

Cervical Spine – Alignment



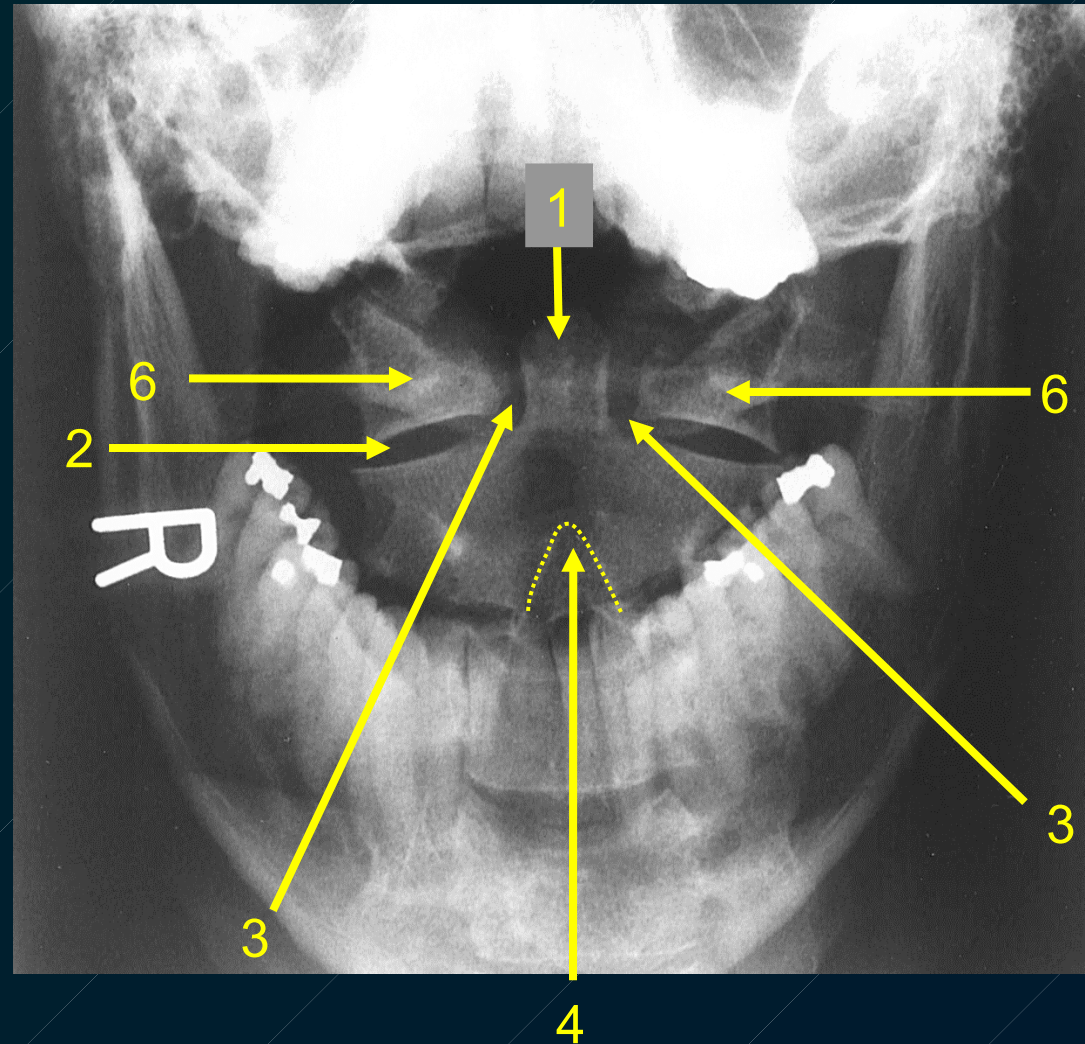
Spinal Digitizer
Biomechanical Measurements
By

Tariq J. Faridi, Intern – Loma Linda University – Fall

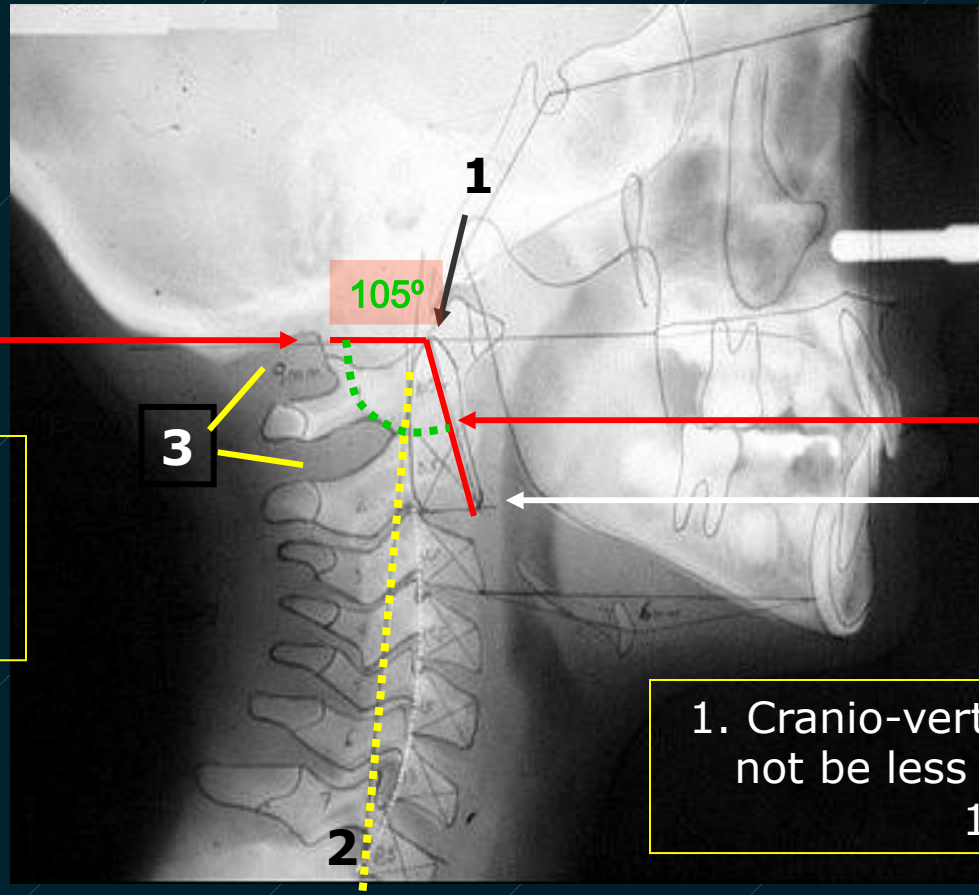
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Coronal Plane Alignment

1. Are the atlanto-axial facet joint spaces of equal height?
1. Is the dens symmetrically placed between the lat. masses of atlas?
1. Is spinous process of C2 centrally located?
1. Are the lateral masses of Atlas of equal height?



Sagittal Alignment a Cephalograph



McGregor plane

Odontoid plane

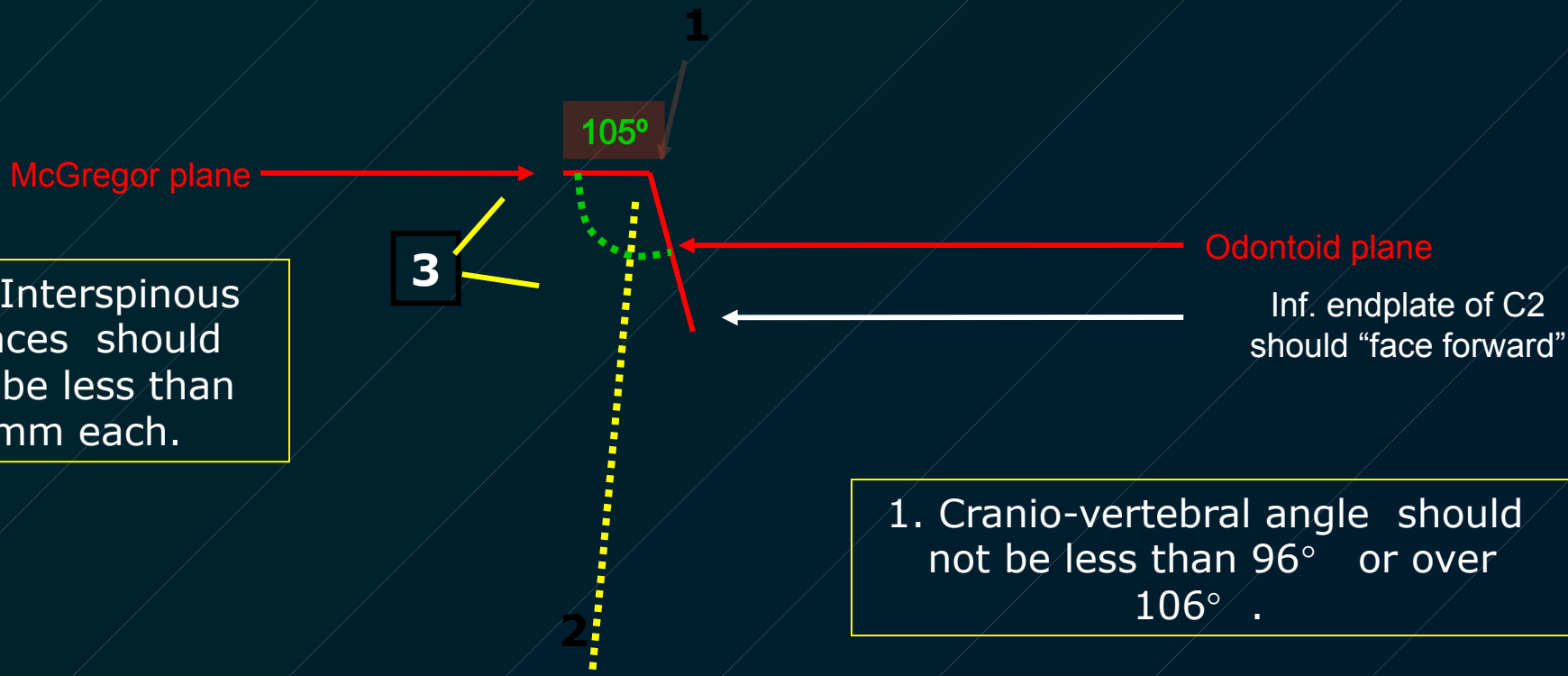
Inf. endplate of C2
should "face forward"

3. Interspinous
spaces should
not be less than
8mm each.

1. Cranio-vertebral angle should
not be less than 96° or over
 106° .

2. Line drawn between posterior borders of C2-C7
should fall behind all cervical vertebrae bodies

Sagittal Alignment a Cephalograph



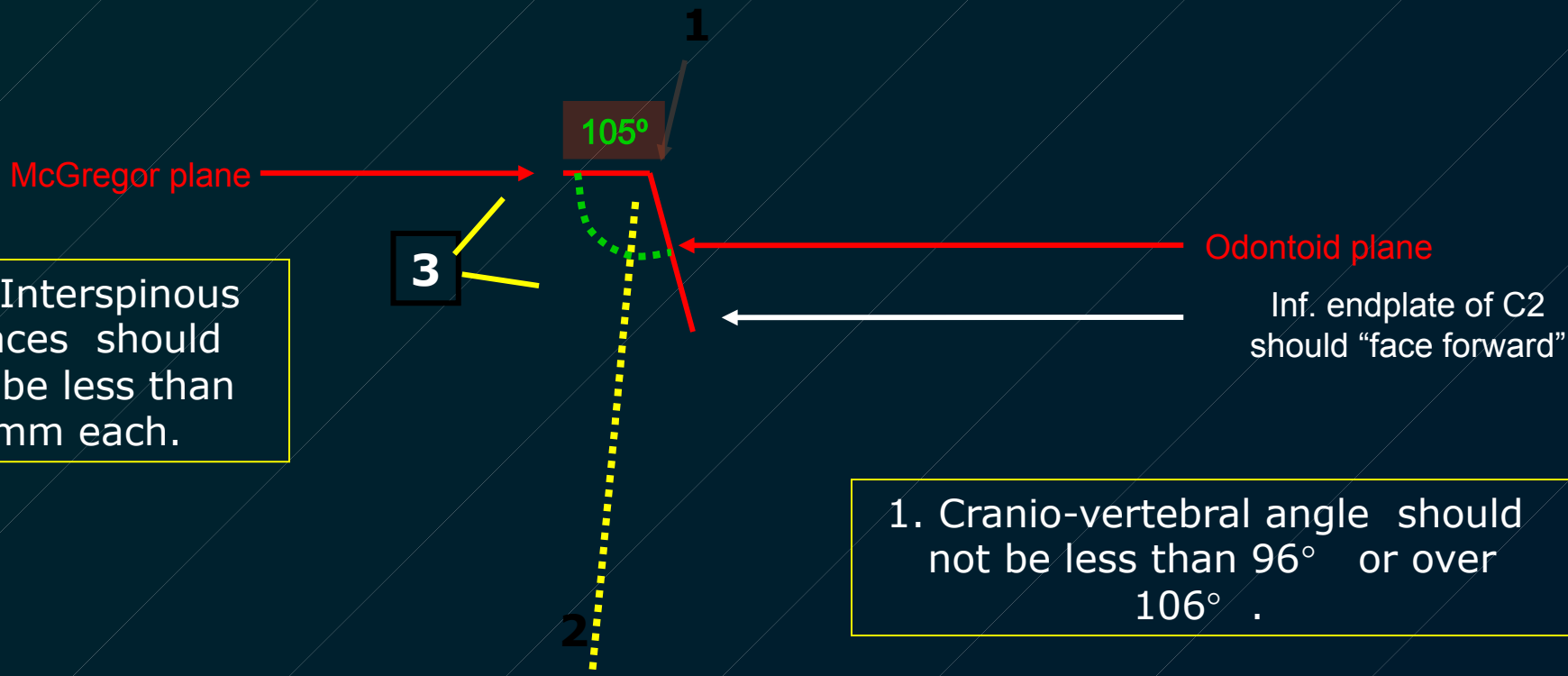
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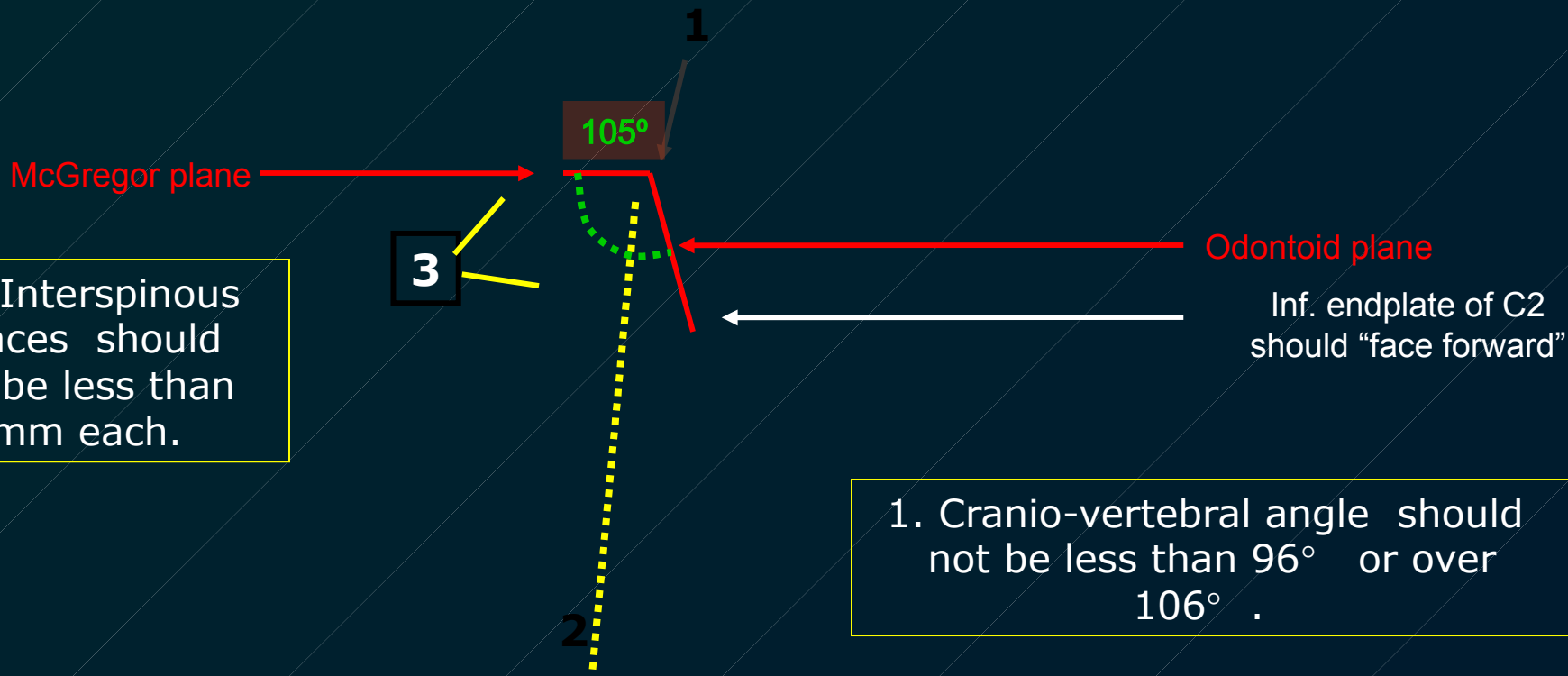
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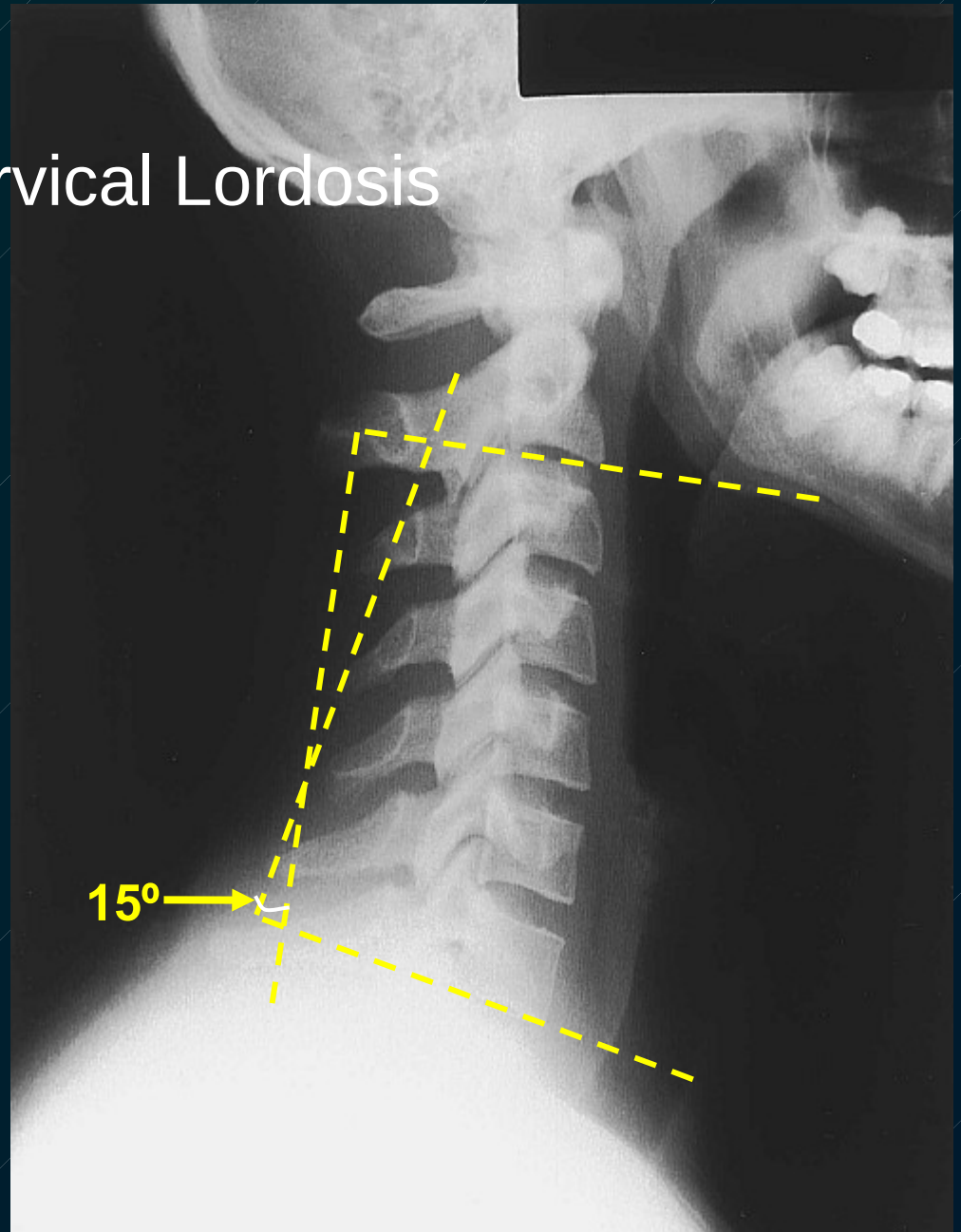
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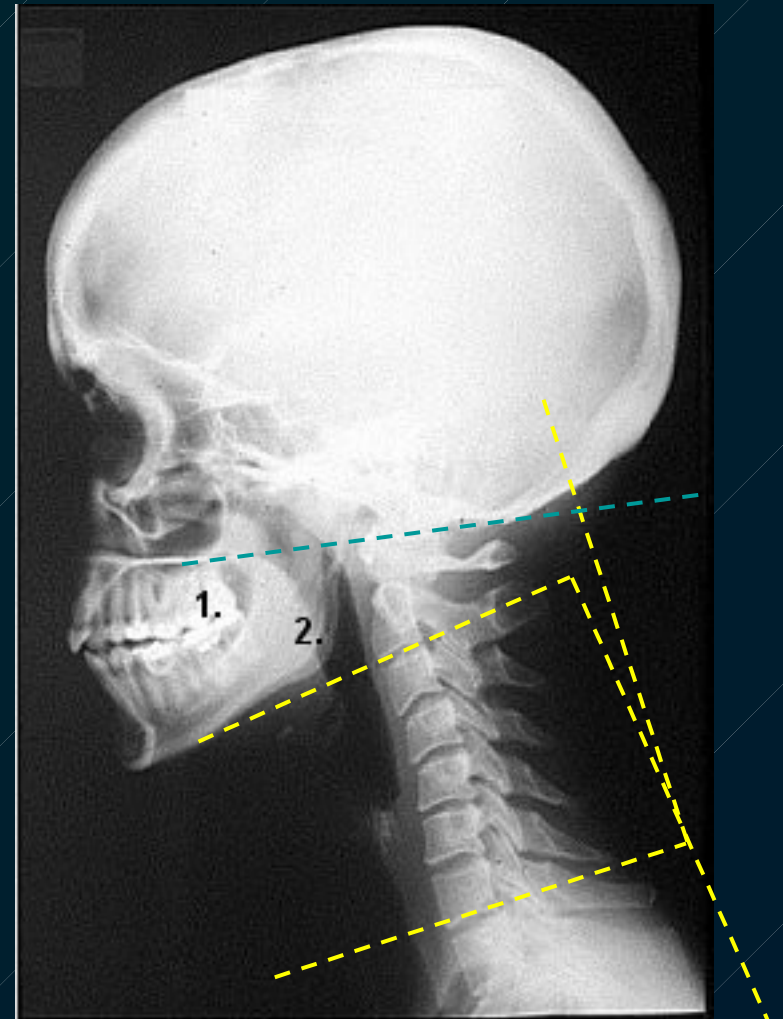
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Cervical Lordosis

Cobb Method
(norm= 30°)

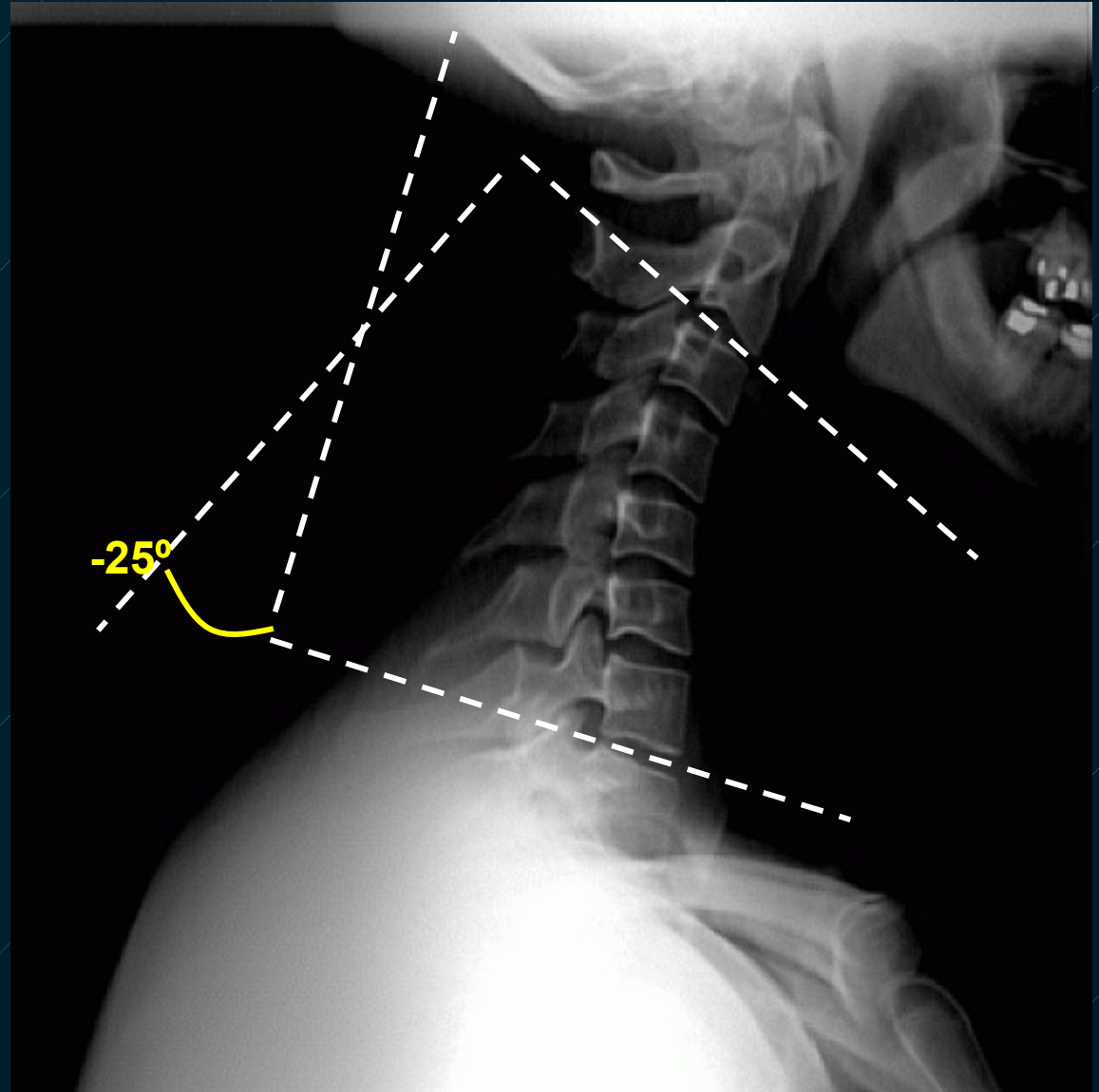


Significance of Inferior Endplate of C2,

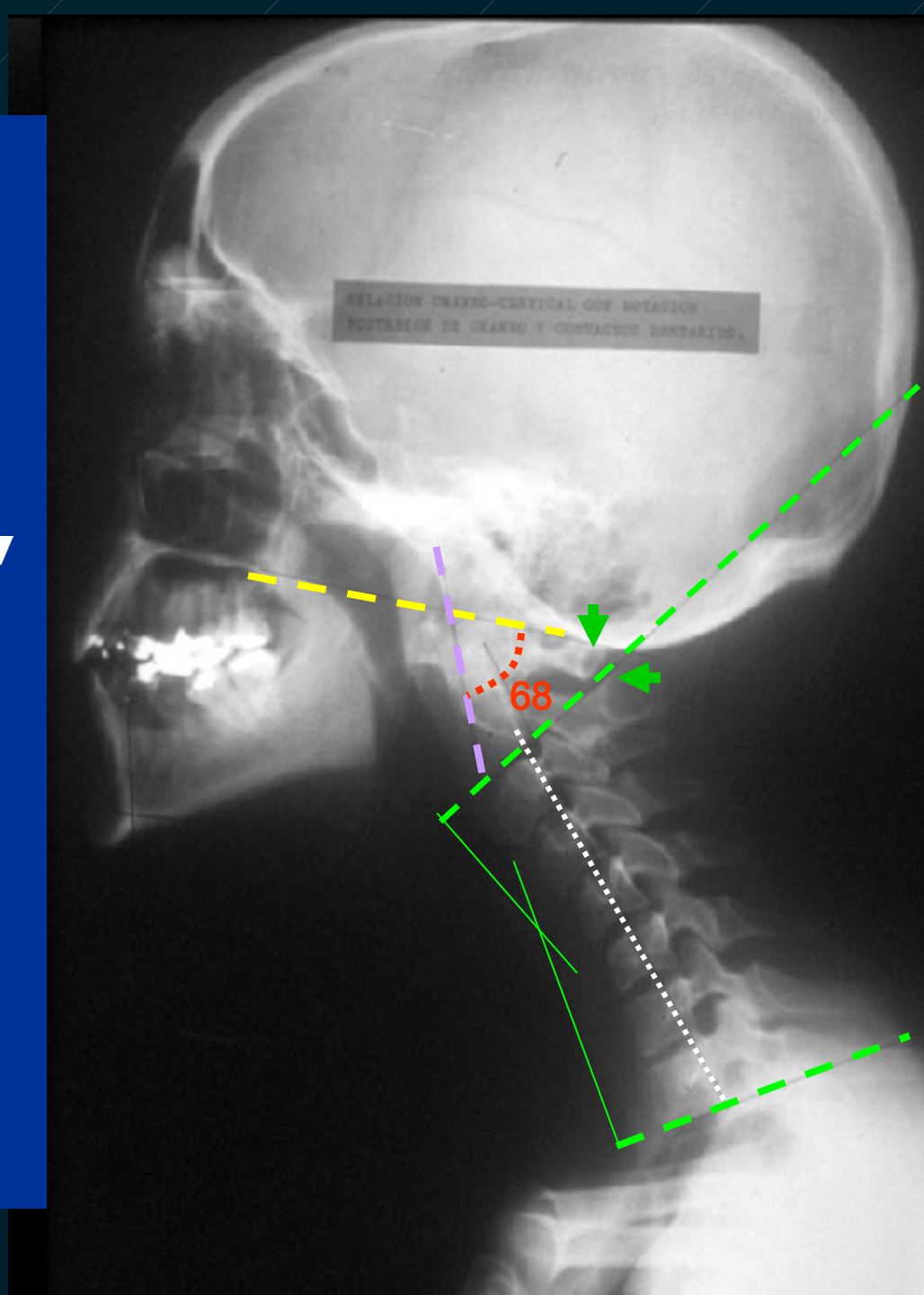


According to Cobb Method ; a Kyphosis of 8°

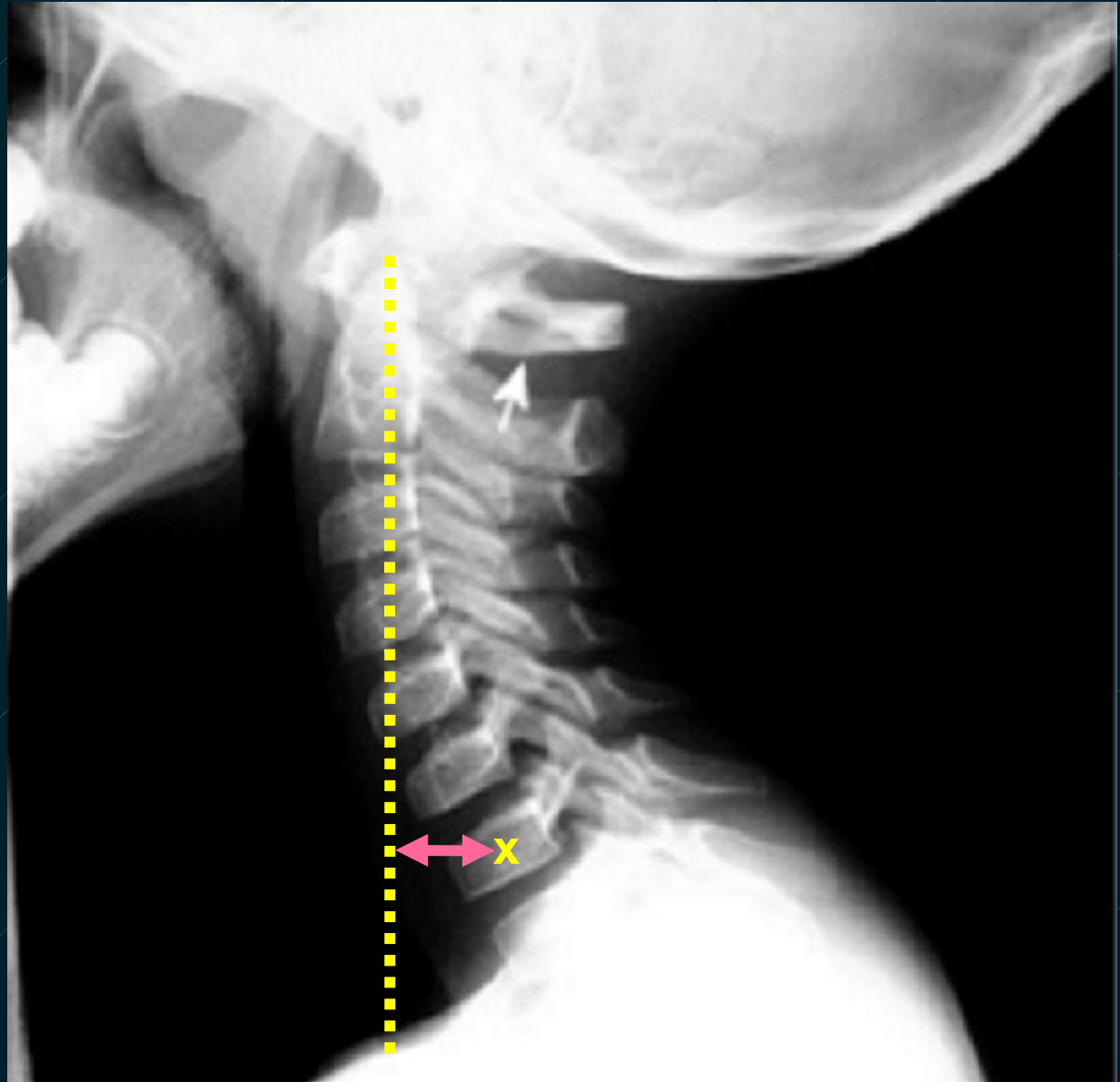
Whiplash - Reversed Lordosis



- 1. **McGregor plane**
Not horizontal
- 1. **Odontoid plane**
Directed anteriorly
- 1. **Craniovertebral angle**
68° (instead of 96-106°)
- 1. **Spinous proc. C1 and 2**
No sub-cranial spaces
- 1. **Inferior endplates C2 and 7**
20° kyphosis, instead of 30-40°
of lordosis
- 1. **C2-7 line**
All intervening vertebrae
behind the line

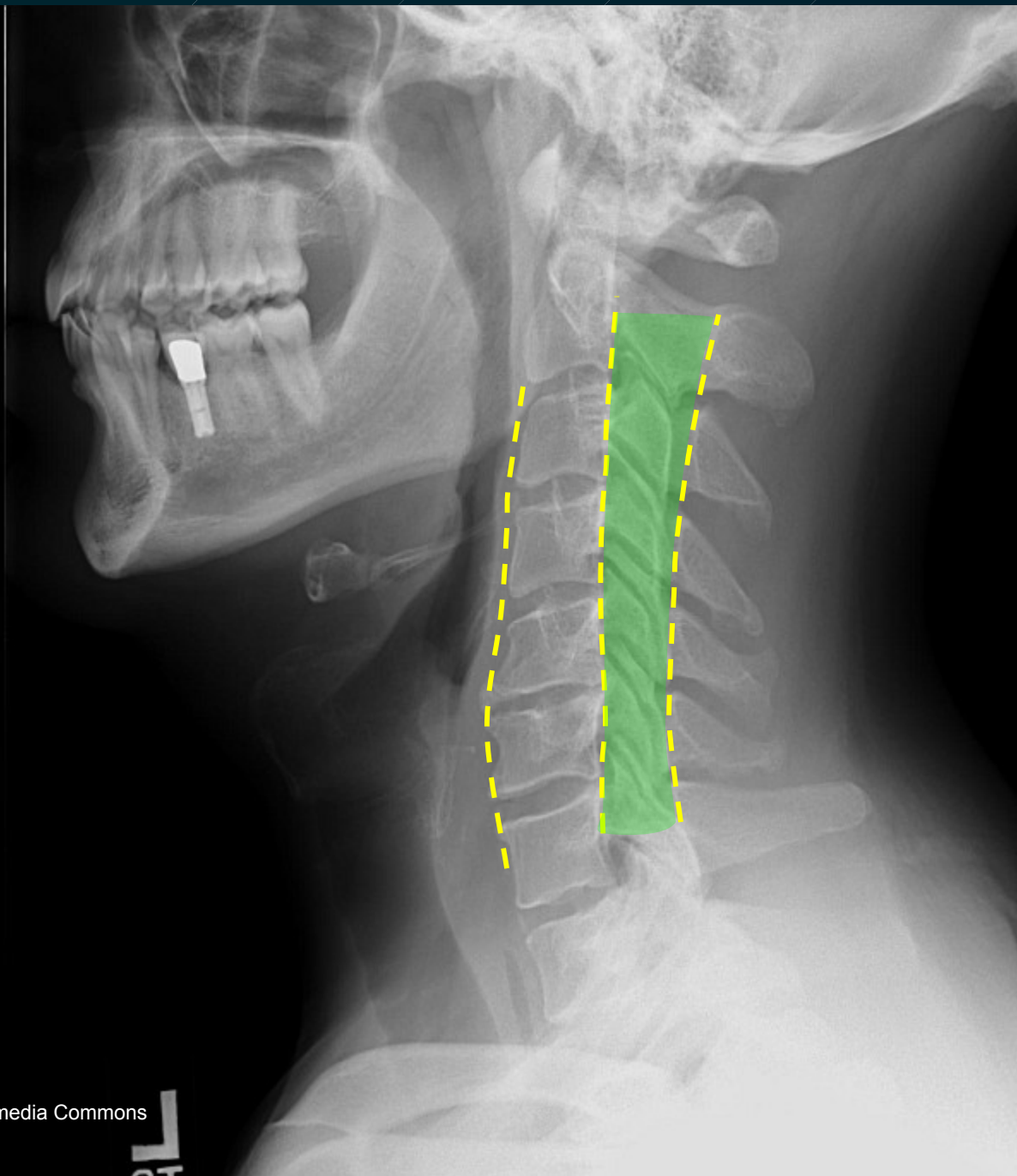


Central Gravity Line

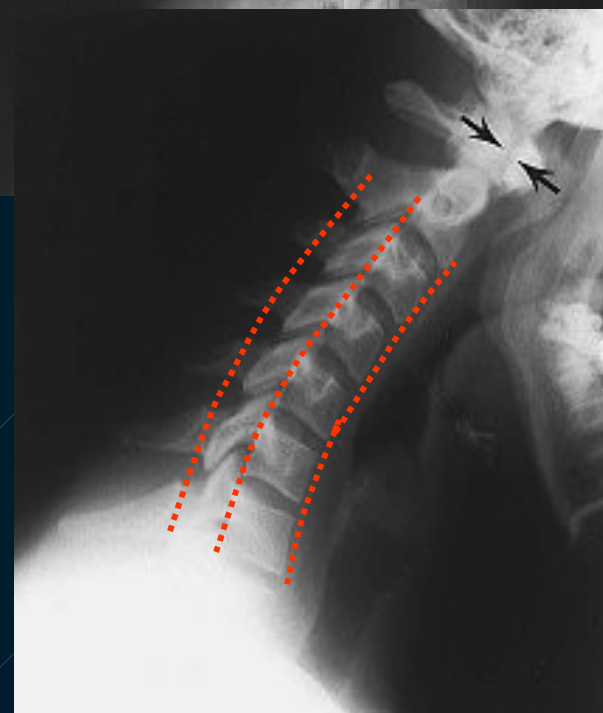
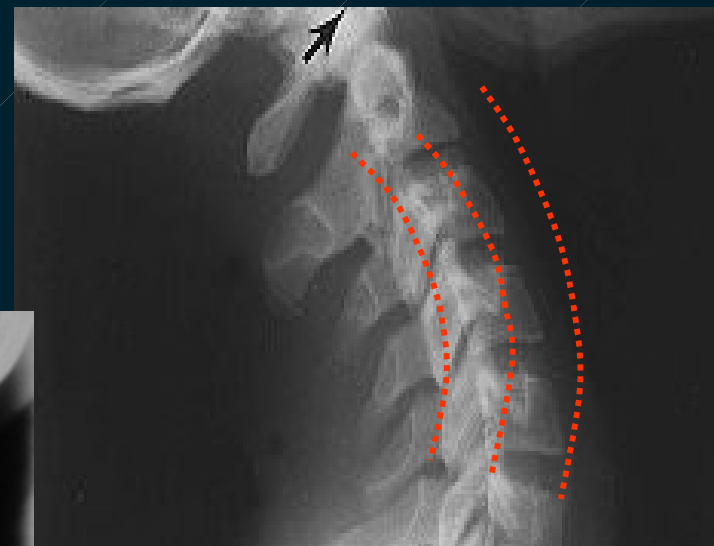
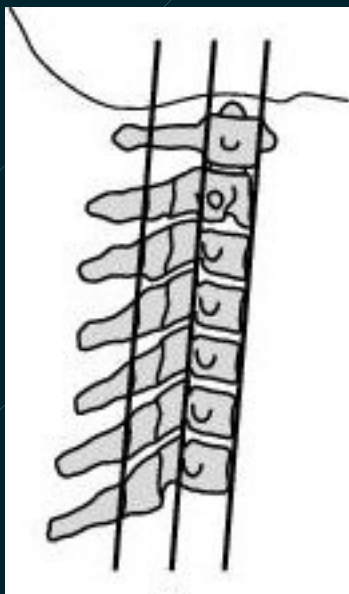


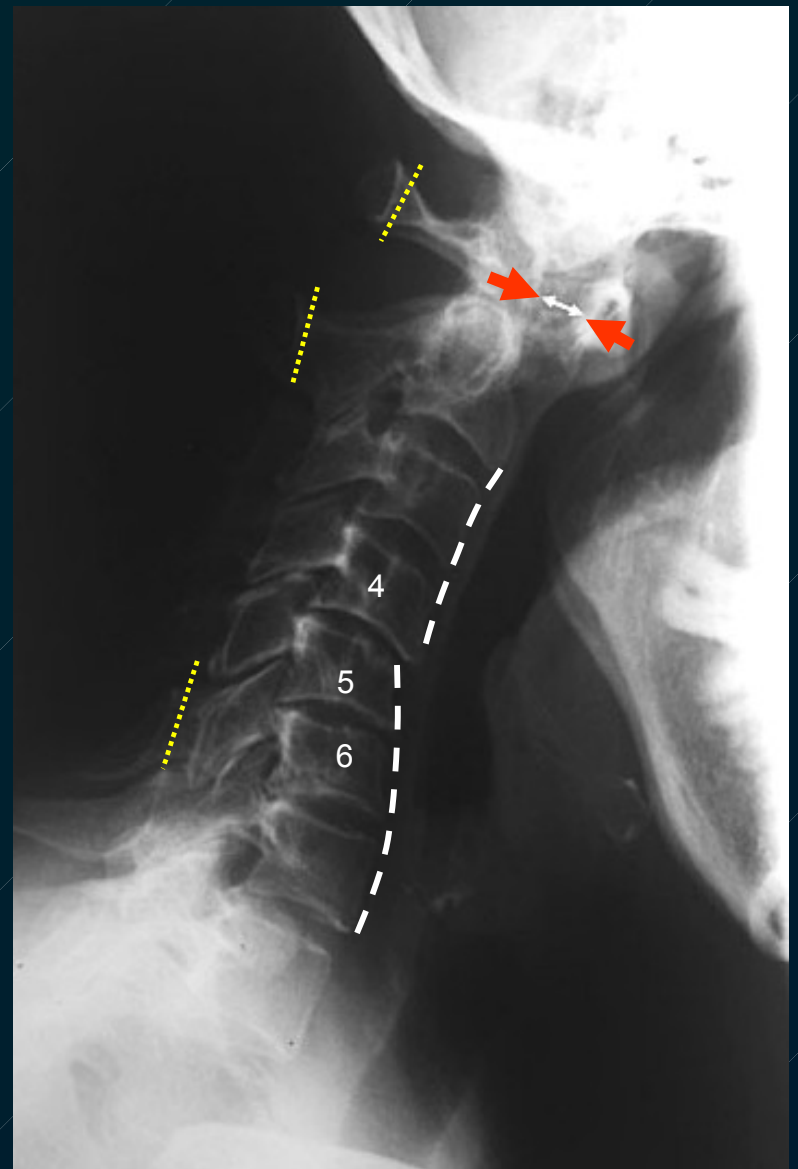
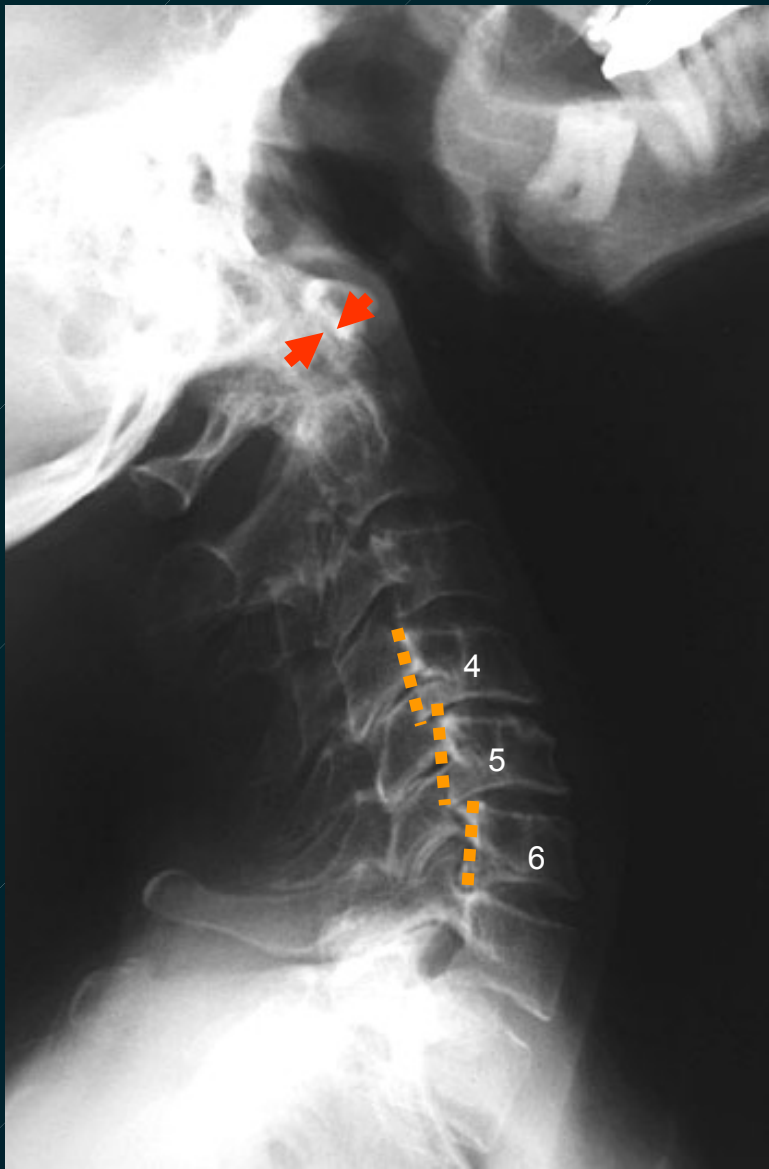
The 3 Lines and Canal Width

Width should be at least
16 mm at C41
13 mm at C3
12 mm at C4-C7n



Dynamic Alignment Integrity





RA; paresthesias with flexion. Extension film= retrolisthesis. Flexion= predental space increases to 7mm. Reversed curve for lower cervical and 'kink' on

Coronal Alignment

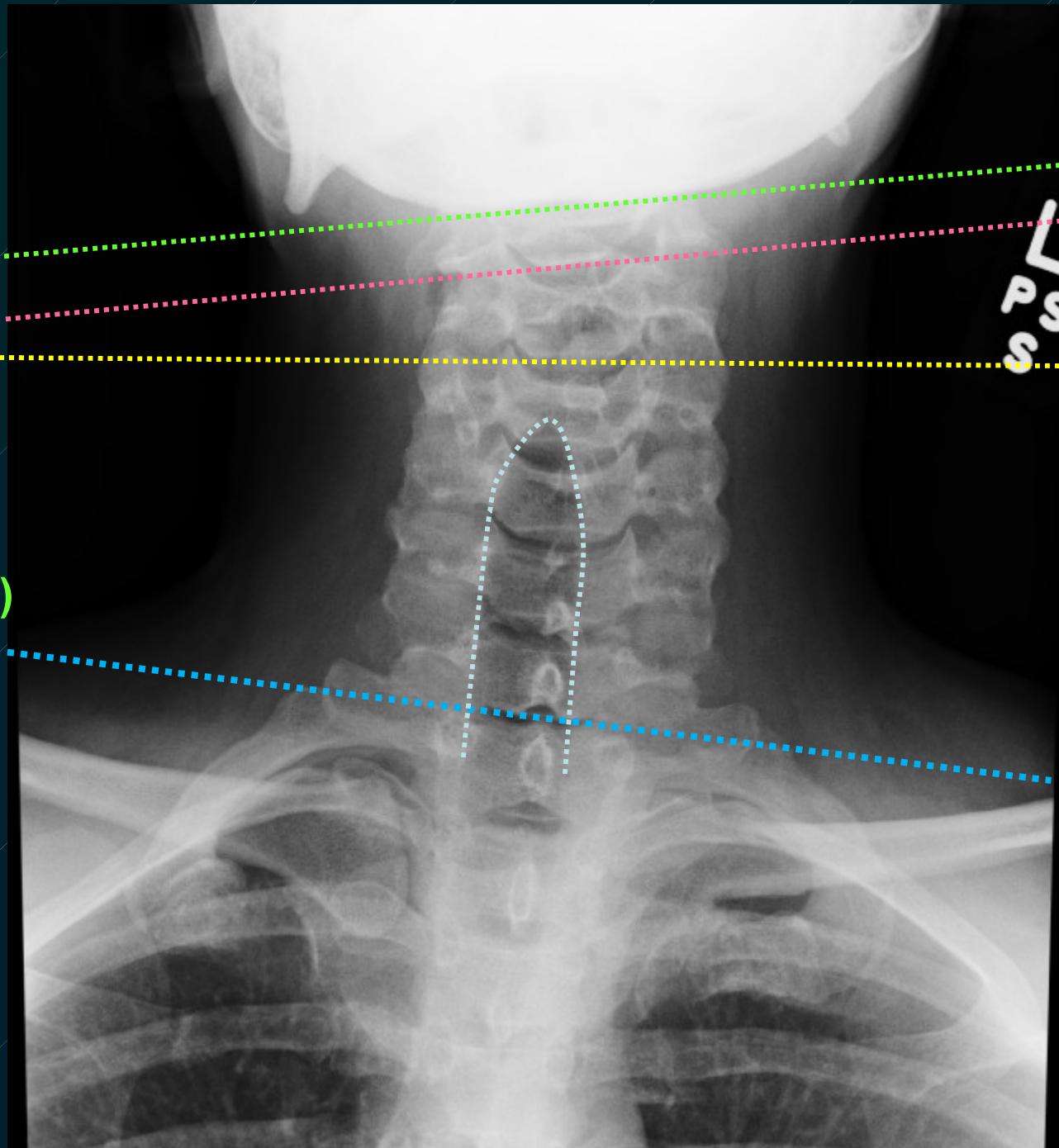
SBR CO (occiput)

SBR C2

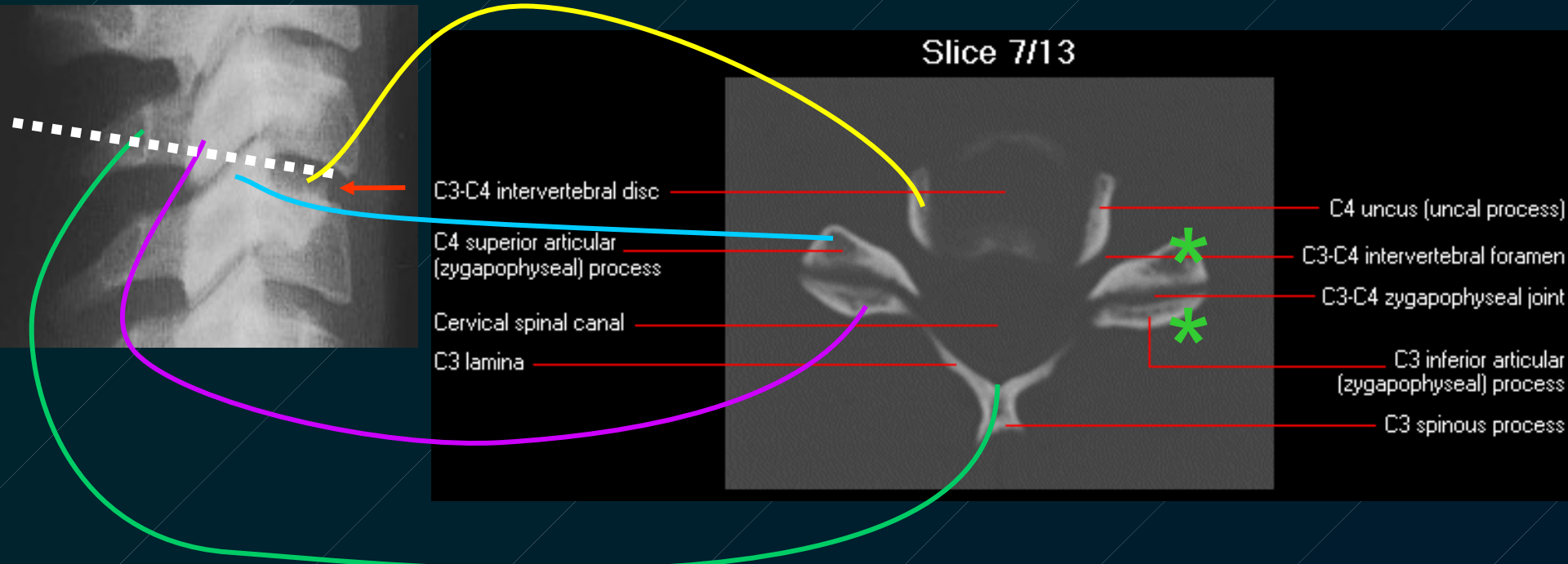
SBR (?) C3

SBR C4-7

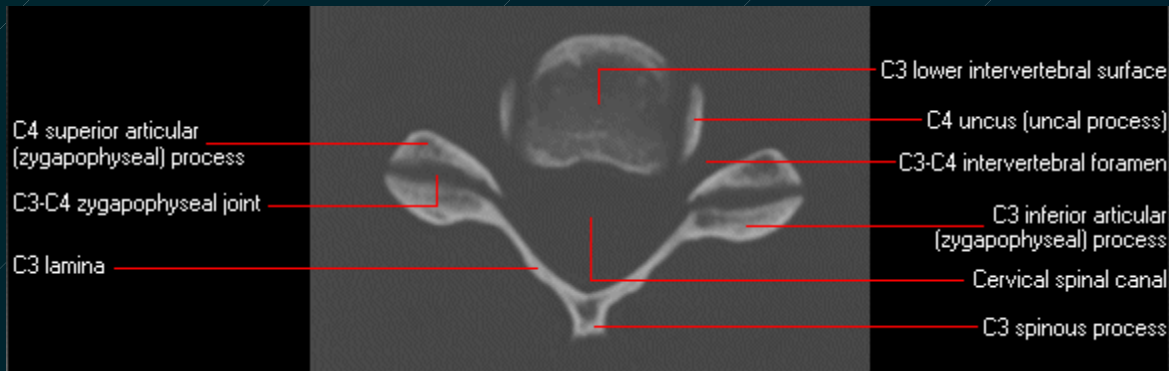
Note also R rotation
(tracheal shadow)



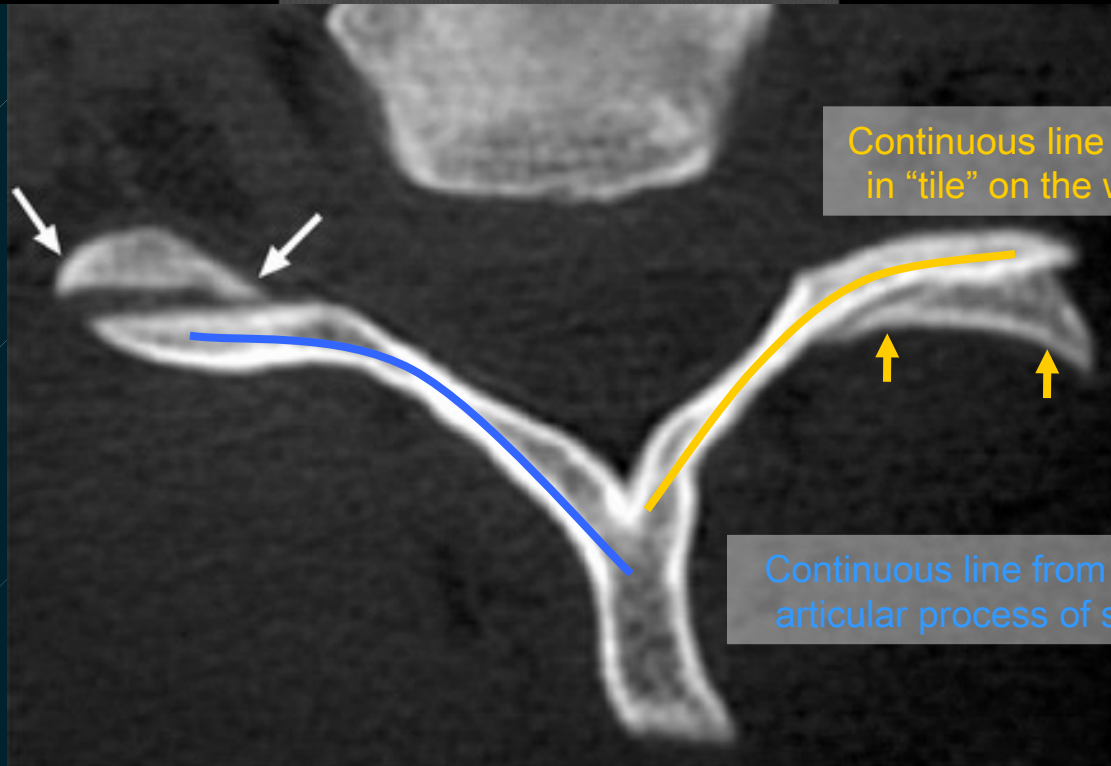
C3/4 joint – Axial CT Scan (bone window)



***The facet of the vertebra above is 'on the outside'
Think of tiles on a roof***

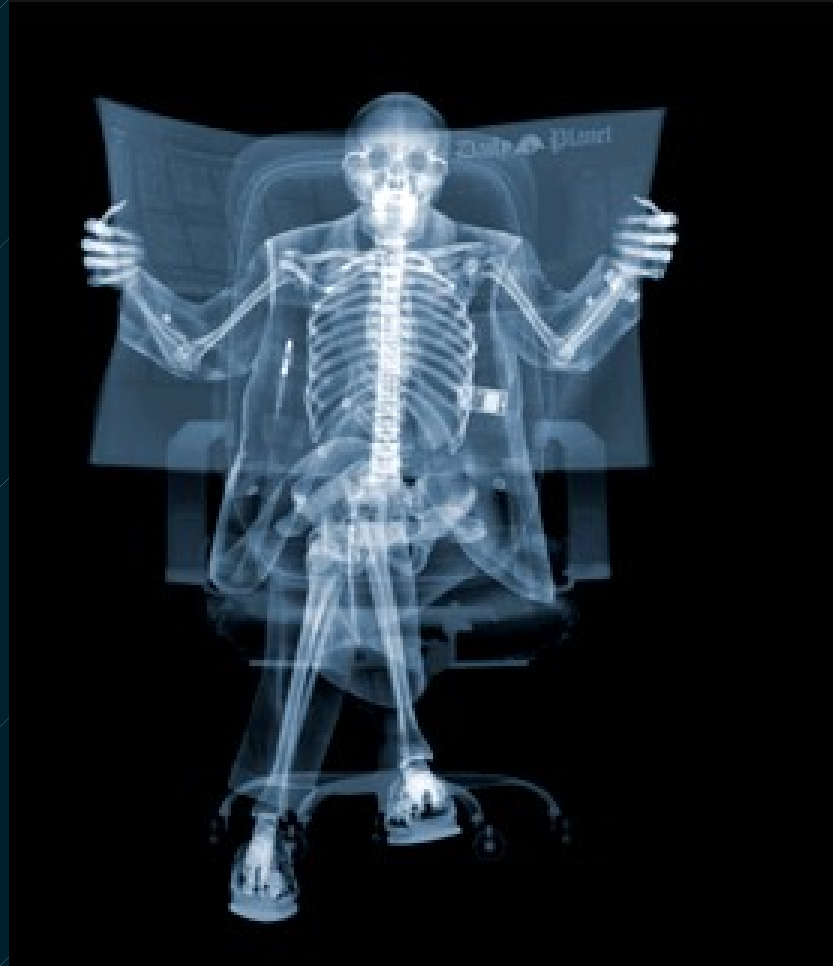


Normal
(meat and
2 buns)

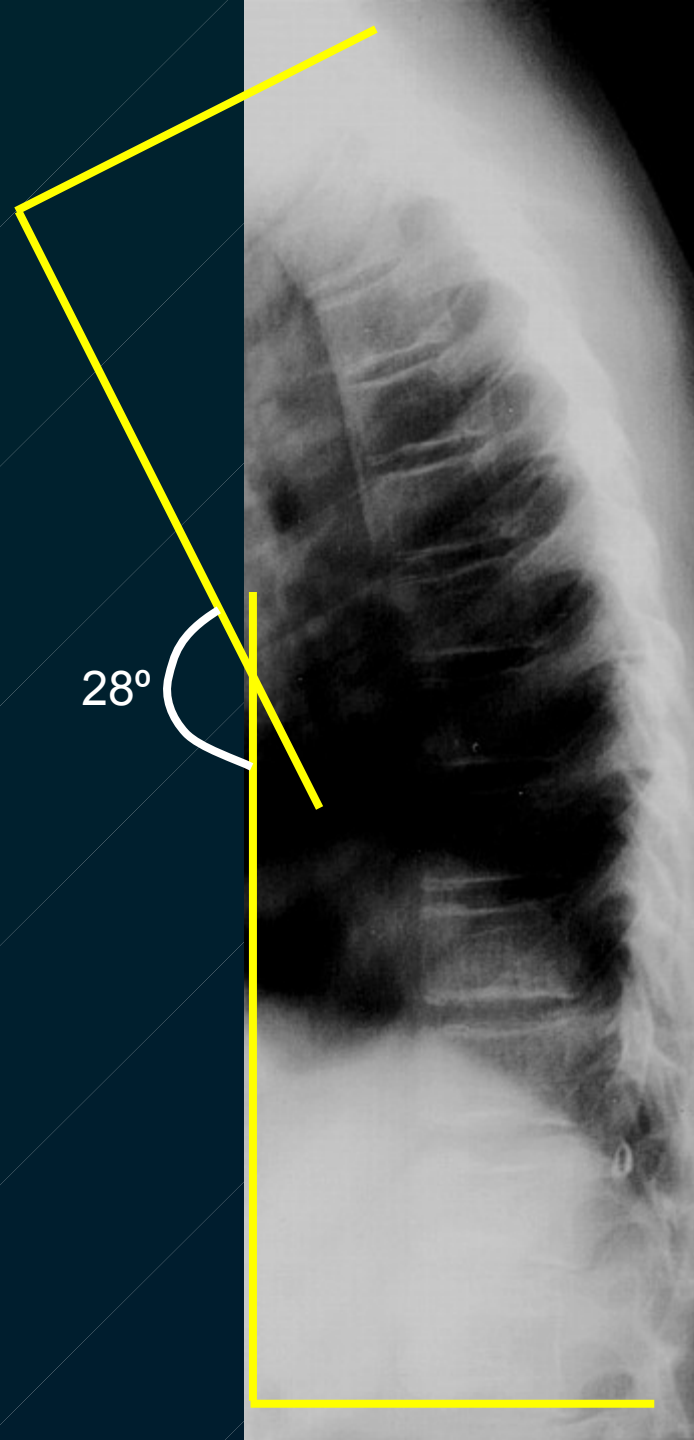


Jumped facet/ Hamburger sign: A 45-year-old man – motor vehicle accident. Top axial CT scan: facet joint (arrows) with the normal hamburger appearance.

Thoracic Spine – Alignment

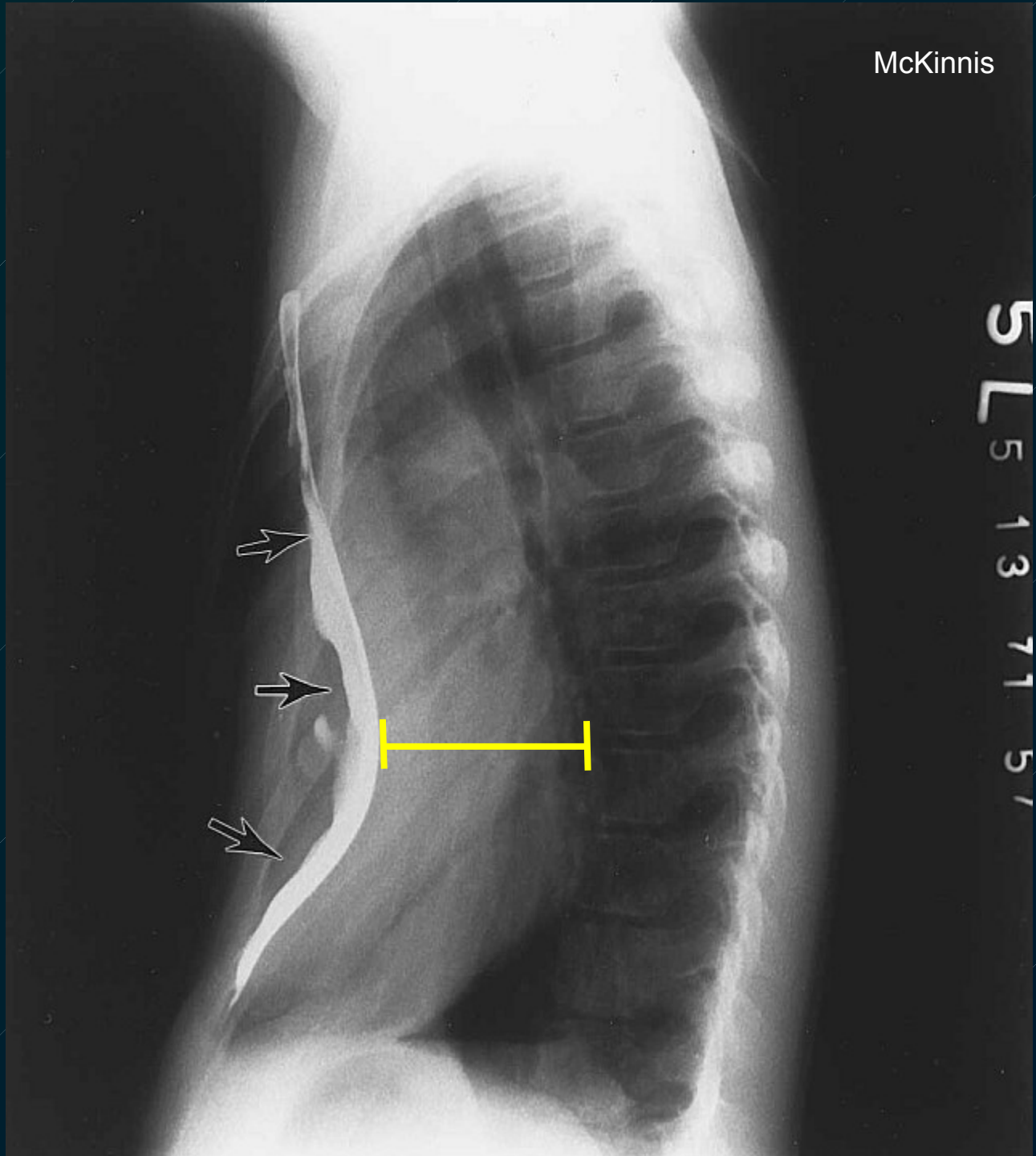


Thoracic Kyphosis



Thoracic Cage Dimension

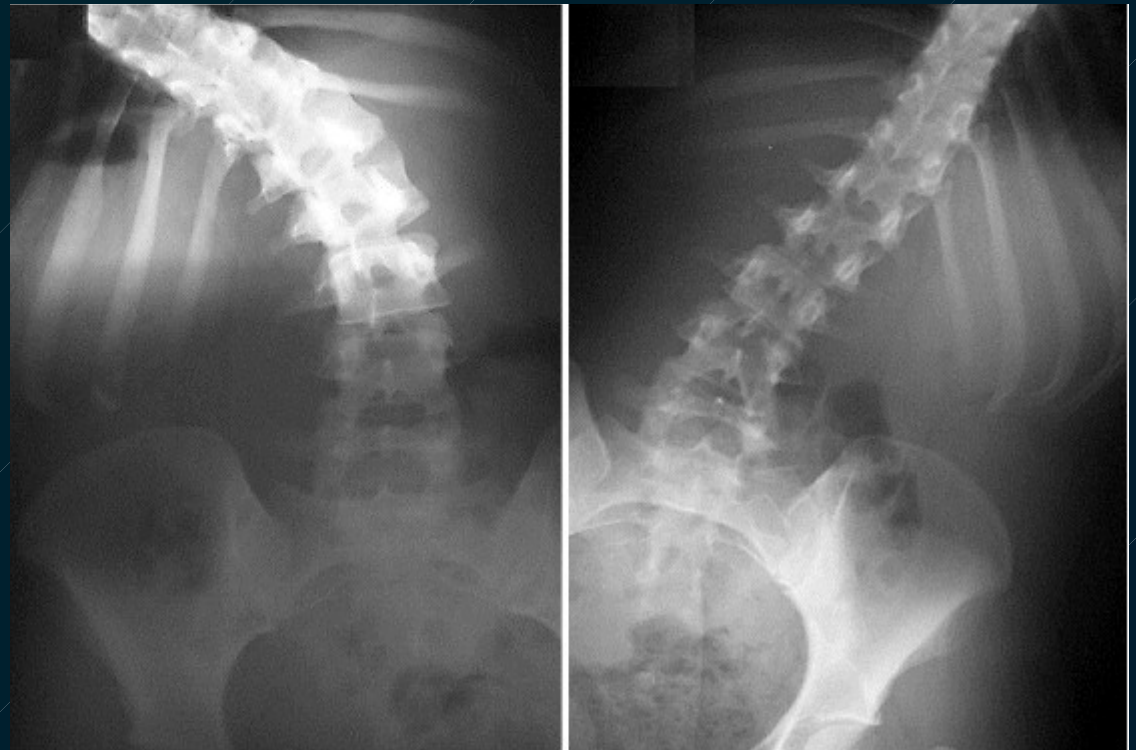
Pes Excavatum



5
L
5
13
71
57

Structural/ Functional

Structural does not correct on sidebending towards the convexity



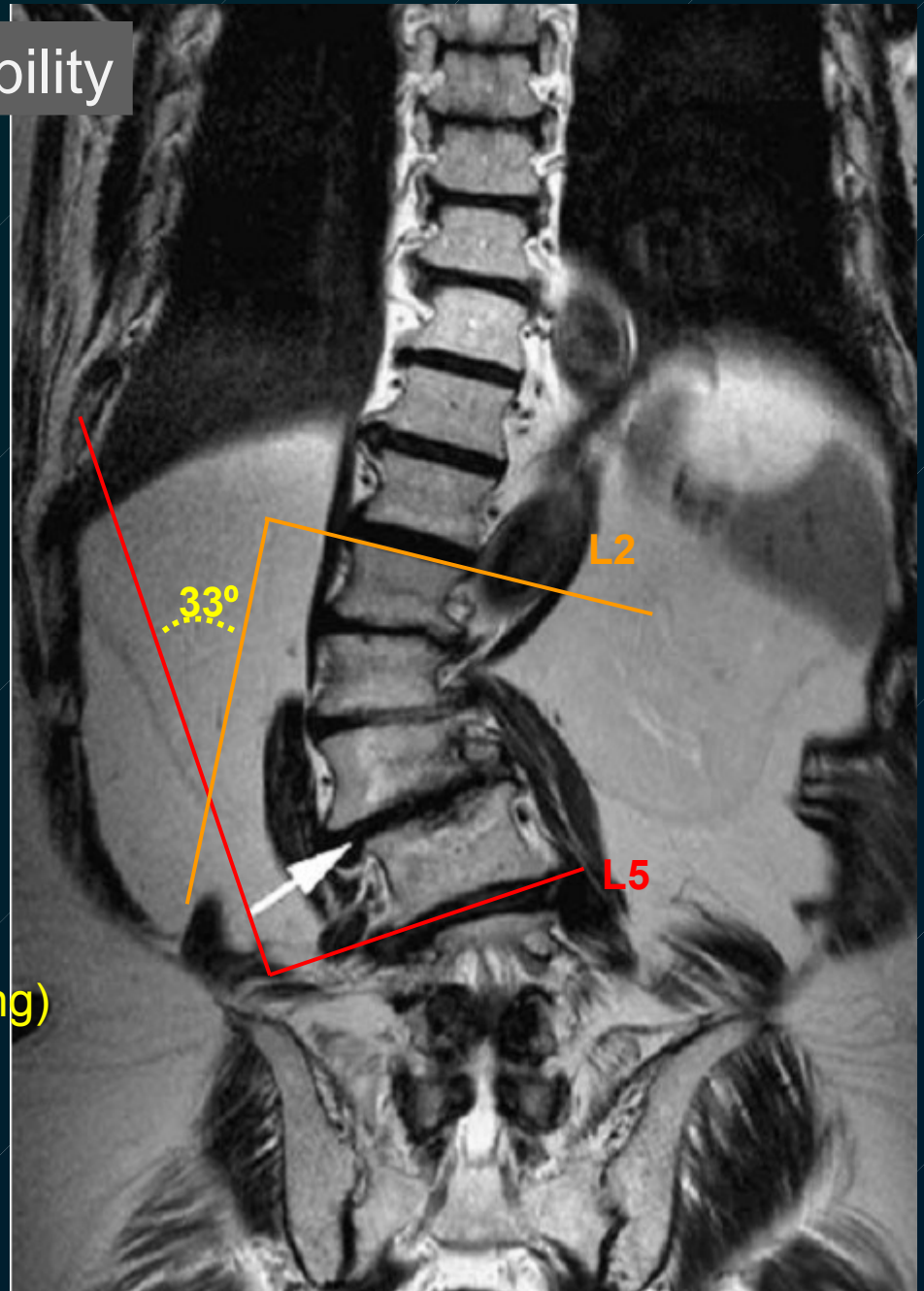
R. Sidebending view

L. Sidebending view

Degenerative scoliosis - instability

R. convex lumbar curve

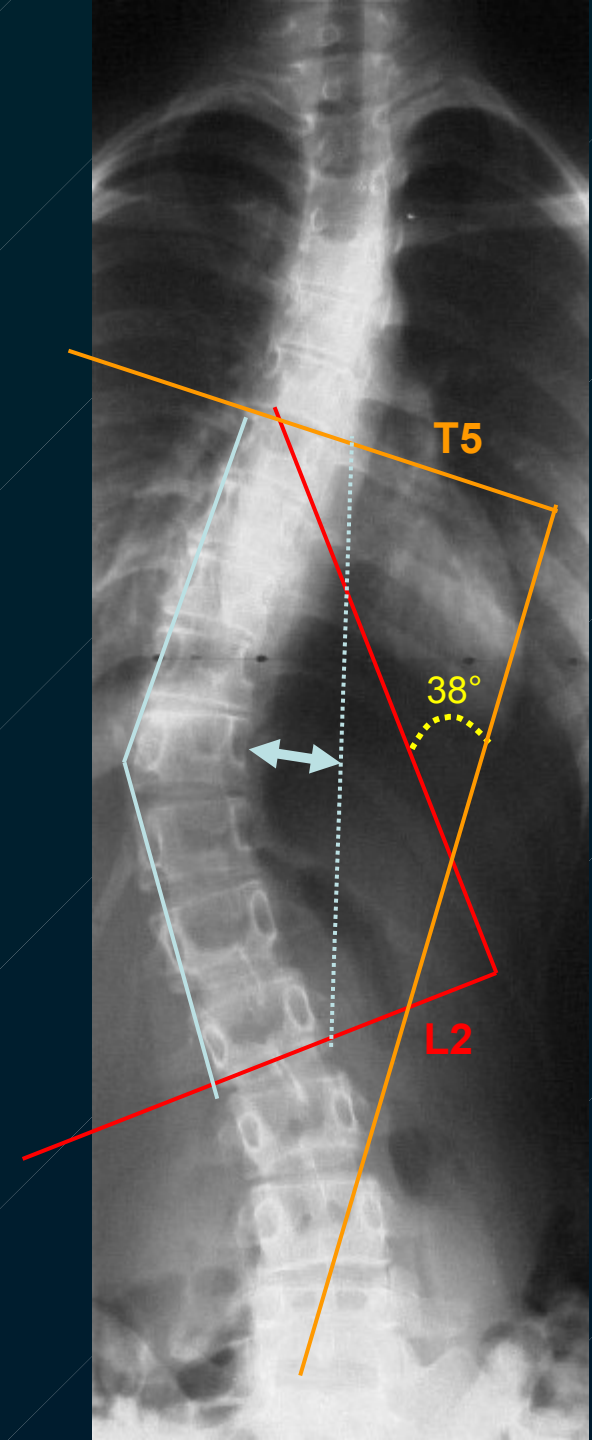
- Top vertebra of curve
- Bottom vertebra
- Cobb angle = 33°
(probably much greater in standing)



Scoliosis – Cobb :

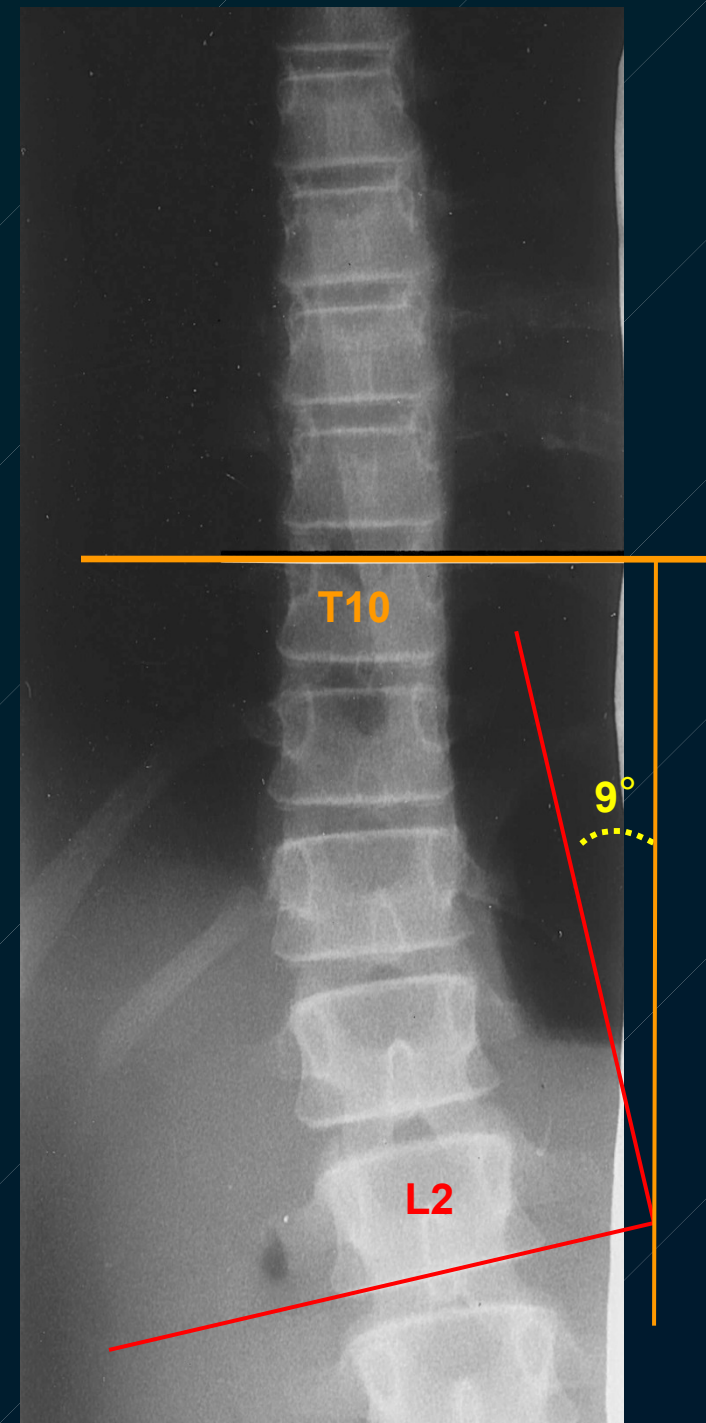
(L. convex thoraco-lumbar curve)

- Top vertebra of curve
(uppermost vert. tilting towards concavity)
- Bottom vertebra
(lowermost vert. tilting towards concavity)
- Two perpendicular lines drawn from these lines. Where the two lines intersect = 38°
- Apex at T11



R. thoracolumbar curve

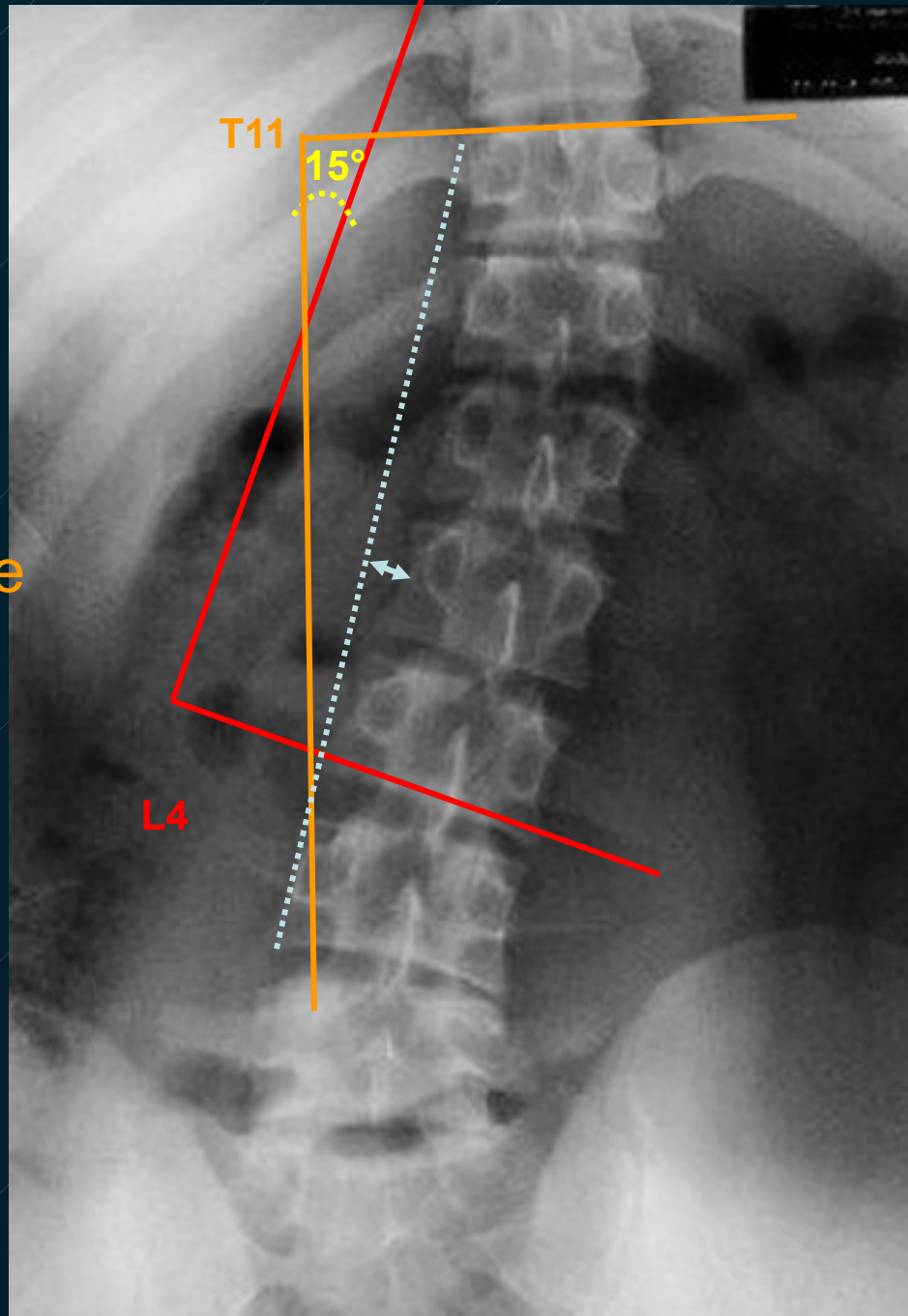
- Top vertebra of curve
- Bottom vertebra
- Cobb angle = 9°



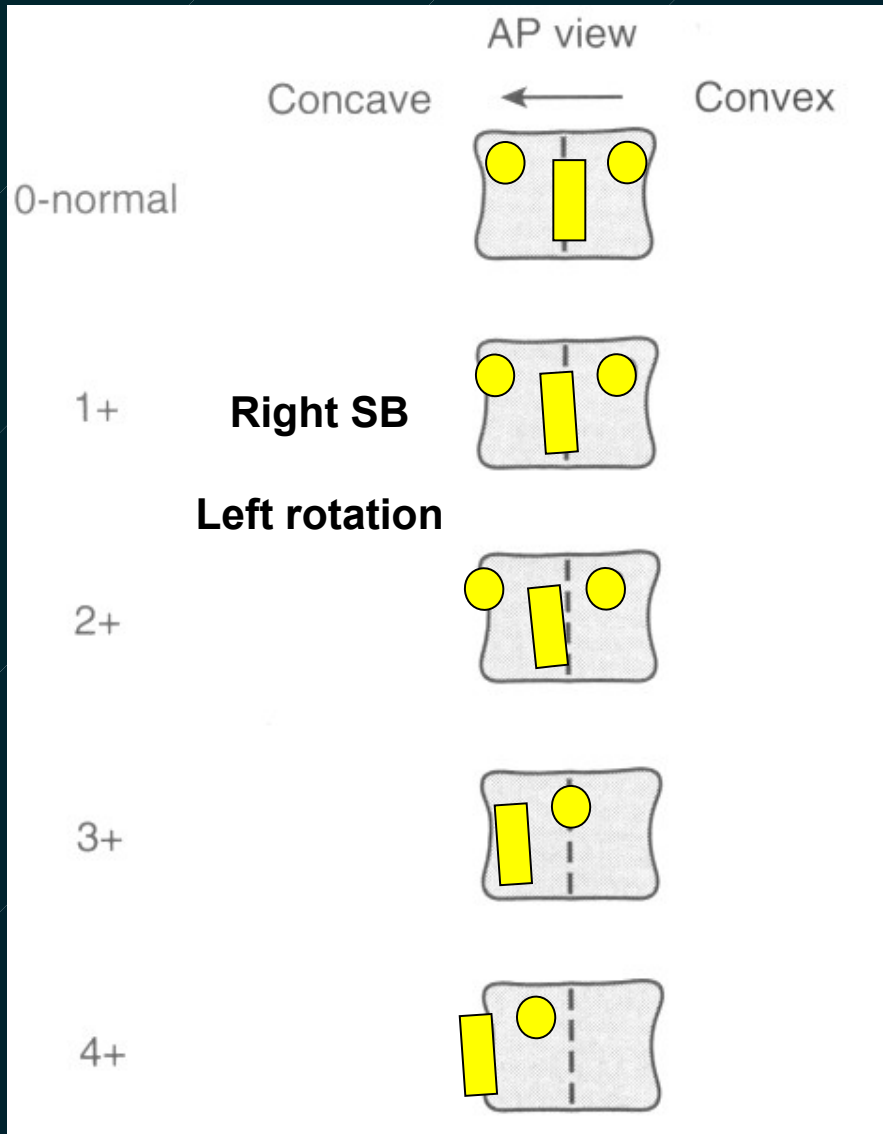
Post Traumatic Scoliosis

Top vertebra of curve

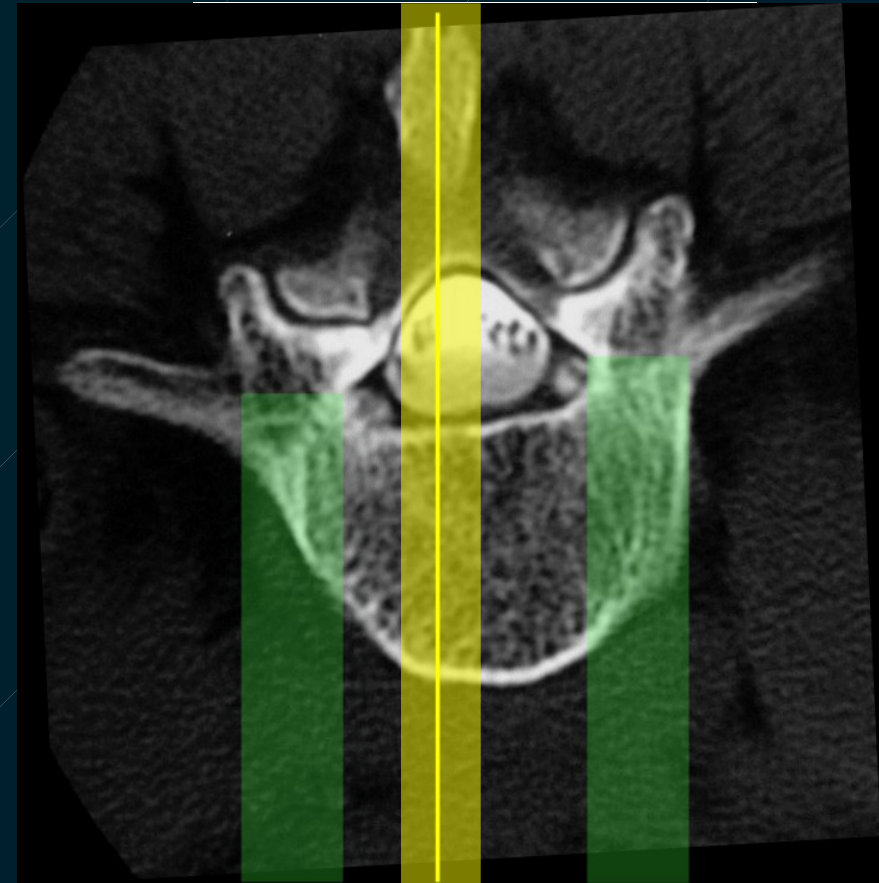
- Bottom vertebra
- Cobb angle = 15°
- Apex at L2



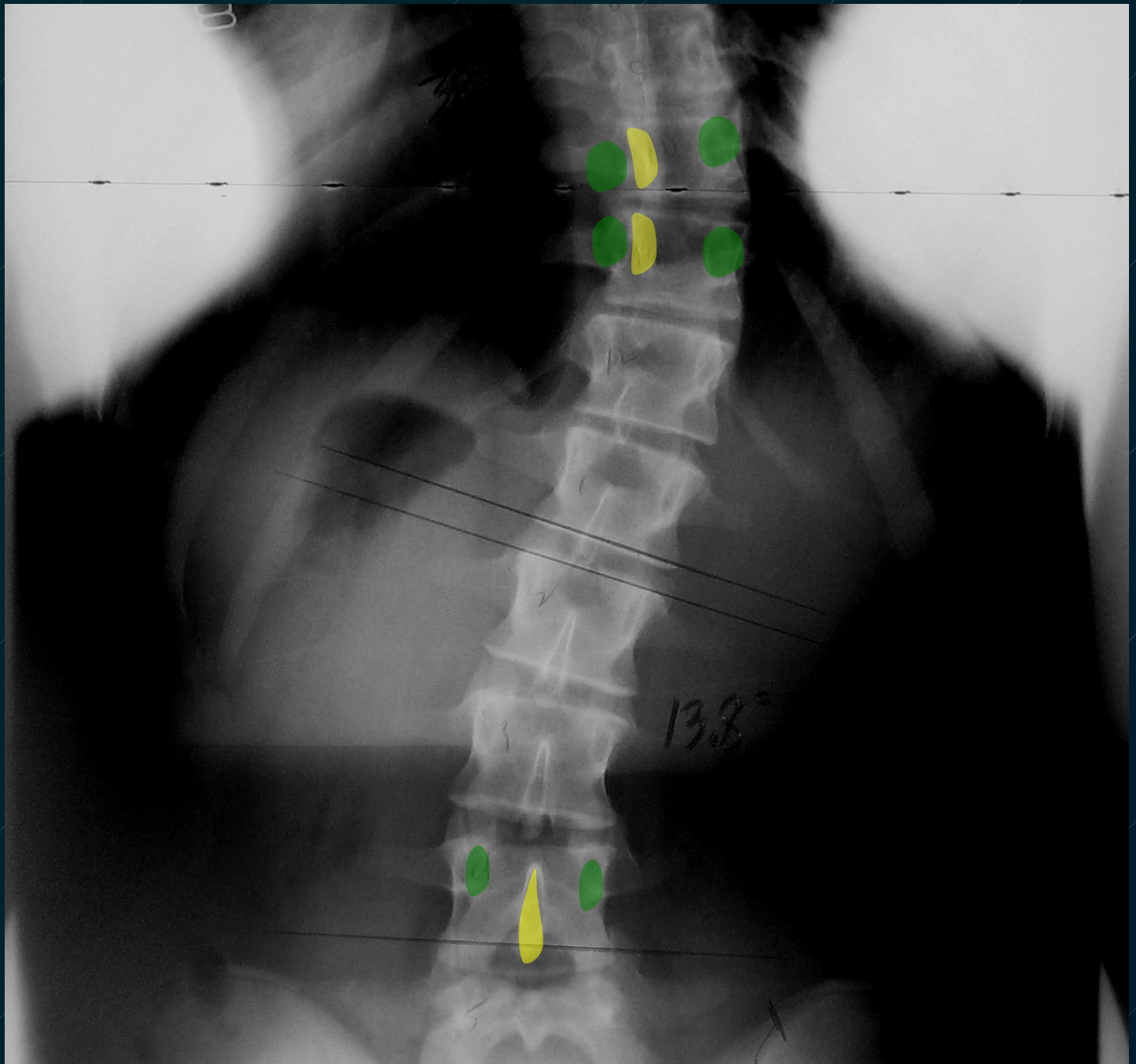
Measuring rotation



Looking from above



1+ left rotation:
Spinous process to right;
Left pedicle closer to midline



Radiographic Exercise

Area L; Th; T/L?

Type ("C/ S")

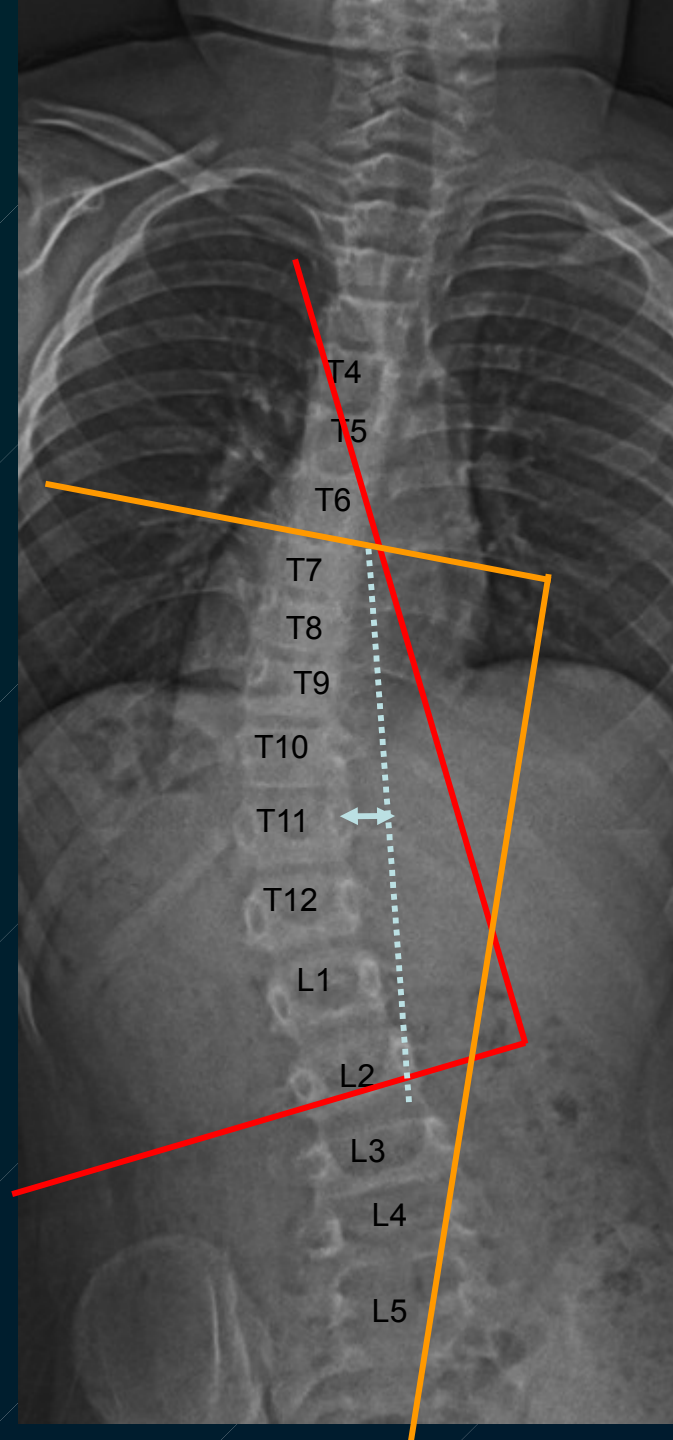
Direction

Top vertebra?

Bottom vertebra?

Apex?

Rotation?



Area L; Th; T/L?

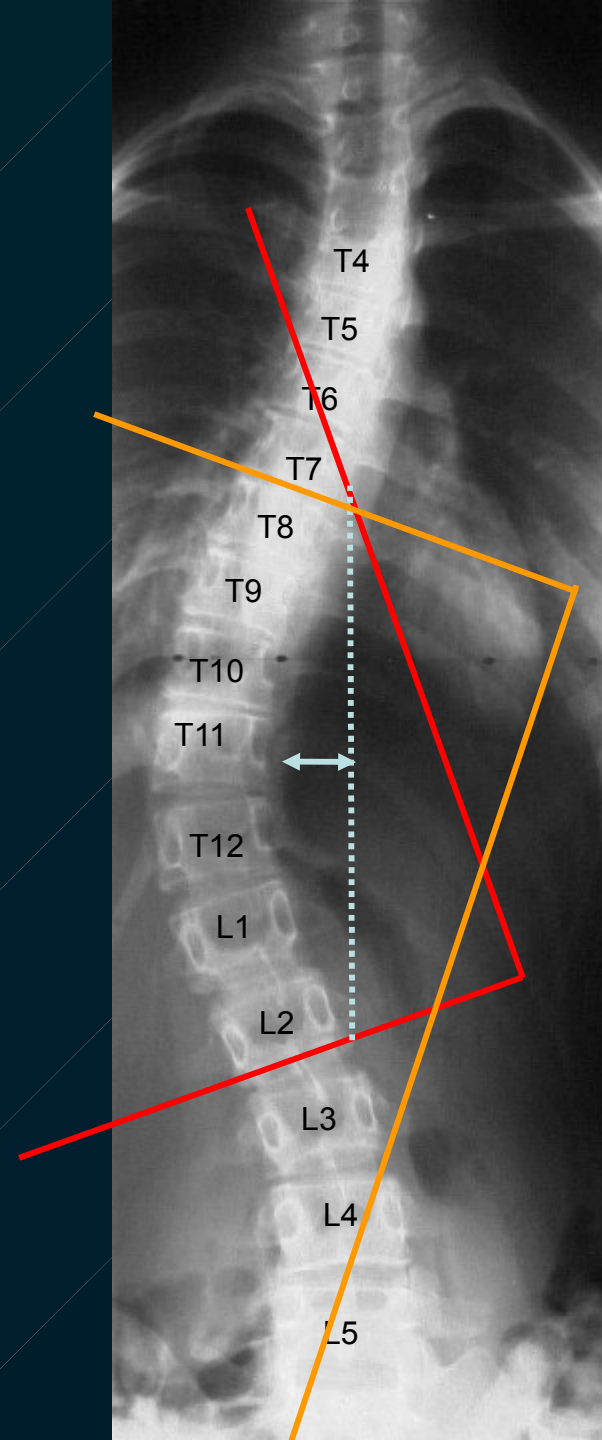
Type ("C/ S")

Direction

Top vertebra?

Bottom vertebra?

Apex



Area L; Th; T/L?

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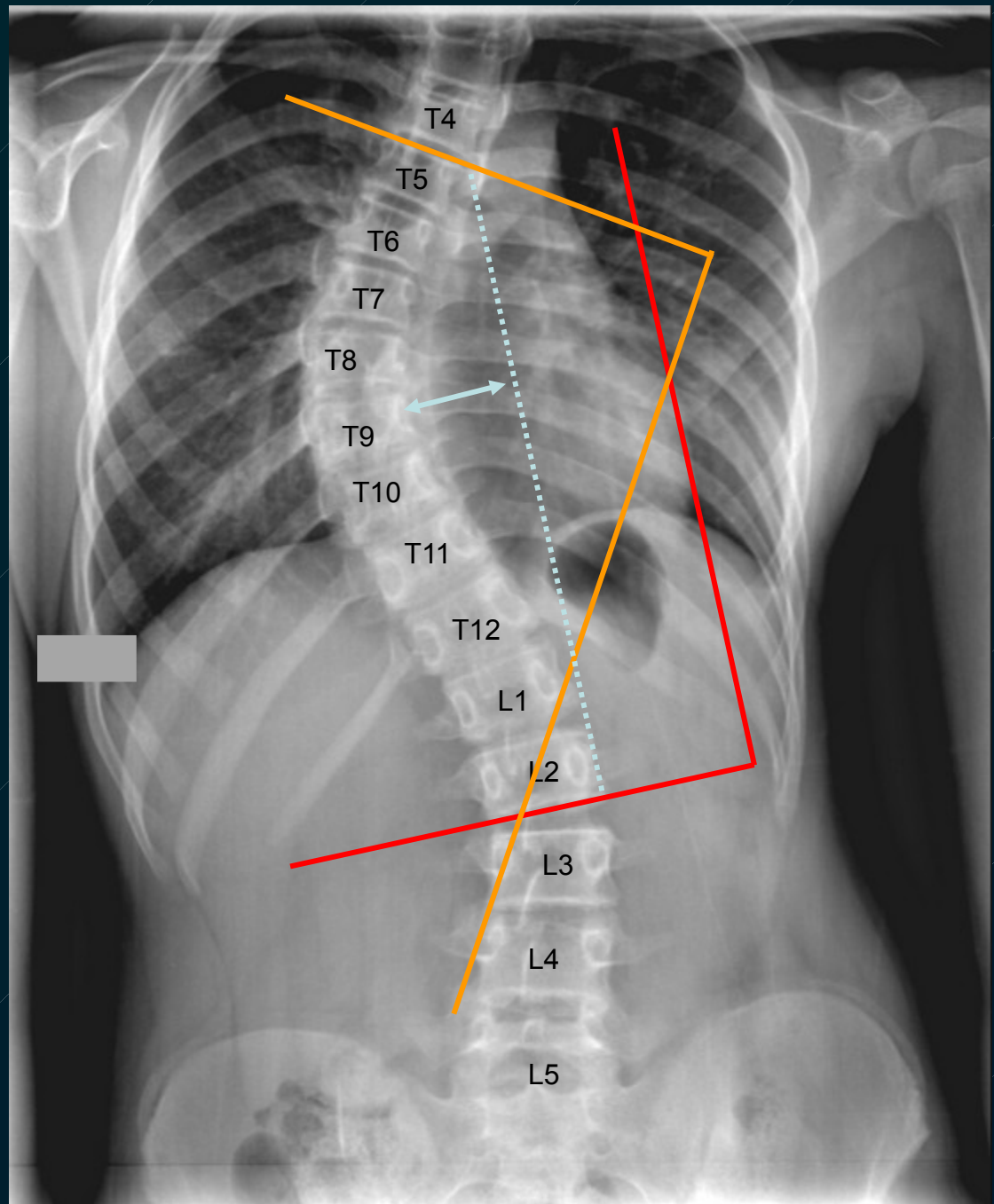
Direction

Top vertebra?

Bottom vertebra?

Apex

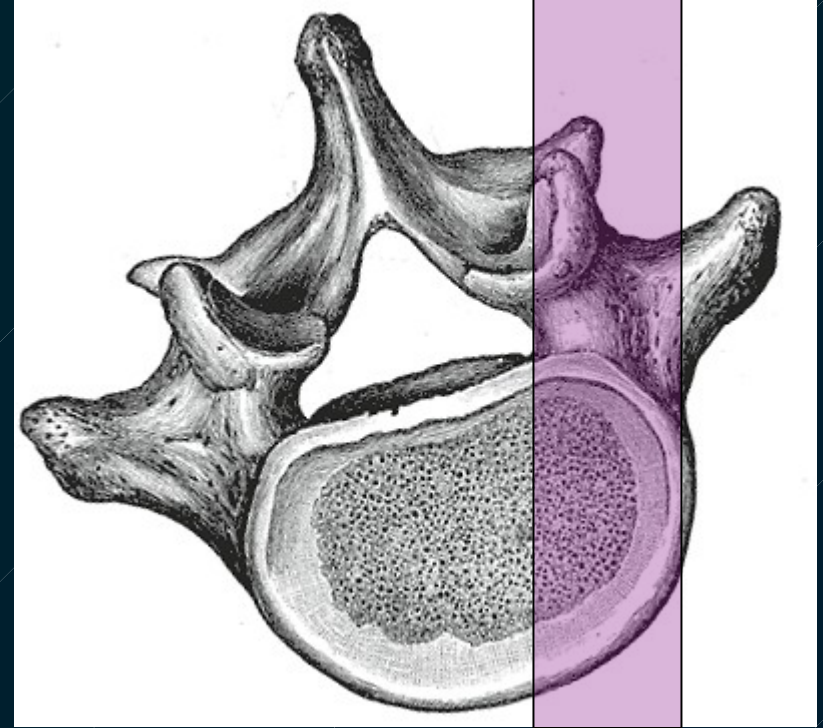
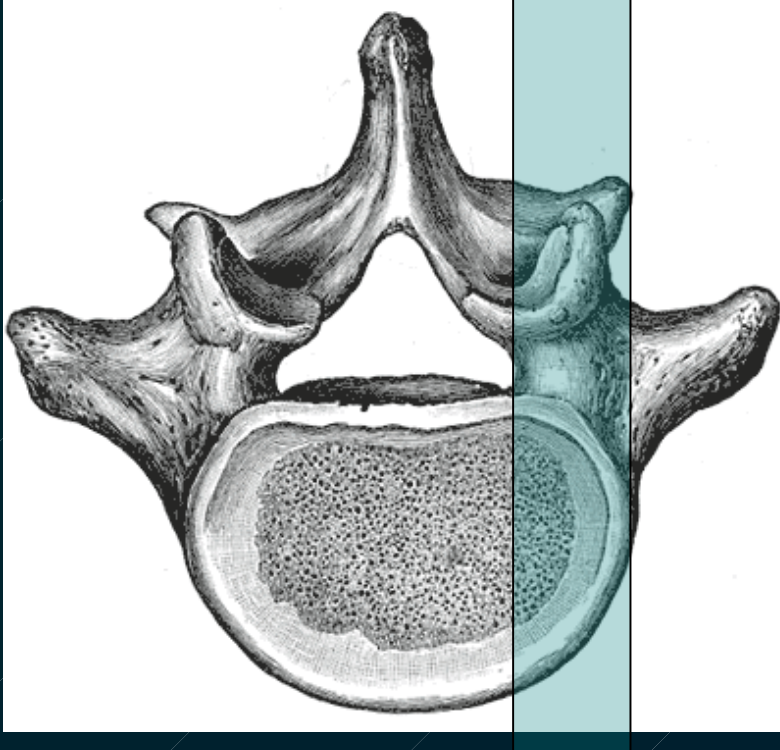
Rotation



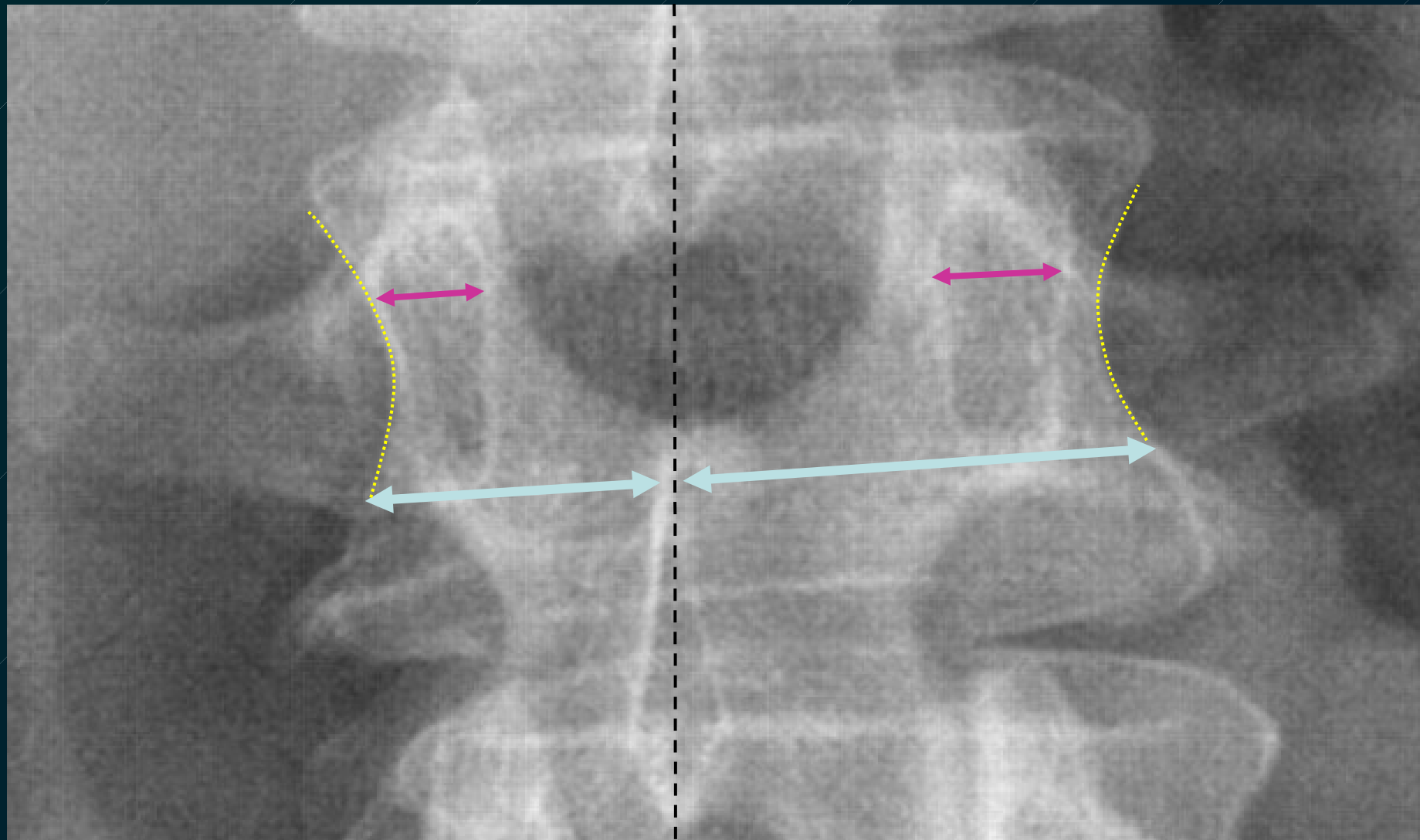
Lumbar – Alignment



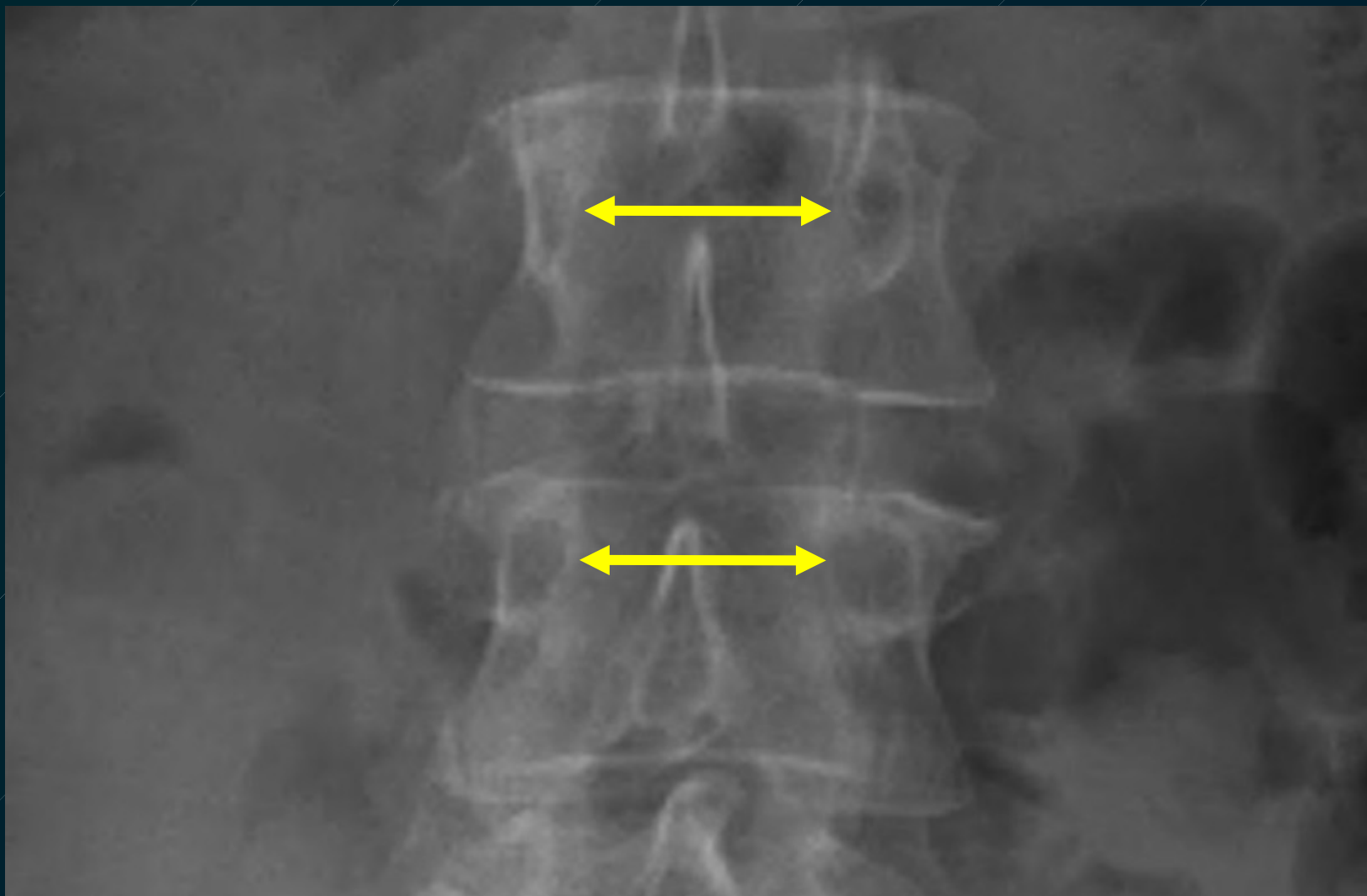
Pedicle Method for Estimating Rotation



Rotation estimated by pedicle width, pedicle position, and the position of the spinous process.

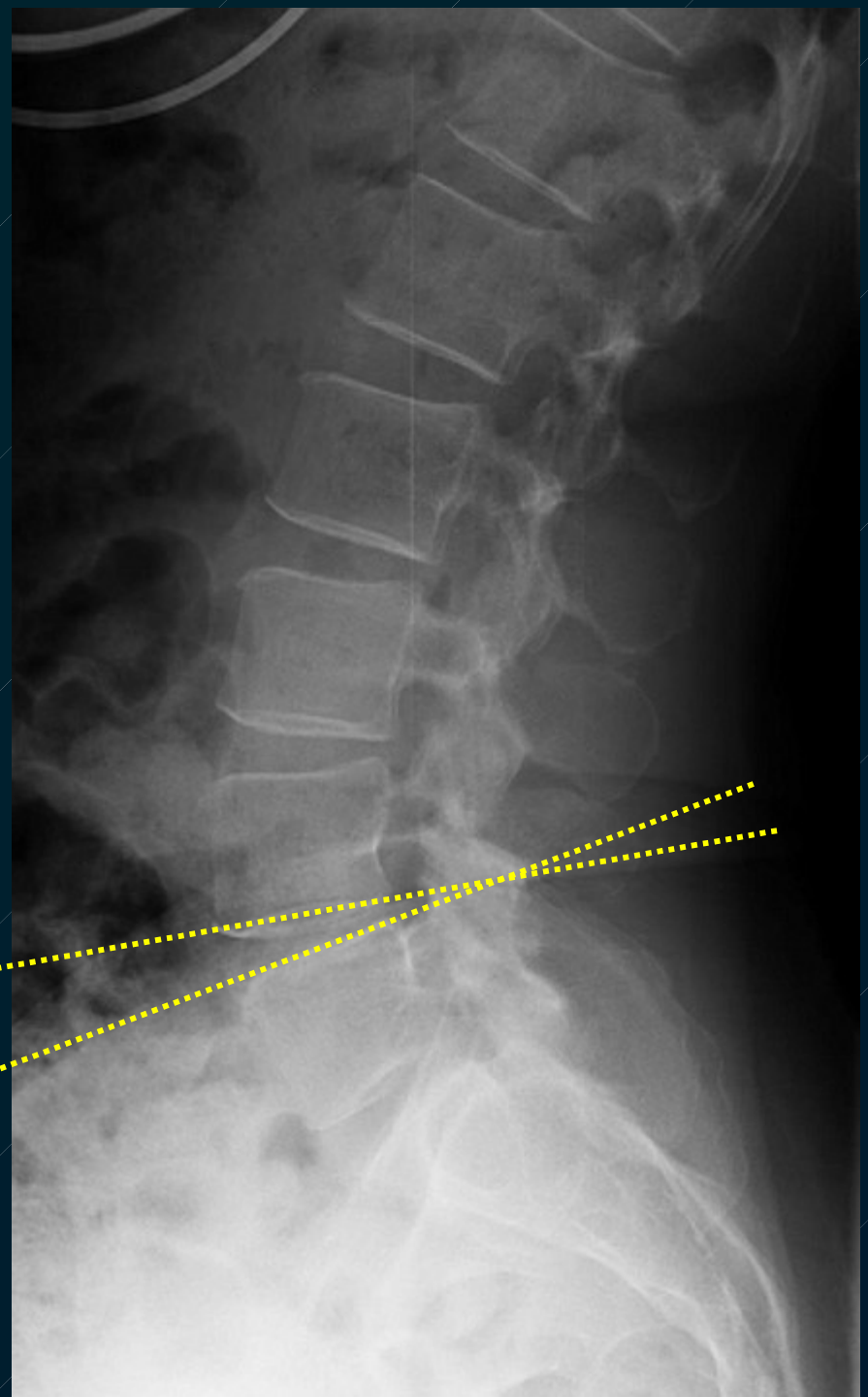


Interpedicular Distance



Lumbar Intervertebral Disc Angles

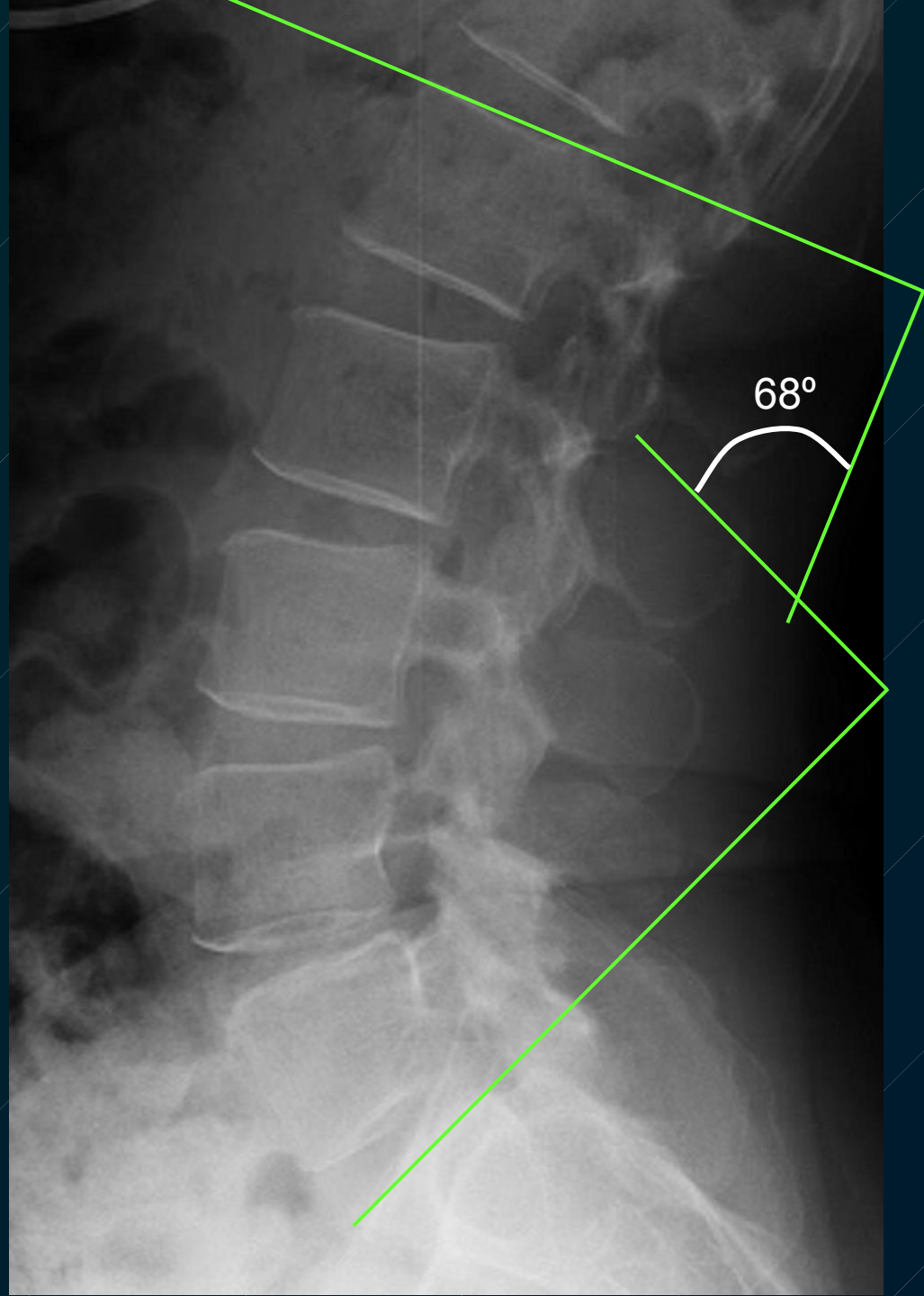
12°



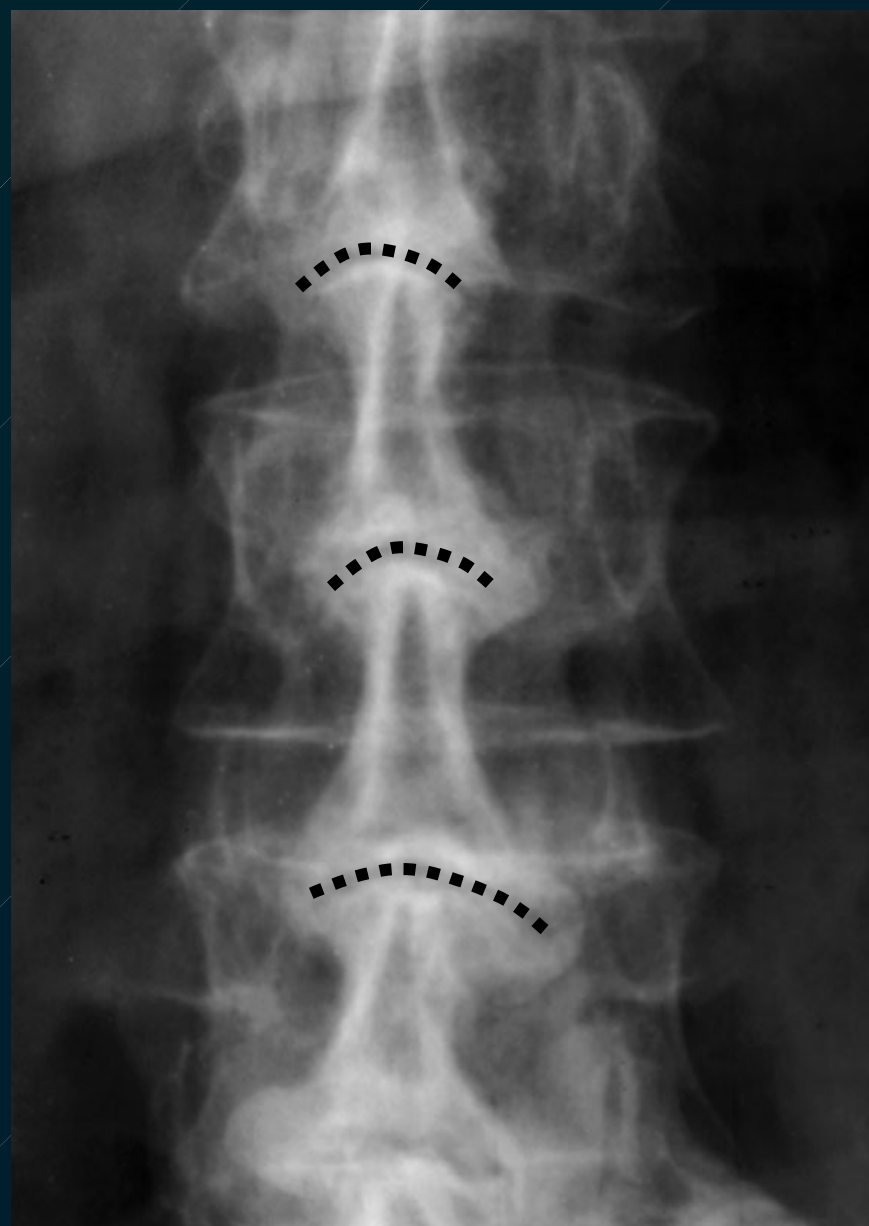
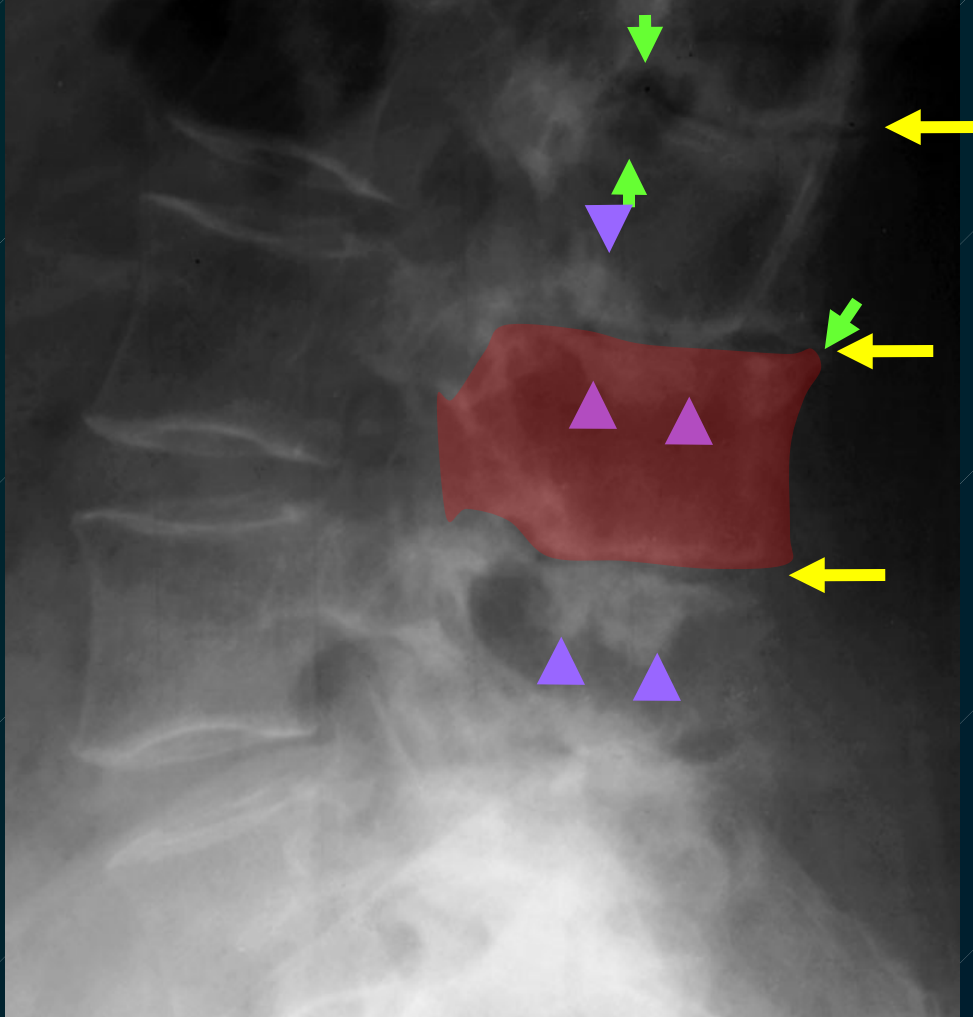
Lumbar Lordosis

Norm=
50 to 60 degrees

What's limiting
L3/4 extension?

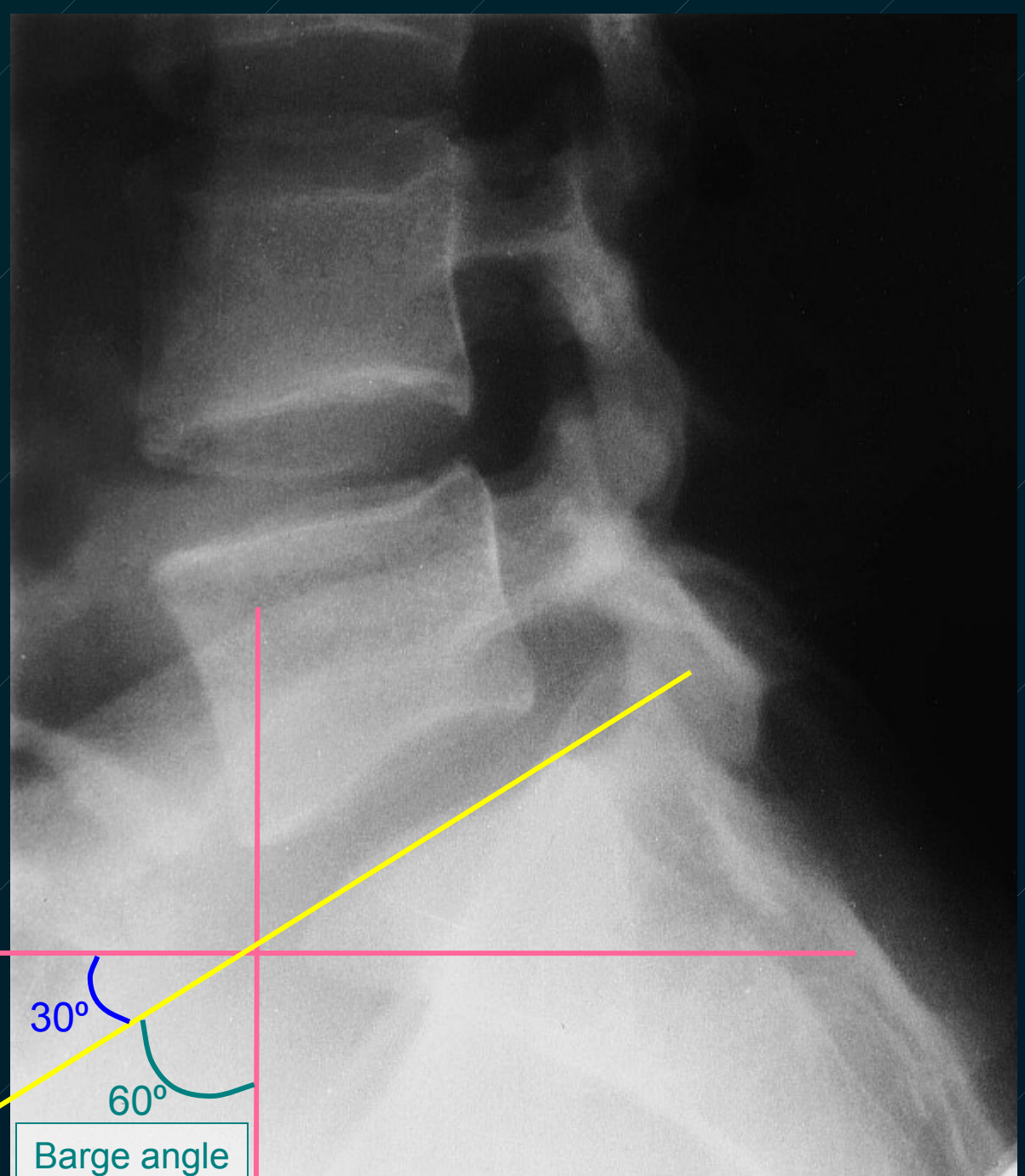


Baastrup's disease



Baastrup's disease - "kissing spines." The spinous processes of adjacent vertebrae contact and show reactive eburnation. This may lead to impingement of intervening ligaments.

Sacral Angle



Ferguson angle

30°

60°

Barge angle

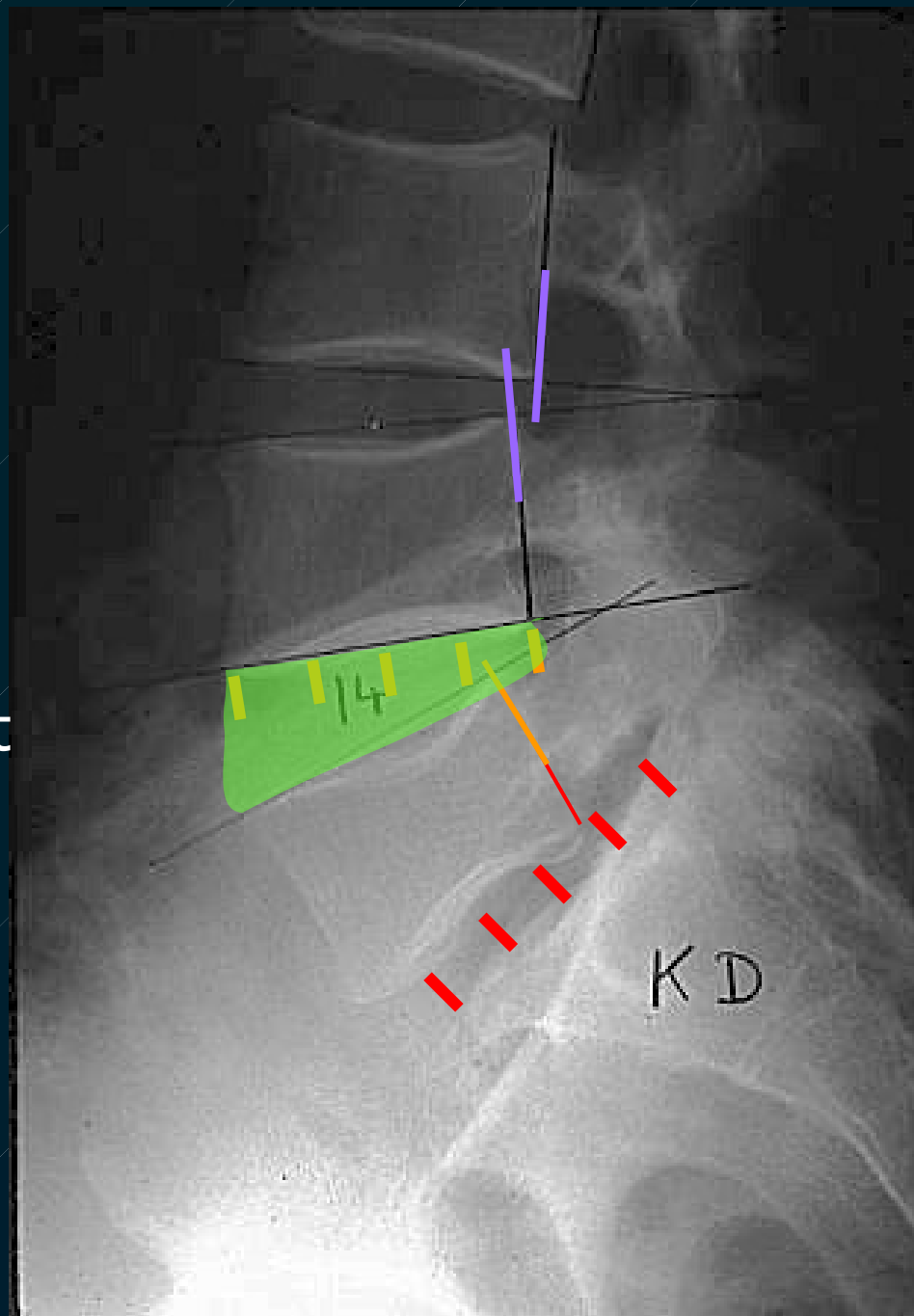


L5/S1 gr.1
spondylolisthesis
(anterolisthesis)

L4/5 Gr. 1 retrolisthesis

Note angulation of L4/5 is
14 degrees, but should not
be more than 8 degrees
per segment.

L3/4 Gr. 1 retrolisthesis

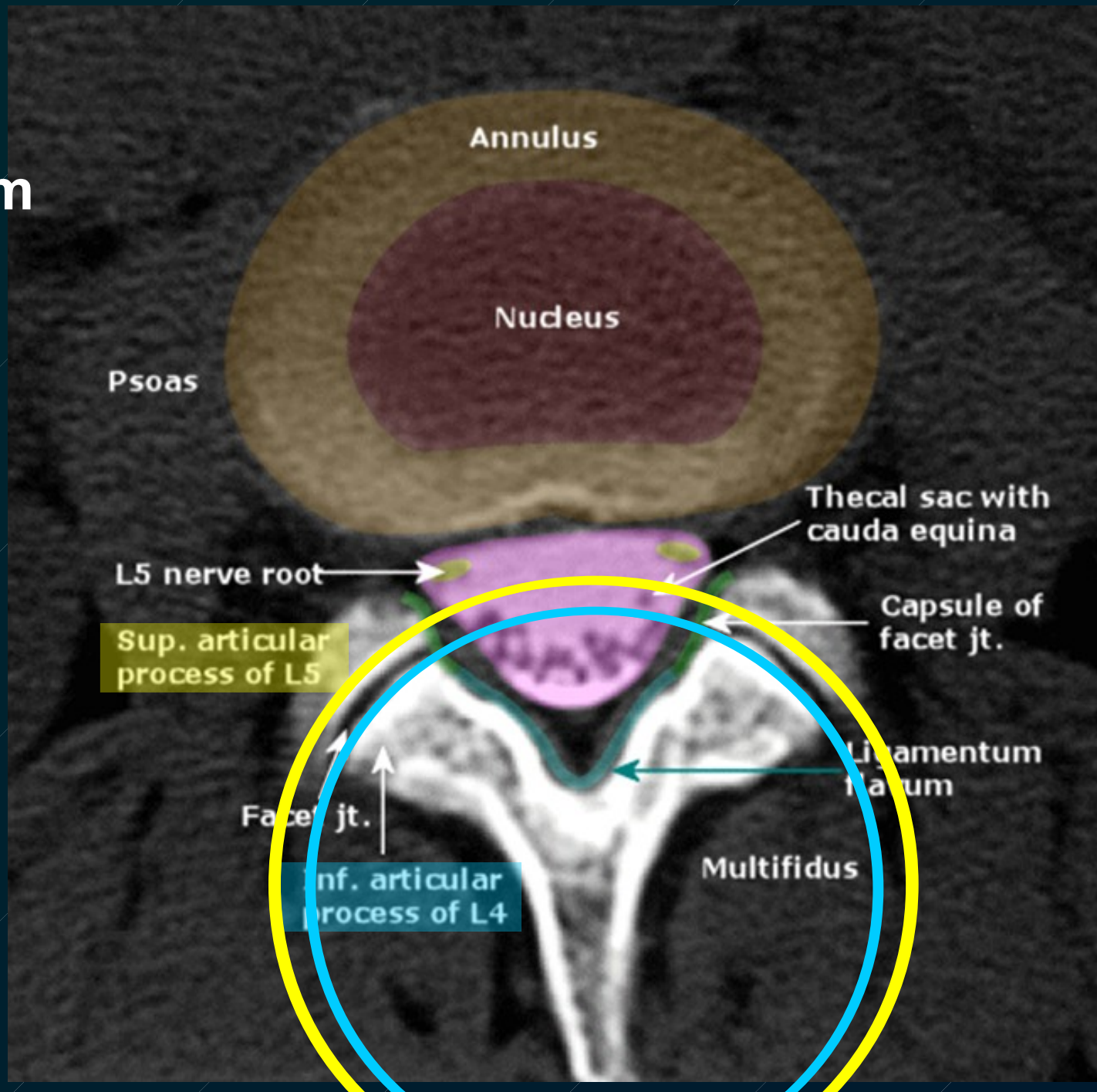




Grade IV spondylolisthesis. A 17-year-old boy with chronic low back pain and **no neurologic dysfunction**. T2: grade IV spond. of L5/S1.

Degenerated disc (arrows) adheres both to L5 and S1, without extrusion
Parasagittal view: obliteration of L5-S1 foramen; no compromise of L5 nerve

Axial CT Myelogram L4/5



Stenosis - Changes in Alignment



3-Joint Degeneration

Yong-Hing K, Kirkaldy-Willis WH. *Orthop Clin North Am* 1983;14:491-504

Starts in ONE joint

Eventually
involves 3 joints of
segment

one disc

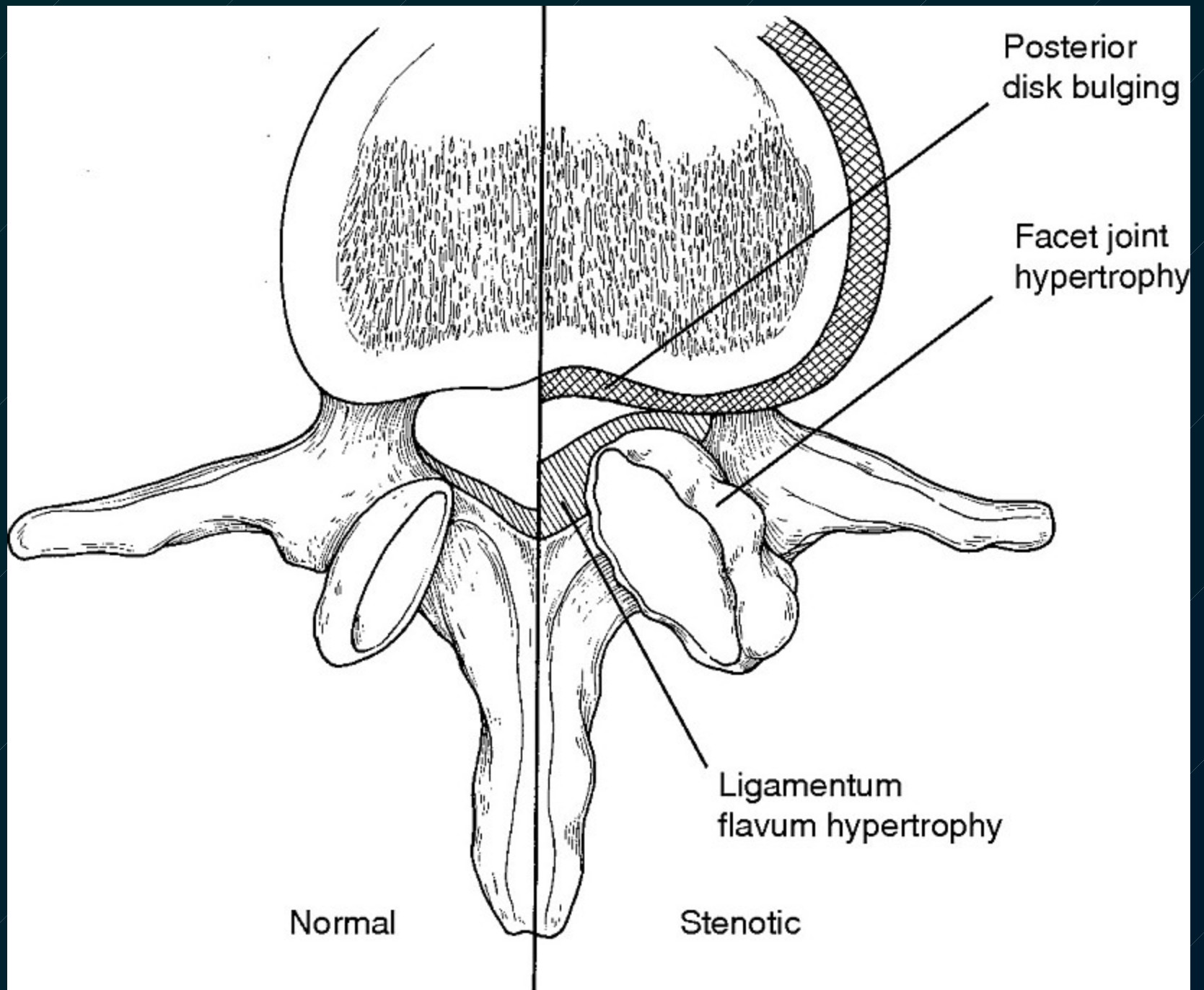
two posterior
joints

Later mechanical
changes

affect levels
above and below

cause similar
changes there

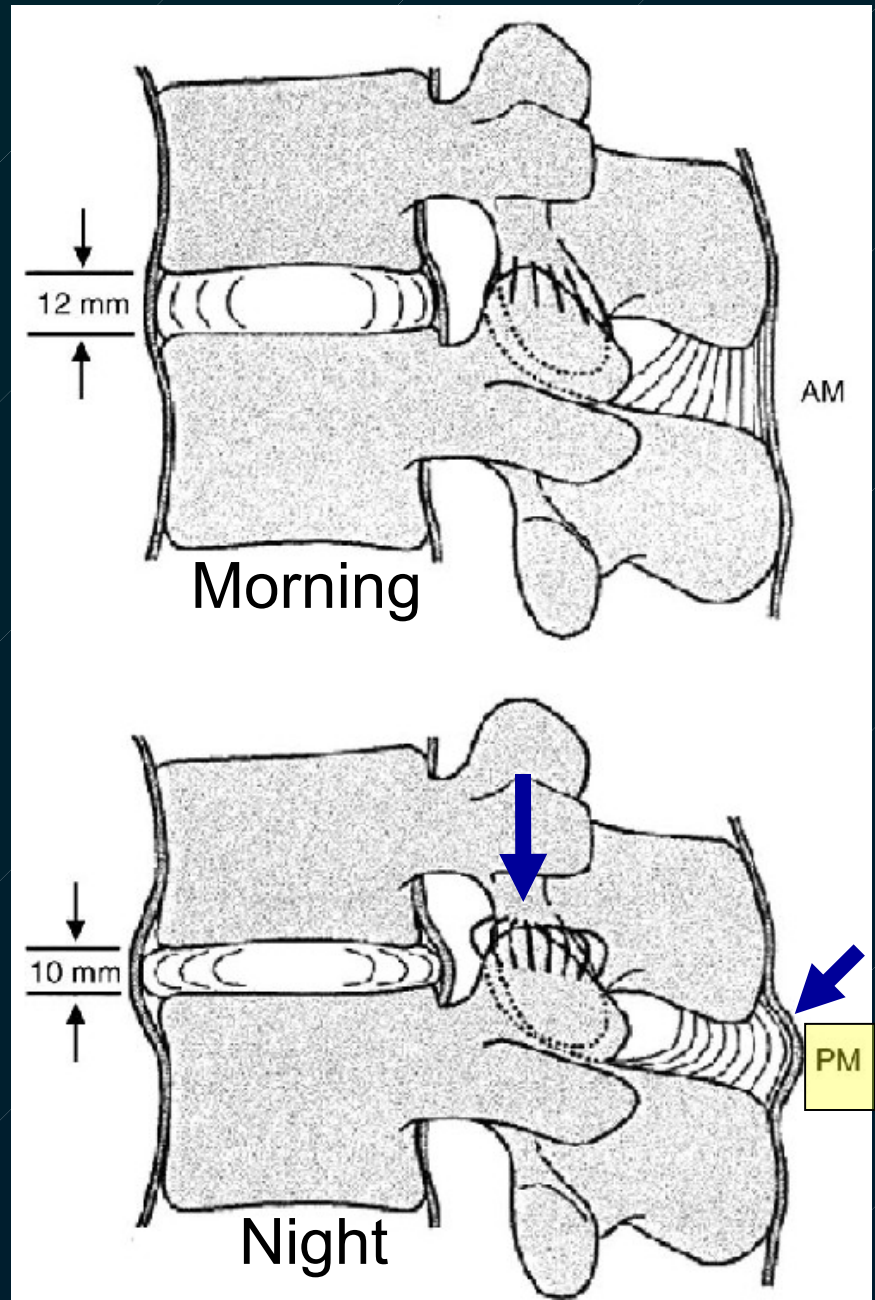
Result: multilevel spondylosis and stenosis



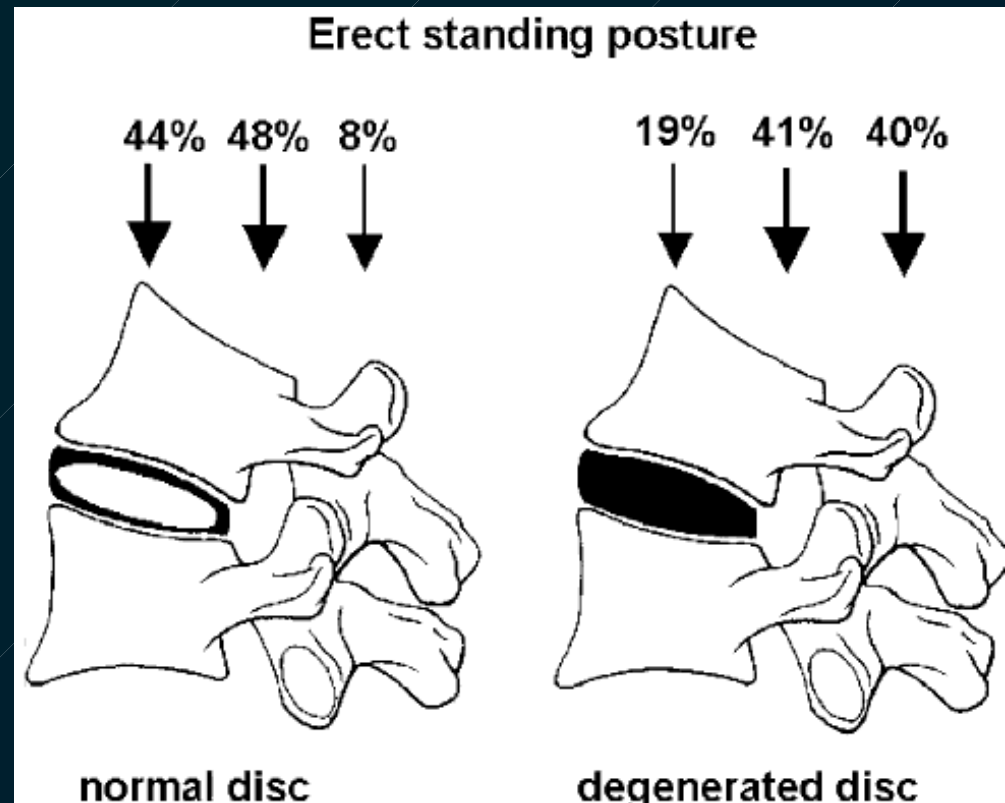
Posture

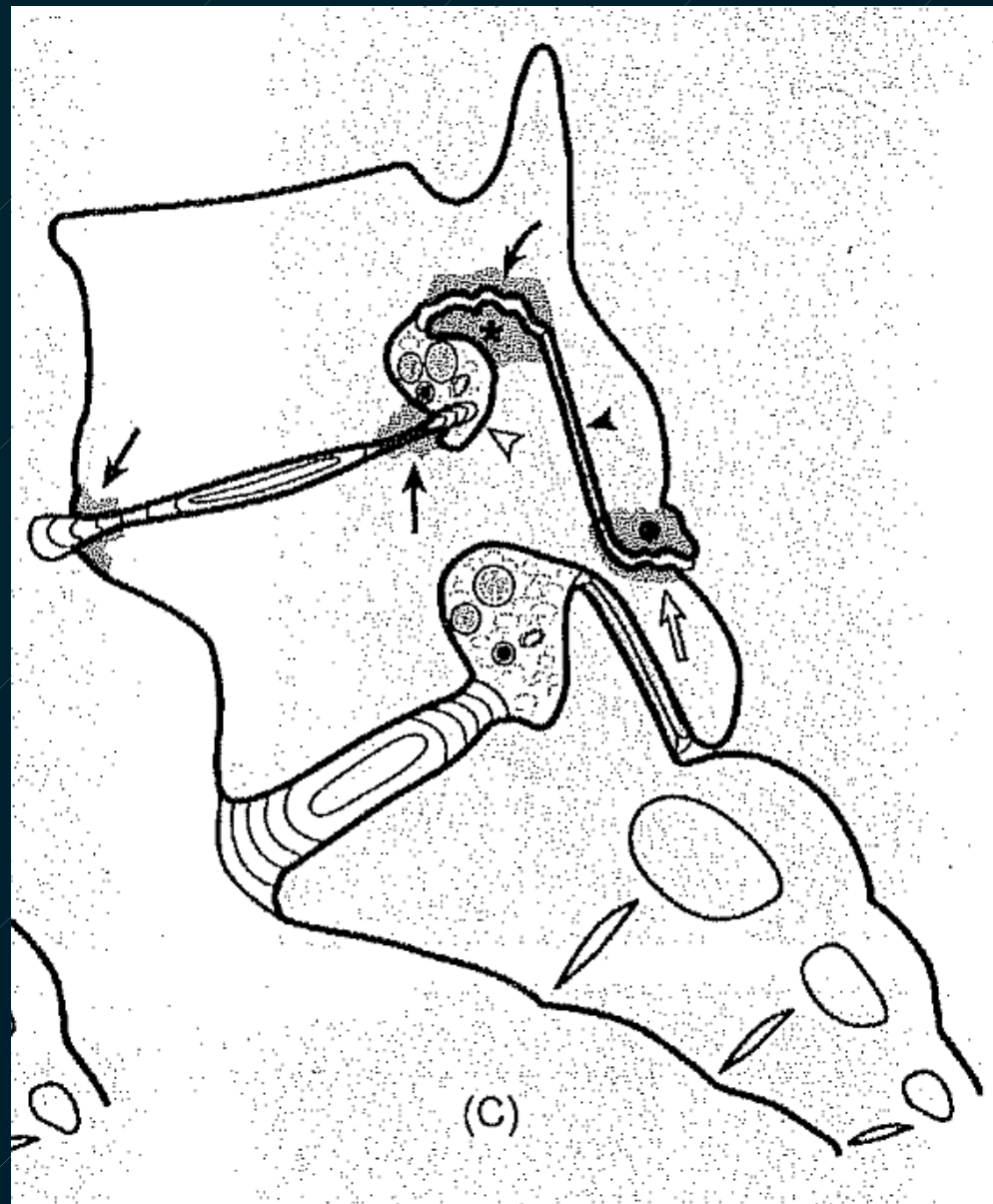
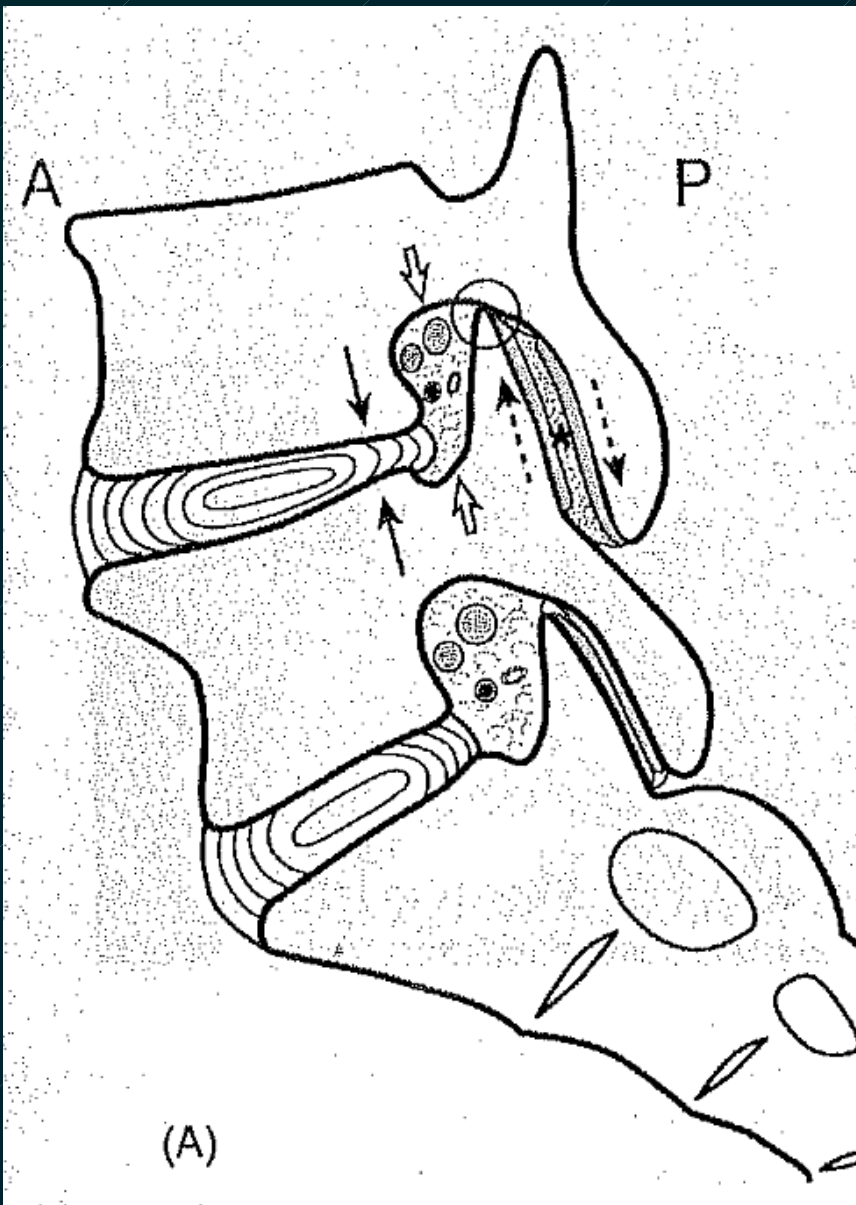
Minor changes:

- Alter distribution of stresses
- Put ligaments on slack
- Give rise to pain

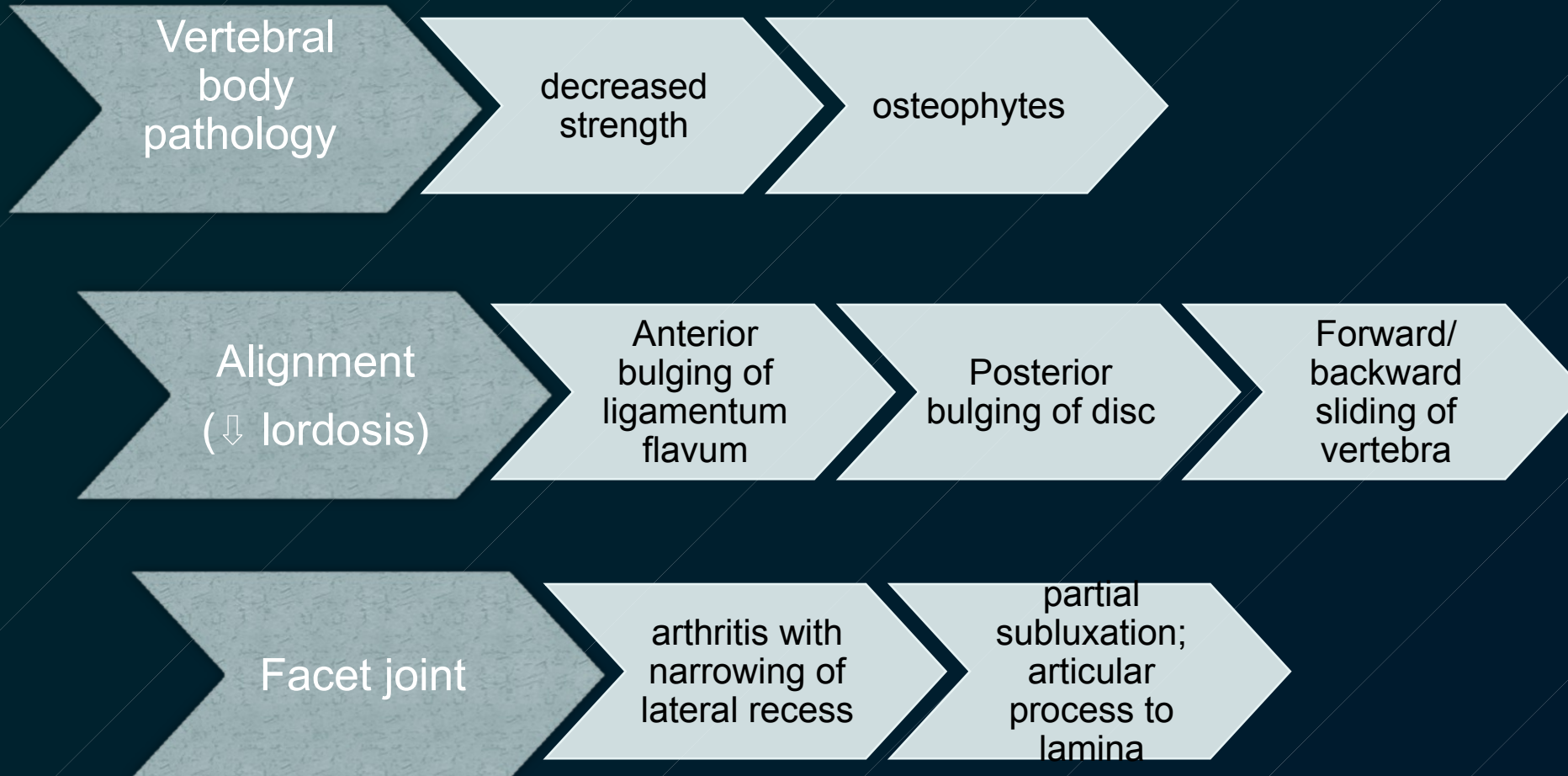


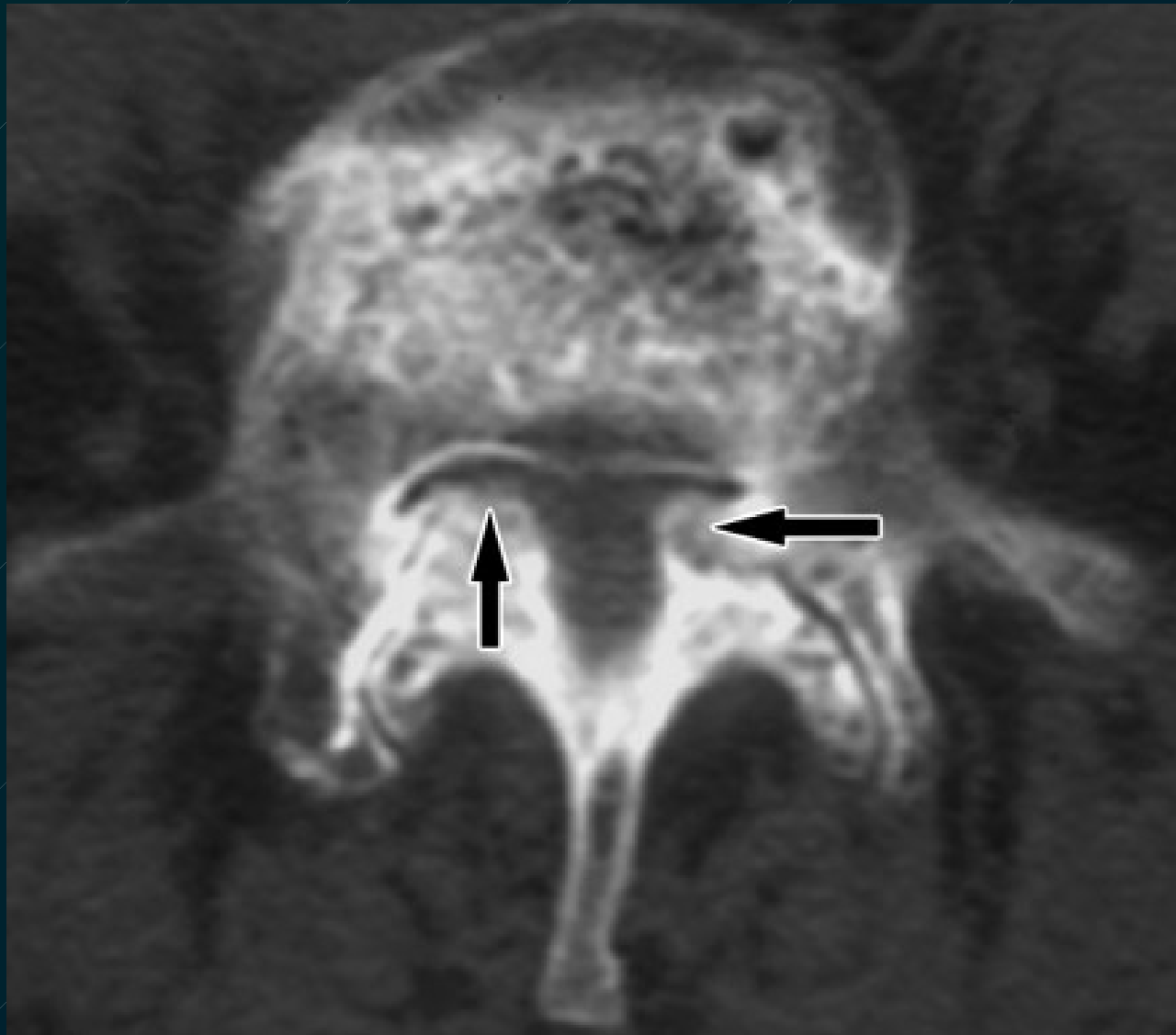
- Shifted weight distribution
- Over time; weaker vertebral body





Loss of Disc Height





Axial CT: L4 vertebra in 62-year-old woman with degenerative spondylolisthesis. Subluxed inferior articular processes of sup. vertebra (arrows) cause central canal and lateral recess stenosis. Note sagittal orientation of right facet joint.