Spinal injuries

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Anatomical review of spinal column and spinal cord

The spine, also known as the vertebral column or spinal column, is a column of 26 bones in an adult body – 24 separate vertebrae interspaced with cartilage, and then additionally the sacrum and coccyx. Prior to adolescence, the spine consists of 33 bones because the sacrum's five bones and the coccyx's four do not fuse together until adolescence. The vertebrae are named by the first letter of their region (cervical, thoracic, or lumbar) and with a number to indicate their position along the superior-inferior axis.

Each vertebra has several important parts: the body, vertebral foramen, spinous process, and transverse process.

- The *body* is the main weight-bearing region of a vertebra, making up the bulk of the bone's mass.
- Extending from the body, the *transverse processes* are thin columns of bone that point out to the left and right sides of the body.
- The *spinous process* extends from the ends of the transverse processes in the posterior direction.
- Between the body, transverse processes and spinous process is the *vertebral foramen*, a hollow space that contains the spinal cord and meninges.

Between the vertebrae of the spine are thin regions of cartilage known as the intervertebral discs. The vertebrae of the spine align so that their vertebral canals form a hollow, bony tube to protect the spinal cord from external damage and infection. The canal is protected by the ligamentum flavum posteriorly and the posterior longitudinal ligament anteriorly.The outermost layer of the meninges, the dura mater, is closely associated with the arachnoid mater which in turn is loosely connected to the innermost layer, the pia mater. The meninges divide the spinal canal into the epidural space and the subarachnoid space. The pia mater is closely attached to the spinal cord.

Between the vertebrae are small spaces known as intervertebral canals that allow spinal nerves to exit the spinal cord and connect to the various regions of the body. fig 1,2

Fig 1: posterior view through spinal column and canal

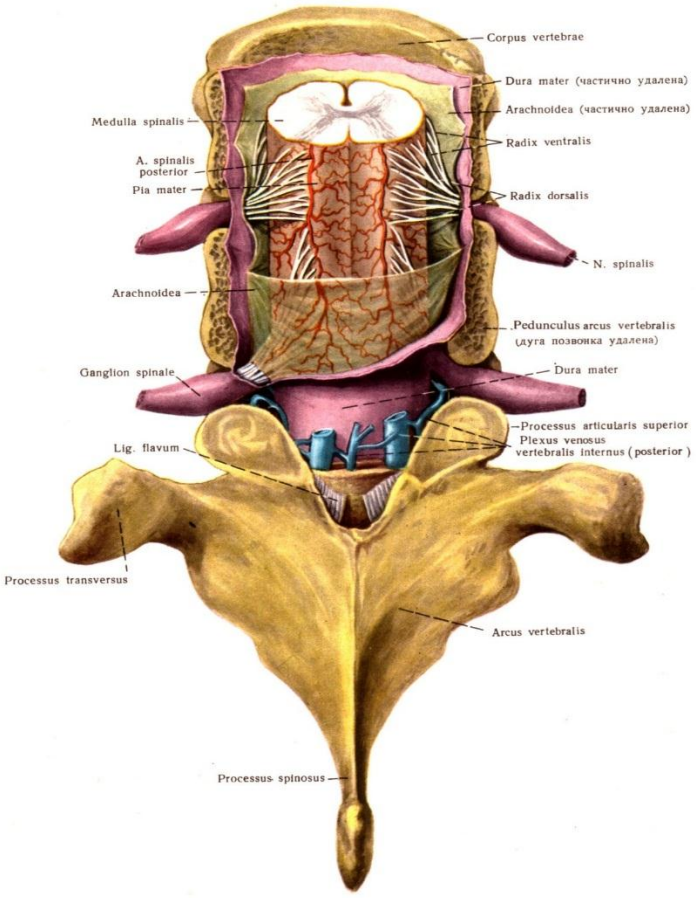
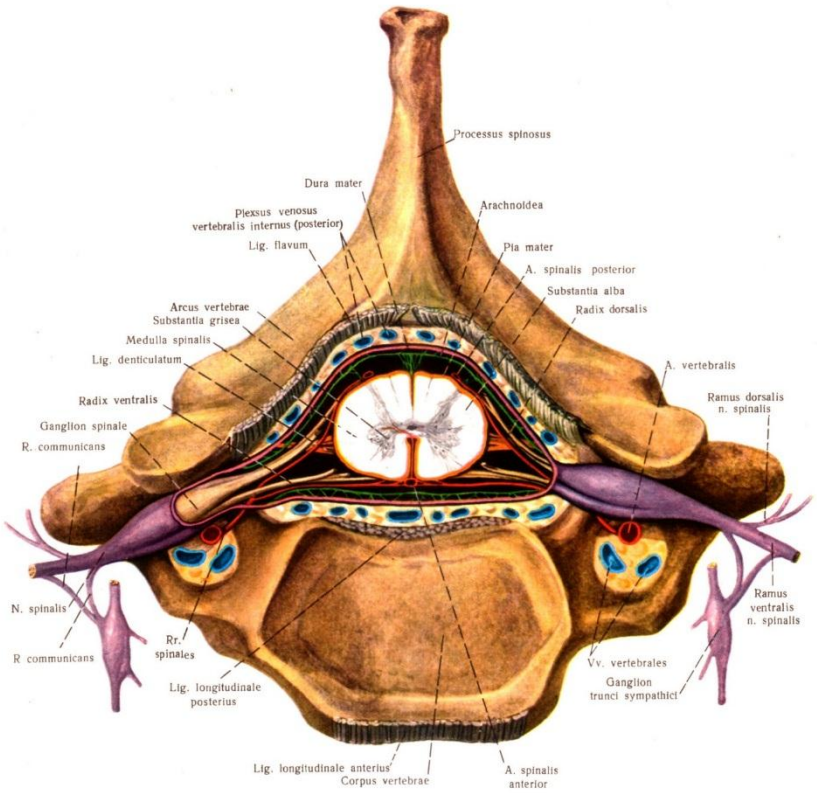


fig 2: axial section showing spinal vertebra and cord



The spinal cord is a long, fragile tube like structure that begins at the end of the brain stem and continues down almost to the bottom of the spine (spinal column). The spinal cord consists of nerves that carry incoming and outgoing messages between the brain and the rest of the body. It is also the center for reflexes. Like the brain, the spinal cord is covered by three layers of tissue (meninges). The spinal cord and meninges are contained in the spinal canal.fig 3. The cord has central gray matter9neurones) and peripheral white matter) tracts.

Fig 3: cross section through spinal cord

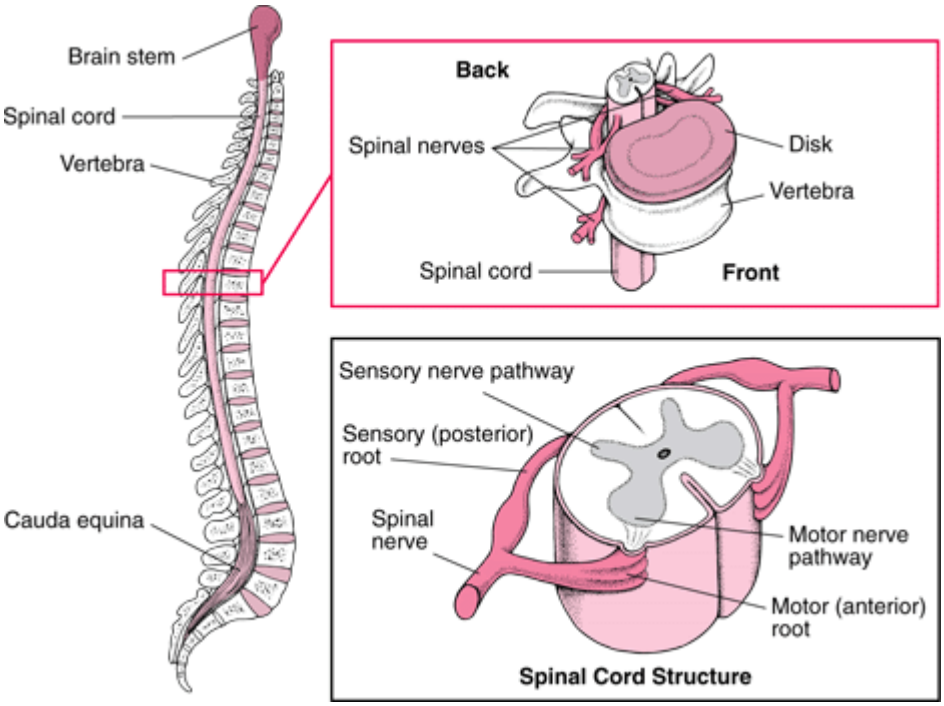
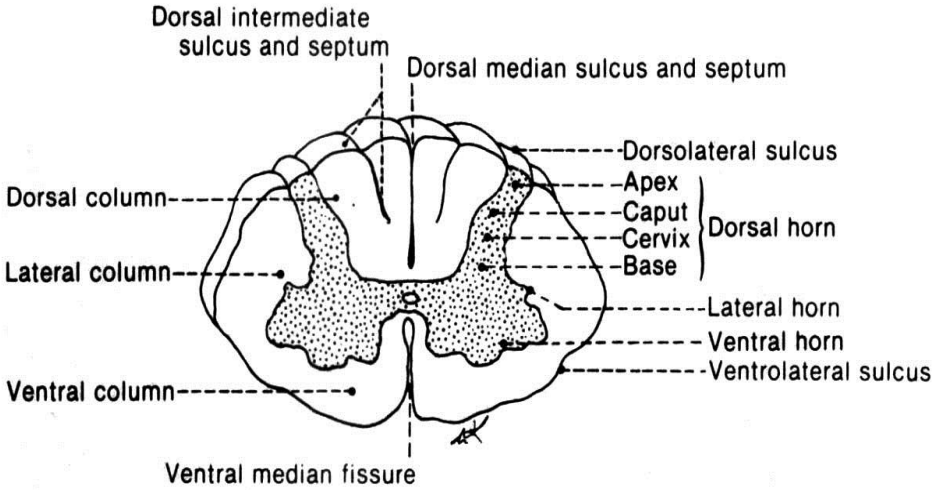
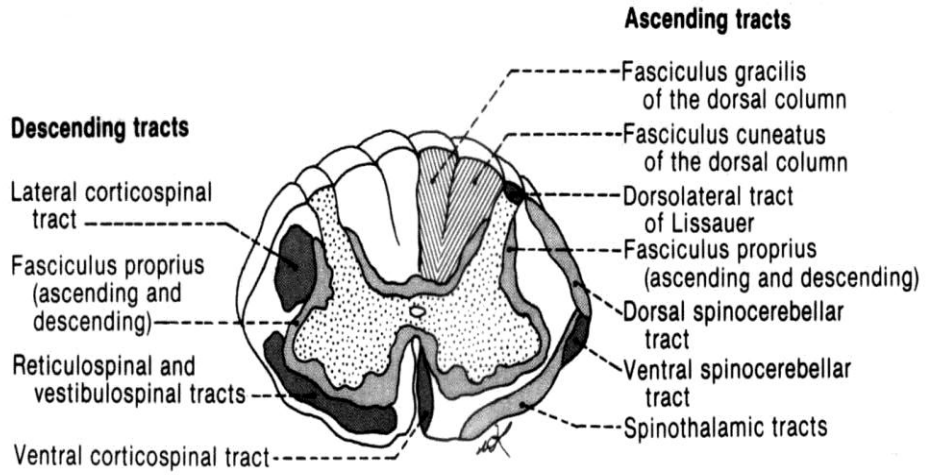


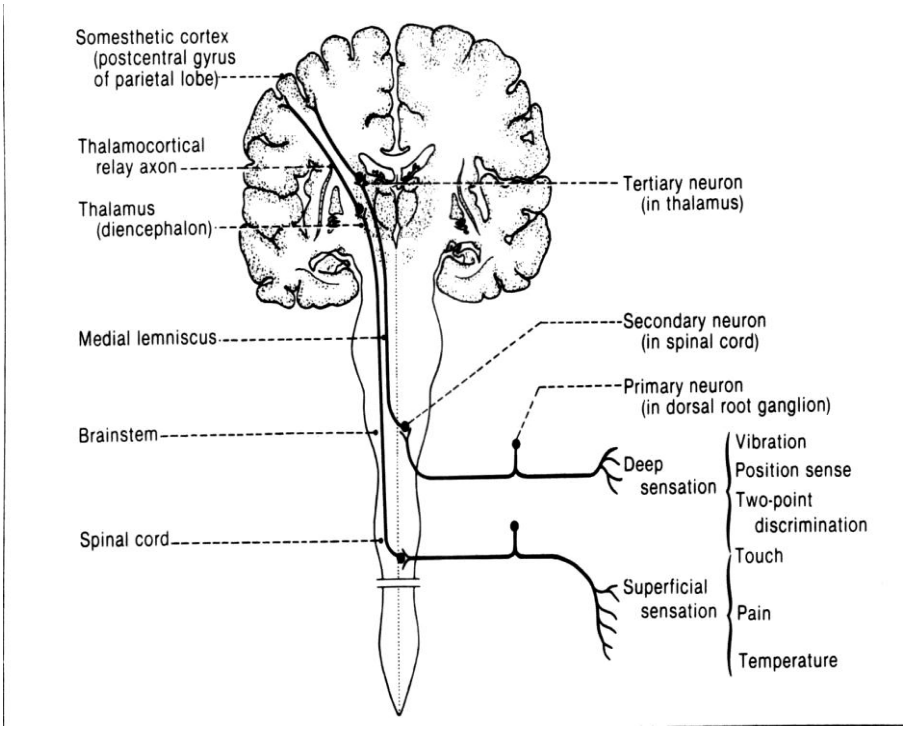
Fig 4: columns of spinal cord



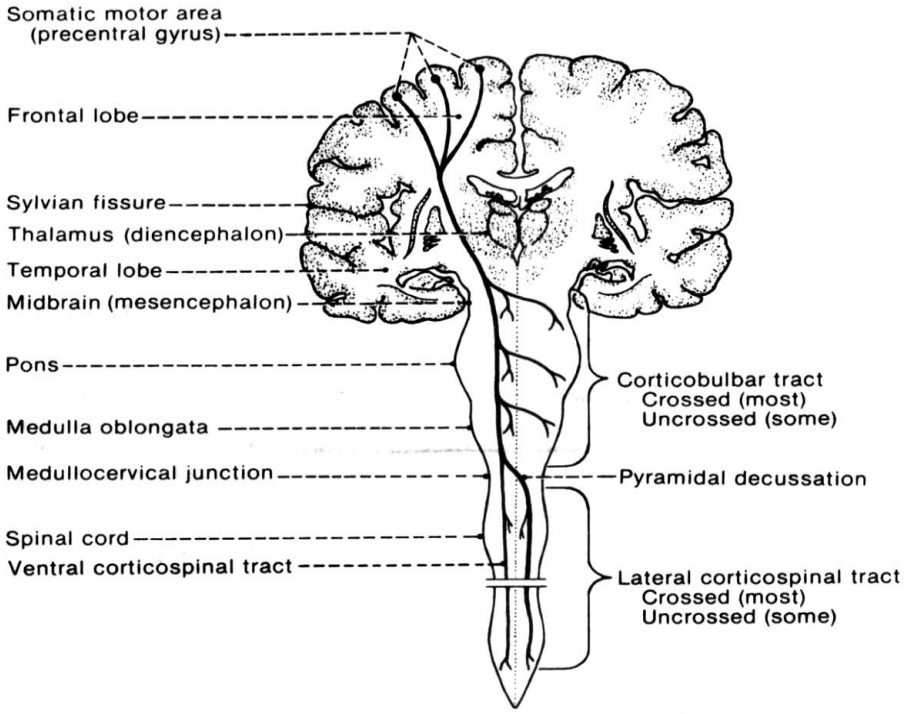
On cross section; the cord has ascending tracts for (conveying information to the brain) and descending ones for (conveying information from the brain) as shown in the next figures. The spinal cord ends about three fourths of the way down the spine, but a bundle of nerves extends beyond the cord. This bundle is called the cauda equina because it resembles a horse's tail



the following picture shows the ascending tracts and modalities conducted



While the descending tracts are illustrates in the next picture



The spinal level does not correspond to cord level. Thus for cervical C2 – C7 region and in order to get the correct corresponding cord level we have to add +1. And for T1 – T6 = add +2, for T7 – T9 = add +3, for T10 = L1, L2 level, for T11 = L3, L4 level and L1 corresponds to sacro coccygeal segments.

Spinal cord injury

It is a damage that causes changes in cord function, either temporary or permanent. These changes translate themselves into loss of muscle function, sensation, or autonomic function in parts of the body served by the spinal cord below the level of the lesion. Injuries can occur at any level of the spinal cord and can be classified as *complete injury*, a total loss of sensation and muscle function, or *incomplete*, meaning some nervous signals are able to travel past the injured area of the cord.it can be also classified as being acute or chronic

Terminology

- Plegia = complete lesion
- Paresis = some muscle strength is preserved

- Tetraplegia (or quadriplegia)
    - Injury of the cervical spinal cord
    - Patient can usually still move his arms using the segments above the injury (e.g., in a C7 injury, the patient can still flex his forearms, using the C5 segment)
- Paraplegia
    - Injury of the thoracic or lumbo-sacral cord, or cauda equina
- Hemiplegia
    - Paralysis of one half of the body
    - Usually in brain injuries (e.g., stroke)

How to assess level neurologically

1. Motor examination (myotomal area assessment) by examining muscle bulk, power grading and muscle tone systematically and getting out the ASIA motor scoring system as shown below.
Nb. Motor level = the last level with at least 3/5 (against gravity) function

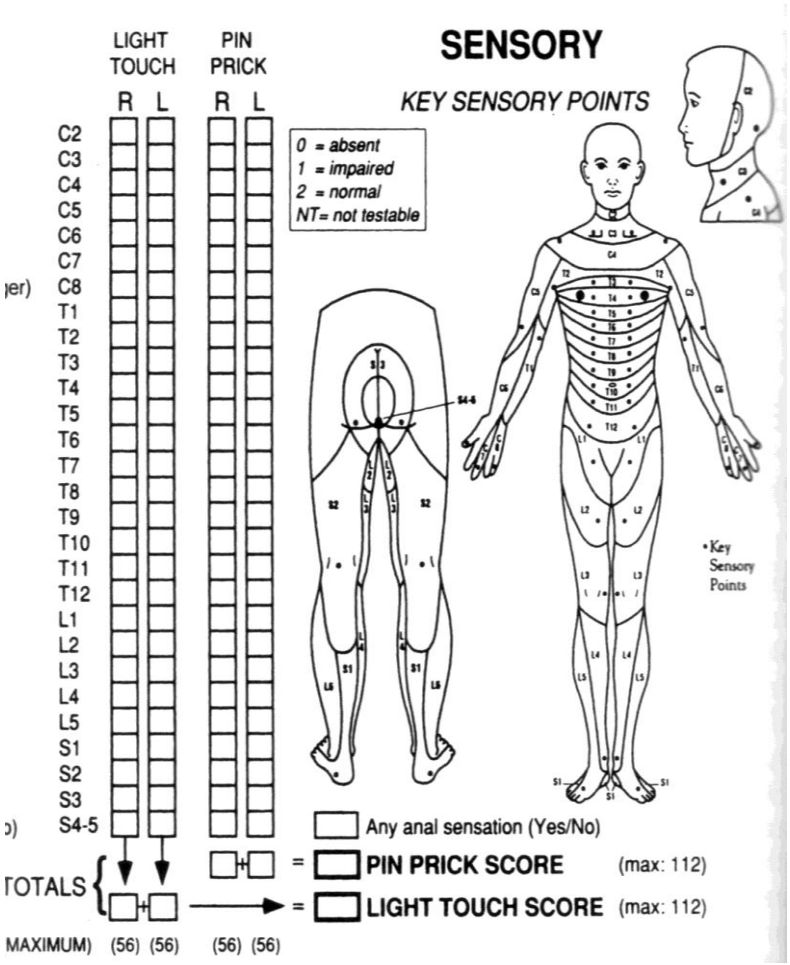
Table 26-7 ASIA motor scoring system
(EXTREMITIES)

RIGHT grade	Segment	Muscle	Action to test	LEFT grade
0-5	C5	deltoid or biceps	shoulder abduction or elbow flexion	0-5
0-5	C6	wrist extensors	cock up wrist	0-5
0-5	C7	triceps	elbow extension	0-5
0-5	C8	flexor digitorum prof	squeeze hand	0-5
0-5	T1	hand intrinsics	abduct little finger	0-5
0-5	L2	iliopsoas	flex hip	0-5
0-5	L3	quadriceps	straighten knee	0-5
0-5	L4	tibialis anterior	dorsiflex foot	0-5
0-5	L5	EHL	dorsiflex big toe	0-5
0-5	S1	gastrocnemius	plantarflex foot	0-5
50	← TOTAL POSSIBLE POINTS →			50
GRAND TOTAL: 100				

2. Sensory system examination assessing all modalities of sensation by examining dermatomal regions systematically to identify sensory level if any. As shown in the next image
Nb. Sensory level = the last level with preserved sensation

Table 26-6 Key sensory landmarks

Level	Dermatome
C4	shoulders
C6	thumb
C7	middle finger
C8	little finger
T4	nipples
T6	xiphoid
T10	umbilicus
L3	just above patella
L4	medial malleolus
L5	great toe
S1	lateral malleolus
S4-5	peri-anal



3. Reflexes examination. Deep Tendon Reflexes
a. Arm (Bicipital: C5, Styloradial: C6,Tricipital: C7)
b. Leg (Patellar: L3, some L4, Achilles: S1)
c.Pathological reflexes (Babinski =UMN lesion, Hoffman =UMN lesion at or above cervical spinal cord, clonus (plantar or patellar) =long standing UMN lesion).

4. Radiographic level = the level of fracture on plain XRays / CT scan / MRI.