Radiology of Cervical Spine Trauma

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Cervical Spine Trauma

- Vertebral column fractures account for 3-6% of all skeletal injuries,
- mostly in people between 20 - 50 yrs and 80% are male.
- More injuries in thoracic and lumbar regions, but the cervical area has greater potential risk for spinal cord injury.
- Auto accidents, sports, and falls from heights

Imaging Standards

- Written clinical need for imaging
- Quality “diagnostic” images
- Written radiographic report (not a note in SOAP notes). Check lists are not supported.
- Incorporation of imaging report in the patient file

Canadian C. Spine Rule

National Emergency X-Radiography Utilization Study (NEXUS)
Normal anatomy in 43-year-old woman. Sagittal T2-weighted MR image (TR/TE, 4500/117) obtained on 0.3-T MR scanner shows normal apical ligament (1), anterior occipitoatlantal membrane (2), anterior atlantoaxial membrane (3), anterior longitudinal ligament (4), tectorial membrane (5), dural reflection (6), posterior occipitoatlantal membrane (7), posterior atlantoaxial membrane (8), nuchal ligament (9), flaval ligaments (10), area of interspinous ligaments (11), and supraspinous ligament (12).

Standard Radiographs

- First examination obtained.
- Can be done as portable exam.
- Failure to diagnose unstable injury on arrival may lead to additional, permanent neurologic damage.
- Complementary to CT; some injuries subtle on axial images.
Technical Notes

• APOM – patient positioning
• APLC – pt. Positioning/tube tilt/collimation

Technical Notes

• Lateral Cervical--40inch FFD.
• Post. Arch C1 over nameplate

Technical Notes

• REMOVE CLOTHING AND JEWLREY

Technical Notes

• Two views perpendicular--MINIMUM
CERVICAL SPINE

POSITIONING PROCEDURES

Neutral Lateral Cervical:
- FFD: 72”, kVp: 70, mA: 200
- Time or mAs will depend on measurement of patient. Measure in cm.
- Tube Tilt: None
- Patient position: Erect with face directed forward. No flexion of chin.
- Central Ray: C3, just below and behind angle of mandible
- Measure: Across traps, side to side at level of C7.
- Breathing: Hold or exhale and hold, to lower shoulders.
- Misc.: Weights maybe needed to lower shoulders.

AP Lower Cervical:
- FFD: 40”, kVp: 70, mA: 100
- Time or mAs will depend on measurement of the patient. Measure in cm.
- Tube Tilt: 15 degrees cephalad
- Patient position: Erect or supine, Anterior to Posterior, Chin elevated slightly.
- Central Ray: At C3/C4, or the Thyroid (Adam’s Apple).
- Measure: At the level of C3, Adam’s Apple from front to back.
- Breathing: Hold or exhale and hold.

AP Open Mouth:
- FFD: 40”, kVp: 70, mA: 100
- Time or mAs will depend on measurement of the patient. Measure in cm.
- Tube Tilt: None
- Patient position: Erect or supine in AP. Mouth open with mastoid process and upper incisor line parallel to floor (central ray).
- Central Ray: At C1/C2. Through the middle of open mouth
- Measure: At the level of C3, As for the AP Lower Cervical
- Breathing: Hold
Flexion Lateral Cervical:
FFD: 72”, kVp: 70, mA: 200
Sec: **Time or mA depends on measurement of patient. Measure in cm.
Tube Tilt: None
Patient position: Erect in lateral position. Chin tucked and head and neck flexed forward to patient tolerance. Done following “Cleared Cervical spine”. Motion is done by the patient.
Central Ray: C3
Measure: Across traps, side to side at level of C7.
Breathing: Hold or exhale and hold, to lower shoulders.
Misc.; Weights maybe needed to lower shoulders.

Extension Lateral Cervical:
FFD: 72”, kVp: 70, mA: 200
Sec: **Time or mA depends on measurement of patient. Measure in cm.
Tube Tilt: None
Patient position: Erect in lateral position. Chin elevated and head and neck extended backward to patient tolerance.
Central Ray: C3
Measure: Across traps, side to side at level of C7.
Breathing: Hold or exhale and hold, to lower shoulders.
Misc.; Weights maybe needed to lower shoulders.

Left Posterior Oblique Cervical
FFD: 72”, kVp: 70, mA: 200
Sec: **Time or mA depends on measurement of patient. Measure in cm.
Tube Tilt: 15 degrees Cephalad for posterior oblique. Caudal tube tilt for anterior oblique.
Patient position: Erect in 45 degree oblique position.
Central Ray: C3
Measure: Across traps, side to side at level of C7. SAME AS LATERAL
Breathing: Hold or exhale and hold, to lower shoulders.
Misc.; Weights maybe needed to lower shoulders.
Cervical Oblique Projections

**Left Posterior Oblique (LPO)**
- Patient’s shoulders and body are rotated 45 degrees.
- Head is positioned with sagittal plan parallel to film.
- Chin is slightly elevated to project mandible off of spine.
- Posterior oblique image demonstrates the opposite side intervertebral foramen (IVF).
- Anterior obliques show the same side IVFs.

**Right Posterior Oblique (RPO)**
- **Time or mAs depends on measurement of patient. Measure in cm.**
- Tube Tilt: 15 degrees Cephalad for posterior obls. Caudal tube tilt for anterior obls.
- Patient position: Erect in an oblique position of 45 degrees rotation.
- Central Ray: C3
- Measure: Across traps, side to side at level of C7. SAME AS LATERAL
- Breathing: same as for LPO

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Cervical Spine

- Optional Projections:
  - Swim-Lateral Cervicothoracic projection; Demonstrates the level of C7/T1.
  - AP Open Mouth Lateral Bending Aids in Evaluation of upper cervical stability
  - Pillars Projections; Demonstrate the articular pillars and facet joint spaces.

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AP Pillars Projections
- **Time or mAs depends on measurement of patient. Measure in cm.**
- Tube Tilt: 35 degrees Caudal for AP and Cephalad T.T. for PA.
- Patient position: Erect or supine in AP or PA position. Turn head/face away from side being imaged.
- Central Ray: C3
- Measure: Anterior to posterior with tube tilt.
- Breathing: Hold or exhale and hold.

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AP Pillars Projection (Left shown)
- Must do both sides, just as for the oblique projections
Swim Lateral Cervicothoracic Spot Projection

FFD: 40”, kVp: 80, mA: 300

Sec: **Time or mAs depends on measurement of patient. Measure in cm. Figure technique as a Lateral Lumbar**

Tube Tilt: None or 10 degree caudal.

Patient position: Erect in lateral position.

Central Ray: C7/T1, top of clavicle.

Measure: Mid-clavicle to shoulder against bucky, to include shoulder.

Breathing: Hold or exhale and hold, to lower shoulders.

Compensating filter is necessary of the cervical region, to prevent gross overexposure. The image must be sufficiently exposed however to view the C7/T1 level.

**Additional special projections**

Lines and Measurements

- Anterior and posterior vertebral lines.
- Spinalisшир line.
- Posterior Spinal Process line.
- Cervical-Odontoid line.
Lateral cervical with decreased KVP for better demonstration of prevertebral soft tissues.

MVC

- 25 yoa Female
- Seen at hospital released
- Chiro. office limited
- Mobility and pain
- Films obtained

Findings?

Lines of Mensuration

- Chamberlain line (posterior margin of foramen magnum to hard palate): odontoid should not project more than 3mm above this line.
- McRae line (defines foramen magnum, basion to opisthion): odontoid should be at or just below this line.
Basilar Impression

Apparent Basilar Impression
Projectional distortion

Signs of Segmental Instability
- Fanning of spinous processes
- Loss of parallelism of facet surfaces
- Disc angle of >11 degrees relative to adjacent discs
- Anterolisthesis or Retro. of > 3.5mm.
- ADI > 3mm
Signs of Segmental Instability

- Arclual kyphosis due to muscle spasm
- Angular kyphosis due to ligament injury

Foreman and Croft: Whiplash Injuries, pg 147

Signs of Segmental Instability

- Flexion/Extension evaluation = instability on flexion at C4/C5.

Foreman and Croft: Whiplash Injuries, pg 147
Functional Radiographic Diagnosis of the Cervical Spine: Flexion/Extension

- 28 healthy patients and 31 patients with cervical spine pain and soft tissue injury were studied.
- Active flexion/extension = 19 hypermobile segments and 60 hypomobile segments
- Passive (forced/stressed) flexion/extension = 31 hypermobile segments and 43 hypomobile segments
- Immobilized the upper thorax to gain truer motion in the cervical region, without thoracic spine involvement.
- Used variation of film overlay methods to measure relative segmental positions on flexion/extension films.
Passive functional radiographs of the cervical spine in flexion and extension were taken of 20 patients with painful limitation of mobility of the cervical spine and 20 subjects, similar in sex and age, without complaints.

Five physicians measured the angles of segmental mobility in a blind study.

The results of the study prove that the evaluation method by Penning shows usable, and, for segments C3/C4 to C6/C7, significant selectivity.

The correlation between the five reviewers showed good to very good results.

The measured values, however, have to be considered, in connection with the appropriate clinical symptoms, as still "normal" or "functionally disordered" in the context of segmental hypo-/hypermobility.