

## Spinal cord

The spinal cord is a long, tube-like band of tissue. It connects your brain to your lower back. Your spinal cord carries nerve signals from your brain to your body and vice versa. These nerve signals help you feel sensations and move your body. Any damage to your spinal cord can affect your movement or function. The spinal cord is a thick column of nerves surrounded by vertebrae that runs from the brain stem to the lumbar region of the spine. Like the brain, the spinal cord has both grey and white matter. The spinal cord sends information between the brain and most of the body through the spinal nerves.

### Spinal nerves

Pairs of spinal nerves exit the vertebrae along the length of the spinal cord. At the lumbar region, the spinal cord branches into a group of spinal nerves that exit the lumbar vertebrae and sacrum. The spinal nerves control body functions like movement, bladder and bowel control and breathing. The spinal nerves are numbered after nearby vertebrae.

What is the purpose of the spinal cord?

Your spinal cord's main purpose is to carry nerve signals throughout your body. These nerve messages have three crucial functions. They:

- **Control body movements and functions.** Signals from your brain to other body parts control your movements. They also direct autonomic (involuntary) functions like your breathing rate and heartbeat, as well as bowel and bladder function.
- **Report senses to your brain.** Signals from other parts of your body help your brain record and process sensations like pressure or pain.
- **Manage your reflexes.** Your spinal cord controls some reflexes (involuntary movements) without involving your brain. For example, your spinal cord manages your patellar reflex (involuntarily moving your leg when someone taps your shin in a certain spot).

Your spinal cord has three main parts:

- Cervical (neck).
- Thoracic (chest).
- Lumbar (lower back).
- Like your brain, layers of tissue called meninges cover the spinal cord. These protective tissues include:
  - **Dura mater.** The outer layer that protects your spinal cord from injury.
  - **Arachnoid mater.** The middle layer between the epidural and subarachnoid space.
  - **Pia mater.** The inner layer that covers your spinal cord.

The epidural space is between the dura mater and arachnoid mater. This space is where healthcare providers insert anesthesia during childbirth, known as epidurals.

The subarachnoid space is between the arachnoid mater and the pia mater. Here, cerebrospinal fluid (CSF) provides extra cushioning and protection for your spinal cord.

Sometimes, providers need to insert a needle into the subarachnoid space to test CSF for certain infections. This procedure is called a spinal tap. Both the epidural and arachnoid spaces provide extra shock absorption for your spine.

You have 31 pairs of nerves and nerve roots in your spinal cord. These include:

- Eight cervical nerve pairs (nerves starting in your neck and running mostly to your face and head).
- Twelve thoracic nerve pairs (nerves in your upper body that extend to your chest, upper back and abdomen).
- Five lumbar nerve pairs (nerves in the low back that run to your legs and feet).
- Five sacral nerve pairs (nerves in the low back extending into the pelvis).

You also have a nerve bundle at the base of your spinal cord called the cauda equina. The cauda equina comes from the Latin words for “horse’s tail,” because early anatomists thought the nerve collection looked like a horse tail. The cauda equina includes nerves that provide sensation to your lower body.

Your spinal nerves send electrical signals between your brain, spinal cord and the rest of your body. These electrical nerve signals help you feel sensations (sensory nerve) and move your body (motor nerves).The spinal cord begins at the bottom part of your brainstem, called the medulla oblongata. At your lower back, your spinal cord forms a cone shape called the conus medullaris.In most adults, your spinal cord is about 18 inches (45 centimeters) long.

The spinal cord is divided into five different parts.

- Sacral cord
- Lumbar cord
- Thoracic cord
- Cervical cord
- Coccygeal

Several spinal nerves emerge out of each segment of the spinal cord. There are 8 pairs of cervical, 5 lumbar, 12 thoracics, 5 sacral and 1 coccygeal pair of spinal nerves

It performs the primary processing of information as it carries sensory signals from all parts of the body to the Central Nervous System through afferent fibres.

Nerve tissue consists of the grey and white matter spread across uniformly.

The smooth muscles and the skeletal system carrying nerve fibres liaise different reflexes when ventral horn projects axons which carry motor neurons.

It also helps intercede autonomic control for visceral functions which consist of neurons with descending axons. It is a sensitive site, which is severely affected in case of a traumatic injury.

Understanding the physiology of the spinal cord helps in detecting and determining the various methods to deal with diseases and damage related to the spinal cord.

### Structure Of Spinal Cord

The Spinal cord runs through a hollow case from the skull enclosed within the vertebral column. Spinal nerves arise from different regions of the vertebral column and are named accordingly, the regions are – Neck, chest, pelvic and abdominal.

Cross-section of spinal cord displays grey matter shaped like a butterfly surrounded by a white matter.

Grey matter consists of the central canal at the centre and is filled with a fluid called CSF (Cerebrospinal fluid). It consists of horns (four projections) and forms the core mainly containing neurons and cells of the CNS. There are two dorsal and two ventral horns.

The white matter consists of a collection of axons permitting communication between different layers of CNS. A tract is a collection of axons and carries specialized information. Ascending tracts and descending tracts send and transmit signals from the brain respectively to various nerve cells across the body.

Spinal nerves act as mediators, communicating information to and from the rest of the body and the spinal cord. We have 31 pairs of spinal nerves.

Three layers of meninges surround the spinal cord and spinal nerve roots.

- Dura mater
- Arachnoid mater
- Pia mater

Dura mater consists of two layers- periosteal and meningeal. Epidural space is present between the two layers.

Subarachnoid space lies between the arachnoid mater and pia mater. It is filled with cerebrospinal fluid.

## Spinal Cord Injuries

Damage to any part of the spinal cord or spinal nerves results in permanent and life-long damage to the spinal cord affecting the normal functioning of the spinal cord without any replacements.

It often causes long-term changes in the strength, body posture and reflexing of the body. Voluntary control of limbs post an injury depends on the severity and location of the injury.

One has a complete injury when he loses the ability to move or sense below the injury. The incomplete injury allows the injured to perform some sensory and motor functions.

Spinal cord injury not only has an impact on the spinal nerves and the vertebral column but affects other muscles and vital organs as well.

Paralysis from an injury can be of two types:

- Tetraplegic
- Paraplegic

Tetraplegia is a paralysis that results in total or partial loss of use of all four limbs and torso.

Paraplegia, on the other hand, is similar to tetraplegia, except it doesn't affect the arms.

These injuries result in the inability to voluntarily move limbs, lose sensation, delayed or exaggerated reflexes, changes in sexual functions, intense shooting pain due to damaged nerve fibres. It also causes shortness of breath, cough and muscle spasms. Spinal Cord Nerves

The spinal nerves consist of a group of 31 nerves. These nerves are attached to the spinal cord by two roots- dorsal sensory root and ventral motor root.

The sensory root fibres carry sensory impulses to the spinal cord. The motor roots, on the contrary, carry impulses from the spinal cord.

The spinal nerves carry messages to and from the skin of specific regions of the body called dermatomes.

The spinal cord nerves can be grouped as:

- Cervical

- Thoracic
- Sacral
- Lumbar
- Coccygeal

### Cervical Nerves

Cervical means of the neck. There are 8 cervical nerves that emerge from the cervical spine (C1-C8).

### Thoracic Nerves

Thoracic means of the chest. There are 12 thoracic nerves that emerge from the thoracic spine (T1-T12).

### Lumbar Nerves

Lumbar means from the lower back region. There are 5 lumbar nerves that emerge from the lumbar spine (L1-L5).

### Sacral Nerves

Sacral means of the sacrum. The sacrum is a bony plate at the base of the vertebral column.

There are 5 sacral nerves that emerge from the sacral bone (S1-S5).

### Coccygeal Nerves

Coccygeal means of the tailbone. There is 1 nerve that emerges from the coccygeal bone.

### Function Of Spinal Cord

Important functions of Spinal Cord are mentioned below:

- Forms a connecting link between the brain and the PNS
- Provides structural support and builds a body posture
- Facilitates flexible movements
- Myelin present in the white matter acts as an electrical insulation
- Communicates messages from the brain to different parts of the body
- Coordinates reflexes
- Receives sensory information from receptors and approaches towards the brain for processing.

## Function of CNS

The nervous system regulates the internal environment of the body. It is essential for maintaining homeostasis.

Homeostasis refers to the relatively stable and balanced conditions inside the body that are necessary to support life. Some of those that homeostasis regulates include:

- body temperature
- blood pressure
- heart rate
- breathing
- metabolism
- blood glucose levels
- blood acidity levels
- water and electrolytes
- digestion

The ANS receives information from the environment and other parts of the body and regulates the activity of the organs, accordingly.

The ANS is also involved in the following bodily functions:

- producing bodily fluids, such as sweat
- urination
- sexual responses

One critical function of the ANS is to prepare the body for action through the “fight or flight” response.

If the body perceives a threat in the environment, the sympathetic neurons of the ANS react by:

- increasing heart rate
- widening the airways to make breathing easier
- releasing stored energy
- increasing strength in the muscles
- slowing digestion and other bodily processes that are less important for taking action