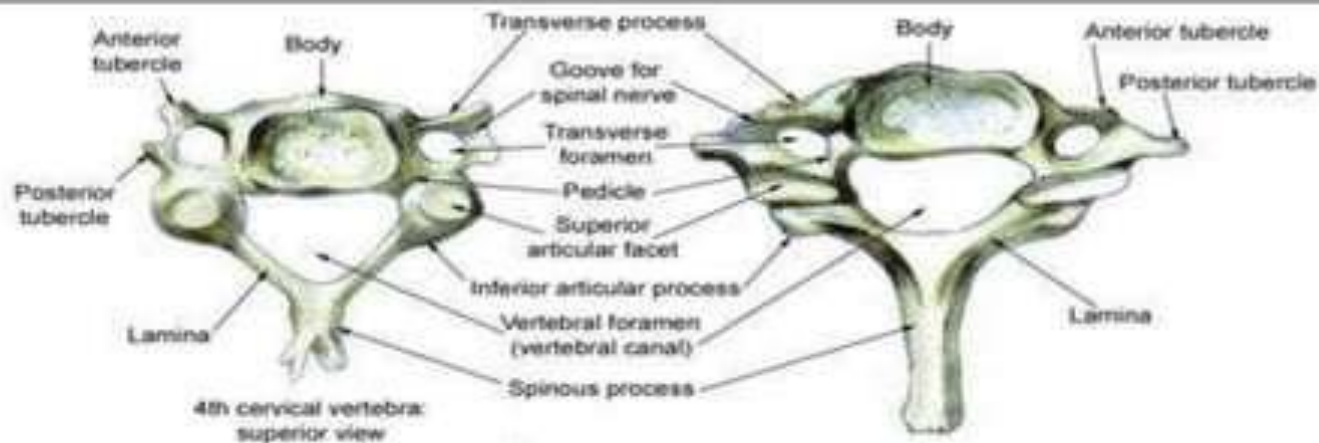


CERVICAL SPONDYLOSIS

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4th cervical vertebra: superior view

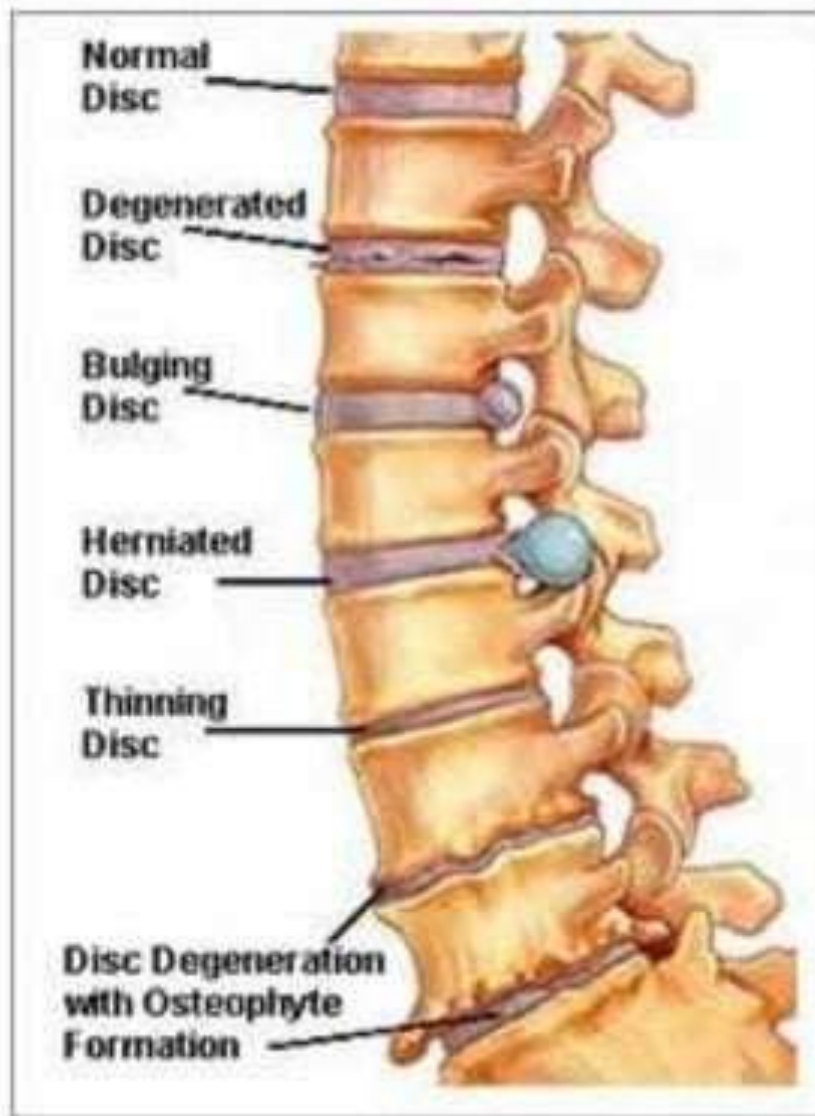
7th cervical vertebra: superior view

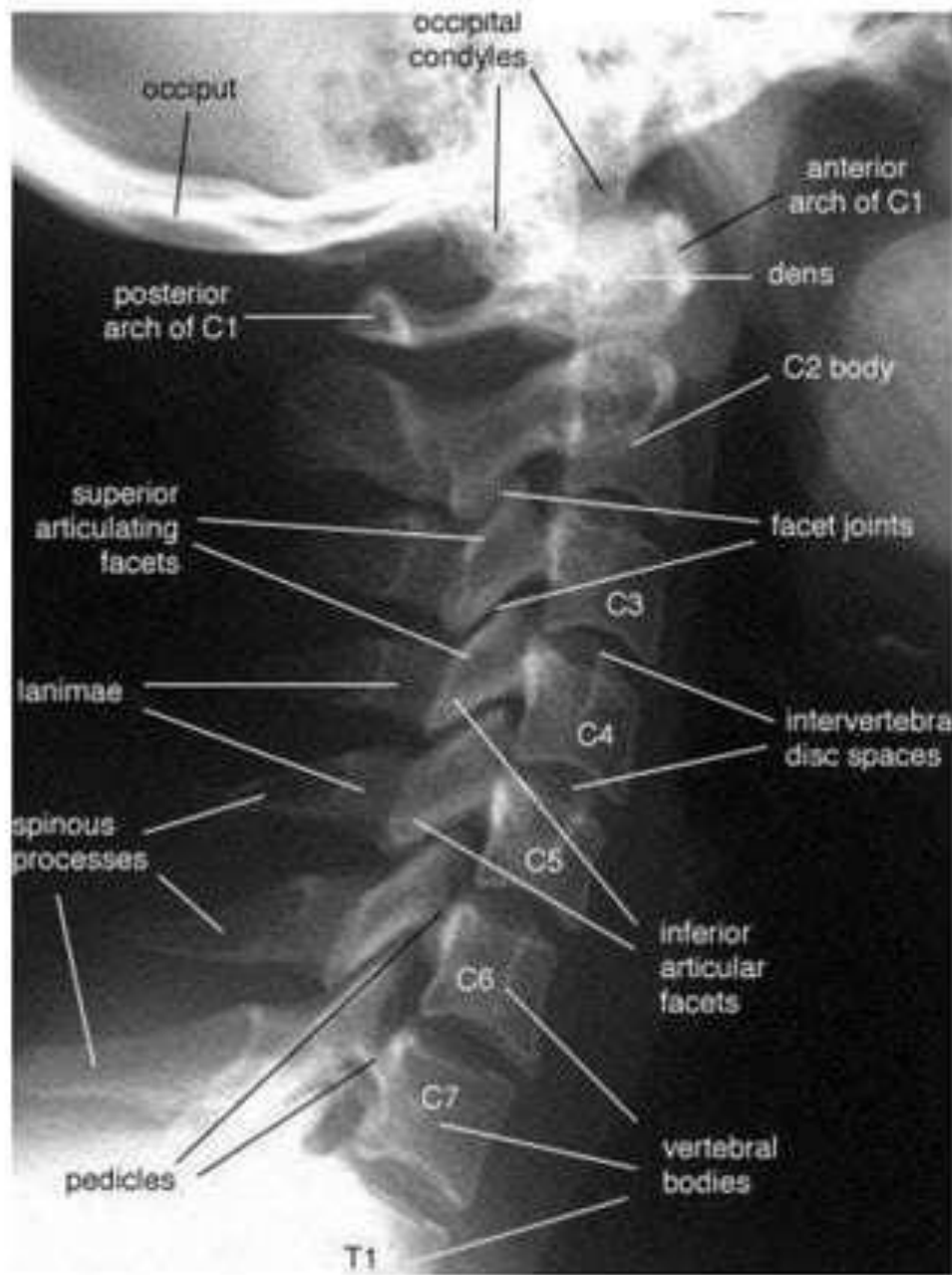


2nd cervical to 1st thoracic vertebrae: right lateral view



3rd, 4th and 5th cervical vertebrae: anterior view





- Cervical Spondylotic Myelopathy (CSM) was first described by Brain et al in 1952.
- A common condition.
- Estimated to account for 2% of all hospital admissions.
- Most frequent cause of spinal cord dysfunction in patients older than 55 years.
- On the basis of radiologic findings, 90% of men older than 50 years and 90% of women older than 60 years have evidence of degenerative changes in the cervical spine.

- A degenerative disease of the cervical spine, intervertebral discs, ligaments and cartilaginous material.
- Commonly seen in individuals after the age of 40 years.
- Believed to be part of the normal aging process of the vertebral column.
- Some authors also include the degenerative changes in the facet joints, longitudinal ligaments, and ligamentum flavum.
- Spondylosis progresses with age and often develops at multiple interspaces.

- Chronic cervical degeneration - most common cause of progressive spinal cord and nerve root compression.
- Spondylotic changes can result in stenosis of
 - spinal canal leading to Myelopathy.
 - lateral recess and foramina leading to Radiculopathy.

- Studies involving radiological investigation of asymptomatic individuals show that spondylotic changes increase with each decade of life:
 - 5-10% by the age of 20-30 years
 - >50% by age 45 years, and
 - >90% by 60 years of age.
- So the prevalence of abnormal MRI of the cervical spine as related to age in asymptomatic individuals emphasizes the dangers of predicting operative decisions on diagnostic tests without precisely matching those findings with clinical signs and symptoms.

- The course of cervical spondylosis may be slow and prolonged.
- May either remain asymptomatic or have mild cervical pain.
- Long periods of nonprogressive disability are typical.
- Few cases - the patient's condition progressively deteriorates.
- Both sexes affected equally.

- Cervical spondylosis usually starts earlier in men than in women.
- Most commonly in individuals aged 40-60 years.
- Symptoms may appear in persons as young as 30 years.

- Morbidity ranges from
 - Chronic neck pain
 - Radicular pain
 - Diminished cervical range of motion (ROM)
 - Headache, predominantly Suboccipital
 - Myelopathy leading to weakness and impaired fine motor coordination to quadriparesis and/or sphincteric dysfunction in advanced cases.

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.

- Due to annulus bulges - the cross-sectional area of the canal is narrowed.
- This effect may be accentuated by hypertrophy of the facet joints (posteriorly) and of the ligamentum flavum, which becomes thick with age.
- Neck extension causes the ligaments to fold inward, reducing the anteroposterior (AP) diameter of the spinal canal.

- As disk degeneration occurs, the unciniate process overrides and hypertrophies, compromising the ventrolateral portion of the foramen.
- Likewise, facet hypertrophy decreases the dorsolateral aspect of the foramen.
- This change contributes to the radiculopathy that is associated with cervical spondylosis.
- Marginal osteophytes begin to develop.
- Additional stresses, such as trauma or long-term heavy use, may exacerbate this process.

- These osteophytes stabilize the vertebral bodies adjacent to the level of the degenerating disk and increase the weight-bearing surface of the vertebral endplates. The result is decreased effective force on each of these structures.
- Degeneration of the joint surfaces and ligaments decreases motion and can act as a limiting mechanism against further deterioration.
- Thickening and ossification of the posterior longitudinal ligament (OPLL) also decreases the diameter of the canal.

- The blood supply of the spinal cord is an important anatomic factor in the pathophysiology.
- Radicular arteries in the dural sleeves tolerate compression and repetitive minor trauma poorly.
- The spinal cord and canal size also are factors. A congenitally narrow canal does not necessarily predispose a person to myelopathy, but symptomatic disease rarely develops in individuals with a canal that is larger than 13 mm.

- Flexion of the cervical spine may lead to compression of the spinal cord against osteophytic bars while extension may lead to compression against the hypertrophied ligamentum flavum.

CLINICAL FEATURES

- In the initial series reported by Brain et al., the duration of symptoms ranged from one week to 26 years, and almost half of the patients presented symptoms for more than one year at the time of diagnosis.

- Common clinical syndromes associated with cervical spondylosis include the following:
- **Cervical pain** –
 - Chronic suboccipital headache may be present. Mechanisms include direct nerve compression; degenerative disk, joint, or ligamentous lesions; and segmental instability.
 - Pain can be perceived locally, or it may radiate to the occiput, shoulder, scapula, or arm.
 - The pain, worse when the patient is in certain positions, can interfere with sleep.

- **Cervical radiculopathy**

- Compression of the cervical roots leads to ischemic changes that cause sensory dysfunction (eg, radicular pain) and/or motor dysfunction (eg, weakness).
- Most commonly occurs in persons aged 40-50 years.
- An acute herniated disk or chronic spondylotic changes can cause cervical radiculopathy and/or myelopathy.
- The C6 root is the most commonly affected because of the predominant degeneration at the C5-C6 interspace; the next most common sites are at C7 and C5.
- Most cases of cervical radiculopathy resolve with conservative management; few require surgical intervention.

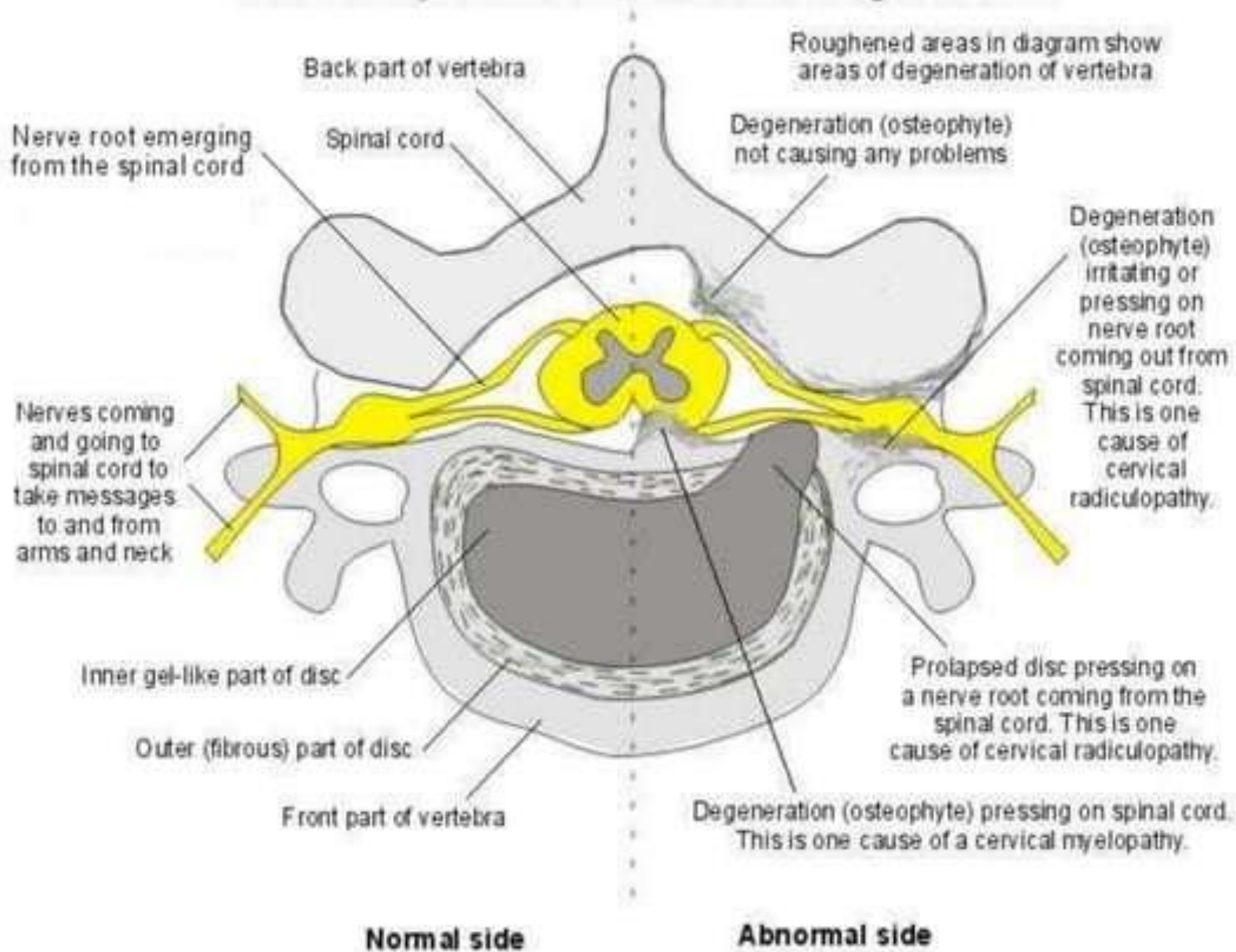
- **Cervical Spondylotic Myelopathy (CSM)**

- The most serious consequence of cervical intervertebral disk degeneration, especially when it is associated with a narrow cervical vertebral canal.
- Insidious onset, which typically becomes apparent in persons aged 50-60 years.
- Complete reversal is rare once myelopathy occurs.
- Involvement of the sphincters is unusual at presentation.

- In a review of 1,076 patients with CSM, gait disturbance was the most common presentation .
- In this series, spastic gait was one of the first symptoms, followed by upper extremity numbness and loss of fine motor control of the hands.
- Other common symptoms of CSM were neck pain, as well as referred pain in the shoulder or subscapular area.

- One-third of patients with cervicalgia due to CSM present with headache and $> 2/3$ patients may present with unilateral or bilateral shoulder pain.
- A significant number of these patients also present with irradiated pain to the arm, forearm and/or hand pain with long periods of remission.

A disc on top of a cervical vertebra looking from above



CAUSES

- Age –
 - observed most commonly in elderly individuals.
 - Among persons younger than 40 years, 25% have degenerative disk disease (DDD), and 4% have foraminal stenosis, as confirmed with MRI.
 - In persons older than 40 years, almost 60% have DDD, and 20% have foraminal stenosis, as confirmed with MRI.
- Trauma –
 - Controversial role.
 - Repetitive, subclinical trauma probably influences the onset and rate of progression of spondylosis.
- Work activity –
 - significantly higher in patients who carry loads on their head than in those who don't.

- Genetics –
 - Unclear role.
 - However, a retrospective, population-based study by Patel et al shows that genetics may play a role in the development of cervical spondylotic myelopathy (CSM).
 - Patients older than 50 years who have normal cervical spine radiographic findings are significantly more likely to have a sibling with normal or mildly abnormal radiographic results.

PHYSICAL EXAMINATION

- Decreased ROM in the cervical spine, especially with neck extension
- Hand clumsiness
- Sensory deficits
- Hyper-reflexia in the lower extremities and in the upper extremities below the level of the lesion
- A characteristically broad-based, stooped, and spastic gait
- Extensor plantar reflex in severe myelopathy

PHYSICAL EXAMINATION

- **Spurling sign** - Radicular pain is exacerbated by extension and lateral bending of the neck toward the side of the lesion, causing additional foraminal compromise.
- **Lhermitte sign** - This generalized electrical shock sensation is associated with neck extension.
- **Hoffman sign** - Reflex contraction of the thumb and index finger occurs in response to nipping of the middle finger. This sign is evidence of an upper motor neuron lesion.

IMAGING

- **Plain cervical radiography** –
 - Routine in every patient with suspected cervical spondylosis.
 - valuable in evaluating the uncovertebral and facet joints, the foramen, intervertebral disk spaces, and osteophyte formation.
 - Flexion-extension views may be needed to detect instability.

X RAY CERVICAL SPINE LATERAL VIEW



- Myelography, with computed tomography (CT) scanning, can also be used to assess spinal and foraminal stenosis.
 - Since myelography method is invasive, most physicians depend on MRI in diagnosing cervical spondylosis.
 - Myelography adds anatomic information in evaluating spondylosis.
 - May be especially useful in visualizing the nerve root takeoff.
 - CT scanning, with or without intrathecal dye, can be used to estimate the diameter of the canal.
 - CT scans may demonstrate small, lateral osteophytes and calcific opacities in the middle of the vertebral body.

- MRI is a considerable advance in the use of imaging to diagnose cervical spondylosis with following advantages:
 - Direct imaging in multiple planes
 - Better definition of neural elements
 - Increased accuracy in evaluating intrinsic spinal cord diseases
 - Non-invasiveness
- False-positive and false-negative MRI results occur frequently in patients with cervical radiculopathy; therefore, MRI results and clinical findings should be used when interpreting root compression.

- T2-weighted hyperintensity at the level of spinal compression has also been shown to correlate with CSM severity and has been supposed to be an important prognostic factor. Such findings are thought to represent edema and inflammation.
- On the other hand T1-hypointensity has been shown to be a more severe sign, representing ischemia, myelomalacia, or gliosis as has been correlated with postoperative worst outcome.



HISTOLOGY

- Thinning and fragmentation of the articular cartilage may be observed.
- The normal smooth, white articular surface becomes irregular and yellow.
- Continued loss of articular cartilage leads to exposure of areas of subchondral bone, which appear as shiny foci on the articular surface (eburnation).
- Fibrosis, increased bone formation, and cystic changes frequently occur in the underlying bone.
- Loss of articular cartilage stimulates new bone formation, usually in the form of nodules (osteophytes) at the bone edges.

DIFFERENTIAL DIAGNOSIS

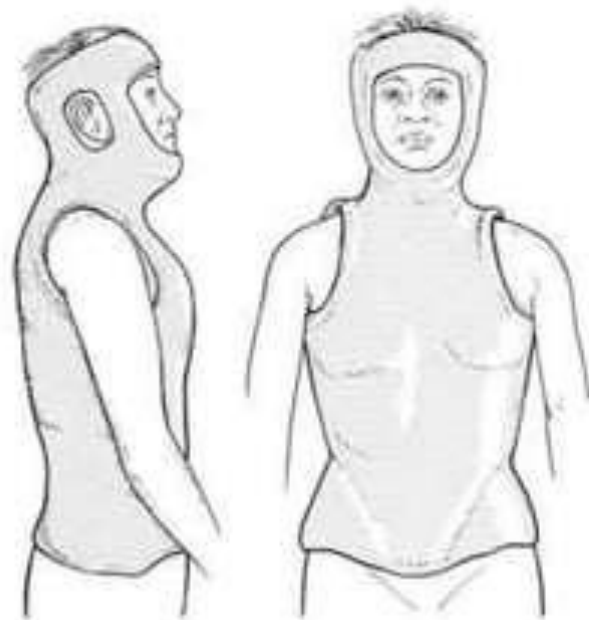
- Congenital – Arnold-Chiari malformation, tethered cord, syringomyelia
- Acquired – trauma, herniated intervertebral disc, kyphosis, extramedullary haematopoiesis, epidural lipomatosis
- Neoplastic – spinal cord tumours, carcinomatous meningitis, paraneoplastic syndrome
- Vascular – haematoma, spinal cord infarction, spinal cord AVM,
- Autoimmune – multiple sclerosis, Devic syndrome
- Infectious – paraspinal abscess, osteitis/osteomyelitis, pyogenic discitis, AIDS-related myelopathy, tuberculosis, spinal meningitis, viral and syphilitic involvement
- Amyotrophic lateral sclerosis

TREATMENT

PHYSICAL THERAPY :-

- Immobilization of the cervical spine is the mainstay of conservative treatment for patients with cervical spondylosis.
- Immobilization limits the motion of the neck, thereby reducing nerve irritation.
- Soft cervical collars are recommended for daytime use only, but they are unable to appreciably limit the motion of the cervical spine.
- More rigid orthoses (eg, Philadelphia collar, Minerva body jacket) can significantly immobilize the cervical spine.

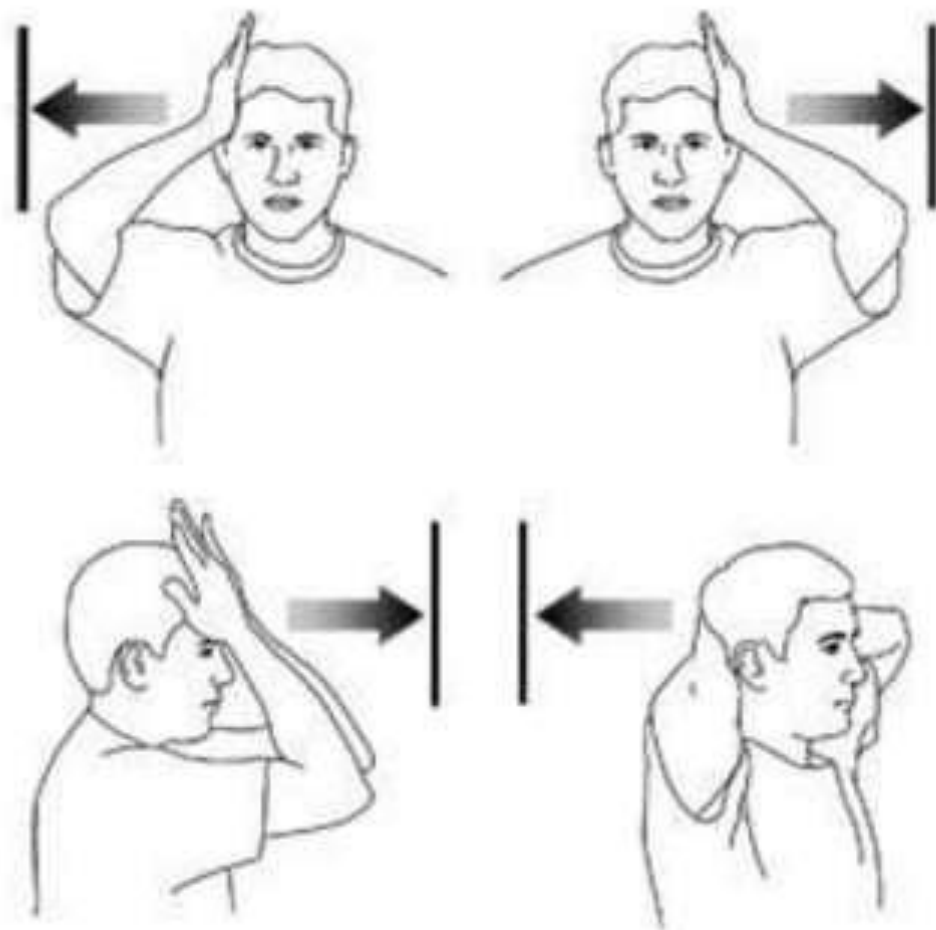
Philadelphia Collar



Minnerva Body Jacket

- The patient's tolerance and compliance are considerations when any of the braces are used.
- A program of isometric cervical exercises may help to limit the loss of muscle tone that results from the use of more restrictive orthoses.
- Molded cervical pillows can better align the spine during sleep and provide symptomatic relief for some patients.

- The use of cervical exercises has been advocated in patients with cervical spondylosis.
- Isometric exercises are often beneficial to maintain the strength of the neck muscles.
- Neck and upper back stretching exercises, as well as light aerobic activities, also are recommended.
- The exercise programs are best initiated and monitored by a physical therapist.
- Passive modalities generally involve the application of heat to the tissues in the cervical region, either by means of superficial devices (eg, moist-heat packs) or mechanisms for deep-heat transfer (eg, ultrasound, diathermy).



Isometric Neck Exercises

- Mechanical traction is a widely used technique.
- May be useful because it promotes immobilization of the cervical region and widens the foraminal openings.
- However, traction in the treatment of cervical pain was not better than placebo in 2 randomized trials.



- Manual therapy, such as massage and mobilization may provide further relief for patients with cervical spondylosis.
- Mobilization is performed by a physical therapist and is characterized by the application of gentle pressure within or at the limits of normal motion, with the goal of increasing the ROM.
- Manual traction may be better tolerated than mechanical traction in some patients.

OCCUPATIONAL THERAPY :-

- Patients with upper extremity weakness often lose their ability to perform activities of daily living (ADL), vocational activities, or recreational activities.
- Lifestyle modifications may involve an evaluation of workplace ergonomics, postural training, neck-school therapy (supervised, small-group therapy), stress management, and vocational assistance.
- Disability can be improved with specific strengthening exercises of the upper extremities, special splinting to compensate for weakness, and the use of assistive devices that allow the patient to perform previously impossible activities.

DRUGS

- NSAIDs
- Steroids
- Opioids
- Drugs for radicular pain like Carbamazepine, Pregabalin

- With non-operative treatment, approximately 75% of patients have complete or partial, but significant, relief of symptoms.
- Non-operative treatment of spondylosis with radiculopathy has not been compared with surgical therapy in randomized trials.

- Kadaňka et al. compared in a randomized study conservative and surgical treatment of spondylotic cervical myelopathy to establish predictive factors for outcome after conservative treatment and surgery.
- The clinical, electrophysiological and imaging parameters were examined to reveal how they characterized the clinical outcome.
- The patients with a good outcome in the conservatively treated group were of older age before treatment, had normal central motor conduction time (CMCT), and possessed a larger transverse area of the spinal cord .
- The patients with a good outcome in the surgically treated group had a more serious clinical picture.

Conclusion was :

- Patients should preferably be treated conservatively if they have a spinal transverse area larger than 70 sq mm , are of older age and have normal CMCT.
- Surgery is more suitable for patients with clinically worse status and a lesser transverse area of spinal cord.

SURGICAL INTERVENTIONS

- Indications for surgery include the following:
 - Progressive neurologic deficits
 - Documented compression of the cervical nerve root and/or spinal cord
 - Intractable pain
- The aims of surgery is to relieve pain and neuronal structure compression, as well as, in select cases, to achieve stabilization.

- Approaches for surgery - Anterior or Posterior or combined.
- Anterior approaches include the following :
 - Diskectomy without bone graft
 - Diskectomy with bone graft
 - Cervical instrumentation
- Posterior approaches include the following :
 - Decompressive laminectomy and foraminotomy
 - Hemilaminectomy
 - Laminoplasty
- The approach selected is determined by the type and location of pathology and by the surgeon's preference.

- When anterior compression of the spinal cord is the most important component, anterior techniques are preferred. Some examples are disc protrusions or marked osteophytosis.
- Anterior approaches have the advantage of more readily restoring the cervical lordosis, which is useful for cases where the kyphosis exacerbates the spinal cord compression.
- While using this approach, the compressive factors should not exceed 2-3 disc levels.
- An anterior approach is :
 - technically more demanding
 - Carries a higher risk and
 - often requires fusion.

- There are mainly two posterior approaches for the treatment of CSM:
 - laminectomy (with or without fusion) and
 - laminoplasty.
- Posterior approaches may be considered when the pathology is located at the posterior portion of the spinal canal, for example, in cases of hypertrophied ligamentum flavum.
- Nevertheless, posterior decompression also addresses anterior compression because it indirectly decompresses the spinal cord by enlarging the spinal canal.

- When compared to anterior approaches, posterior procedures offer advantage for the treatment of CSM :-
 - Enables direct visualization of the spinal canal and wide decompression of spinal cord and nerve roots.
- Procedures such as laminectomy without fusion and laminoplasty also present disadvantage :-
 - development of instability or postlaminectomy kyphosis.
 - Furthermore, none of the posterior approaches enable primary resection of anterior pathology.

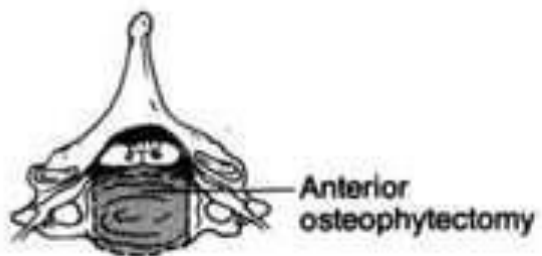
Laminoplasty

- Preserves most of the bony posterior vertebral elements and, therefore, may decrease the risk of postlaminectomy kyphotic deformity in comparison with laminectomy.
- Besides that, in comparison with laminectomy with fusion, laminoplasty seems to present a decreased incidence of adjacent-level degeneration by preserving normal cervical range of motion.

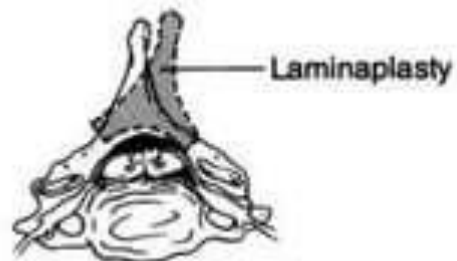
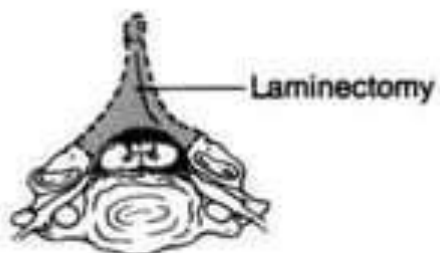
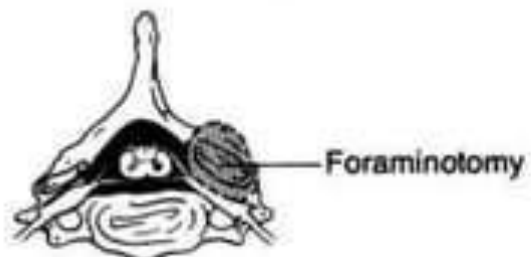
Laminectomy (with and without Fusion)

- The oldest technique for posterior decompression of CSM is laminectomy without fusion.
- The major postoperative complication of such approach is post-laminectomy instability.
- The groups of patients in risk for such complication are those who present signs of preexisting instability and those in which aggressive facet resection is performed.
- In these cases instrument stabilization at the time of laminectomy is recommended.
- Instrumented fusion serves to both stabilize the cervical spine as well as secure the spine in an optimal lordotic configuration.

Anterior Surgical Approach



Posterior Surgical Approaches



- For performing a decompressive cervical laminectomy/laminotomy (“posterior approach”), the compressive changes should be present in more than 2-3 disc levels.
- So called “keyhole foraminotomies” are carried out at levels involved with radiculopathy.
- The posterior approach to cervical radiculopathy has similar results as the anterior approach when used for the proper indications.
- Surgical intervention for cervical myelopathy is controversial. Once moderate neurological signs and symptoms develop, surgical intervention is likely to be beneficial over further medical treatment.

- **Predictive factors for the outcome of surgery for CSM** are:
 - Age
 - Duration of symptoms
 - Preoperative clinical status
 - Anteroposterior diameter of the canal
 - Area of the spinal cord at the level of the maximal compression
 - Findings of hyperintense areas in the spinal cord
 - One level or multilevel compression
 - Congenital diameter of the spinal canal (expressed as Pavlov's index)
 - Chosen method of decompression.

PREVENTION

- Avoid high-impact exercise (eg, running, jumping).
- Maintain cervical ROM with daily ROM exercise.
- Maintain neck muscle strength, especially neck extensor strength.
- Avoid holding the head in 1 position for a long period (for example, while driving or watching TV).
- Avoid prolonged neck extension.
- Be careful when performing physical activities that are done infrequently; such activities can trigger a flare in symptoms.

THANK YOU

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- A progressive, age-related degeneration of intervertebral discs in the cervical spine is followed by a decrease of the intervertebral space.
- Clinical studies indicate that subperiosteal bone formation occurs next, forming osteophytic bars that extend along the ventral aspect .
- Uncinate process hypertrophy also occurs, often encroaching upon the ventrolateral portion of the intervertebral foramina.
- Nerve root irritation also may occur as intervertebral disc proteoglycans degrade.

- Ossification of the posterior longitudinal ligament can occur with cervical spondylosis and can be an additional contributing source of severe anterior cord compression.
- Age-related hypertrophy of the ligamentum flavum and thickening of bone may result in further narrowing of the spinal cord space.

- The consecutive myelopathy of the cervical spine may be due to direct spinal cord compression, ischaemia due to compression of related vascular structures, repeated local trauma to the spinal cord by physiological movements in the presence of osteophytic bars, or a combination of these factors.
- More recently, shearing forces have been theorized to be important factors in the pathophysiology of cervical spondylotic myelopathy.

- Narrowing of the spinal canal and abnormal or excessive motion may result in shear forces that cause axonal injury in the cervical cord, where changes seen in the cord may actually be a form of stretch injury .
- Although the exact pathophysiology underlying cervical spondylotic myelopathy remains uncertain, it is largely accepted to be a disorder that involves compressive forces on the spine, likely due to multiple factors

- The narrowing of the spinal canal itself does not usually cause any symptoms.
- It is when inflammation of the nerves occurs at the level of increased pressure that patients begin to experience clinical problems.