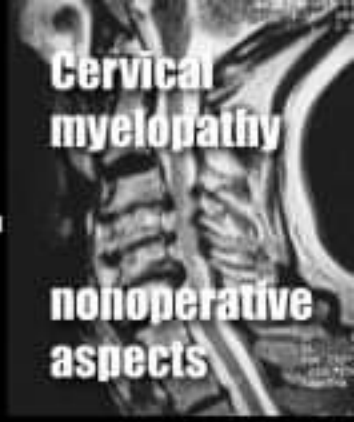
Cervical myelopathy

What causes it?

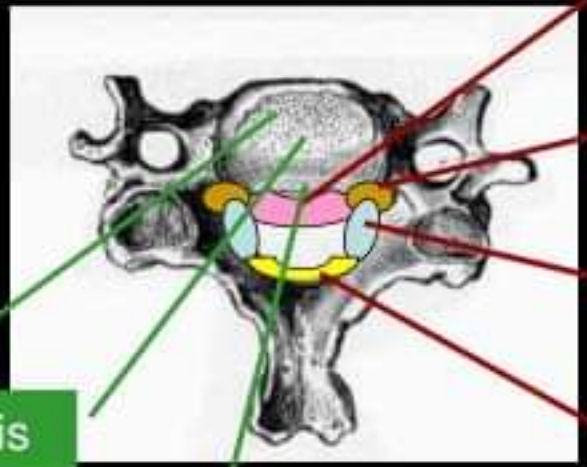


DEGENERATION → stenosis → CORD COMPRESSION

ISCHAEMIA

PREDISPOSITION

- kyphosis
- spondylolisthesis
- disc prolapse



- protruding disc
- osteophyte
- uncovertebral joint enlargement
- facet joint enlargement
- lig. flavum hypertrophy

What causes it?

DEGENERATION

ISCHAEMIA

PREDISPOSITION

- less important
- difficult to explain gradual deterioration on vascular basis
- compression of anterior spinal artery may be important in deterioration in trauma

What are the symptoms?

vague + slow = delay

Symptoms of myelopathy

Clumsy weak numb hands

Leg stiffness or weakness

Neck stiffness

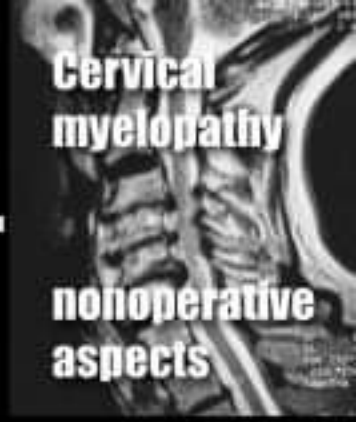
Pain in shoulders or arms

Unsteady gait

Urinary hesitancy

L'Hermitte's sign

What are the signs?



nonspecific

Signs of myelopathy

Wasting of hand intrinsics

Hyperreflexia

Hoffmann's sign

Variable sensory loss

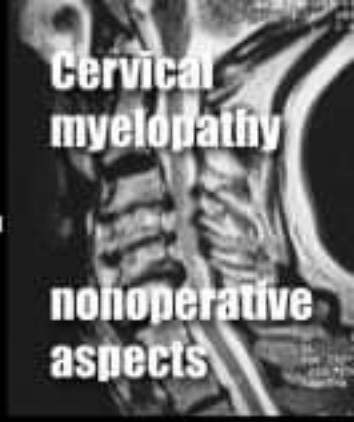
Inverted radial reflex

L'Hermitte's sign

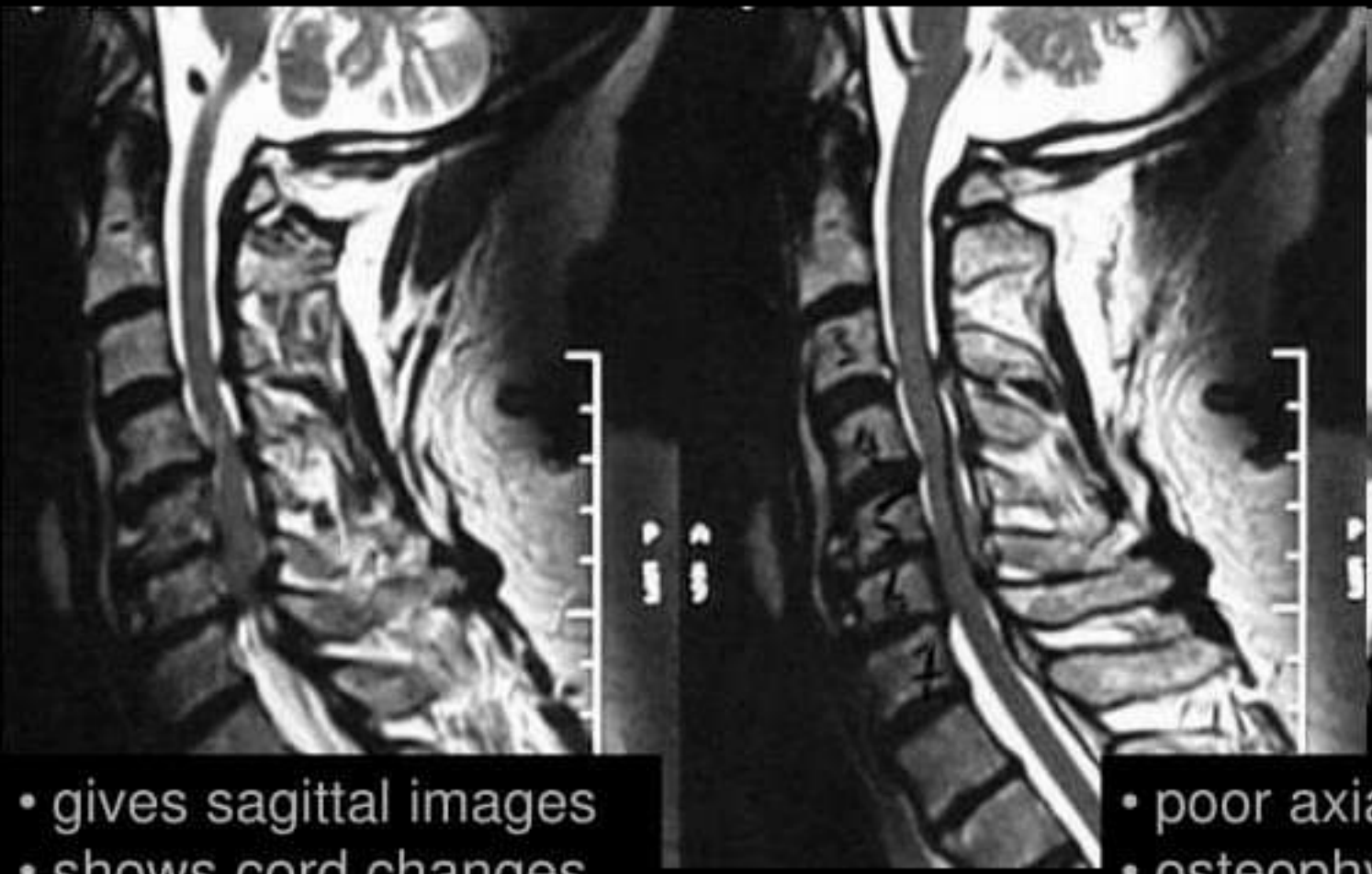
Upgoing plantar response

Ankle clonus

What tests to order?



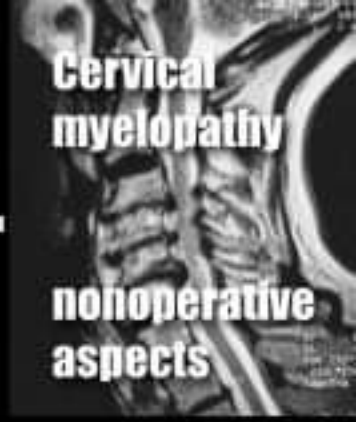
MRI is best



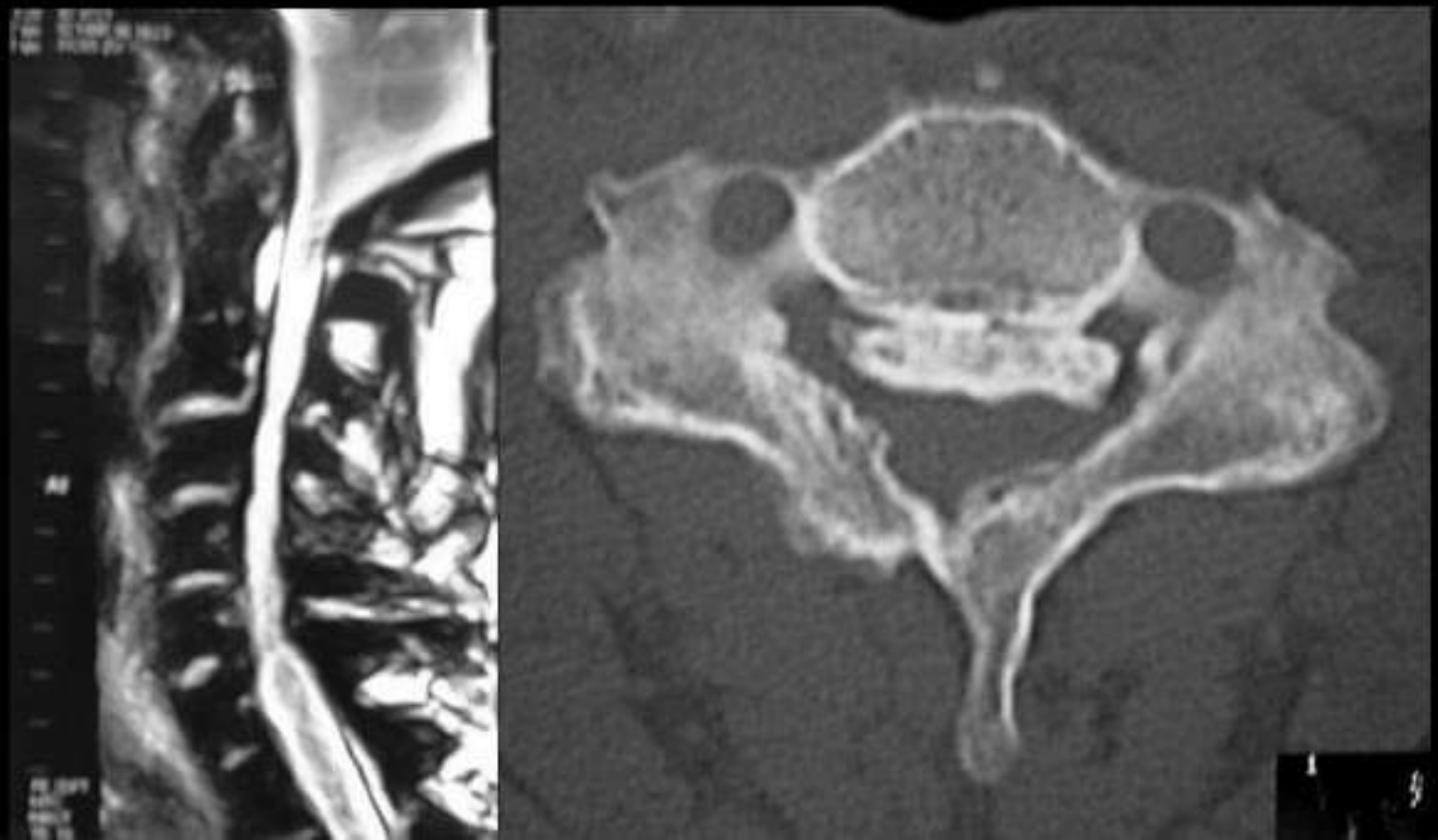
- gives sagittal images
- shows cord changes

- poor axial images
- osteophytes unclear

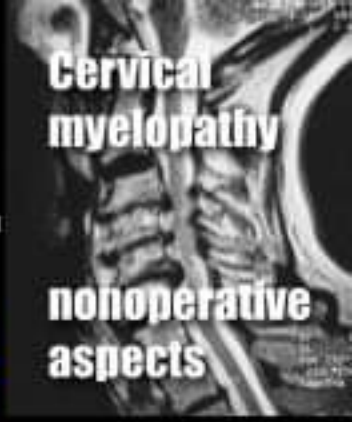
What tests to order?



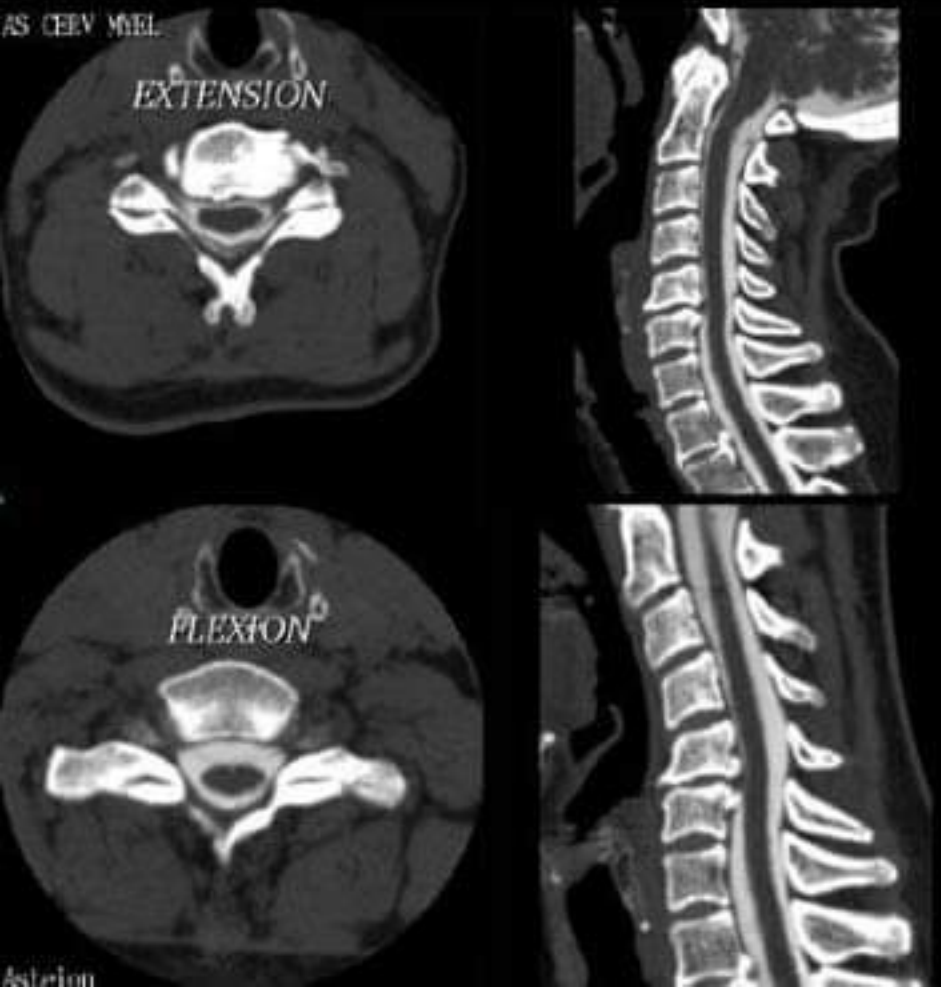
CT is useful

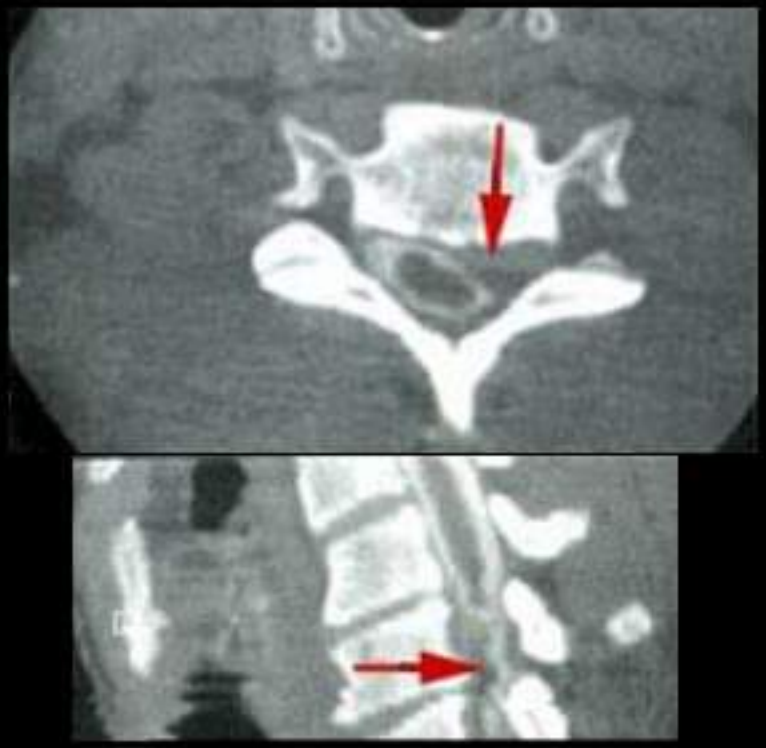


What tests to order?



CT-myelogram valuable





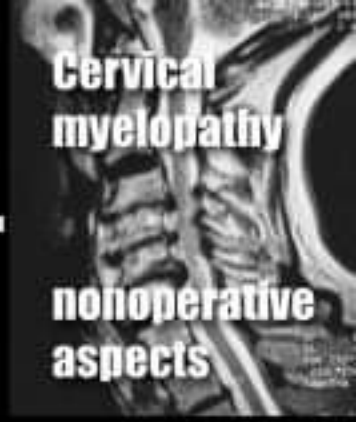
- dynamic
- sagittal reformats
- show bone well

What else could it be?

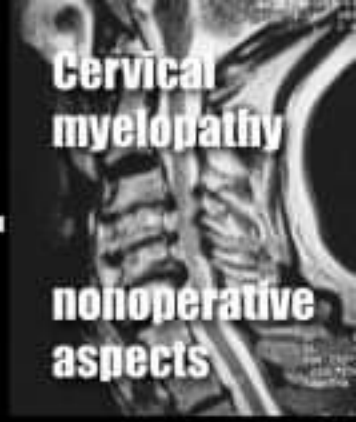
wrong in 15%

Differential diagnosis

- amyotrophic lateral sclerosis
- metastatic tumour
- multiple sclerosis
- syringomyelia
- spinal cord infarction
- vitamin B12 deficiency
- intradural tumour
- hereditary spastic paraplegia



What is likely to happen?

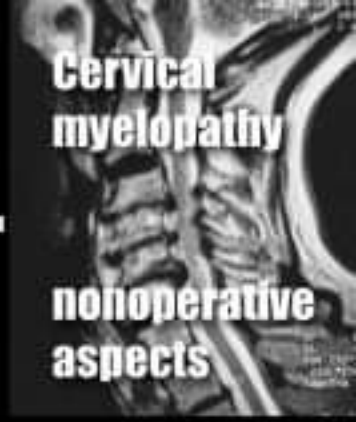


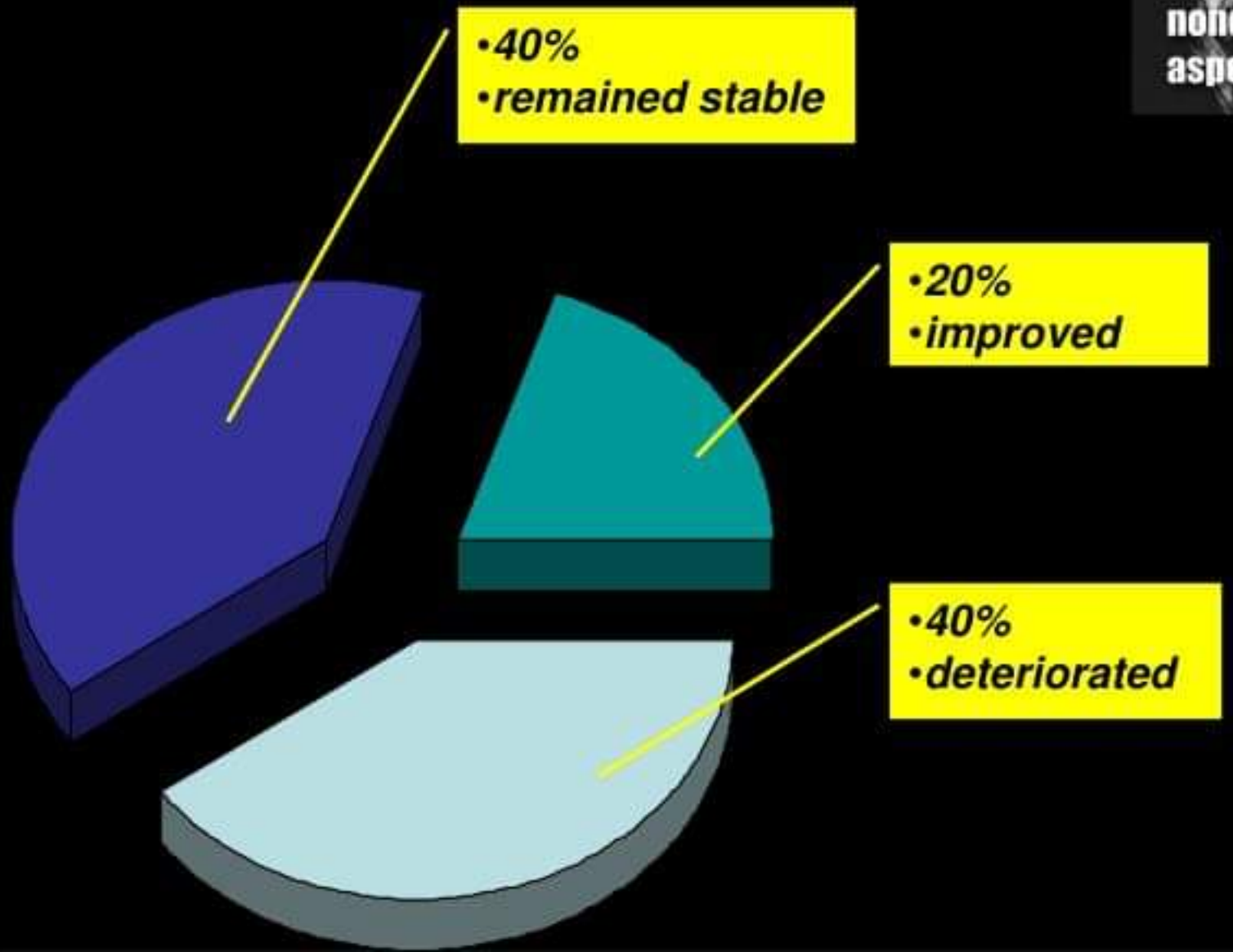
- *75%
- *stepwise deterioration
- *quiescent stability in between
- *may be prolonged

- *20%
- *gradual deterioration

- *5%
- *rapid onset
- *lengthy disability

What is likely to happen?





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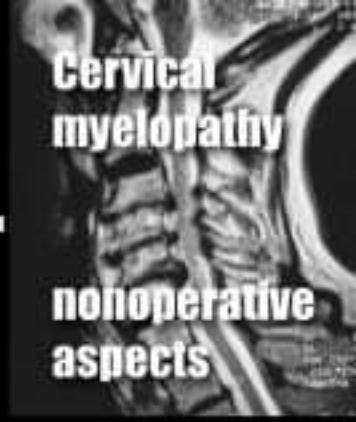


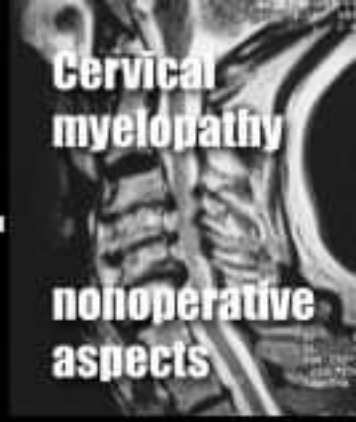
more recent studies less optimistic

especially surgical papers….

Overall consensus

- minority improve
- deterioration pattern variable
- deterioration more likely if
  - older
  - long duration symptoms
  - severe symptoms

What is the treatment?



- regular clinical review

- symptomatic treatment

DEFINITION

- Cervical myelopathy is the manifestation of long-tract signs resulting from a decrease in the space available for cervical spinal cord due to progressive multilevel circumferential compressive disease.
- Any space occupying lesion within the cervical spine with the potential to compress the spinal cord can cause cervical myelopathy.
- Cervical spondylosis is the most common cause of cervical spinal cord dysfunction in individuals older than 55 years.

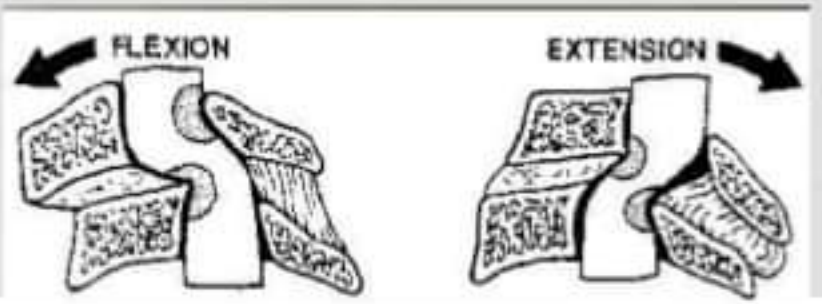
COMPRESSIVE MYELOPATHY

CAUSES (mode compression based) CAUSES (mode compression based)

EXTRADURAL	INTRADURAL	INTRAMEDULLARY
• *Cervical Spondylosis* • Disc prolapse • Trauma • Tumor-Metastasis, • multiple myeloma • CVJ anomalies • TB spine • Epidural abscess • Epidural haematoma	• Tumor-NF,meningioma, • lipoma,sarcoma • metastasis • Arachonoiditis • Sarcoidosis • Cervical menigitis • AVM • Leukemic infiltration • Arachonoid cyst	• Syrinx • Tumor – ependymoma • astrocytoma • Haemagioblastoma • Haematomyelia

SPONDYLOSIS CAUSING CORD COMPRESSION

- Static-mechanical cord compression
- Dynamic-mechanical cord compression
- Impairing the circulation within the cord



1. STAT

Cervical Myelopathy (Static stenosis)

- Osteophyt
- Spinal lig
- Disc mat

➢ which e
canal spa
stenosis

➢ Those
narrowed
mm) are
vulnerable to static-
mechanical compression

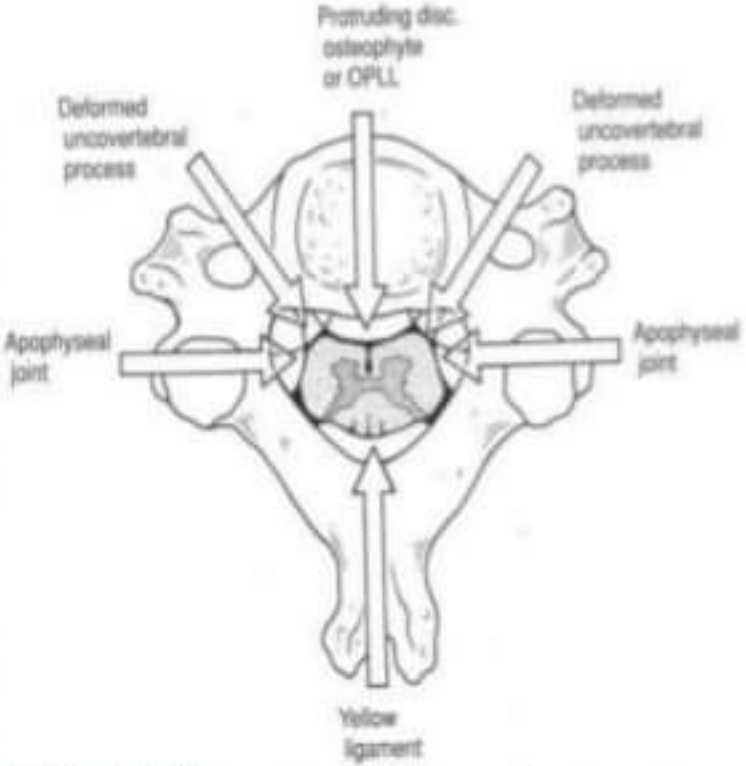


FIG. 6-2. Various pathologic situations can produce cervical cord compression under physiologic loads. They include hypertrophy of the ligamentum flavum (1), cervical disc herniations (2), and instability with anterior and/or posterior cervical cord compression from abnormal vertebral motion (3).

2. DYNAMIC-MECHANICAL CORD COMPRESSION CAUSING MICRO TRAUMA

NECK MOVEMENTS

Neck flexion

- lengthens post. Wall by 5 cm and ant. Wall by 1.5 cm
- Reduces the AP diameter of the spinal canal by 2-3 mm
- Streching of cord
- During each movement micro-traumas occur when compressive elements come in contact.

Neck extension

Ligamentum flavum to pinch the cord against anterior osteophytes

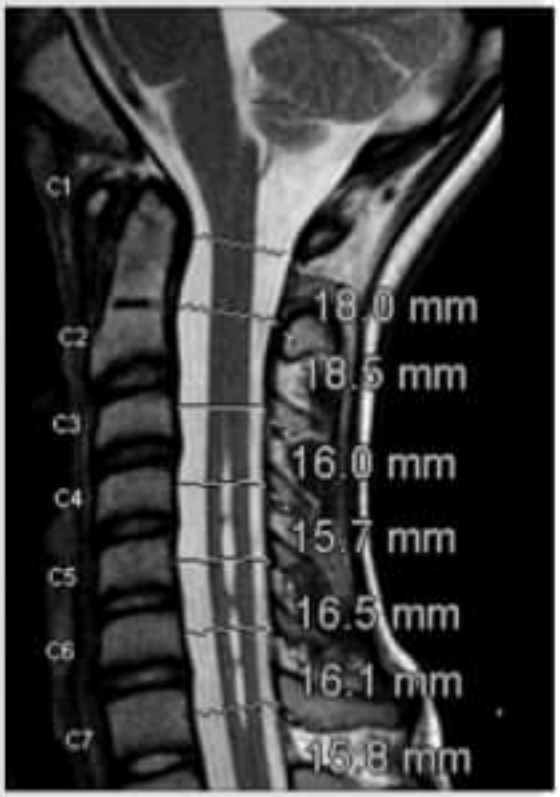
Lateral neck movements

Nerve root compression

Radicular symptoms

CANAL DIMENSION

- The normal cervical canal diameter from C3-C7 in Caucasians is **16-18mm** (< Asians)
- Cervical cord varies little in size from C1-C7, measuring approximately 10mm in diameter (**range 8.5-11.5mm**)
- 2/3rd unoccupied by the spinal cord from C1-C3 and 1/4th C4-C7.



3. VASCULAR PHENOMENA IMPAIRING THE CIRCULATION WITHIN THE CORD

- Osteophytes can compress
  - the Anterior Spinal Artery or
  - a critical medullary feeder, or
  - can compress venous drainage

  leading to a neuroischemic myelopathy usually affecting the anterior cord
- Venous stasis stemming from canal stenosis appears to have an important pathophysiologic role in cervical myelopathy by causing chronic ischemia and cord edema.

CLINICAL PRESENTATION

- Neck stiffness (early complaint)
- Leg weakness, stiffness (proximal >> distal)
- Gait abnormalities
- Difficulty with fine motor movements and tasks with hands "Clumsy myelopathic Hands"
- Loss of bladder or bowel sphincter control
- Heavy feeling in the legs
- Poor exercise tolerance

- Radiculopathy
- **L'Hermitte's phenomenon** - intermittent electric shock sensations down the neck, back and limbs, exacerbated by neck flexion
- Numbness and tingling in the limbs
- Chronic Suboccipital Headache : suboccipital may rediate to base of the neck and vertex of the skull

- Myelopathy's hand
  - Clumsiness
  - Intrinsic wasting

CLINICAL SIGNS AND SYMPTOMS

- Patients may present with pain, paresthesias, weakness or combination of these symptoms
- Pain usually is in the cervical region, upper limb, shoulder and/or interscapular region, Intermittent shoulder pain
- >2/3 patients present with unilateral or bilateral shoulder pain
- 1/3 patients present with headache
- Redicular signs: often non dermatomal
- Rediculopathy, most commonly 6^{th} and 7^{th} roots occurs from C5-6 or C6-7 spondylosis
- More pain proximally in their limbs, while paresthesias dominate distally

EXAMINATION FINDINGS

- Patients present with a number of clinical findings which are predominantly upper motor neuron signs.
- Weakness is more severe in the upper limbs.
- Gait is usually affected with an ataxic broad based gait. Usually stiff and spastic
- Hypertonia - increased resting muscle tone identified by passive movement.
- Hyperreflexia - exaggerated response to normal physiological reflexes.
- Ankle clonus - forced dorsiflexion at the ankle giving rise to sustained beats of clonus (more than three beats is considered pathological).

EXAMINATION FINDINGS

Muscular atrophy:

- Supraspinatus, Infraspinatus, Deltoid, Triceps and the first dorsal interosseus muscle
- motor weakness, most commonly in the iliopsoas followed by quadriceps femoris
- Sensory abnormalities: variable pattern
- Loss of vibratory sense or proprioception in the extremities can occur
- Spinothalamic sensory loss may be asymmetric

- Most commonly Sensory symptoms including
  - Upper extremity numbness
  - Pain, and paresthesias initially,

  followed by lower extremity sensory changes
- Motor dysfunction may be unilateral or bilateral depending on the extent and location of cord damage

EXAMINATION FINDINGS

- Babinski sign - extension of the great toe on scratching of the sole of the foot.
- Hoffman's reflex - flicking of the terminal phalynx of the middle or ring finger causing concurrent flexion at the terminal phalynx of the thumb and index finger.
- Finger escape sign - the small finger spontaneously abducts due to weak intrinsic muscles.

EXAMINATION FINDINGS

Lhermitte's Sign
(Barber Chair phenomenon)

Axial compression test

Spurling's test

Finger Escape sign

Shoulder abduction relief sign

JAPANESE MYELOPATHY SCORE

- Normal function- Score of 17
- Grade 1 - Score of 13 to 16
- Grade 2 - Score of 9 to 12
- Grade 3 - Score of 5 to 8

I. Upper extremity function
   0. Impossible to eat with either chopsticks or spoon
   1. Possible to eat with spoon, but not with chopsticks
   2. Possible to eat with chopsticks, but inadequate
   3. Possible to eat with chopsticks, but awkward
   4. Normal

II. Lower extremity function
   0. Impossible to walk
   1. Need cane or aid on flat ground
   2. Need cane or aid only on stairs
   3. Possible to walk without cane or aid, but slow
   4. Normal

III. Sensory
   A. Upper extremity
      0. Apparent sensory loss
      1. Minimal sensory loss
      2. Normal
   B. Lower Extremity
      0. Apparent sensory loss
      1. Minimal sensory loss
      2. Normal
   C. Trunk
      0. Apparent sensory loss
      1. Minimal sensory loss
      2. Normal

IV. Bladder function
   0. Complete retention
   1. Severe disturbance
      (1) Inadequate evacuation of the bladder
      (2) Straining
      (3) Dribbling of urine
   2. Mild disturbance
      (1) Urinary frequency
      (2) Urinary hesitancy
   3. Normal

NURICK'S DISABILITY SCALE

Grade	Level of Neurological Involvement
Grade I	No difficulty in walking
Grade II	Mild gait involvement not interfering with employment
Grade III	Gait abnormality preventing employment
Grade IV	Able to walk only with assistance
Grade V	Chairbound or bedridden

ROLE OF RADIOLOGICAL INVESTIGATIONS

- The correlation between radiographic evidence of spondylotic cord damage and clinically significant CSM is not perfect

CT SPINE

- A CT scan is helpful in assessing
  - Canal stenosis
  - May show osteophytes better than plain radiography
  - Good at defining the neural foramina
  - Useful in diagnosing Ossification of PLL

CT SPINE

- Canal stenosis or narrowing is considered when the antero-posterior diameter at the site of maximum lesions (C5/C6 or C6/C7) is less than 12 mm
- On horizontal cuts: discopathies ("soft" or calcified), joint hypertrophy, facet joint osteoarthritis and ligamentous calcifications,
- On reconstructed images: the static spinal disorders (deformities) and degenerative spondylolisthesis.
- CT enables a better appreciation of the components of the canal stenosis than conventional radiology:

MRI C SPINE

- MRI remains the imaging modality of choice for CSM
- MRI allows for
  - clear visualization of cord impingement or compression
  - to accurately measure space within the spinal canal
- Signal intensity may be increased at the level of cord damage, particularly on T2-weighted images, due to

  Inflammation , edema,

  ischemia, gliosis

SURGICAL TREATMENT

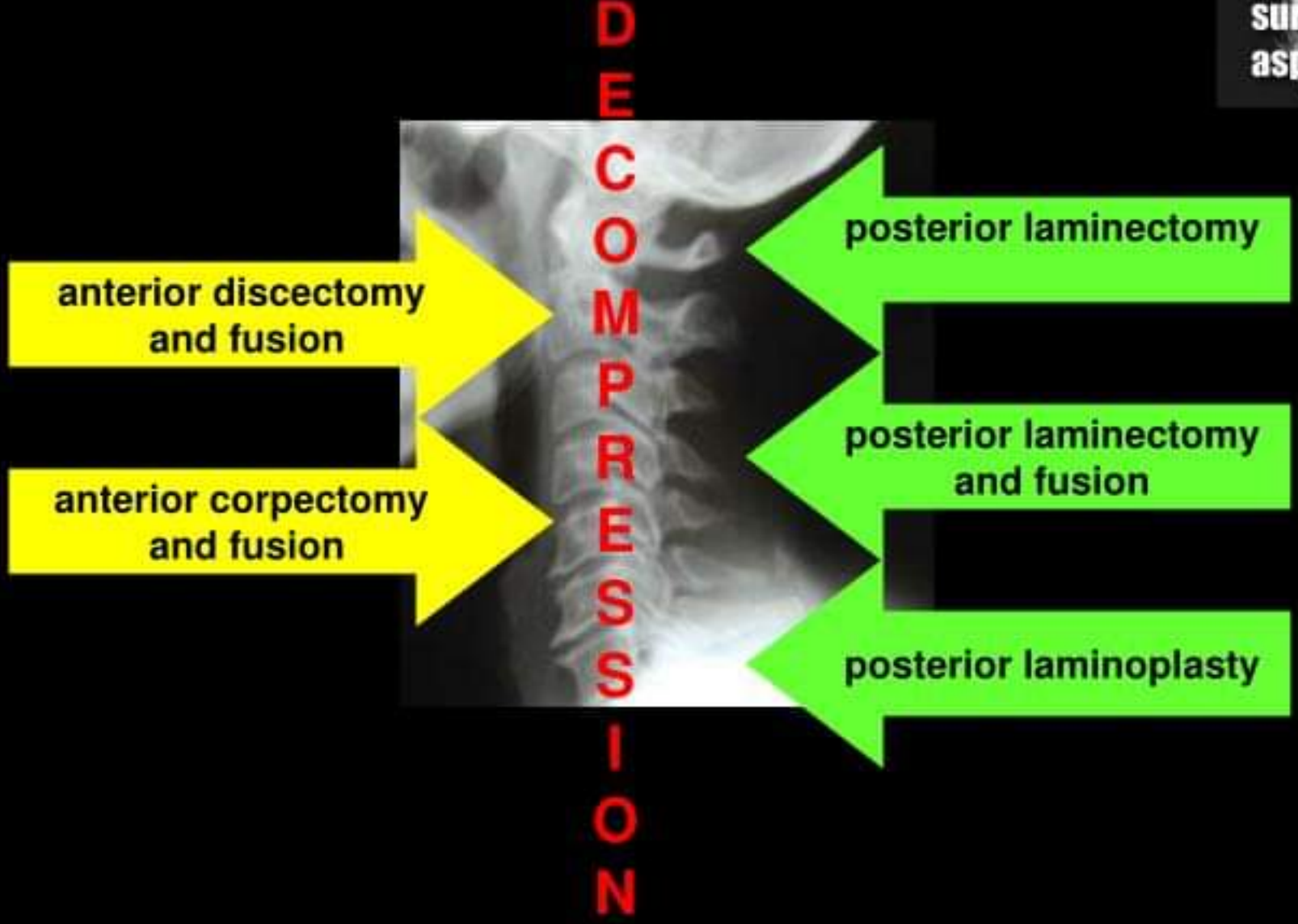
- Patients who are operated on early (within a year of the onset of symptoms) have better outcomes than those who are operated on more than a year after the onset of symptoms
- Several studies have shown that many patients treated surgically have good outcomes

Ebersold M et al., J Neurosurg 1995;82(5):745-751

What is the treatment?

- surgery indicated if
  - established myelopathy with symptoms and signs
    - aim is to halt progression
    - hope is to reverse deficit
    - earlier intervention gives better results
    - even severe deficit may improve
  - early myelopathy with documented progression
  - ? subtle symptoms with no signs and only early MRI changes

What is the treatment?



Anterior surgery

Advantages

- approach pathology directly
- can decompress central and foraminal stenosis
- can effectively stabilise the segment in lordosis
- approach is easy and well tolerated

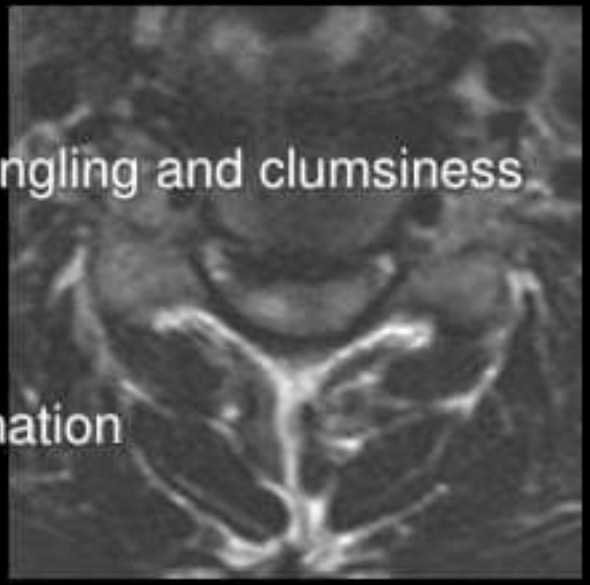
Anterior surgery

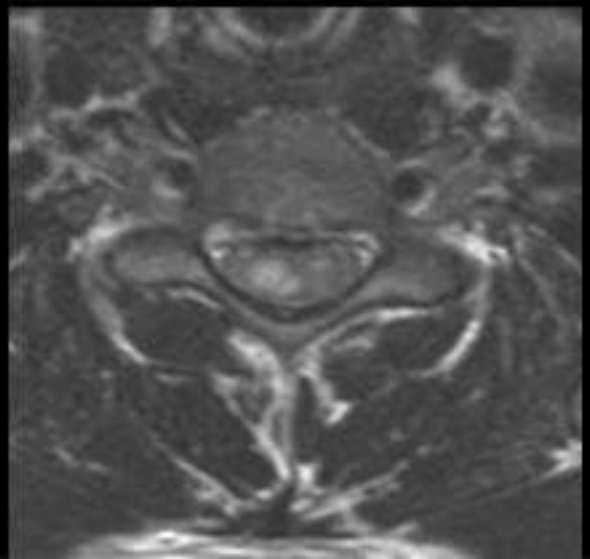
Disadvantages

- osteophytes difficult to deal with
- multiple levels more difficult
- risks of
  - dysphagia / oesophageal injury
  - recurrent laryngeal nerve injury
  - neurological injury
  - vascular injury
- adjacent degeneration may occur

Anterior surgery

- 33 year old manager
- 6 month history of increasing tingling and clumsiness
  - esp right hand
- minimal neck pain
- no trauma
- signs of myelopathy on examination





Anterior surgery

Single level pathology

- anterior discectomy and fusion is the clear choice
- options
  - iliac crest graft vs cage (etc)
  - plate
- if osteophytes present
  - theoretically remove them
  - practically can leave them?

Anterior surgery

Two level pathology

- corpectomy vs discectomy x 2
- corpectomy
  - complete clearance behind vertebral body
  - better access to osteophytes
  - higher union rate
  - more morbidity from approach and graft harvest
- plate advisable

Anterior surgery

Three + level pathology

- corpectomy is mainstay
- can use combination
  - discectomy at lower end may increase stability
- problems with nonunion and graft dislodgement
- consider additional posterior stabilisation
  - esp if removing 3 vertebrae

Anterior surgery

Immediate
post-op

2 weeks post-op

6 weeks post-op

Anterior surgery

1-level

•discectomy
•plate optional

2-level

•discectomy = corpectomy
•plate recommended

3+-level

•corpectomy better
•nonunion
•graft dislodgement
•add posterior fixation if removing 3 vertebrae

Posterior surgery

Advantages

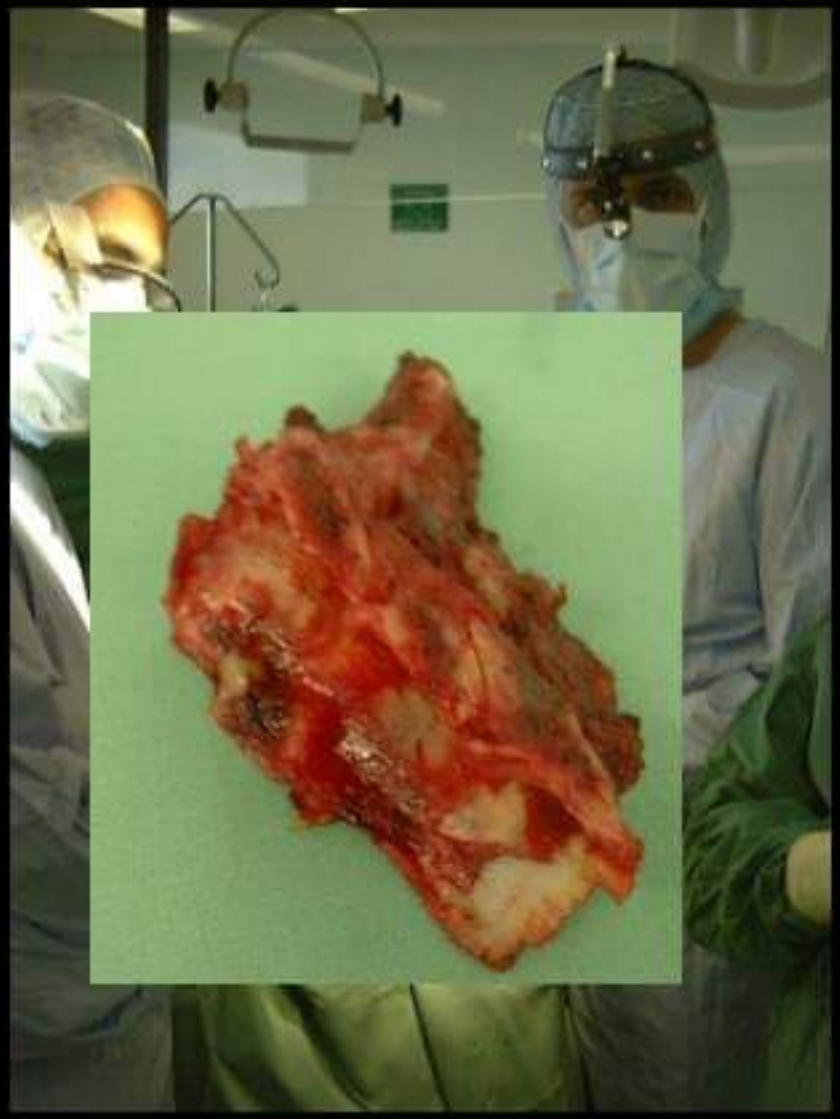
- multiple levels easily addressed
  - usually reserved for 3 or more levels
- no risk to vital anterior structures
- less risk of neurological injury
- can avoid fusion

Posterior surgery

Disadvantages

- less effective in kyphosis as relies on posterior cord 'drift'
- can result in kyphosis (10-50%)
- increased pain from approach
- dura exposed with possible peridural scar

Posterior surgery



Laminectomy alone

- neck must be lordotic, or neutral and stiff
- must avoid excessive facet joint removal
- en bloc resection safest
- beware postop palsy, esp. C5
  - due to posterior cord drift and resultant nerve root traction
  - usually settles

Posterior surgery

Laminectomy and fusion

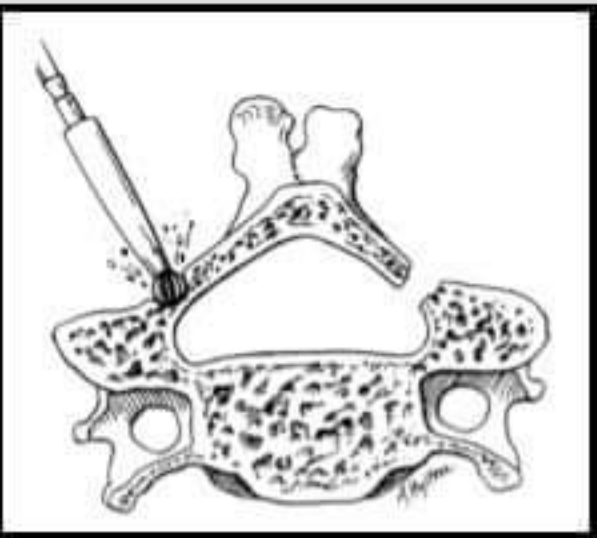
- indicated if
  - neck neutral and mobile OR kyphotic OR unstable
  - associated mechanical pain
- allows more extensive decompression
- results in stiffness
- increased cost / complications
- usually lateral mass fixation

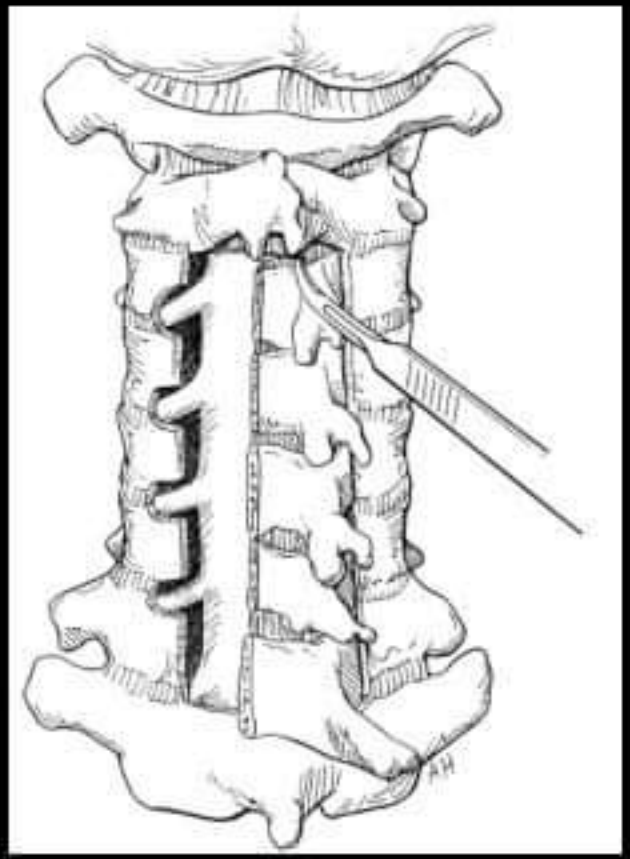
Posterior surgery

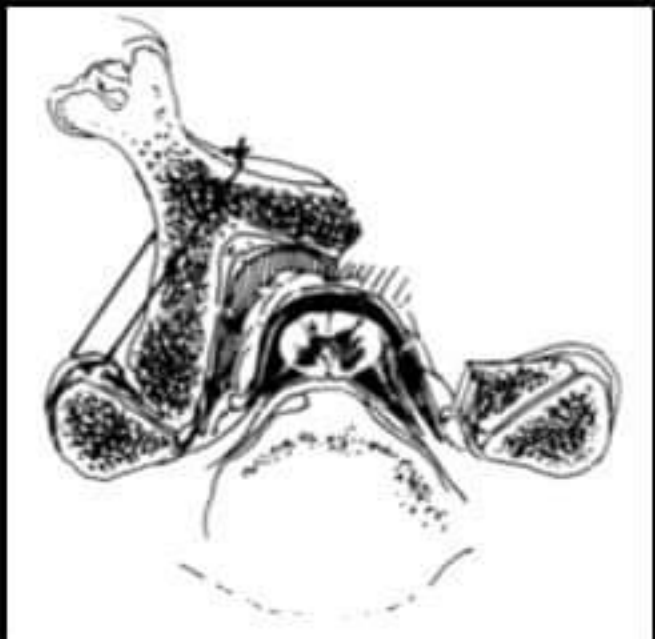
Laminoplasty

- provides effective canal decompression and neurological improvement
- avoids problems of
  - postoperative kyphosis
  - stiffness from fusion (?)
  - instrumentation
- not suitable for kyphotic neck
  - cord cannot fall away

Posterior surgery

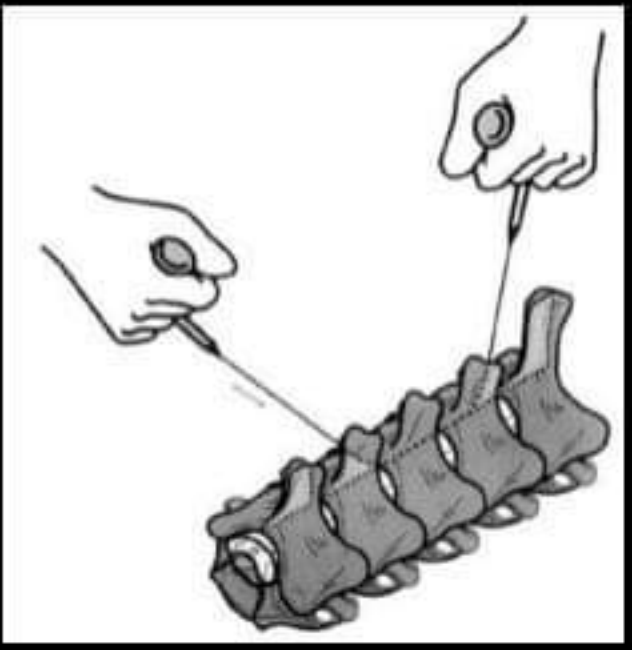


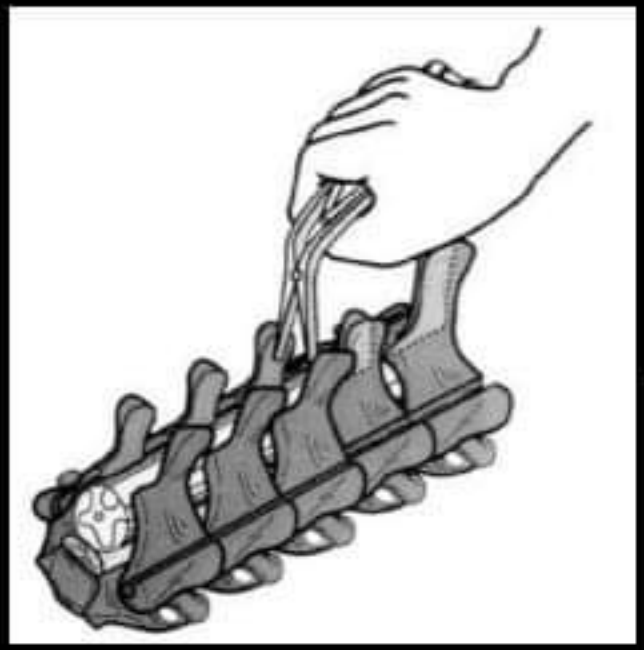


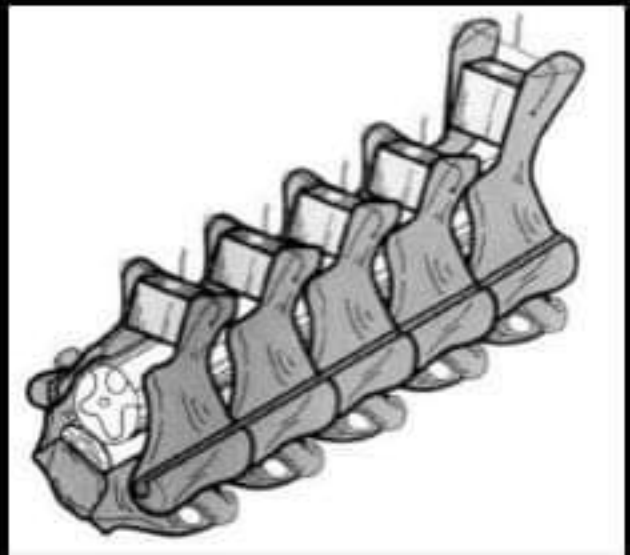


eccentric hinge

Posterior surgery







symmetric open-door

Posterior surgery

laminectomy

•neutral or lordotic neck
•stable spine

laminectomy and fusion

•kyphotic neck
•instability

laminoplasty

•low complication rate
•pain and stiffness still occur
•?procedure of choice

Choice of approach

ANTERIOR	POSTERIOR
one or two levels	more than three levels
kyphosis	lordosis
disc prolapse	osteophytes

? the future

ADVANTAGES

Anterior approach

- Direct decompression
- Stabilization with arthrodesis
- Correction of deformity
- Axial lengthening of spinal column
- Good axial pain relief

Posterior approach

- Less loss of motion
- Not as technically demanding
- Less bracing needed
- Avoid graft complication

DISADVANTAGES

Anterior approach

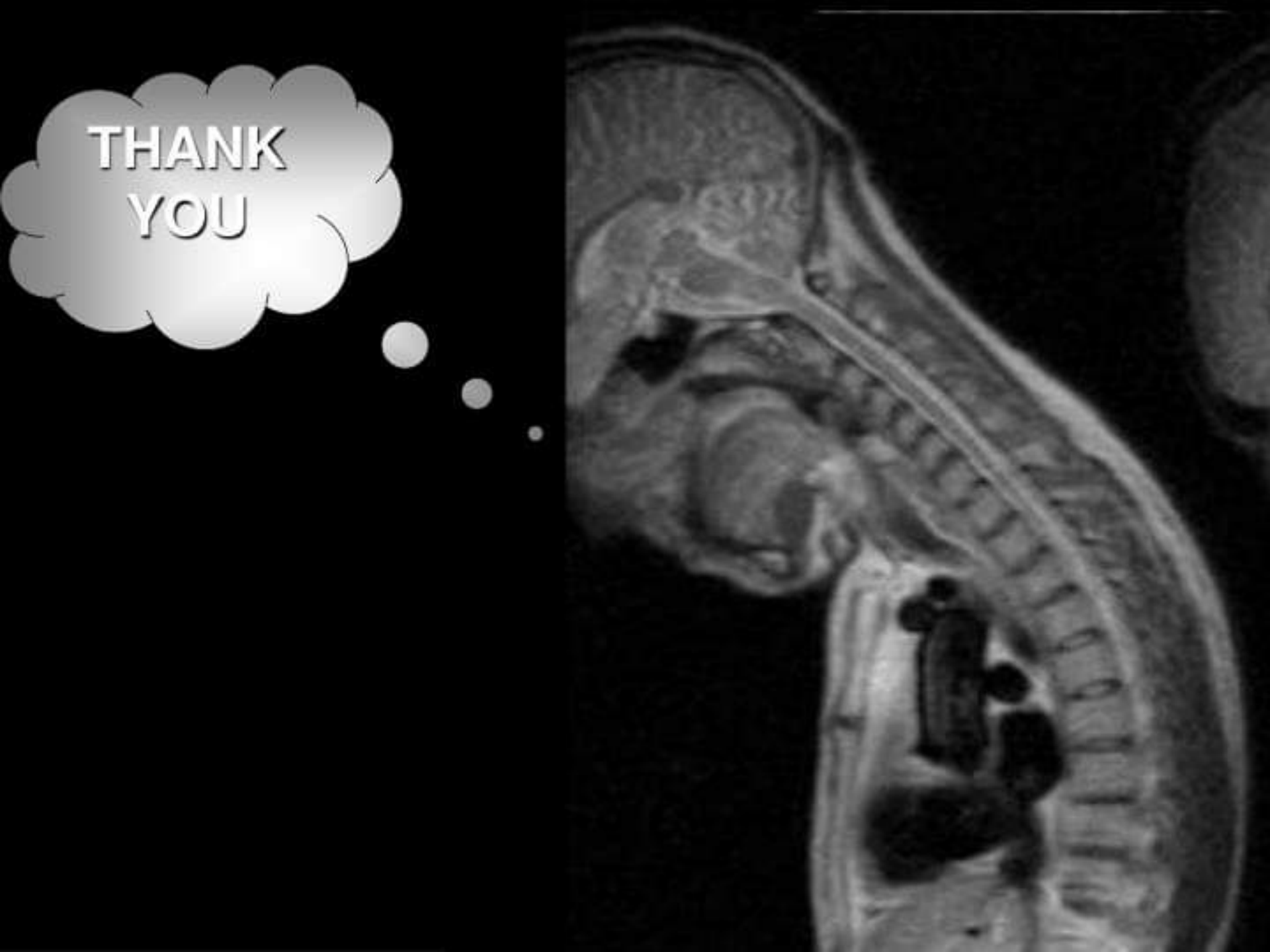
- Technically demanding
- Graft complications (dislodgement, fracture and severe settling in to the cancellous vertebral body)
- Need for post-operative bracing limitations
- Loss of motion
- vertebral artery, upper airway compromise, dysphagia

Posterior approach

- Indirect decompression
- Pre-operative kyphosis and / or instability
- Late instability
- Adjacent segment degenration
- Laminectomy- increase risk of post laminectomy kyphosis, swan-neck deformity or instability with late neurology deterioration
- Laminoplasty-techniques decrease above risk but potential complication like inadverent closure of the opened lamina with current stenosis

POSTERIOR APPROACH

Laminectomy	Laminoplasty
The laminal arch along with the ligamentum flavum are removed to create room within the spinal canal	The lamina are reconstructed in a way that creates more room within the spinal canal but are not removed
Relatively less complicated procedure	More Complicated procedure
The Lamina are removed, a kyphotic deformity can develop postoperatively	Improved neck stability and mobility and less kyphosis after a laminoplasty (structural integrity of the vertebrae are maintained)


THANK
YOU