Cervical Spine – Alignment

Spinal Digitizer
Biomechanical Measurements
By
Tariq J. Faridi, Intern – Loma Linda University – Fall
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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?
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 vertebrael bodies.

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

McGregor plane

Odontoid plane

Inf. endplate of C2 should “face forward”
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 vertebral bodies.

3. Interspinous spaces should not be less than 8mm each.
1. Cranio-vertebral angle should not be less than $96^\circ$ or over $106^\circ$.

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

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

105°

McGregor plane

Inf. endplate of C2 should “face forward”

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

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Sagittal Alignment
a Cephalograph

McGregor plane

Odontoid plane

Inf. endplate of C2 should “face forward”
Cervical Lordosis

Cobb Method
(norm = 30°)
According to Cobb Method; a Kyphosis of 8°
Whiplash - Reversed Lordosis

-25°
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
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)
The facet of the vertebra above is ‘on the outside’

Think of **tiles** on a roof
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

28°
Thoracic Cage Dimension

Pes Excavatum
Structural/ Functional

Structural does not correct on sidebending towards the convexity.
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?
Type ("C/ S")
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 - "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
- Barge angle

30° - 60°
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

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

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

Vertebral body pathology:
- decreased strength
- osteophytes

Alignment (↓ lordosis):
- Anterior bulging of ligamentum flavum
- Posterior bulging of disc
- Forward/backward sliding of vertebra

Facet joint:
- arthritis with narrowing of lateral recess
- partial subluxation; articular process to lamina
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.