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# Clinico-anatomy of cervical and lumbar vertebra and its disease and management

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## ABSTRACT

The nervous system is the part of an animal's body that coordinates its behavior and transmits signals between different body areas. In vertebrates it consists of two main parts, called the central nervous system (CNS) and the peripheral nervous system (PNS). The CNS contains the brain and spinal cord. The Main contents of CNS are Brain and Spinal cord. The spinal cord is a long bundle of nerves and cells that extends from the lower portion of the brain to the lower back. It carries signals between the brain and the rest of the body. in *Ayurveda* nervous system is correlated with *Uttamangiya Sharir* that control the all-sense organ activities. Any injury to spinal cord produce diseases, main cervical and lumbar region

**Key words:** Nervous System, Spinal Cord, Spondylosis, Vata Vyadhi

## INTRODUCTION

The vertebral column, also known as the backbone or spine, is part of the axial skeleton. The vertebral column houses the spinal canal a cavity that encloses and protects the spinal cord. In humans, the vertebral column usually consists of 33 vertebrae, placed in series and connected by ligaments and intervertebral discs. However, the number of vertebrae can vary between 32 and 35. Usually there are 7 cervical, 12 thoracic, 5 lumbar, 5 sacral and 4 caudal (coccygeal) vertebrae.<sup>[1]</sup>

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## Spinal cord

Spinal cord is a long, thin, tube-like structure which is the part of central nervous system. It starts from the oblongata in the brain stem and extends down to between the 1<sup>st</sup> and 2<sup>nd</sup> lumbar vertebrae. Length in male around 45 cm (18 inch) and in female 43 cm (17 inches) Spinal cord is a main pathway for information connecting the brain and rest of the body.<sup>[2]</sup>

## Vertebral column

The vertebral column, also known as the spinal column, is the central axis of the skeleton in all vertebrates. The vertebral column provides attachments to muscles, supports the trunk, protects the spinal cord and nerve roots and serves as a site for haemopoiesis. The mammalian vertebral column consists of five morphologically differentiated groups of vertebrae: cervical, thoracic, lumbar, sacral and coccygeal (caudal). In humans, the vertebral column usually consists of 33 vertebrae, placed in series and connected by ligaments and intervertebral discs. However, the number of vertebrae can vary between 32 and 35. Usually there are 7 cervical, 12 thoracic, 5 lumbar, 5 sacral and 4 caudal (coccygeal) vertebrae. In

humans, the length of the vertebral column is 71 cm in males and 61 cm in females.<sup>[3]</sup>

### Curvatures

The normal spine has an S-shaped curve when viewed from the side. This shape allows for an even distribution of weight and flexibility of movement. The spine curves in the following ways:

- The cervical spine curves slightly inward, sometimes described as a backward C-shape or lordotic curve
- The thoracic spine curves outward, forming a regular C-shape with the opening at the front or a kyphotic curve
- The lumbar spine curves inward and, like the cervical spine, has a lordotic or backward C-shape

The curves of the spine can be exaggerated in any plane, leading to pain, deformity and neurologic dysfunction. Some abnormal curves are asymptomatic while other requires treatment.

Some excessive and abnormal curves are amenable to surgical treatment. Excessive kyphosis or increased angulation forward can be due to trauma or other causes. Scoliosis or a lateral curvature of the spine viewed from the back may be corrected with surgery. There are many types of kyphosis and scoliosis that only need careful observation.<sup>[4]</sup>

### Intervertebral disc

The intervertebral disc (IVD) is important in the normal functioning of the spine. It is a cushion of fibrocartilage and the principal joint between two vertebrae in the spinal column. They also provide a shock-absorbing effect within the spine and prevent the vertebrae from grinding together.

### Functions Intervertebral disc

An intervertebral disk acts as shock absorber between each of the vertebrae in the spinal column by keeping the vertebrae separated when there is impact from activity. They also serve to protect the nerves that run down the middle of the spine and intervertebral disks

- **Covering of Spinal Cord:** Like brain spinal cord is protected and nourished by three layers of membranes called meninges.
- **Duramater (Outer):** between duramater and vertebrae is a space (epidural space) filled with adipose tissue and blood vessels. Dural sac ends at the 2<sup>nd</sup> sacral vertebra.
- **Arachnoid Mater (Middle):** Space b/w arachnoid and underlying piamater is subarachnoid space which contain CSF (cerebral fluid).
- **Piamater (Inner):** Tightly associated with spinal cord.
- **Spinal Cord Segment:** Spinal cord is divided into 5 segments, which is correspond 31 pairs of spinal nerves which arises from spinal cord.

1. Cervical segment / cervical spinal nerve - 8
2. Thoracic segment / thoracic spinal nerve - 12
3. Lumbar segment / lumbar spinal nerve - 5
4. Sacral segment / sacral spinal nerve - 5
5. Coccygeal segment / coccygeal spinal nerve - 1

Total = 31

### Spinal cord anatomy

The spinal cord is a cylindrical structure, greyish-white in colour. It has a relatively simple anatomical course. The spinal cord arises cranially as a continuation of the medulla oblongata (part of the brainstem). It then travels inferiorly within the vertebral canal, surrounded by the spinal meninges containing cerebrospinal fluid. At the L2 vertebral level the spinal cord tapers off, forming the conus medullaris.<sup>[5]</sup>

As a result of the termination of the spinal cord at L2, it occupies around two thirds of the vertebral canal. The spinal nerves that arise from the end of the spinal cord are bundled together, forming a structure known as the cauda equina.

The spinal cord is marked by two depressions on its surface. The anterior median fissure is a deep groove extending the length of the anterior surface of the

spinal cord. On the posterior aspect there is a slightly shallower depression – the posterior median sulcus.

#### Other Structures

- **Conus Medullaris:** Spinal cord end around the L1/L2 Vertebral level, forming a structure known as conus medullaris.
- **Cauda Equina:** Spinal cord end around the L1/L2 Vertebral level, but a bundle of nerves extends beyond the cord up to L5 known as Cauda equina, it carries nerve impulses to form the leg's "Horse tail" nerves that arise from lumbar, sacral and coccygeal portion of spine.
- **Filum Terminale:** An extension of pia mater that extends from conus medullaris to the tail bone. Helps to anchor the spinal cord in place.

#### Enlargements

Spinal cord has two swelling

1. **Cervical enlargement** - from spinal cord segment C4-T1 (Vertebral level) corresponds brachial plexus nerve which supply upper limb.
2. **Lumbar enlargement** - from spinal cord segment L2-S3 (Vertebral level T9-T12) corresponds to lumbosacral plexus which innervates lower limbs.

#### Function of Spine

1. Posture
2. Spinal cord encasement
3. Weight transmission
4. Posture
5. Vital organ back support
6. Muscles attachments

#### Neurological examinations

Nervous System Examination

1. General examination
2. Motor symptoms – power, coordination, nutrition and involuntary movements.
3. Sensory movements

4. Cranial nerve examination
5. Reflexes (DTR, Superficial)
6. Higher functions (mental status examinations)
7. Etiological

**Gait Disorder - Neurogenic or Myopathic:** Gait means pattern of walking or manner of walking.

- Normal Walking
- Wide base gait - cervical myelopathy
- Waddling gait - proximal myopathy
- Walking on tip toe - S1 weakness
- Walking on heels - L5 weakness

Gait is an essential component of neurological examination.<sup>[6]</sup>

Unexpected abnormalities may be detected.

Types of Gait:

1. Spastic gait - hemiplegia
2. Scissor's gait - cerebral diplegia, paraplegia, quadriplegia.
3. Stamping gait - ataxia
4. Reeling gait - cerebellar ataxia
5. Festinating gait - parkinsonism
6. High steppage gait - anterior tibialis paralysis, peripheral neuropathy
7. Waddling gait - muscular dystrophy
8. Limping gait (Antalgic gait) - sciatica
9. Hysterical gait - A bizarre gait not resembling any known pattern

**Unilateral** - Hysterical gait, Spastic gait, Antalgic gait

**Bilateral** - Festinating gait, Stamping gait - in tabs dorsalis, Ataxic gait, Walding gait

#### Cervical Diseases

1. Cervical spondylosis
2. Cervical radiculopathy
3. Cervical myopathy

4. Cervical stenosis
5. HNP (Herniated nucleus pulposus)
6. Fracture / subluxation etc.<sup>[7,8]</sup>

**Special Tests:** Compression test, Distraction test, Valsalva test, Swallowing test and Adson test etc.

**Compression test:** The neck compression test (Spurling test or sign), if positive, is useful when assessing a patient for cervical radiculopathy. This test is best performed by having the patient actively extend his or her neck, laterally flex, and rotate to the side of the pain while sitting. If you feel any pain during the test, it's considered a positive result. This means you may have cervical radiculopathy. A normal result means you don't feel any pain and suggests you don't have cervical radiculopathy.

**Distraction test:** The Cervical Distraction test is designed to detect the presence of radicular pain in the symptomatic limb, caused by cervical nerve root compression. With the patient in the seated position, place one hand under the chin and cup the occiput with the other. Apply a distraction load by gradually tractioning upwards.

**Valsalva test:** Valsalva maneuver is a forced expiration against a closed glottis, associated with an increase in the intrathoracic and intra-abdominal pressure. It is simple but associated with complex cardiovascular changes, controlling the arterial blood pressure was one of the first aims as it is affected by signals of the bar receptor.

The test is positive if there is radicular pain exacerbate in the upper or the lower limb in neurological conditions.

**Swallowing test:** Difficulty or pain upon swallowing can sometimes caused by cervical spine pathology such as –bony protuberance, bony osteophytes, soft tissue swelling due to haematoma, infections or tumour in anterior portion of cervical spine.

**Adson test:** Adson's test is a provocative test for Thoracic Outlet Syndrome accompanied by compression of the Subclavian artery by a cervical rib or tightened anterior and middle scalene muscles.

### Lumbar Disorders

- Lumbar disc herniation
- Lumbar disc prolapse
- Lumbar stenosis
- Spondylolisthesis
- Lumbar spondylosis
- Sciatica
- Cauda equina syndrome<sup>[9,10]</sup>

**Special Tests:** SLR Test, Lassegue's test, Cross SLRT, Reverse SLRT, Femoral Stretch test and Bowstring test etc.

**SLR Test:** The Straight Leg Raise (SLR) test is a commonly used test to identify impairment in disc pathology or nerve root irritation. It has also specific importance in detecting disc herniation and neural compression. It can also classify as a neurodynamic evaluation test as it can detect excessive nerve root tension or compression.

This test places tensile stresses at the sciatic nerve and of traction at the lumbosacral nerve roots primarily from L4 to S2. During SLR these nerve roots are pushed anteriorly and inferiorly pulling the duramater is pulled caudally, laterally and anteriorly. Tension in the sciatic nerve occurs in a sequence as it pulls the sciatic foramen, then the sacrum and then the nerves that cross over the pedicles and finally the intervertebral foramen. The pain or tenderness is often localized in the vicinity of the greater sciatic notch.

**Lasegue's test:** Lasegue sign or straight leg raising test (SLRT) is a neurodynamic exam to assess nerve root irritation in the lumbosacral area. It is an integral element to the neurological exam for patients presenting with low back pain with or without radicular pain. The other less commonly used name is Lazarevic sign.

**Cross SLRT:** For a patient with back pain radiating down their right leg, also perform the crossed SLR maneuver. If elevating their LEFT leg passively reproduces pain down his/her affected RIGHT leg, this is highly predictive of a sciatic radiculopathy and disk

herniation. The crossed SLR maneuver essentially stretches the left L4-L5-S1 nerve root and thus tugs on the right L4-L5-S1 nerve root.

**Reverse SLRT:** It is like SLRT in prone position. which may need further validation in regard to its true sensitivity and specificity in the diagnosis of a high lumbar radiculopathy.

**Femoral Stretch test:** The Femoral Nerve Tension Test, also known as the Femoral Nerve Stretch Test (FNST) is a test used to screen for sensitivity to stretch soft tissue at the dorsal aspect of the leg, possibly related to nerve root impingements.

**Bowstring test:** Bowstring sign is a passive provocative clinical test that is performed in patients presenting with low back pain to determine the lumbosacral nerve tension. It is also known as popliteal compression test or Posterior Tibial Nerve stretch sign.

### Clinical Examination of Spine

History

General examination

Inspection

Palpation

Movements and measurements

Special test

Neurology

### Systemic disease of spinal cord

- Common Condition Affecting Spinal Cord

  1. Congenital – spinal bifida
  2. Infective – tuberculosis
  3. Traumatic – fracture ( cervical, lower thoracic, upper lumbar most common region involve)
  4. Neoplastic – primary or secondary
  5. Metabolic – osteoporosis
  6. Degenerative –PIVD, LCS
  7. Inflammatory –Ankylosing spondylosis
  8. Paralysis – depends on location, extent of damage.

9. Meningitis

- Additional

1. Kyphosis
2. Lordosis
3. Scoliosis
4. Ligamentum flavum hypertrophy
5. Prolapse of uterus
6. Syringomyelia
7. Brown squard syndrome
8. Pott's disease
9. Sciatic nerve neuropathy
10. Neuralgia
11. Neuritis
12. Paresthesia

**Classical spinal cord syndrome:** Central cord syndrome (CCS) is an incomplete traumatic injury to the cervical spinal cord – the portion of the spinal cord that runs through the bones of the neck. This injury results in weakness in the arms more so than the legs. The injury is considered “incomplete” because patients are usually not completely paralyzed.

**Syringomyelia:** Syringomyelia (sih-ring-go-my-E-lee-uh) is the development of a fluid-filled cyst (syrinx) within your spinal cord. Over time, the cyst can enlarge, damaging your spinal cord and causing pain, weakness and stiffness, among other symptoms.

**Brown sequard syndrome:** Brown- Sequard syndrome (BSS) is a rare neurological condition characterized by a lesion in the spinal cord which results in weakness or paralysis (hemiparaplegia) on one side of the body and a loss of sensation (hemianesthesia) on the opposite side.

**Conus medularis vs cauda equina lesions:** The most distal bulbous part of the spinal cord is called the conus medullaris, and its tapering end continues as the filum terminale. Distal to this end of the spinal cord is a collection of nerve roots, which are horsetail-like in

appearance and hence called the cauda equina (Latin for horse's tail).

#### Diagnostic Criteria

1. X-ray
2. MRI
3. Myelogram
4. CT Scan
5. EMG
6. Nerve conduction test (NCT)
7. Lumbar puncture

#### Lumbar Puncture

Lumbar puncture is a aspiration CSF from the spinal subarachnoidal space by the puncturing the spaces b/w lumbar 2<sup>nd</sup> & 3<sup>rd</sup> or lumbar 3<sup>rd</sup> and 4<sup>th</sup> vertebrae.

#### Indications

**A. – Absolute:** Meningitis

Subarachnoid haemorrhage

**B. – Relative:** Neuro syphilis

Unexplained coma

Guillain barre syndrome

Multiple sclerosis

**C. – Radiological :** Myelography

Pneumoencephalography (PEG)

**D. – Therapeutic:**

#### To Introduce Drugs:

- a) Methotrexate 0.25 mg/kg bi weekly in leukemia.
- b) To reduce raised intracranial tension in hypertensive encephalopathy.
- c) To administer spinal anesthesia.

#### Contraindications

- a) Raised intracranial tension.
- b) Marked spinal deformity.
- c) Local infection.

- d) Suspected cord compression

#### Modern Management

- a) Bed rest
- b) Education on proper body mechanics (to help decrease the chance of worsening pain or damage to the disc)
- c) Physical therapy, which may include ultrasound, massage, conducting and exercise programs.
- d) Weight control.
- e) Use a lumbosacral back support.
- f) Medicine to control pain and relax muscles.

#### Medicines

- a) Steroid – prednisolone, methotrexate
- b) Antibiotics
- c) Analgesics – diclofenic, voveron, ultracet.
- d) Multivitamins – neurobion
- e) Calcium<sup>[11]</sup>

#### Ayurvedic Management

By using *Panchakarma* therapy

1. *Basti*
2. *Katibasti*
3. *Snehan*
4. *Swedan*
5. *Siravedha*

By using Ayurvedic medicine (*Saman Chikitsa*)

- a) Gold preparation - *Rasrajras, Yogendra Ras, Vrihat Vatchintamani Ras, Swarana Guggul*
- b) *Vata Shamak* drugs - *Ekgangaveer Ras, Sameerpannag Rasa*
- c) Analgesic - *Rasna Guggul, Rasna Saptak Kwath, Maharasnasaptak Kwath.*

#### DISCUSSION

The vertebral column (spinal column, spine, or backbone) forms the central axis of the body's

skeleton. It supports the skull superiorly and participates in the formation of the pelvis inferiorly. The vertebral column comprises the following five regions in cephalocaudal sequence: cervical, thoracic, lumbar, sacral and coccygeal. The vertebral column contains the spinal cord within the vertebral canal, protecting the spinal cord from external trauma. Optimal medical and surgical management of spinal disease is crucially dependent on accurate clinical and radiological diagnosis, which in turn, are reliant on a sound understanding of the structural and functional anatomy of the vertebral column.

In ayurveda most of the spinal injury or disorder count under *Vata Vyadhies*. There is detail description of 80 types *Vata Vyadhies* are describe by *Acharya Charak* and other texts of *Ayurveda* classics such as – *Kativata*, *Greeva Stambha*, *Gradhasi* etc.

## CONCLUSION

In present era thousands of peoples suffering from spinal cord disorders are related to lumbar regions. There is no definite treatment of these disorders available in modern science. There are lots of side effects of allopathic drugs and surgical process (for example – spinal surgery failure cases). It is necessary to know about anatomy and physiology of these structures for proper treatment of disease. Proper knowledge of anatomy and physiology are helpful to its examinations and they are beneficial diagnosis and treatment of diseases, so applied knowledge vertebral column and its examination are very necessary for a physician in the prevention and management of vertebral disorder. In Ayurvedic classics, there are many drugs are mentioned which is useful to treat vertebral disorders, we will also use *Panchkarma* procedures for this disorder such as- *Katibasti*, *Snehan*, *Swedan* and *Basti Karma* are continuously given in vertebral disorders.

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