CERVICAL, THORACIC & LUMBAR SPINE

Back to Basics

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www.jprad.com
Radiographic Positioning & Factors
- Cervical spine
- Thoracic spine
- Lumbar spine

Radiographic Evaluation—tools you can use
- Cervical spine
- Thoracic spine
- Lumbar spine
Cervical Spine Views

3 Views-
- APOM, AP lower cervical, and neutral lateral performed first; standard views
- If needed, Followed by extended and flexed lateral views>>> evaluate for ligamentous laxity and/or instability
- Oblique views are helpful in evaluating the intervertebral foramina
APOM

- **FFD**: 40”
- **CR**: uvula; if needed, 5 degree with cephalad tube tilt
- **Collimate**: 5x5
AP OPEN MOUTH

Structures Visualized:
- Dens
- C1 lateral masses
- Occipital Condyles
- C2 body
- C2 SP
AP Lower Cervical

- **FFD**: 40-3”
- **Tube Tilt**: 15° cephalad
- **CR**: C3/4 (thyroid cartilage)
- **Collimate**: 7x10
Tube Tilt Rule

- For every 5 degrees of tube tilt, move x-ray tube one inch closer to the patient.
- 15 degree tube tilt = move tube closer by 3 inches (40 inches to 37 inches)
AP LOWER CERVICAL

Structures Visualized

- Vertebral Bodies
- TP’s
- SP’s
- Upper Ribs
- Upper Lung Fields
- Uncinate Processes
- Tracheal Air Shadow
NEUTRAL LATERAL

- FFD 72”
- CR C3
- Collimate 7X10
LATERAL CERVICAL

Structures Visualized

- Vertebral bodies C2-T1
- Disc Spaces
- ADI
- SP’s, Lamina, Pedicles,
- Articular Pillars and Facets
- Tracheal Air Shadow
- George’s Line & Spino-laminar line
- Sella Turcica
- C1 Arches
LATERAL EXTENDED

- **FFD**: 72"
- **CR**: C3
- **Collimate**: 8x10
- May need to be landscape in patients with greater range of motion
LATERAL FLEXED

- **FFD**: 72”
- **CR**: C3
- **Collimate**: 8x10

- May need to be landscape in patients with great range of motion
Posterior vs. Anterior Obliques

**Posterior**
- Visualize the opposite IVF’s
- Example: Left posterior oblique radiograph, visualizes the right IVF.

**Anterior**
- Visualize the same side IVF’s
- Example: Right anterior oblique radiograph, visualizes the right IVF.
LEFT ANTERIOR OBLIQUE

- FFD 72”
- CR C3
- Tube tilt 15 ° caudad**
- Collimate 7-8x10
LEFT POSTERIOR OBLIQUE

- FFD 72-3”
- CR C3
- Tube tilt 15 ° cephalad***
- Collimate 7-8x10
CERVICAL OBLIQUE

Structures Visualized

- IVF’s - should be open and about the same size at every level.
- Vertebral Bodies
- C1 arches
- Ribs
- SP’s
- Facets
Evaluation: ABC’S

- Alignment
- Bone
- Cartilage
- Soft tissue
Alignment- ABC’s

- Lines of interest
- Posture
- Lordosis
Lines of Interest

- Spinolaminar line (green)
- Posterior cervical line (blue)
- Anterior cervical line (red)

These lines should draw in a smooth arc. If there is disruption of these lines, then further evaluation of the bony structures is required.
Radiographic Signs of Instability-
(Evaluate on the lateral radiographs)

- Vertebral body displacement >3-3.5mm
- Greater than 11 degree angulation
- Widened interlaminar & interspinous space
- Widened facet joints
- Widened interpediculate distance (AP view)
- Atlanto-dental interspace>3mm adults; >5mm in children

These findings indicate skeletal, ligamentous and articular disruption.

Measuring Intersegmental Translation- compare to the level below

Greater than 3-3.5 mm of vertebral body motion= ligamentous instability

Need to compare the flexed and extended lateral to the neutral lateral radiograph.

www.chiro-trust.org
Measuring Angulation

- Lines drawn on the Inferior endplates.
- Greater 11 degrees = ligamentous instability
Other Evaluation Tips

- Spinous processes should be equidistant
  - If widening or increased distance, indicator of interspinous ligament injury/disruption.

- Facet joints imbricated (stacked on top of each other 😊)
More Evaluation

ADI-atlantodental interspace:

- V-shaped is normal

- Indicator of ligamentous instability (Transverse Ligament) with widening of the ADI on the Neutral lateral, or on the Flexed lateral, or on the Extended lateral.
  - Greater than 3mm in children & greater than 5mm in adults
Radiographic Signs of Instability

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Evaluation

- Cervical Gravity Line: Vertical line through apex of odontoid, should intersect C7
Cervical Gravity Line

- Gravity line anterior to C7
  - Anterior shift in weightbearing

- Gravity line posterior to C7
  - Posterior shift in weightbearing
Evaluation

- Cervical Lordosis Angle: Normal 35-45 degree
  - In this case, mild anterior shift in weightbearing

Yochum, T & Rowe, L. 2005.
Lordosis Angle

- Hypolordosis- loss of or straightening of the normal lordosis, less than 35 degrees.
- Hyperlordosis- increased lordosis, greater than 45 degrees.
Bone- ABC’s

- Cortex
- Shape and size of the vertebral bodies
  - Should be same size at every level
    - Example: compression deformity= trauma or pathologic from age related osteoporosis, primary bone tumor or mets
- Pedicles and spinous process
  - Make sure they are there!!
  - Equidistant to each other
- Intervertebral foramina
Bone- continued

- Lateral masses of C1 and Dens of C2
  - Normal in shape and size with intact cortex
Cartilage-ABC’s

Joints:

- Facet & Uncovertebral joints
  - Shape, size and density
    - Example: Sclerosis, narrowing and hypertrophied = degenerative joint disease

- Intervertebral discs
  - Size
    - Example: Disc narrowing with/without spondylophytes = degenerative disc disease
Soft Tissue- ABC’s

- Prevertebral or anterior soft tissues of the cervical spine
- Normal calcifications within the soft tissues
- Tracheal air shadow & Upper lung fields
Lateral cervical spine

- Evaluate the anterior and posterior soft tissues

- Prevertebral (anterior) soft tissues:
  - Retropharyngeal: >7.0-mm
  - Retrotracheal: >22.0-mm
Prevertebral Soft Tissues

- Why do we need to look at them?
  - Widening of the anterior/ prevertebral soft tissue and/or increased density = Differential diagnosis is edema due to trauma, infection, or a mass/tumor.
Posterior Soft Tissues

- Don’t miss fractures of spinous process when evaluating the soft tissues

- Normal nuchal bones—calcification within the ligamentum nuchae, normal physiologic variant.
Soft tissues-continued

- Normal calcification of the thyroid cartilage
- AP radiograph of cervical spine
  - Tracheal air shadow
  - Upper lung field
  - Lateral soft tissues
    - Atherosclerosis of carotid arteries
- Tracheal deviation to the right.

- The normal tracheal cartilage calcification is also deviated to the right.
Atherosclerosis of bilateral carotid arteries
2 Views of the Thoracic Spine

- AP and Lateral views

- PA chest view is optional
  - With full inspiratory effort
AP Thoracic Projection

- **FFD**: 40”
- **CR**: T6
- **Collimate**: 7x17
Lateral Thoracic View

- FFD 40”
- CR T6
- Collimate 10x17

Take image during expiration to blur out the ribs
AP and Lateral Thoracic Views
Evaluation: ABC’S

- Alignment
- Bone
- Cartilage
- Soft tissue
Alignment-ABC’s

- Posture
  - Convexities
  - Scoliosis
    - If 10-15 years of age, curve less than 20 degrees maybe monitored, assess for progression of 5 degrees or more in a 3 month timeframe.
    - Curves 20-40 degrees may be surgical
Scoliosis

- Cobb-Lippman method of mensuration
Alignment-continued

- **Kyphosis**
  - Normal = 20-40 degrees (increases with age)
  - Hypokyphosis: less than 20 degrees
  - Hyperkyphosis: more than 40 degrees
Bone- ABC’s

- Shape and size of vertebral bodies
  - Compression deformity=fracture or normal morphology

- Intervertebral foramina
  - Equal in size
  - Stenosis: degenerative posterior osteophyte, degenerative disc disease, facet degeneration, and/or degenerative retrolisthesis.

- Pedicles
  - Missing pedicle= aggressive pathology such as tumor or metastatic disease
Bone-continued

- Spinous processes
  - Make sure they are present, normal cortices, normal size

- Intervertebral foramina
  - Make sure they are clear and equal size
  - Stenosis = posterior osteophyte, degenerative disc disease, degenerative retrolisthesis, facet degeneration
Cartilage-ABC’s

- Disc spacing
  - Degenerative disc disease = disc narrowing with or without spondylophytes

- Facet joints
  - Hypertrophied and sclerosis = degenerative joint disease

- Normal costochondral cartilage calcification of the lower ribs
Soft tissues- ABC’s

- Chest
  - Lung fields: check for radiopacities/nodules/tumors

- Tracheal air shadow
  - No deviation; should be midline

- Aortic knob
  - Atherosclerosis-age related
  - Normal in size
Soft tissue- continued

Hemidiaphragm

- Megenblase should not be superior to the left hemidiaphragm = Hiatal hernia
Hiatal Hernia

- Air above the left hemidiaphragm
2-3 Views of the Lumbar Spine

- AP
- Lateral
- Angulated PA or AP lumbosacral spot view
  or
- Lateral lumbosacral spot view
AP Lumbar Spine

- **FFD**: 40"
- **CR**: 1” above iliac crest
- **Collimate**: 10 x 17
Lateral Lumbar View

- FFD 40”
- CR 1” above iliac crest
- Collimate 11x17
AP and Lateral Views

www.uwmsk.org
AP Angulated Lumbosacral

- **FFD**: 40”-5”
- **CR**: 1” below ASIS
- **Tube tilt**: 25-35 ° cephalad (25 degrees caudad for PA angulation)
- **Collimate**: 10x12
AP (PA) Angulated Lumbosacral

**Structures Visualized**

- L5-S1 Disc Space
- Sacroiliac (SI) Joints: Best radiograph to evaluate for the SI joints
- Sacrum Sacral Foramen
- L5 TP's and SP's
- L5 Vertebral Body
(Left) Posterior Oblique View

- **FFD**: 40”
- **CR**: 1” above iliac crest
- **Collimate**: 11x14
Scotty Dog

- Nose = Transverse process
- Eye = Pedicle
- Ear = Superior facet
- Front leg = Inferior
- Collar thru the neck = Fracture

www.imageinterpretation.co.uk
Evaluation: ABC'S

- Alignment
- Bone
- Cartilage
- Soft tissue
Alignment-ABC’s

- Anterior and posterior vertebral body line (lateral radiograph)
  - Evaluate for anterolisthesis/retrolisthesis of the lumbar segment, compare to the level below.
    - Cause of anterolisthesis = degenerative changes or pars interarticularis defect or fracture
    - Cause of retrolisthesis = most commonly degenerative changes

- Posture
  - Gravity Line
    - Anterior shift in weightbearing
    - Posterior shift in weightbearing
Evaluation

- Ferguson Gravity Line: from center of L3, should intersect anterior 1/3 of sacrum
Evaluation

- Ferguson Gravity Line
  - Anterior shift in weightbearing = increased stress on facet joints
  - Posterior shift in weightbearing = increased stress on the IVF, pars interarticularis, facet joints & posterior disc.
Evaluation

- Normal Lordosis: 50-60 degrees
Alignment- continued

- Lordosis
  - Normal lordosis: 50-60 degree
  - Hypolordosis: loss of the lumbar lordosis with straightening.
  - Hyperlordosis: increased lumbar lordosis

- Scoliosis/convexities
  - If 10-15 years of age, curve less than 20 degrees maybe monitored, assess for progression of 5 degrees or more in a 3 month timeframe.
  - Curves 20-40 degrees may be surgical
Bone- ABC’s

- Shape and size of vertebral bodies
  - Compression deformities

- Pedicles and spinous process
  - Make sure they are present and in the correct location
  - Fractures of pedicles
  - Spina bifida occulta, normal variant.
Normal spina bifida occulta

- No fusion at the junction of the lamina and spinous process
- Posterior cleft
Bone-continued

- Pars interarticularis
  - Defect/fracture
  - Classification of pars interarticularis defects/fractures
    - Grade of spondylolisthesis (anterolisthesis)
Cause of Anterolisthesis

Types/Causes

- Type 1: Dysplastic (congenital)
- Type 2: Isthmic
  - 2a = fatigue fracture of the pars interarticularis
  - 2b = elongation of the pars
  - 2c = acute fracture of the pars
- Type 3: Degenerative disc disease or degenerative facet joints
- Type 4: Traumatic, fractures to the neural arch
- Type 5: Pathologic, bone disease
Grade of Spondylolisthesis

- Grade 1 spondylolytic spondylolisthesis at L5

- Meyerding Classification:
  - Grade 1-4
Bone- continued

- Intervertebral foramina
  - Make sure they are clear and equal size
  - Stenosis = posterior osteophyte, degenerative disc disease, degenerative retrolisthesis, and/or facet degeneration.
Bone-continued

- Lower ribs
  - Normal costochondral cartilage calcification

- Sacrum/Ilium

- Hips-femur and acetabulum if included in the AP lumbar study
Cartilage-ABC’s

- Facet joints
  - Degenerative changes

- Sacroiliac joints
  - Degenerative changes = bony proliferation, sclerosis and joint narrowing.
  - Inflammatory (ankylosing spondylitis) = bilateral erosive changes, widening of the joint; or complete fusion
Cartilage-continued

- Transitional segments
  - L5 = sacralization
  - S1 = lumbarization
  - Classification

- Intervertebral discs
  - Disc spacing = narrowing with/without spondylophytes is degenerative changes.
TRANSITIONAL SEGMENT AT L5
Transitional Segment at L5

- Sacralization of L5
  - Bilateral pseudoarthrosis, articulation to the sacrum,
  - IIb Castellvi

- Complication
  - Increased stress above and below
  - Early degenerative disc disease at L4-L5.
Castellvi Types

- Type II and IV-associated with low back pain = Bertolotti’s syndrome - inflamed transitional segment.

- Clinically misdiagnosed as sacroilitis.
Soft tissues- ABC’s

● Anterior soft tissues
  ● Atherosclerosis of abdominal aorta, iliac arteries
    ● Calcification of abdominal aorta: width of abdominal aorta should not exceed 2.0 cm (lateral radiograph)
  ● Gallstones: right upper abdominal quadrant, AND anterior to the spine
  ● Kidney stones: right or lower abdominal quadrant, but overlies or adjacent to the spine.

● Lower lung field
  ● Check for radiopacities or tumors/masses

● Bowel gas
Atherosclerosis of abdominal aorta

- Widening of abdominal aorta, greater than 4.5 cm
Soft tissues-continued

- **Organ shadows**
  - Kidney: calcifications/stones
  - Liver: Enlarged (hepatomegaly)
  - Spleen: Enlarged (splenomegaly); extending inferiorly from the left 12th rib.

- **Pelvic basin**
  - Bladder shadow: Distended= prostate pathology
  - Uterine fibroids (benign calcifications)
  - Vas deferens calcification= V-shaped tubular calcification within the mid portion of pelvic basin
    - Associated with diabetes
Vas Deferens Calcification
Soft tissues-continued

- Surgical artifact within the abdomen and pelvic basin
  - Cholecystectomy (gallbladder removal)
  - Vascular clips
  - Intrauterine device
The End