MIDLANDS SURGICAL ANATOMY TEACHING SERIES

MSATS HANDOUT 2021/22

High Yield | Surgical Relevance | CPD Accredited

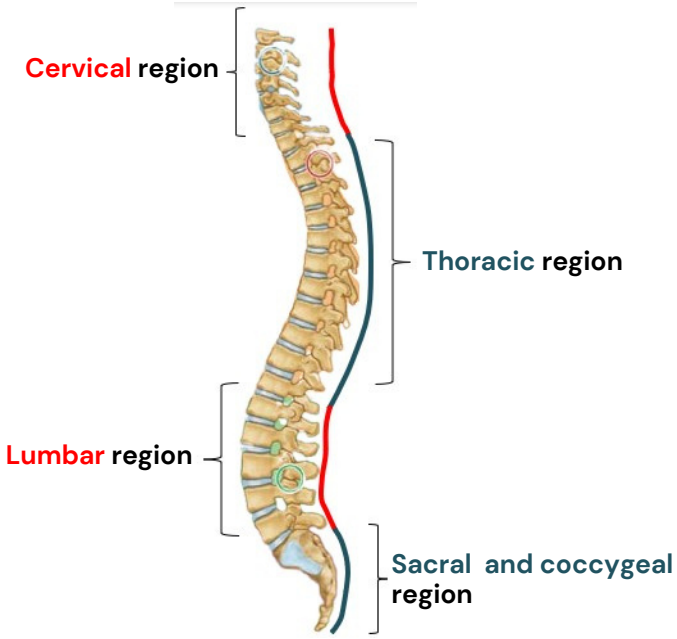
SPINE ANATOMY

Objectives: *To understand the bony anatomy, ligaments, neural contents and vascular supply of the vertebral column and spinal cord. Apply anatomical knowledge to the setting of neurosurgical procedures including a laminectomy, discectomy or lumbar puncture*

Bony Anatomy

Spine curvature

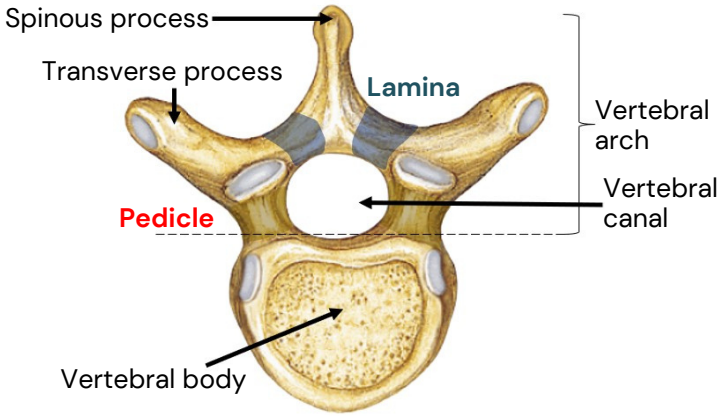
- The spine possesses two curvature types
  - **Kyphotic** - *thoracic and sacral*
  - **Lordotic** - *cervical, lumbar and coccygeal*
- Infants are born with kyphotic curves and develop lordosis with age [When learning to extend the neck and **developing bipedalism**]
- Increased age regresses the spine to mainly kyphotic curves due to decreased bone mass



Typical Vertebra Features

- Vertebral body - anterior spinal cord protection
- Vertebral arch - protection and support
- **Pedicle** - joins body and arch
- Transverse process - muscle and ligamentous attachments
- Spinous process - increasingly posteroinferior projection when observing spinal column from superior to inferior direction
- **Lamina** - joins lateral transverse to medial spinal processes.

All structures unite to form a hollow, **vertebral canal** along the spinal column which houses the spinal cord.



Spinal levels

- Spinal nerves exit inferior to their corresponding vertebra, e.g. T1 nerve below T1 vertebra
- **Except** in the cervical region where spinal nerves exit superior to their corresponding vertebra excluding C8 [Exits inferior to C7, **NO** C8 vertebra
- Important as spinal cord compression pathologies can be clinically affirmed via observation of corresponding spinal level defect, e.g. paraesthesia/weakness

Regions	Vertebrae	Spinal nerves
Cervical	C1 to C7	C1 to C8*
Thoracic	T1 to T12	T1 to T12
Lumbar	L1 to L5	L1 to L5
Sacral	S1 to S5	S1 to S5
Coccyx	Co1	Co1

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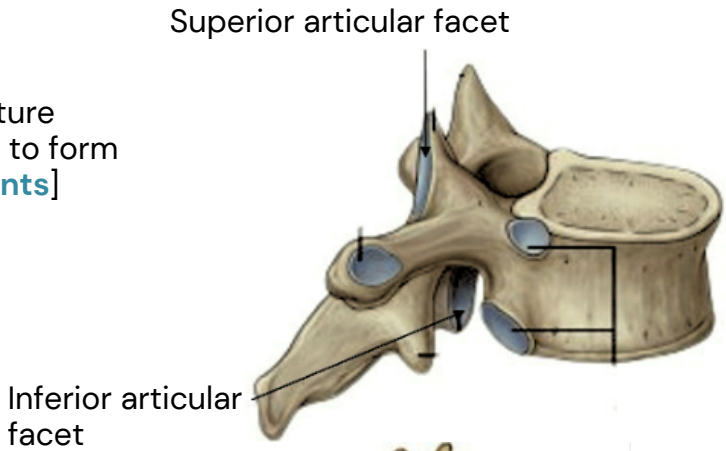
[Continued typical features]

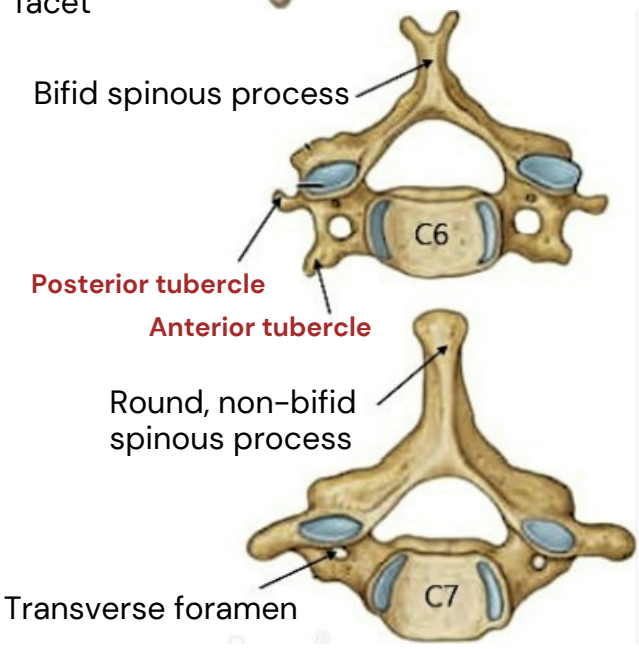
- **Articular facets** - facilitates vertebrae juncture
  - Superior and inferior articular facets join to form zygapophyseal joints [**synovial plane joints**]



Region-specific unique features

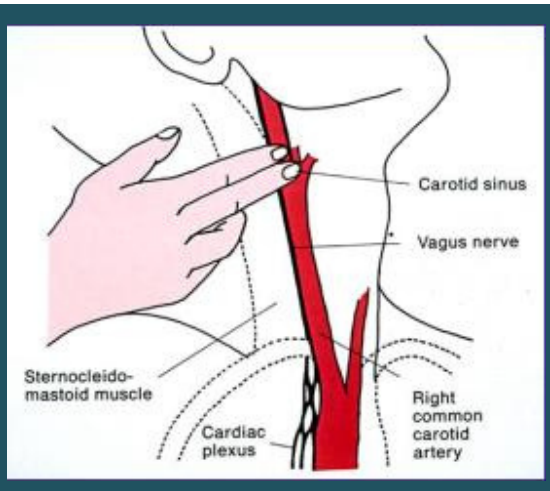
Cervical Vertebrae

- Transverse foramen function to house vertebral arteries, veins and sympathetic plexus
  - Except C7 which only houses small accessory veins, no artery
- Anterior and posterior tubercles of transverse process - cervical muscle attachment sites
- Bifid spinous process
  - Except C7 which has a long, non-bifid terminal
- Uncinate process - facilitates flexion and extension, limits lateral flexion
  - Present between C3 to T2
  - Forms **uncovertebral joints**
  - Common site for **osteophyte formation**
    - Impinges spinal nerves needs uncinectomy for palliation



Chassaignac's tubercle

- Eponymous name for **C6 anterior tubercle**
- Key clinical landmark for:
  - Performance of vagal manoeuvres such as carotid sinus massage to terminate supraventricular tachycardia
  - Stellate ganglion block to relieve head and neck pain



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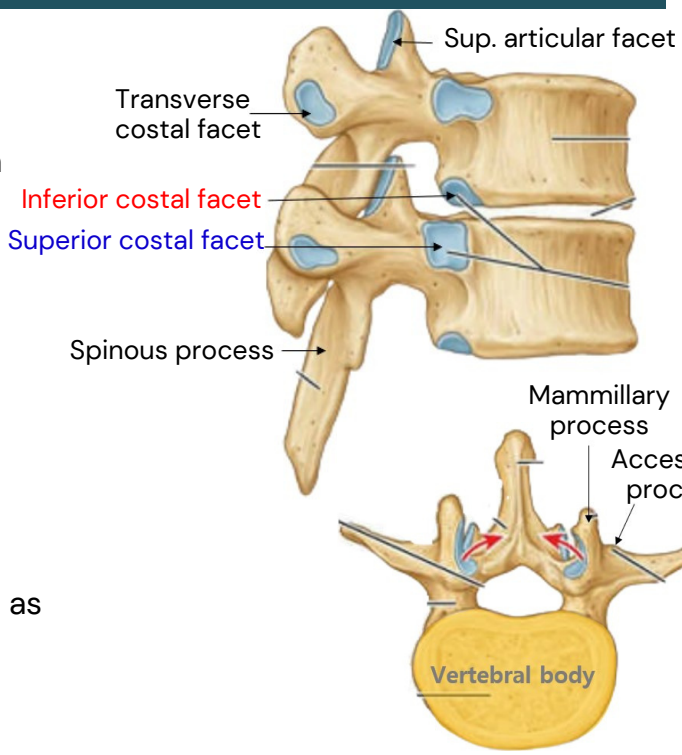
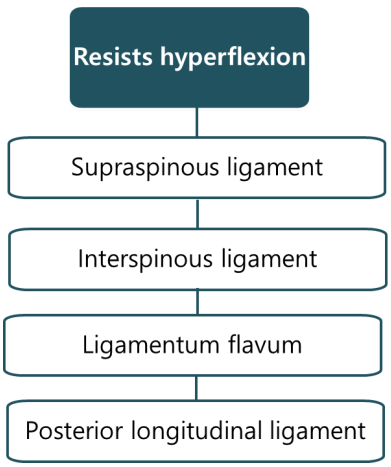
Thoracic Vertebrae

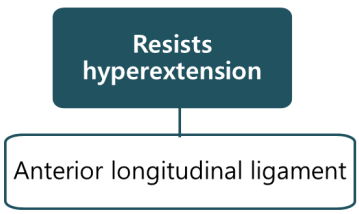
- 3 costal facets
  - **Superior costal facets** - articulates with corresponding rib head
  - **Inferior costal facet** - joins superior rib head
  - **Transverse facet** - articulates with tubercle of corresponding rib
- T12 is commonly fractured due to transitional vertebra features.

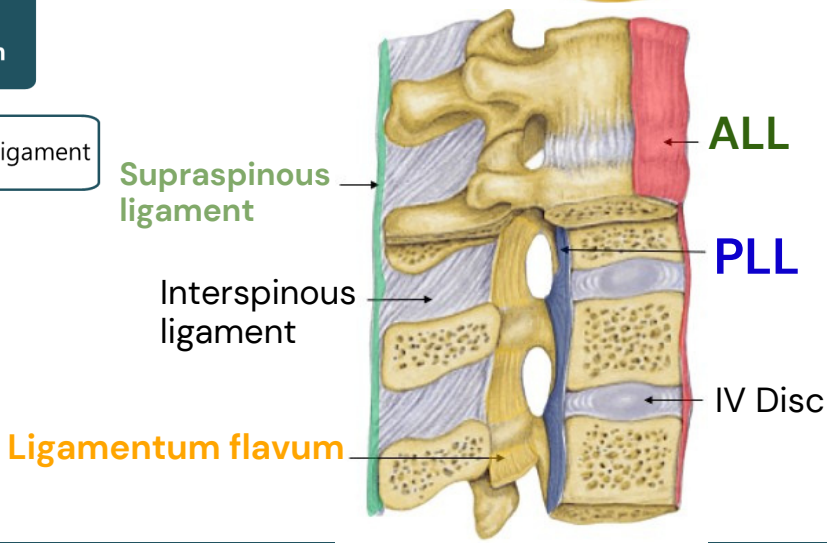


Lumbar Vertebrae

- Large, kidney-shaped vertebral body
- Accessory and mammillary process function as additional muscle attachment sites

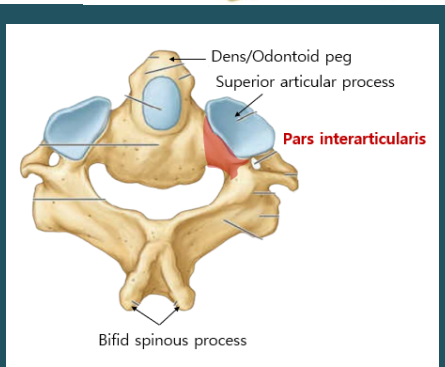






Pars interarticularis

- **Pars interarticularis** is the column between the superior and inferior articular process
- Prone to concentration of mechanical force
- Injury in cervical region results in spondylolysis or spondylolisthesis of the axis (Hangman fractures), can also occur elsewhere



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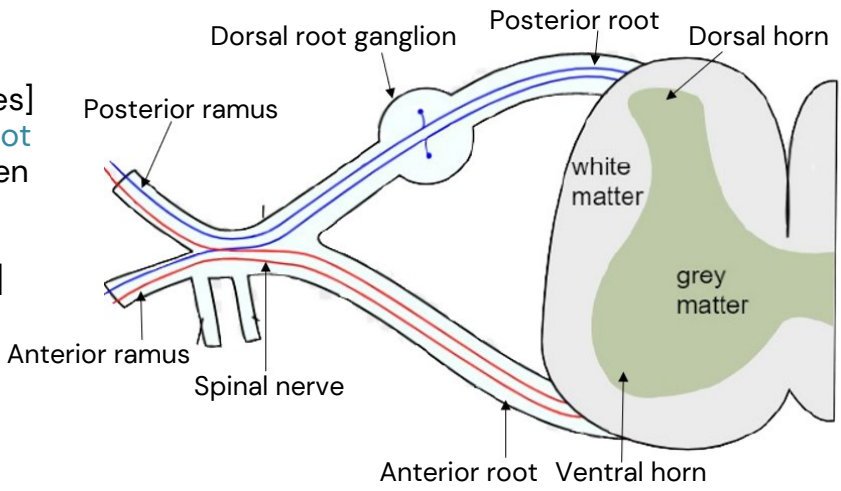
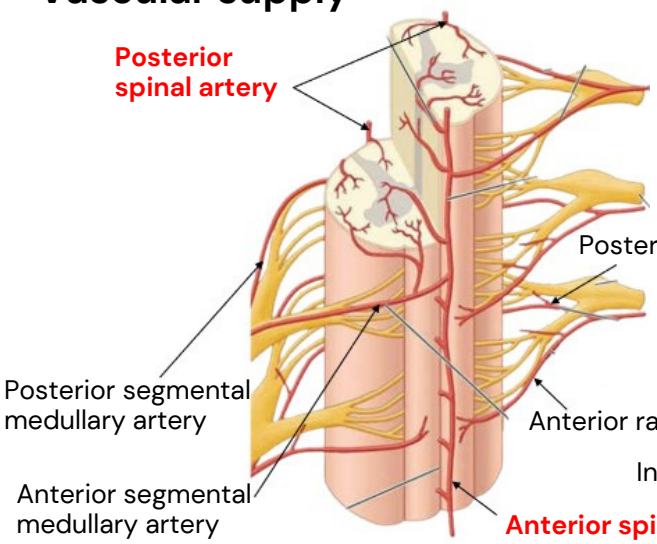
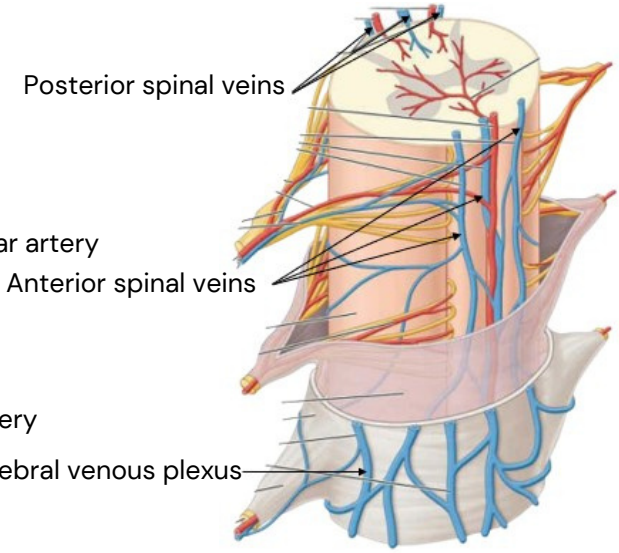
Peripheral nerve pathway

- Afferent sensory nerves [Blue lines] enter dorsal horn via posterior root
- Synapse with interneuron between dorsal and ventral horn
- Exits via anterior root through efferent motor neuron [Red lines] which innervates distal skeletal muscles
- Central canal contains cerebrospinal fluid



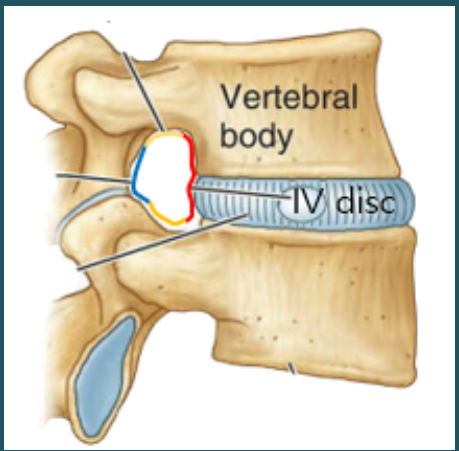
Vascular supply





Intervertebral foramen

Boundaries	Structure
Anterior	Posterolateral aspect of corresponding vertebral body + IV disc
Posterior	Zygapophyseal joint + joint capsule
Superior	Inferior vertebral notch of superior vertebrae
Inferior	Superior vertebral notch of inferior vertebrae



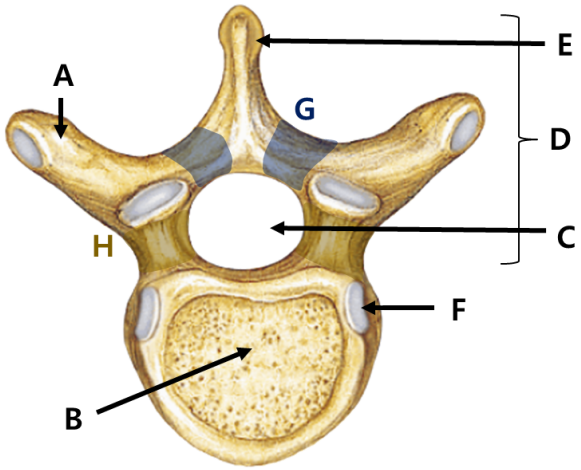
SPINE ANATOMY

Test yourself...

1) Label the structures...

Vertebra features

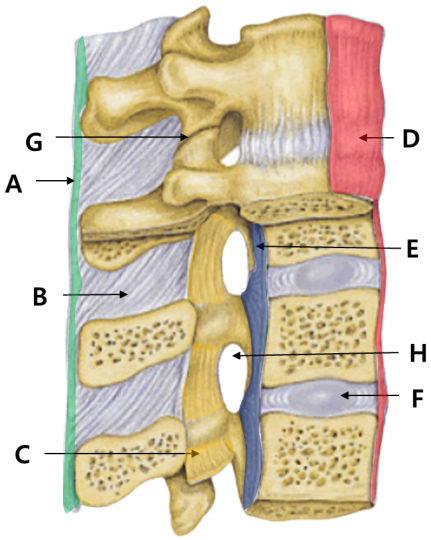
- A .....
- B .....
- C .....
- D .....
- E .....
- F .....
- G .....
- H .....



2) Label:

Spinal column ligaments

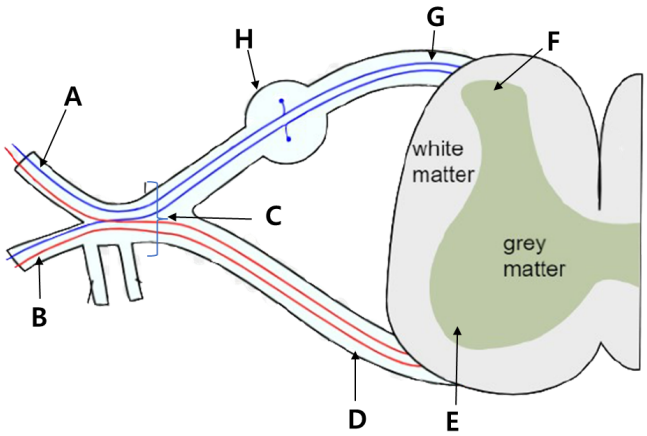
- A .....
- B .....
- C .....
- D .....
- E .....
- F .....
- G .....
- H .....
- I .....



3) Label:

Spinal cord section

- A .....
- B .....
- C .....
- D .....
- E .....
- F .....
- G .....
- H .....



SPINE ANATOMY

Test yourself...

MCQ 1
Which orientation does the elderly vertebral column regress to due to reduced bone mass?

A. Hyperlordosis
B. Hyperkyphosis
C. Hyperscoliosis
D. Spondylolysis
E. Hypokyphosis

MCQ 2
Which option bests describes the features of a cervical vertebrae?

A. Large kidney-shaped body, round vertebral canal, prominent mammillary process
B. Circular vertebral body, round vertebral canal, costal facets on vertebral body
C. Triangular vertebral body, round vertebral canal, non-bifid spinous process
D. Rectangular vertebral body, triangular vertebral canal, bifid spinous process
E. Large kidney-shaped vertebral body, oval vertebral canal, accessory transverse process

MCQ 3
When performing a lumbar puncture what are the three layers, in order, that a needle should puncture immediately prior to meeting the meningeal layers?

A. ALL, PLL, Ligamentum flavum
B. ALL, PLL, interspinous ligament
C. Supraspinous ligament, interspinous ligament, ligamentum flavum
D. Supraspinous ligament, interspinous ligament, PLL
E. Interspinous ligament, ligamentum flavum, supraspinous ligament

MCQ 4
Where does the C4 spinal nerve exit?

A. Between C4 to C5
B. Between C5 to C6
C. Between C3 to C4
D. Between C1 to C2
E. Between C6 to C7

MCQ 5
A 65-year-old lady presents with sudden onset of pain and paraesthesia in her left leg. Further, she reports that the pain radiates along the posterior thigh and leg. Examination reveals sensory loss in the dorsum of her left foot. Her reflexes remain intact and she has a positive left sided straight leg raise test. Which is the most likely cause of this presentation?

A. L5 nerve compression
B. Sciatic neuropathy
C. L4 nerve compression
D. Multiple sclerosis
E. S1 nerve compression

MCQ 6
A patient complains of acute pain followed by sudden onset quadriparesis weakness. Clinical examination reveals the loss pain and temperature sensation within the T7 dermatome. The patient has recently undergone laparoscopic abdominal aortic aneurysm. Which vessel is likely to be implicated in this pathology?

A. Artery of Bernasconi and Cassinari
B. Artery of Wollschlaeger and Wollschlaeger
C. Artery of Davidoff and Schechter
D. Terminal artery of Wilder
E. Artery of Adamkiewicz

SPINE ANATOMY

Test yourself...

OSCE Station - Case Based Discussion

A 68-year-old male presents to the A&E complaining of 1 week history of urinary incontinence and severe back pain. Further history reveals he experienced bilateral, gradual onset lower limb weakness and has reduced sensation in the saddle region. He recalls that he experienced brief back pain when moving furniture. He is afebrile, HR 77 bpm, BP 117/85 and RR of 16 breaths/minute. There are no other systemic neurological sequelae. You are the F1 doctor on-call tasked with seeing this patient.

Q1. What further assessments and investigations would you like to perform/order?

Q2. Describe the relevant anatomy with specific reference to the boundaries of the intervertebral foramen.

Q3. What is the likely diagnosis?

Q4. What surgical treatment methods are likely to be employed?

Q5. What are the common post-operative complications of Q5's method?

Q6. What activity should the patient be advised against and which advised for?

Answers

1. A – Transverse process, B – Vertebral body, C – Vertebral canal, D – Vertebral arch, E – Spinous process, F – Superior costal facet, G – Lamina
2. A – Supraspinous ligament, B – Interspinous ligament, C – Ligamentum flavum, D – ALL, E – PLL, F – Intervertebral disc, G – Zygapophyseal joint, H – Intervertebral foramen
3. A – Posterior ramus, B – Anterior ramus, C – Spinal nerve, D – Anterior root, E – Ventral horn, F – Dorsal horn, G – Posterior root, H – Dorsal root ganglion

MCQs

B, D, C, C, A, E

OSCE

1. Urgent MRI Spine, Full A-E , analgesia
2. Refer to intervertebral foramen (page 4)
3. Cauda equina syndrome secondary to lumbar intervertebral disc herniation/prolapse
4. Surgical decompression: laminectomy / discectomy
5. Spinal nerve injury, Worsening neurological deficit or Haematoma
6. Advise against flexion exercise and heavy-load lifting, encourage bed rest.