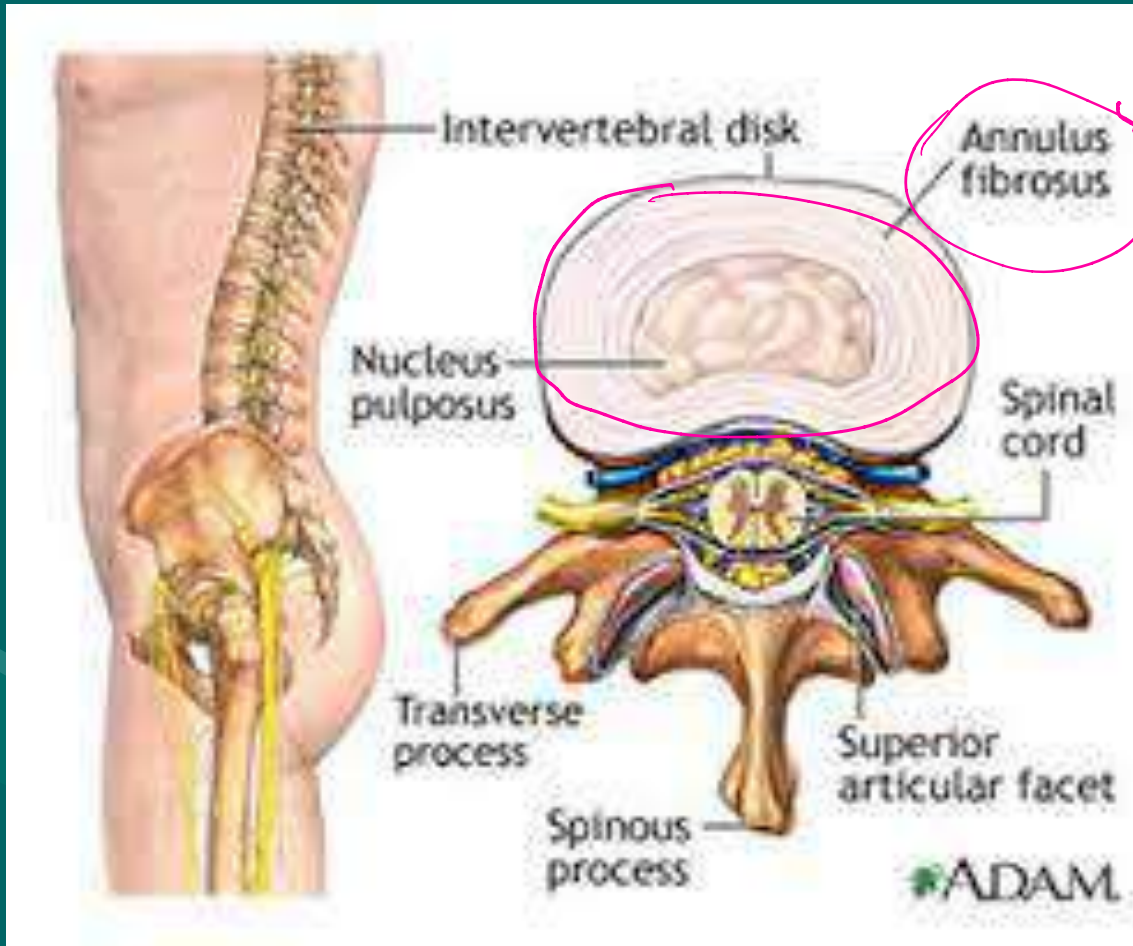
* Spondylo
thesis
btwn L3
and L4
~

INTERVERTEBRAL DISC PATHOLOGY

- The intervertebral disc which lies between each two vertebral bodies is composed of a central gelatinous core known as the nucleus pulposus and surrounded by fibro cartilage called annulus fibrosus.
- Most common articular disorders :
 - ❖ Degenerative disc disease. → جميع عصب
بسر نخلة
 - ❖ Disc bulging and herniation. → الفقر مس
عنه
 - ❖ Infection. → life style
بس كلنا رج نوبل آله

* OsteoArthritis

✚ Vertebral disc normally is kidney shaped



DEGENERATIVE DISC DISEASE

By x-ray

- ❖ Is not really a disease but a term used to describe the natural degenerative changes in the intervertebral discs.
- ❖ Disc degeneration is part of the natural process of aging, and is one of the most common causes of low back pain.

□ The DDD is characterized by:

- Disc space narrowing. شوینشوت ۹
- Osteophytes formation at the vertebral body margins. bone spurs
- Subchondral bone sclerosis (mainly at the end plates). خنک ایمن
- In some cases, collection of gas is seen in the intervertebral disc (vacuum disc phenomenon). زاد "سیمک"

هون مافي

★
Osteophytes formation

Narrowing of disc space
بالدمع

↑ زادياني
Sclerosis

بالوضع الطبيعي يكون
خط ابيض رفيع



DISC HERNIATION

* انزاع غضروفی

۳۸۴ MRI

- The herniated disc is a portion of the nucleus pulposus extends through a tear in the annulus fibrosus, resulting in a focal protrusion at the margin of the disc. خلاف
- About 90% of disc herniation occurs at L4-L5 and L5-S1, with most of the remainder at L3-L4. ↓

Types of disc herniation:

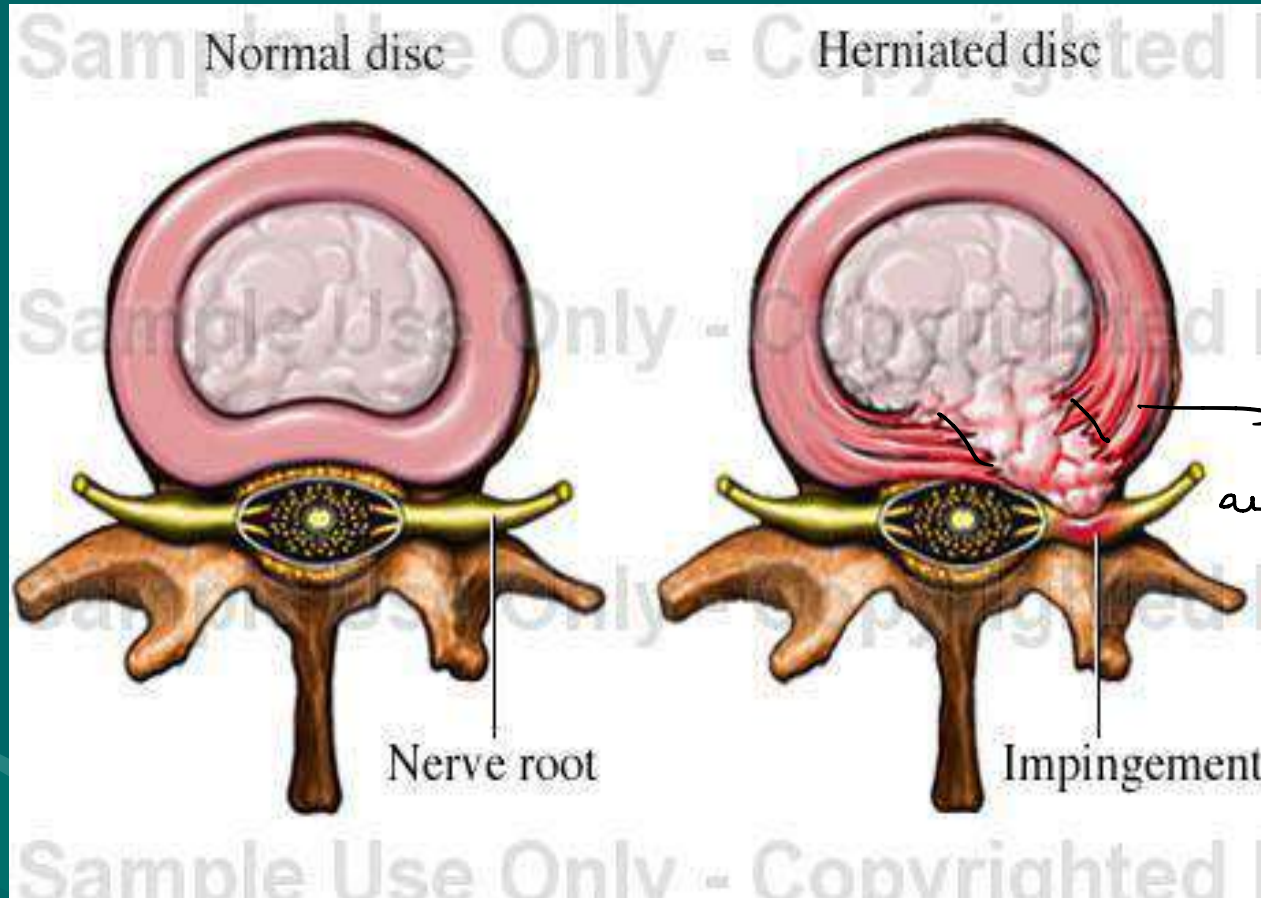
لومبار اسپاندیلولیت

۱۷ علی ای

✓ Prolapse.

✓ Extrusion.

✓ Sequestration.



بس نخكي مي bulge → Axial + sagittal cut

DISC PROLAPSE

✚ Tear is partial

The herniated nucleus pulposus extends through a tear in some of the annular fibers, but still confined by the intact outer most annular fibers

★ DISC EXTRUSION

Sagittal + Axial

- The herniated nucleus pulposus penetrates through a complete tear of the annulus fibrosus.

- The extruded disc material may extend superiorly or inferiorly, but remain attached to the parent disc.

↑ superior
↓ inferior

Disc herniation

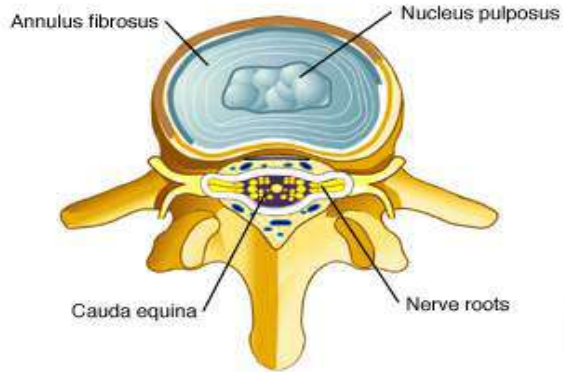
بالتفصيل

DISC SEQUESTRATION

)Free fragment (

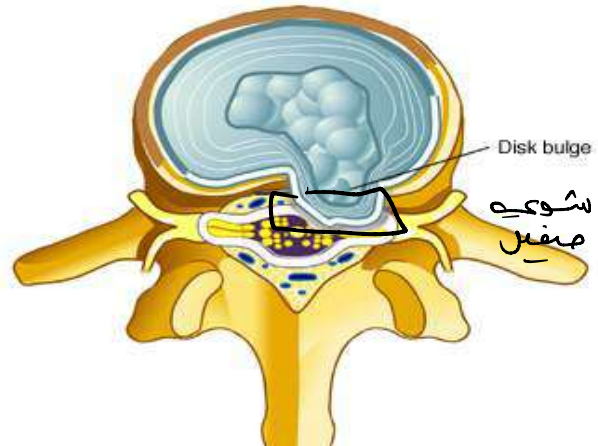
- The disc herniates through a complete tear and penetrate the posterior longitudinal ligament and lies within the epidural space.
- The herniated disc breaks free of the parent disc and can migrates superiorly or inferiorly within the epidural space or into the neural foramen as a separate fragment.

Disc اسود اسود
stable wire

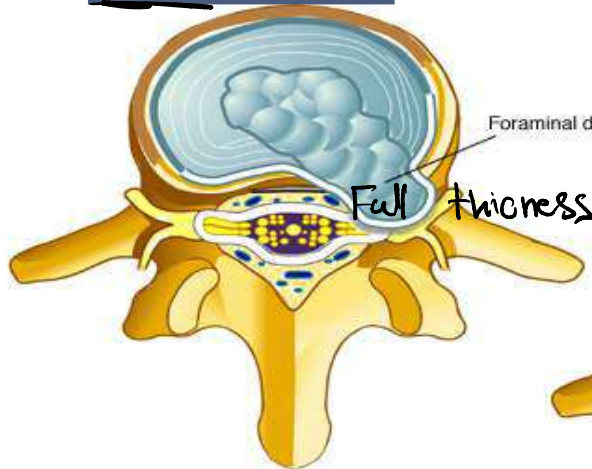


dise

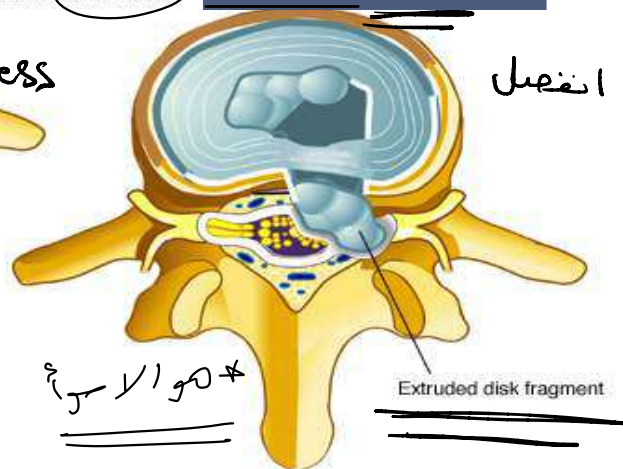
Prolapse » partial tear



Extrusion » complete tear



Sequestration » free segment





MR 2004V HFS +LPH
STUDY 1
10-Oct-06
14:08:22
2 IMA 8 / 1

Lum1 - spinal
MRI
T₂

L1-L2
hydratation
vertebrae

37



Avanto 330968
MR 2004V HFS +LPH
STUDY 1
10-Oct-06
14:08:22
2 IMA 9 / 1

hyperintensity

over

* Disc
herniation

10cm MF 1.09

E TR 4000.0
P R4.0 TE 113.0
SL 4.0 TA 03:13
00*300 BW 190.0
2*320s M/ND
ra(1.1)
A3/SAT1
C:SP2-5
*tse2d1_25 / 150

Disc herniation / plain film →

Can plain film be used to diagnose disc herniation ?

★ NO → Disc مایه → No soft tissue

Then why are plain films routinely ordered for patients with low back pain ?

Plain film is essential and may reveal the presence of one of the common causes of back pain such as:

- Degenerative disc disease. ✗ narrow disc space
- Sacralization / lumberiz-
- Facet joint osteoarthritis.
- Spondylolisthesis.
- Neoplastic disease.

bone lesion
sclerotic
نشان

(1) xray
(2) MRI
+ neural defect

LUMBAR SPINE TUMORS

Can be classified into two groups:

1- Bone Tumors. → MSK

2- Spinal Canal Tumors. →

× Contant

× gaw usao

TUMORS OF THE SPINE

1- Tumors of bone

- Hemangioma of Vertebral body.
- Osteoid osteoma
- Osteoblastoma
- Aneurysmal bone cyst
- Histiocytosis x (Eosinophilic granuloma)
- Multiple myeloma
- Metastasis

Tumors of the spinal canal

صفحة

✧ - Intramedullary: occur inside the cord

✦ Ependymoma ✓

✦ Spinal cord will be expanded

DD of C

✦ Astrocytoma ✓

✦ Lipoma ✓

✧ - Extramedullary-intradural:

✦ Spinal cord will be compressed

Occur within the meninges covering the spinal cord:

✓ neurofibroma and schwannoma

✓ Meningiomas

✓ Dermoid and epidermoid

Tumors of the spinal canal /2

سابسي X

ماديا

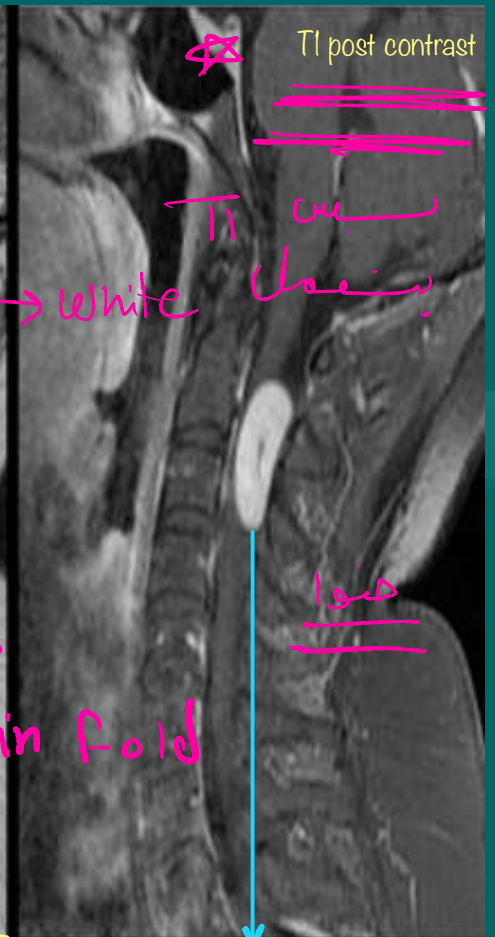
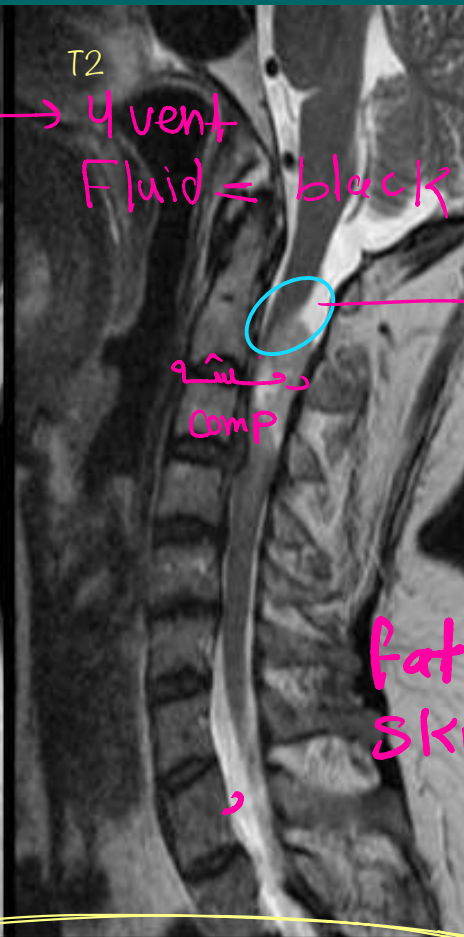
* - Extradural:

Appear between the meninges and the bones of the spine:

o Metastasis:

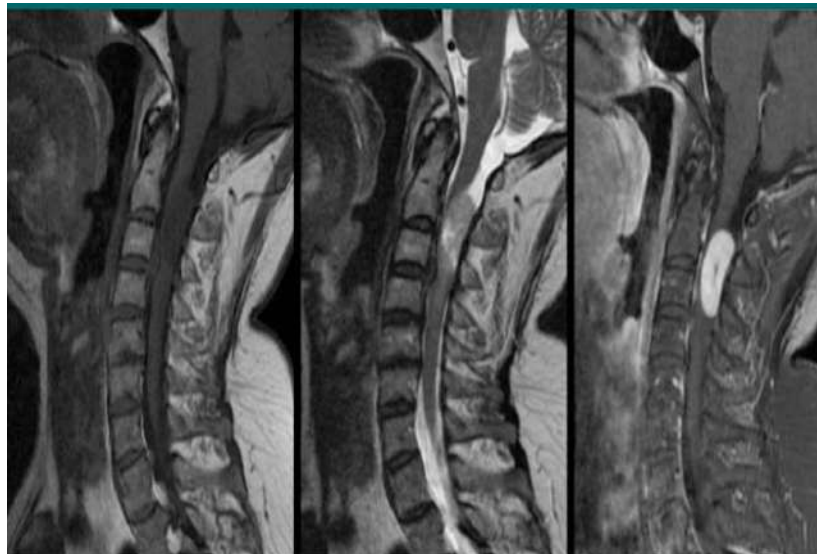
o Meningiomas / Lymphoma

★ Cervical spine MRI,
sagittal view, T1

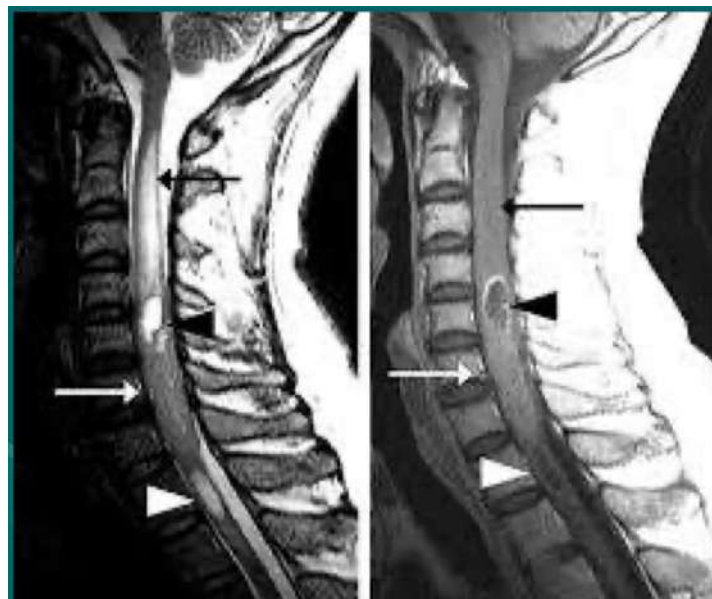


★ Compressed cord » extra- medullary intra-dural tumor
★ Avid enhancement » meningioma
Cervical Spinal sch → كلها دهنوا ايدي

Copy



Cervical Spinal schwannoma.



* Cervical spine MRI, sagittal view, T2

T1 post-cont.

* Com or Expand

قارن مع normal

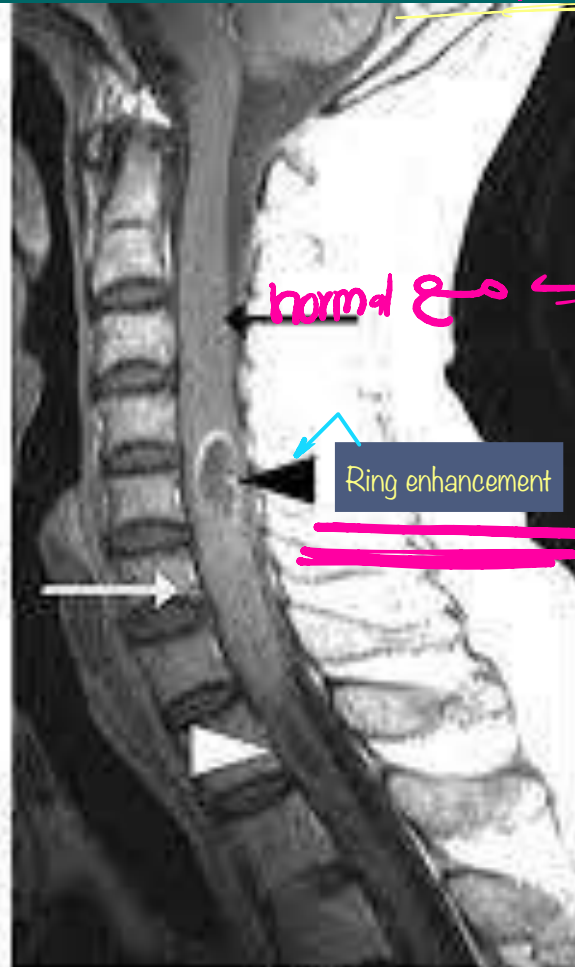
Ring enhancement

* Expanded cord »
intra-medullary

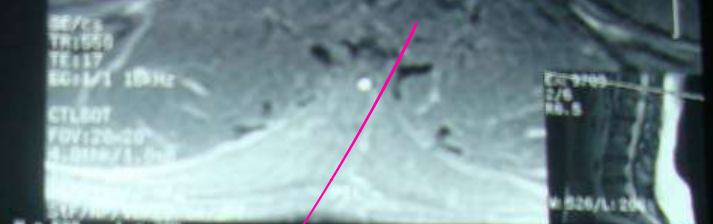
T1
Post
Contrast



(a)



(b)



X

SECURITY FORCES HOSPITAL - BIVAN,

ES HOSPITAL-RIYADH
BOHEM 3000000

50 M 010072

17/12/05

10:09

 $MF = 1.5$ $MF = 1.5$

1



1

10



10

1

100

10

15

54

1

1

11

11

TAI-RIYAN

IBRAHIM

0 M 6168

17/12/0

10:1

MF: 1.

extradural

ص. ١٤

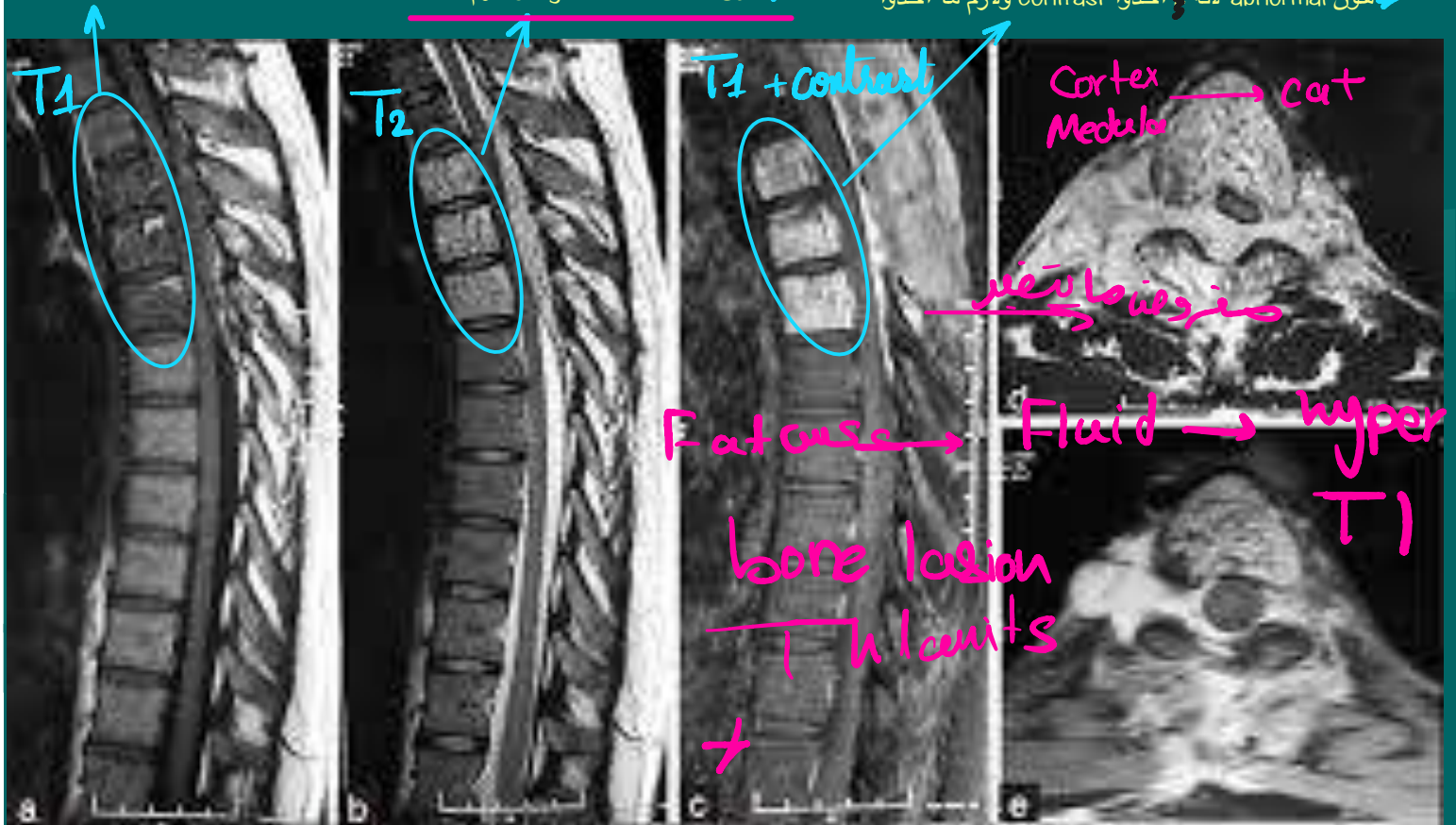
meningioma
tail

fat و بنشوف ال cortex الي هي الخط الاسود .. الطبيعي على T1 يكون high و على T2 يكون ~~high~~ low و ما ياخذ contrast

• هون abnormal لاته low و لازم high

➡ هون abnormal لانه high و لازم low

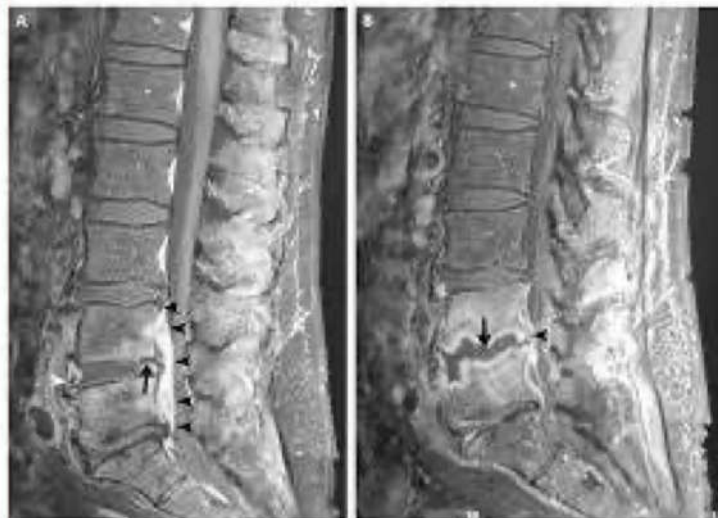
➡ هون abnormal لاته ، اخدوا contrast ولازم ما اخدوا

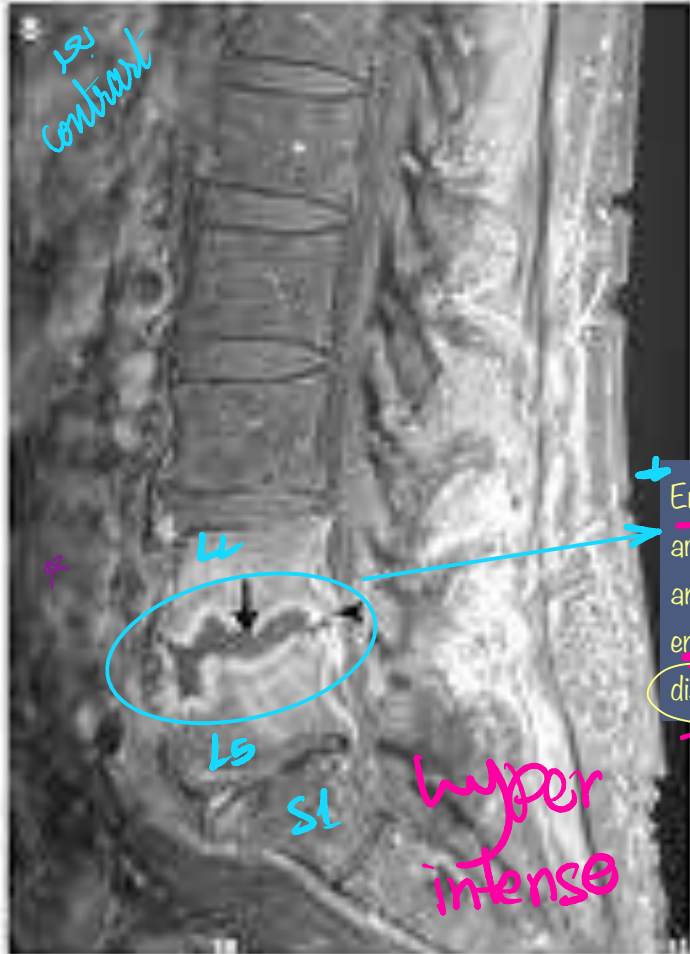
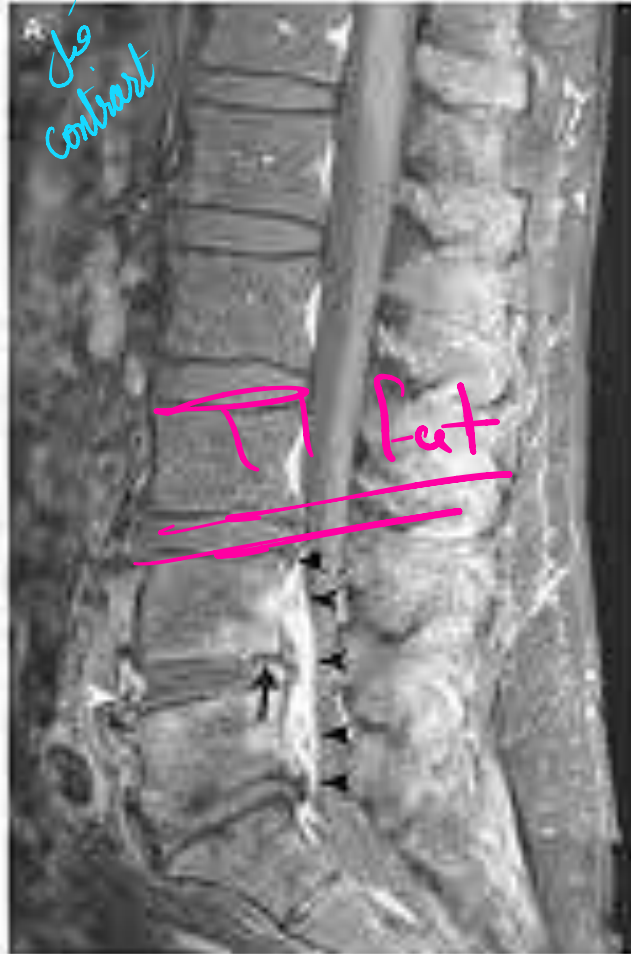


copy



copy





End plates
are irregular
and
enhanced »
discitis

Inflammation
destruction
of the shape.