A NEUROSURGEON'S VIEW

A Preventable Journey to a wheelchair bound-life...

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F.C.S (Neurosurgery)
Cervical Spondylosis

- Spinal Osteoarthritis / Spinal Arthritis
- Degenerative cervical disc disease
- 90% of the world population above 65 but about 10% only have symptoms
  - <40 years: 25%
  - >40 years: 50%
Figure 30-2. The structure of the intervertebral disk is demonstrated with the alternating lamellae of collagen in the annulus and the centrally located nucleus pulposus.
Figure 30-5. Diagram of the innervation of the intervertebral disk.
Cervical Spondylosis: Definition

- Age related degeneration of the cervical spine
- "Osteoarthritis"
- Most common in persons over 40
- Most common cause for myelopathy in persons over 55
- Male > Female
PATHOPHYSIOLOGY

- Intervertebral discs lose hydration and elasticity with age - leading to cracks and fissures.
- The surrounding ligaments also lose their elastic properties and develop traction spurs.
- The disk subsequently collapses as a result of biomechanical incompetence, causing the annulus to bulge outward.
- As the disk space narrows, the annulus bulges, and the facets override.
- This change, in turn, increases motion at that spinal segment and further hastens the damage to the disk.
- Annulus fissures and herniation may occur.
- Acute disk herniation may complicate chronic spondylotic changes.
Cervical Spondylosis

- Hyper-mobility/ Instability of spinal segments
- Irritation/inflammation of heavily innervated vertebral body endplates
- Direct compression of cervical nerve root or spinal cord
- Repetitive trauma to cord or roots
- Ischemic change to the cord
X-Ray Cervical Spondylosis

- occiput
- occipital condyles
- anterior arch of C1
- dens
- C2 body
- facet joints
- superior articulating facets
- spinous processes
- laminae
- C3
- intervertebral disc spaces
- C4
- C5
- inferior articular facets
- C6
- pedicles
- vertebral bodies
- C7
- T1

'Spur' of bone

Narrowing of disc
Degeneration in the Cervical Spine

A Lateral Cervical X-ray

- loss of neck curve
- bone spurs
- loss of disc height
ACUTE HYPERFLEXION ROTATION (OR BOTH)

- Rupture of Disc annulus and PLL
- Nucleolus herniate into spinal cord
- Cord or Nerve Root compression
Cervical Spondylosis - Pathology

Age Related Degeneration and Dehydration of intervertebral Disks

Decreased cartilage between adjacent vertebral bodies

Developmental laxity in the spinal supportive ligaments

Hyper-mobility of spinal segment

Bone-on bone apposition propagates bone spur formation which narrow the cervical spinal canal and may compress the cervical nerve roots and spinal cord.
Spondylitic change with bone spur/disk complex formation

Developmental narrowing of spinal canal with compression of spinal cord and nerve roots
Cervical Spondylosis – Clinical Presentation

**Mechanical**
- Pain
- Stiffness
- Muscle Spasm
- “Pop and Crack”

**Neurologic**
- Nerve Root Compression
- Spinal Cord Compression
Progression in Cervical Spondylosis

Disc Degeneration

Segmental Instability

- vulnerability to trauma
- osteophytosis

- facet hypertrophy
- joint of Luschka

- radiculopathy, myelopathy
Clinical Symptoms and Signs

<table>
<thead>
<tr>
<th>Symptoms or signs</th>
<th>Cases</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Headache</td>
<td>355</td>
<td>27.8</td>
</tr>
<tr>
<td>Dizziness</td>
<td>696</td>
<td>54.5</td>
</tr>
<tr>
<td>Neck stiffness</td>
<td>139</td>
<td>12.3</td>
</tr>
<tr>
<td>Nausea and vomiting</td>
<td>181</td>
<td>14.2</td>
</tr>
<tr>
<td>Weakness and tingling in the neck and/or arms</td>
<td>655</td>
<td>51.3</td>
</tr>
<tr>
<td>Pain in the back, neck, and/or arms</td>
<td>1,106</td>
<td>86.7</td>
</tr>
<tr>
<td>Vertigo and instability of walking</td>
<td>188</td>
<td>14.7</td>
</tr>
</tbody>
</table>
Cervical Spondylosis

Causes

Cumulation of all these -
Bumps, Fall, Injuries, Accidents, Bad posture, Sitting and looking down, Forward position, Incorrect sleep position

- Congenitally narrow vertebral canal
- Athletic person: Rugby, horse riding, soccer
- Genetic
Cervical Spondylosis - Presentation with "Headache"

Kyphotic Angular deformity creates added stress on the paraspinal muscles and causes severe myofascial pain and spasm and often produces suboccipital headaches where the paraspinal muscles insert on the base of the skull.

For this reason, some degenerative cervical spine disease can present with "headache".
3 Clinical Syndromes:

- Axial neck pain
- Cervical Radiculopathy
- Cervical Myelopathy
Neck Pain

Composite map of axial pain patterns from facet joints at C2-3 to C6-7.
Nerve root compression in lateral spinal canal from disc, uncovertebral joint, or facet joint pathology can lead to cervical radiculopathy.
Cervical Radiculopathy

- C₆/C₇ most common
- Radicular pain: compression of inflamed or irritated nerve root
- Increase substance P in Dorsal nerve root → Neurogenic pain mediator
- Mechanical deformation of the Dorsal nerve root cause reduction of blood flow to the sensory nerve cells bodies resulting in pain
- Local inflammatory mediators; examples TNFα causing pain
## On Examination

<table>
<thead>
<tr>
<th>Disk Level</th>
<th>Root</th>
<th>Pain Distribution</th>
<th>Weakness</th>
<th>Sensory Loss</th>
<th>Reflex Loss</th>
</tr>
</thead>
<tbody>
<tr>
<td>C4–C5</td>
<td>C5</td>
<td>Medial scapular border, lateral upper arm to elbow</td>
<td>Deltoid, supraspinatus, infraspinatus</td>
<td>Lateral upper arm</td>
<td>Supinator reflex</td>
</tr>
<tr>
<td>C5–C6</td>
<td>C6</td>
<td>Lateral forearm, thumb and index finger</td>
<td>Biceps, brachioradialis, wrist extensors</td>
<td>Thumb and index finger</td>
<td>Biceps reflex</td>
</tr>
<tr>
<td>C6–C7</td>
<td>C7</td>
<td>Medial scapula, posterior arm, dorsum of forearm, third finger</td>
<td>Triceps, wrist flexors, finger extensors</td>
<td>Posterior forearm, third finger</td>
<td>Triceps reflex</td>
</tr>
<tr>
<td>C7–T1</td>
<td>C8</td>
<td>Shoulder, ulnar side of forearm, fifth finger</td>
<td>Thumb flexors, abductors, intrinsic hand muscles</td>
<td>Fifth finger</td>
<td>—</td>
</tr>
</tbody>
</table>
Pushing down on top of head, with neck in extension (chin up) and head leaning toward symptomatic side elicits pain, typically toward or down the arm (positive Spurling’s sign); 90% specific, 45% sensitive.
Shoulder Abduction Test for Radiculopathy

Physical Exam
Shoulder abduction test/Shoulder abduction relief sign/Bakody’s sign

- Active/passive abduction of ipsilateral shoulder
- Relief of radicular symptoms
- Takes stretch off of the affected nerve root and may decrease or relieve radicular symptoms
Autumn dry leaves
Oil on canvas
1994
73 x 107 cm
CERVICAL SPONDYLOTIC MYELOPATHY is a neurological disorder caused by the narrowing of the spinal canal as a result of degenerative changes in the cervical spine.

- Symptoms and signs may be subtle in early manifestations
- Can be easily missed or incorrectly diagnosed as the natural process of ageing
Cervical Spondyloptic Myelopathy

- Result of degenerative changes
  - ligamentum flavum hypertrophy or buckling,
  - facet joint hypertrophy
  - disc protrusion
  - posterior spondyloptic ridges
- overall reduction in canal diameter
- cord compression
**TABLE 1**
Clinical Presentation of Cervical Spondylotic Myelopathy

**Common symptoms**
- Clumsy or weak hands
- Leg weakness or stiffness
- Neck stiffness
- Pain in shoulders or arms
- Unsteady gait

**Common signs**
- Atrophy of the hand musculature
- Hyperreflexia
- Lhermitte's sign (electric shock-like sensation down the center of the back following flexion of the neck)
- Sensory loss
Cervical Spondyloptic Myelopathy (CSM)

Subtle changes in balance or hand dexterity

Clumsiness or slowness with activities:
- Buttoning buttons
- Using keys
- Change in handwriting
- Difficulty with common tasks using computer keyboard
- Pushing buttons on a cellphone
- Texting Messages
Recent necessity to use handrail while negotiating stairs

Paresthesia and weakness in upper limbs

May have concomitant radicular signs & Symptoms

Change in bowel or bladder dysfunction
Myelopathy Hand

- Test of hand dexterity - 15 seconds grip and release test
- Loss of Motor Strength
- Sensory Changes
- Wasting of the intrinsic muscles
- Spasticity
Finger Escape Signs

Ulnar two digits drift into abduction and flexion after the patient hold the hand in the extended position.
• Vibration in upper & lower limbs
• Hyper reflexia – Abnormal long tract signs
• Hoffmans
• Babinski
Cervical Spondylotic Myelopathy (CSM) - Evaluations

- Plain Xray C.Spine. AP + LAT views
- Narrowing of Disc Space
- Facet Joint Arthrosis
- Bone Spurs
- Ossification of Post Longitudinal ligament (OPLL)
- Kyphotic Alignment
- PAVLOV Ratio – For Stenosis
- Flexion Extension Views + Oblique Views
• Disc Herniation
• Facet Joint Hypertrophy
• Folding of Ligamentum Flavum
• Cord Oedema/ Signal Changes
• Sagittal diameter of cord
Spinal cord pinched

Signal change (white spot) in spinal cord indicating damage
Clinical Equipoise Case

- 57yo female
- Clumsy hands
- Gait instability
- 3 levels of compression
• Presence of bone spurs
• Or any ossification of post longitudinal ligament (OPLL)
Canal Stenosis

- Absolute Stenosis Sagittal Canal Diameter <10mm
- Critical Stenosis < 8mm
- Relative Stenosis < 13mm
- Normal diameter 17 – 18 mm
- Genetic Variation
The dimensions of the cervical spinal canal and spinal cord at C5.

Average canal
1.4 × 2.5 cm

Average cord
0.8 × 1.3 cm
Figure 381-3  Acute hyperextension causes segmental narrowing, especially at the lower cervical segments. The central cord syndrome may result. (From Schneider et al.,15 with permission.)
Pincer mechanism in extension

Pinching forces compromise micro circulation -> Ischemia in watershed area Edema and cavitation.
PAVLOV RATIO = A / B
STENOSIS IF <0.8
Figure 381-4  A lateral cervical spine film and the corresponding diagram. Note the method for measuring the anteroposterior diameter of the spinal canal, and the prominent spondylotic ridge (arrow) at C5-C6.
Diagnosis of CSM

- History
- Physical Examination
- Imaging
- For each individual patient
On examination

Pathologic long tract signs :

- Hoffman’s
- Babinski
- Clonus
- Finger Escape
- L’hermitte’s Signs
- Hyporeflexia
Hoffmann's Sign

The test is done by tapping or flicking the nail of the middle or ring finger to produce flexion of the index finger to the thumb.
L’hermitte’s Signs

Neck flexion causing electric shock sensation and paraesthesia radiating to the upper and lower extremities
Flexing head tractions cord and meninges upwards

Nerve root entrapped by pedicle
Finger Escape Sign
Myelopathy

- Hold fingers adducted and extended
- Small & ring fingers fall into flexion abduction
  - Usually within 30 seconds
Several studies – Mixed Course
Not clearly defined
Tendency to progress to more severe disease
  Quiescent period
  Slow stepwise decline
  Stable neurological dysfunction and a rapid decline
The natural history of is one of the stepwise progression.

Early recognition and treatment is essential for optimum patient outcome before irreversible spinal cord damage.
Cervical Spondylotic Myelopathy

Differential diagnosis

- Amyotrophic Lateral Sclerosis
- Multiple Sclerosis
- Carpal Tunnel Syndrome
- Syringomyelia
- Guillian Barre Syndrome
- Spino Cerebellar degeneration
- Traumatic myelopathy
Progression of Cervical Spondylosis to Cervical Spondylotic Myelopathy

Several studies

- Highly variable and difficult to predict
- Relatively benign form to severe disease with neurological deficit
Syndromes seen in CSM patients

Complete lesions:
Transverse lesion syndrome

Incomplete lesions:
• Motor system syndrome:
• Central cord syndrome:
• Brown-Sequard syndrome
• Brachialgia and Cord syndrome
Indication for Surgery

- Patient Age
- Baseline Function
- Rate of Deterioration
- Severity of Symptoms
- Overall Health and Morbidity
Indication for Surgery

- Ongoing Symptoms refractory to conservative treatment
- Progressive symptoms bowel and bladder dysfunction
- Overt weakness
Surgery

• To prevent further decline
• May not result in substantial spontaneous improvement
• Early surgery for patients with myelomalacia or severe radiographic stenosis
• Intramedullary high signal changes -> poor prognosis
**Myelopathy** : Any pathological condition of the spinal cord
- Upper motor neuron signs
- Motor weakness, positive Babinski sign, spasticity, hypereflexia, clonus

**Radiculopathy**: Pathological condition of a spinal nerve root
- Lower motor neuron sign
- Motor weakness, Muscle fasciculation, Muscle atrophy, hyporeflexia
Prognosis

• Condition does not improve without surgery.

• It tends to be progressive and get worse in a stepwise deterioration with periods of stable symptoms.
<table>
<thead>
<tr>
<th>Grade</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade 0</td>
<td>Root signs and symptoms. No evidence of spinal cord involvement</td>
</tr>
<tr>
<td>Grade 1</td>
<td>Signs of spinal cord involvement, but no difficulty walking</td>
</tr>
<tr>
<td>Grade 2</td>
<td>Slight difficulty walking that does not prevent full-time employment</td>
</tr>
<tr>
<td>Grade 3</td>
<td>Difficulty walking that prevents full-time employment or the ability to perform all housework, but that was not severe enough to require someone else help to walk</td>
</tr>
<tr>
<td>Grade 4</td>
<td>Able to walk with someone else’s help or the aid of a frame</td>
</tr>
<tr>
<td>Grade 5</td>
<td>Chair bound or bedridden</td>
</tr>
</tbody>
</table>
Saggital CT reconstruction:

Osteophyte present
C3/4
**NON-SURGICAL TREATMENT**

- Usually steady deterioration
- Trail of non-surgical management indicated in non-acute patients

Various modalities:

- Medications
- Immobilization
- Physiotherapy
- Traction
- Manual therapies

- Cervical exercises
- Passive modalities
- Occupational therapy
- Recreational Therapy
- Lifestyle changes
- Other modalities
SURGICAL TREATMENT

Controversial

Indications

Goals

Approaches

Anterior

Combined

Posterior
ISOLATED NECKPAIN IS NOT AN INDICATION FOR SURGERY
FIGURE 123. Lumbosacral spine.
ANTERIOR APPROACHES

Anterior Cervical Discectomy without graft fusion

Anterior Cervical Discectomy with graft fusion

Anterior cervical Discectomy with graft fusion and plating

Discectomy & Corpectomy with graft fusion +/- plating

Interbody fusion with cages

Oblique Corpectomy

Prosthetics
POSTERIOR APPROACHES

Laminectomy

Hemi-Laminectomy

Laminoplasty

Keyhole Foraminotomy / Lamino-foraminotomy

+/- posterior spinal fusion

Posterior cervical stabilization:
Spinous process wiring / Interfacet wiring / Facet wiring / Lateral Mass plates
Figure 3. The skin edges are retracted vertically with a single-toothed self-retaining retractor.

Figure 4. Dissection along the carotid-esophageal cleavage plane.
Figure 5. Dissection of the longus colli muscles away from the vertebral bodies.

Figure 6. Application of self-retaining retractors.
Figure 5. This radiograph, taken 12 months postoperatively, shows single-level ACDF with plating.
Figure 5. Recent improvements in interbody cage design in Europe, such as this Raban cage (Signus Medizintechnik, Alzenau, Germany), now usually allow the use of local cancellous autograft without supplemental anterior fixation for single-level fusions.
Peek Cages
CORPUSCLES
Figure 8. Axial diagram of the extent of disectomy and osteophyte resection required for adequate decompression. Note that uncinate spurs are removed along with the lateral vertebral body surface that forms the medial floor of the foramen.
Corpectomy
Corpectomy & Prosthesis
Plating
Figure 6. Radiograph showing a two-level corpectomy with anterior plate, 14 months postoperatively.
Figure 1. Posterolaterally herniated cervical disc compressing a nerve root.
Figure 33-3. The cross-hatched area in this axial view drawing demonstrates the amount of bone that is removed during posterolateral foraminotomy. As a result, this procedure is most appropriate to address disk herniation or osteophyte that is located in the posterolateral region, as demonstrated by the striped area in the drawing.
Disc Herniation With Nerve Root Compression
Figure 3. A, the paraxial erector muscles have been stripped away from the laminae and spinous processes of C-6 and C-7 and a self-retaining retractor has been inserted. The area within the dotted keyhole line represents the extent of bone removed. B, a portion of the inferior edge of the superior lamina is removed with Kerrison rongeurs. C, the medial aspect of the facet joint is drilled away using a diamond burr. D, laminar bone material is removed from under the walls of the C-7 nerve root.
Axial T2-weighted MRI
LAMINOPLASTY

• Popular technique for the treatment of cervical myelopathy due to multilevel canal stenosis

• Many variations

• Open door cervical Expansile laminoplasty
FIGURE 5. Axial computed tomographic scans obtained at the C5 level. A, preoperative scan showing a narrowed sagittal bony canal diameter. B, scan obtained after laminoplasty with rib allograft. C, scan obtained 2 years later. Note arthrodesis and reconstruction of the posterior bony arch.
Expansile Laminoplasty
Summary

• Cervical Spondylosis and the progression to Cervical Spondylotic Myelopathy is highly variable and difficult to predict.

• 3 clinical syndromes of Cervical Spondylosis are:
  1) Axial Neck Pain
  2) Radiculopathy
  3) Myelopathy

• It is important to diagnose Cervical Myelopathy early (50% improved surgery v/s 16% late surgery after 1 year)
Summary (cntd)

**Cervical Spondylosis**
- Osteoarthritis of the neck
- Axial Neck Pain
- Cervical Radiculopathy

**Cervical Spondylotic Myelopathy**
- Cold Compression
- Myelopathy
- Early Surgical Treatment
Signs

Radiculopathy

• Spurling Sign
• Abduction Test
• Hyporeflexia
• LMN

Myelopathy

• Hoffman Test
• Babinski
• Finger Escape
• L’hermitte’s Signs
• Hyporeflexia
• Clonus
• UMN
Cervical Myelopathy can present in 5 different syndromes.

**Investigations**

MRI is the investigation of choice, X-Rays C.Spine in flexion, extension for instability. CT Scan occasionally used for bone anatomy.
Diagnosis of CSM

Be aware and suspect CSM

 History
 Examination
 MRI

Diagnose early… Refer early…

A Preventable Journey to a wheelchair bound-life…
“Good surgeons know how to get out of trouble.
Better surgeons know how to avoid it.”

Thank you