Segmental Instability in the Cervical Spine

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Review of the ligamentous anatomy
Anterior longitudinal ligament

Posterior longitudinal ligament
Ligamenta Flava

Joint capsule
Nuchal ligament

Alar ligament
Transverse ligament

Longitudinal fascicles of cruciform ligament
Apical ligament

Posterior atlanto-occipital membrane
Assessment of cervical spine stability
Purpose

- Examine the effect of the anterior shear test for the transverse ligament and the distraction test for tectorial membrane using MRI on 16 normal volunteers.
Sharp-Purser test for instability

• Patient seated – head positioned in a slight nod.
• Dr. contacts posterior aspect of C2 and forehead (arms parallel to ground).
• Dr. applies posterior pressure on forehead, stabilizing back of C2.
• Should feel firm end-feel. A positive test is sliding of head, or clunk.
• +LR = 17.3, Sens. = .69, Spec. = .96

Anterior shear test

• Patient supine with cervical spine in neutral position.
• Doctor positioned at head of table with index fingers on posterior aspect of C1 and 3rd and 4th fingers cupping the occiput.
• C2 is stabilized anteriorly by the clinician’s thumbs and P-A pressure is applied to the posterior arch of the atlas.
• No movement should be detected.
• This is a provocation test – perform if Sharp-Purser is negative.
Anterior shear test

- Patient supine with head on pillow.
- Doctor is positioned at head of table.
- Doctors caudal hand holds C2 and the cephalad hand cups the occiput.
- Traction is applied in the neutral, flexed, and extended postures.
- A positive test is excessive translation (over 2mm).

Distraction Test

- Patient supine with head on pillow.
- Doctor is positioned at head of table.
- Doctors caudal hand holds C2 and the cephalad hand cups the occiput.
- Traction is applied in the neutral, flexed, and extended postures.
- A positive test is excessive translation (over 2mm).
Distraction Test

Findings

• Statistically significant changes in the atlanto-axial and in the occipto-axial relationships were found with anterior shear and distraction tests.
• In other words, both tests appear to work according to their theorized mechanisms.
• Because this study was performed on healthy individuals, the amount of motion necessary to reproduce symptoms is unknown.
Biomechanical Analysis of Clinical Stability in the Cervical Spine

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Purpose

• To provide objective criteria upon which to evaluate clinical stability in the lower cervical spine.

• Quantitative biomechanical analysis of the effects of destroying ligaments and facets on the stability of the cervical spine below C2.
Definitions

- Anterior elements: PLL and all structures anterior to it
- Posterior elements: all structures posterior to the PLL
- Clinical stability: ability of the spine to limit its patterns of displacement under physiologic loads so as not to damage or irritate the spinal cord or nerve roots.

Motion segment fixed to test stand
Findings

- The posterior ligaments contributed more to stability in flexion than the anterior structures.
- The anterior ligaments contributed more to stability in extension than the posterior ligaments.
- The displacement with all ligaments intact was very small.
• Upper physiologic horizontal displacement was determined to be 2.7 mm – or 3.5 mm on a lateral x-ray (considering magnification).
• Upper limit of physiologic angular displacement was determined to be 10.7 degrees (not affected by magnification on x-ray).

Criteria for instability

The presence of one or more of the following:
• Either all of the anterior elements or all of the posterior elements are destroyed or unable to function.
• More than 3.5mm of horizontal displacement of one vertebra in relation to an adjacent vertebra, measured on lateral flexion/extension views.
• More than 11 degrees of rotational difference to that of either adjacent vertebra, measured on lateral flexion/extension views.
38 year old male with cervical spine trauma and upper and lower motor neuron signs.
Rheumatoid arthritis

• Chronic, systemic, inflammatory disease of unknown etiology
• Characterized by hypertrophy of synovial tissue and pannus formation that causes erosions of adjacent tissues.
• Prevalence of RA is estimated to be 1-2% of world's population.
• Classically affects peripheral joints, but also predilects the cervical spine.
Rheumatoid arthritis

- RA is more common in women, but men with RA have a greater likelihood of cervical spine involvement.
- 17-85% of patients with RA have cervical spine laxity or instability.
- Only 7-34% of RA patients have neurologic deficit.
- No clear consensus on treatment for patients with evidence of instability but no neurologic deficits.

Patterns of instability with RA

- Atlanto-axial subluxation
  - Occurs in 65% of patients with cervical involvement

- Cranial settling
  - Occurs in 20% of patients with cervical involvement
Neurologic deficits with RA

- May result from direct compression on spinal cord or brainstem from subluxation of spine or pressure from pannus.
- May also result from ischemia of vertebral artery secondary to stenosis.

Symptoms of instability

- Neck pain, headache, occipital neuralgia are early, but nonspecific, findings.
- Pain that is worse when upright and relieved when recumbent (greater occipital branch of C2).
- Ear pain (auricular branch of C2).
- Sensation of head falling forward with flexion and clunking with extension.
- Clumsiness of hand, gait disturbances, heaviness in legs are early signs of myelopathy.
Imaging studies

- APOM, AP lower cervical, LCN, flexion/extension views
- ADI should not measure above 3 mm.
- Central canal measurement (from posterior aspect of dens to anterior aspect of posterior arch of C1) should not measure below 14 mm.
- Cranial settling is assessed with McGregor or Chamberlain lines.
Four years prior

McGregor’s Line

• Measure on LCN view
• Line drawn from the posterior margin of the hard palate to the most inferior surface of the occiput
• The odontoid process should not lie above the line more than 8 mm for males and 10 mm for females
• Most reliable line for basilar impression
Chamberlain’s Line

- Measure on LCN view
- Line drawn from posterior margin of the hard palate to the posterior aspect of the foramen magnum.
- The odontoid process should not project more than 3mm above this line. Over 7mm is definitely abnormal.
- Indicates basilar impression
Take home messages

• RA has high rate of cervical spine involvement and routine radiological screening is recommended.
• DMARD and BA prevent de novo cervical instabilities but do not halt progression of pre-existing lesions.
• Atlanto-axial instability is the most common form of cervical instability with RA.
• Long term radiological follow-up is recommended, even after surgical treatment.
Methods

• Inclusion criteria: individuals with degenerative cervical spondylolisthesis; radiographic examination or surgical intervention; English article
• Searched PubMed from Jan. 1947 to Nov. 2010
• Eight papers were selected to review.
• Each article was appraised by two reviewers.
Findings

• Degenerative cervical spondylolistheses was most common at C3/4 and C4/5.
• Neck and occipital pain are common symptoms.
• Degenerative cervical spondylolisthesis is an important cause of myelopathy in elderly.
• Dynamic central canal stenosis was more likely to correlate with myelopathy than was static stenosis. (take flexion/extension views)