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Common spinal disorders

Objectives:

- ❖ Degenerative neck or back pain.
- ❖ Spinal cord or root entrapment (for example, herniated lumbar disc).
- ❖ Osteoporotic vertebral fracture.
- ❖ Spinal deformity (scoliosis, spondylolisthesis).
- ❖ Destructive (infectious and tumor related) back pain (for example, tuberculosis, metastasis, certain cancers).

Done by: Abdulrhman AL-Zamil

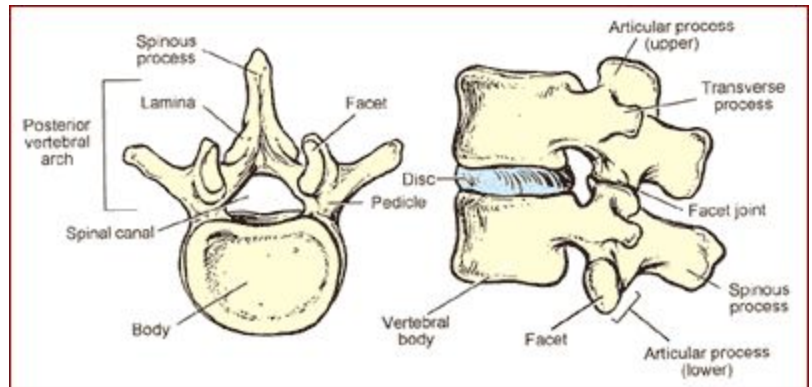
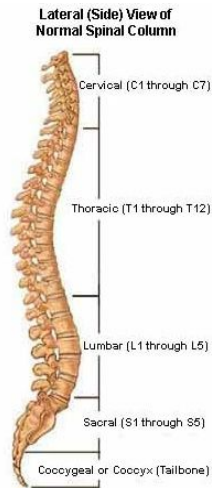
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References: Slides+Notes+Toronto+Appley's+433 Team.

Anatomy of the Spine :

Doctor : you should study the anatomy first to make it easier for you



● Cervical anatomy :

- 7 cervical vertebrae; 8 cervical nerve roots.
- Nerve root exits above vertebra (i.e. C4 nerve root exits above C4 vertebrae), C8 nerve root exits below C7 vertebra.
- Radiculopathy = impingement of nerve root.
- Myelopathy = impingement of spinal cord.
- 80% of the weight goes to the front of the spine (the body) and 20% to the back of the spine

➤ C1&C2:

- C1 (atlas) → 50% of flexion and extension (between occiput and C1). No vertebral body (ring like), no spinous process.
- C2 (axis) → 50% of rotation of Cervical spine between C1 and C2. Has Odontoid process (or Dens.)

➤ C3-C7 :

- Have Transverse foramen which is important for Vertebral Artery → one of the structures that forms the circle of willis in the brain.
- 5% range of motion at each level.
- Transverse foramen → vertebral artery → Circle of Willis. So any fracture or disc herniation affect this area may affect the brain (not common).

- **Thoracic anatomy :**

- Most thoracic vertebrae are typical, have bodies, vertebral arches and seven processes for muscular and articular connection.
- Most rigid part of the mobile spine (C1-L5) → rarely injured (usually in high energy trauma.) → usually osteoporotic fractures.
- It articulates with the ribs, acts as a splint to stabilize the thoracic spine.
- ROM: Mainly rotation, very limited extension and flexion.

- **Characteristics of thoracic vertebra :**

- Costal facets are present on the transverse processes for articulation with the tubercles of the ribs (T11 and 12 have no facets on the transverse process).
- Costal facets are present on the sides of the bodies for articulation with the heads of the ribs.
- The spines are long and inclined downwards.
- The vertebral foramen is small and circular.
- The body is medium size and heart shaped.

- **Lumbar anatomy :**

- **The most common region for fractures and disc herniation. most of the lumbar disc herniation happen posterolateral.**
- ROM: Flexion and Extension.
- **Defect in Pars interarticularis → Spondylolisthesis.**

- **Characteristics of Lumbar vertebra :**

- The Spinous process are short, flat, and quadrangular and project backwards.
- The vertebral foramina are triangular and the body is large and kidney shaped .
- The laminae are thick and the transverse process are long and slender
- The Pedicles are strong and directed backwards.

- **Joints between two vertebral bodies :**

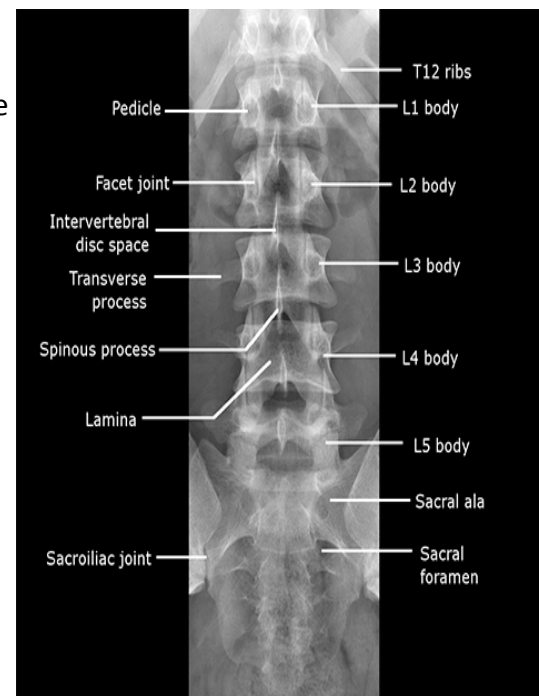
- It is a cartilaginous joint .
- The upper and lower surfaces of the bodies of adjacent vertebrae are covered by thin plates hyaline cartilage.
- Sandwiched between the plates of hyaline cartilage is an intervertebral disc of fibrocartilage .
- collagen fibers of the disc strongly unite the bodies of the two vertebrae.

- **Intervertebral disc :**

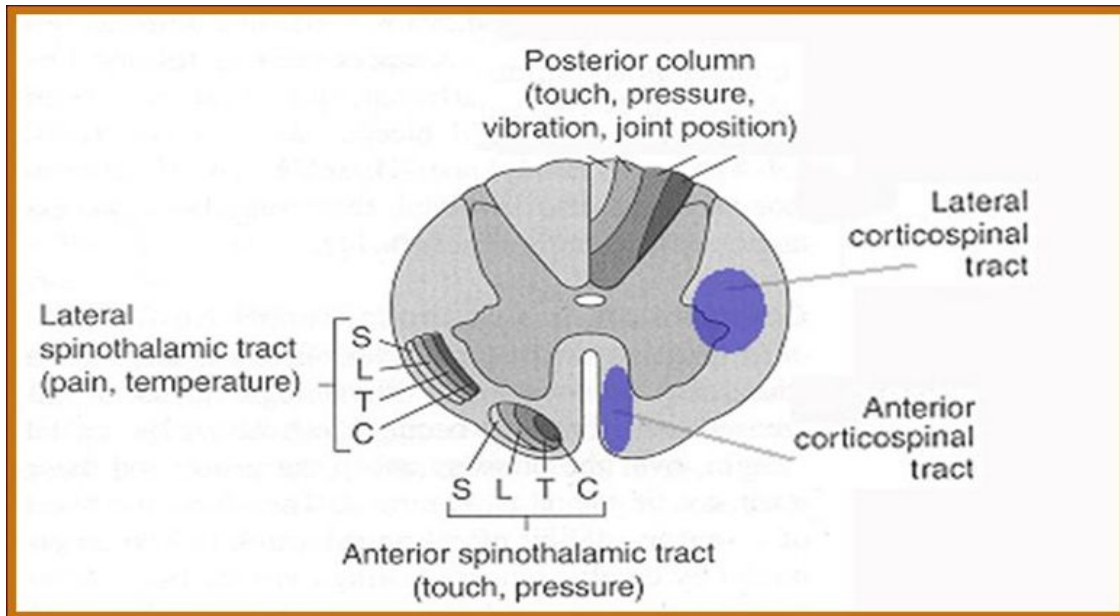
- The intervertebral discs are responsible for one fourth of the length of the vertebral column .
- They are thickest in the cervical and lumbar regions, where the movements of the vertebral column are greatest unlike the thoracic region which is LESS THICK and has less movement .
- Each disc consists of :
 - Peripheral part : the annulus fibrosus, composed of fibrocartilage .
 - Central part : the nucleus pulposus, a mass of gelatinous material containing a large amount of water, a small number of collagen fibers, and a few cartilage cells .
- No discs between the first & second cervical vertebrae or in the sacrum or coccyx.

- **Spinal cord :**

- An Elongated, almost Cylindrical structure, about the thickness of the little finger.
- It is suspended in the vertebral canal & surrounded by the meninges and cerebrospinal fluid (CSF).
- In adults, its Length is approximately 45 cm
- **Extends from foramen magnum to L1- L2 (In children it extends to L3)**
- Continuous above with the medulla oblongata.
- The tapered inferior end forms conus medullaris, which is connected to the coccyx by a non-neuronal cord called filum terminale.
- Gives rise to 31 pairs of spinal nerves.

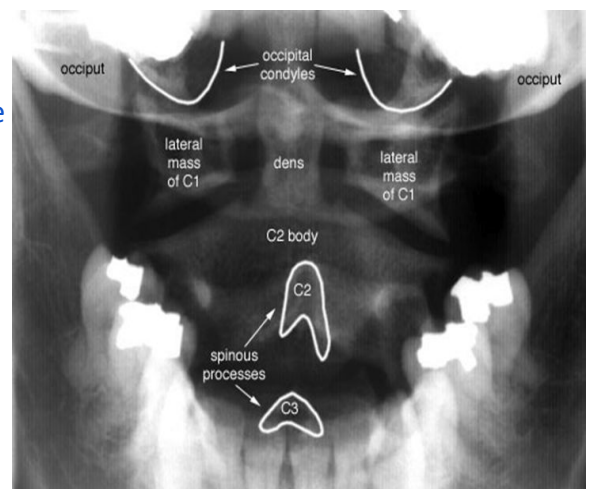


- **Ascending and descending tracts of spinal cord : (Important , в а ж н ы й , önemli , 重要 , مهم)**



- Ascending (afferent)→ sensory. Descending (efferent)→ motor.
- Cervical representation is more Central→ affect upper limb more than lower limb. → Central Cord Syndrome.
- Sacral is the last one to be affected.
- The only tract that cruciate at the Spinal level is the Spinothalamic tract.
- Posterior Column carries Ps : Pressure, Vibration, Position sense, Proprioception, two- points discrimination .
- Lateral Spinothalamic: pain, temperature and fine touch.
- Anterior spinothalamic : crude touch , pressure
- Corticospinal tract : the corticospinal tracts are particularly concerned with the control of voluntary, discrete, skilled movements, especially those of the distal parts of the limbs

- ★ Routine anteroposterior cervical spine view shows the spine from C3 (You can't see C1 and C2 because of the jaw) , so if you want to see C1 AND C2 you have to ask for **open mouth x-ray**.



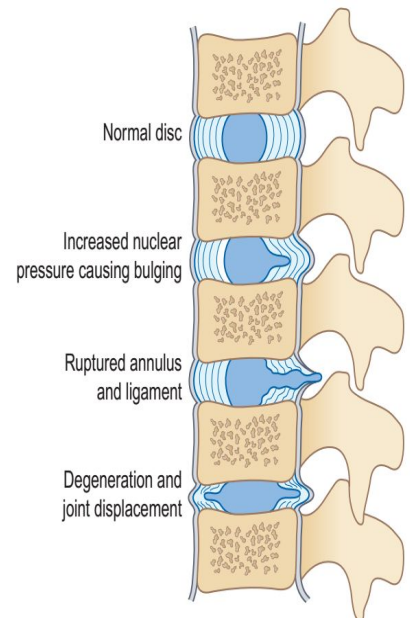
Pathophysiology of intervertebral disc :

- ❖ The disc is completely avascular, the body does not know the disc itself, so once it is there it will be irritating and sometimes could create antibodies against it, but most importantly is that the water or the fluid from the disc will act as irritant to the nerves (i.e. sciatica).^{434Team}

- **Back pain can be due to :**

- **Inter-vertebral disc :**

- The first component of the 3 joint complex. “motion segment”. (Disc anteriorly, canal centrally and 2 facet joints posteriorly)
- **If painful flexion (like in sitting) → disc related pathology (so when you have disc pathology you don't like to bend forward , patient likes to walk and stand rather than set to avoid flexion).**
- Composed of “annulus fibrosus” and “nucleus pulposus”.¹
- **Degeneration of the nucleus causes loss of cellular material and loss of hydration which produces pain.**
- Disc degeneration will also cause:
 - Bulging of the disc → “Spinal” stenosis.
 - Loss of disc height → “Foraminal” stenosis
- Abnormal loading of facet joints.
- Stenosis in the intervertebral foramen.
- Herniation of the nucleus → “Radiculopathy” (e.g. sciatica in the lumbar spine).



18.18 Intervertebral disc prolapse and degeneration Diagrammatic representation of progressive stages in the development of *disc prolapse*. At first there is only bulging of the posterior part of the disc; the annulus fibrosus may go on to rupture and the nucleus pulposus is extruded posteriorly to one or other side. In disc degeneration (lowest figure) the disc becomes desiccated and collapses, causing displacement of the posterior facet joints.

¹ With increasing age, as the lumbar intervertebral discs gradually dry out, the nucleus pulposus changes from a turgid bulb to a brownish, desiccated structure.

- **Facet joint :**

- If painful **extension** → facet or pars interarticularis related pathology.
- Pattern of degeneration similar to other synovial joints.
- Loss of hyaline cartilage, Formation of osteophytes, Laxity in the joint capsule.
- Facet degeneration will cause: Hypertrophy, osteophyte formation.²
- Laxity in the joint capsule: Leading to instability (degenerative spondylolisthesis).

Clinical Presentation :

- **Mechanical pain :**

- Dull back ache aggravated by activity (not present at rest) and prolonged standing.
- Morning stiffness.
- No neurological signs.
- Degeneration +/- Instability. Axial pain.

- **Neurological symptoms :**

- ❖ Spinal cord: Cervical and Thoracic → Spinal cord compression.
 - Cervical: Myelopathy (CSM) → Variable loss of sensory and motor loss, fine movement loss, motor deficit in Upper Limb (rigidity, hyper-reflexia, positive Babinski), fall of objects from hands, upper motor neuron signs in the lower limb; clonus.
 - Spinal cord injuries: complete vs incomplete.
- ❖ Nerve roots: Sciatica
- ❖ Cauda equina: prevalence 0.0004/LBP but serious → (Cauda equina syndrome, a rare disorder affecting the bundle of nerve roots (cauda equina) at the lower (lumbar) end of the spinal cord, is a surgical emergency. Cauda equina syndrome occurs when the nerve roots in the lumbar spine are compressed, disrupting sensation and movement. Nerve roots that control the function of the bladder and bowel are especially vulnerable to damage. It can lead to permanent paralysis, impaired bladder and/or bowel control, loss of sexual sensation, and other problems if left untreated)

² Contributing to spinal stenosis or foraminal stenosis.

❖ Spinal stenosis: Neurogenic claudication

Table III.^{22,32} Differences between neurogenic and vascular claudication

Symptom/sign	Neurogenic Claudication	Vascular Claudication
Pain	Proximal to distal	Distal to proximal
Relief of symptoms	Relieved by sitting/forward bending	Relieved by standing
Walking up hill	Better	Worse
Walking down hill	Worse	Better
Cycling	No symptoms	Symptoms present
Walking distance	Variable	Fixed
Neurological symptoms	Commonly present	Not present
Neurological signs	May be positive especially after walking	Negative
Pulse	Present	Absent
Skin	No changes	Atrophic changes

Degenerative disease :

	Cervical Spine	Lumbar Spine
Introduction	<ul style="list-style-type: none"> • Degenerative changes typically occur in C3-C7. • Presents with axial pain, myelopathy, or radiculopathy. • Physical examination: <ul style="list-style-type: none"> ○ Stiffness (loss of ROM). ○ Neurologic exam: <ul style="list-style-type: none"> - Weakness. - Loss of sensation. - Hyper-reflexia. - hypertonia.(myelopathy, UML) - Special tests: Spurling’s sign. 	<ul style="list-style-type: none"> • Degenerative changes typically occur in L3-S1. • Presents with axial pain, sciatica, neurogenic claudication. • Physical examination: <ul style="list-style-type: none"> ○ Stiffness (loss of ROM). ○ Neurologic exam: <ul style="list-style-type: none"> - Weakness. - Loss of sensation. - Hypo-reflexia, hypo-tonia. LML - Special tests: SLRT.³
Management	<p>A-Conservative:(Conservative always first)</p> <ul style="list-style-type: none"> - rest and short period of immobilization -Physiotherapy: ROM and strengthening -Pain management -Neuropathic medication for radiculopathy f -E.g. Gabapentin or pregabalin <p>B- Surgical procedure :</p> <ul style="list-style-type: none"> -Anterior cervical discectomy and fusion -Posterior laminectomy +/- fusion -Laminoplasty -Cervical disc arthroplasty 	<p>A-Conservative(Conservative is the mainstay): 90% resolved within 12 weeks</p> <ul style="list-style-type: none"> - short period of rest. - Physiotherapy . - Pain management (non-invasive and invasive;epidural and facet injections) <p>B- surgical procedure :</p> <ol style="list-style-type: none"> 1- Laminectomy 2- Discectomy
Surgical Indication	<ol style="list-style-type: none"> 1- Spinal stenosis causing myelopathy. 2- Disc herniation causing severe radiculopathy associated with weakness. 3- Failure of conservative treatment of axial neck pain or mild radiculopathy 	<ol style="list-style-type: none"> 1- Cauda equina. 2- motor deficit and failure of 3 months conservative treatment 3- Instability or deformity e.g. high-grade spondylolisthesis

³ Straight leg raise test.

Spinal cord or root entrapment :

	Spinal stenosis	Disc herniation
General principles	<ul style="list-style-type: none"> - narrowing of spinal canal <10mm. - Causes : <ol style="list-style-type: none"> (1) Congenital vertebral dysplasia (e.g. in achondroplasia or hypochondroplasia). (2) Chronic disc protrusion and peri-discal fibrosis or ossification. (3) Displacement and hypertrophy, or osteoarthritis, of the apophyseal (facet) joints. (4) Hypertrophy, folding, or ossification of the ligamentum flavum. (5) Bone thickening due to Paget's disease. (6) Spondylolisthesis. 	<ul style="list-style-type: none"> - Tear in annulus fibrosus allows protrusion of nucleus pulposus causing either a central, posterolateral, or lateral disc herniation, most commonly at L5-S1 > L4-5 > L3-4.
Management	<ul style="list-style-type: none"> - Conservative treatment is first line of treatment. Activity modification, analgesics, epidural cortico-steroid injections. 	<ul style="list-style-type: none"> - Conservative treatment is first line of treatment for mild sciatica without motor deficit. - Short (2-3 day) period of rest, NSAID, physiotherapy, epidural cortico-steroid injection. - 95% of sciatica resolves within the first 3 months without surgery.
Surgical treatment	<p>Indication for :</p> <ul style="list-style-type: none"> - Motor deficit - severe neurogenic claudication - failure of 6+ months of conservative treatment <p>Procedures:</p> <ul style="list-style-type: none"> - Spinal decompression (laminectomy) is the commonest. 	<p>Indicated for:</p> <ul style="list-style-type: none"> - Cauda-equina syndrome. - Motor deficit also complete loss of sensation usually considers an indication. - Failure of 2 months of conservative treatment. <p>Procedure :</p> <ul style="list-style-type: none"> - Discectomy (only the herniated part)

Osteoporotic Vertebral Fractures :

- Pathological fractures
- Common injury post menopausal, if repetitive will result in loss of height and kyphotic deformity.
- Often missed
- Treatment: Underlying disease

Destructive Spinal Lesions :

- Present with pain at rest or pain at night.
- Associated with constitutional symptoms.
- Most common causes: –Infection –Tumors
- Vertebral body and pedicle are the commonest sites of pathology. (rich of blood supply)

❖ Spinal tumors:

➤ Primary Spinal tumors:

- Rare.
- Benign (e.g. osteoid osteoma) or malignant (e.g. chordoma).
- Management depends on pathology.

➤ Spinal metastasis

- Very common.
- Biopsy required if primary unknown.

First line management in tumor or infection is Biopsy

❖ Spinal infections:

- Most common is TB and Brucellosis.
- History of contact with TB patient, raw milk ingestion.
- Potentially treatable diseases once diagnosis is established and antimicrobials administered.

Spinal Deformities :

	Scoliosis ⁴	Spondylolysis	Spondylolisthesis ⁵
Cause & Notes	1. Congenital 2. Syndromic 3. Neuromuscular 4. Idiopathic: most common type. 80%.	<ul style="list-style-type: none"> ❖ Is a defect in the pars interarticularis. ❖ Plan lateral radiograph 80%, oblique another 15%. ❖ Single photon emission computed tomography. ● Mechanism: <ul style="list-style-type: none"> ○ trauma: gymnasts, weightlifters, backpackers, loggers, labourers ● Clinical Features: Activity-related back pain, pain with unilateral extension (Michelis’ test). ● Investigations: <ul style="list-style-type: none"> ○ oblique x-ray: “collar” break in the “Scottie dog’s” neck. ○ bone scan. ○ CT scan. ● Treatment: <ul style="list-style-type: none"> ○ non-operative: activity restriction, brace, stretching exercise. 	<ul style="list-style-type: none"> ❖ Displacement of a vertebra in relation to a vertebra below. Most people are asymptomatic. ❖ Commonest causes are: <ul style="list-style-type: none"> ○ Degenerative. Osteoarthritic degeneration of facet joints. ○ Isthmic ❖ Severity according to the degree of displacement. ❖ Surgical indication: grade 3 or more, failed conservative ❖ Surgical procedure: according to severity. Instrumented PSF +/- interbody fusion is the commonest

⁴ Scoliosis is an apparent lateral (sideways) curvature of the spine.

⁵ ‘Spondylolisthesis’ means vertebral displacement. Normal laminae and facets constitute a locking mechanism which prevents each vertebra from moving forwards on the one below. Forward shift (or slip) occurs only when this mechanism fails. Listhesis (slippage) is nearly always between L4 and L5, or between L5 and the sacrum.

<p>Types</p>	<p>❖ ADOLESCENT IDIOPATHIC SCOLIOSIS :</p> <ul style="list-style-type: none"> ➤ Between 10 and 14 years, mostly girls. ➤ Vertebral rotation ➤ Deformity without significant pain ➤ Normal neurological examination ➤ Surgical indication : 45 degrees or more ➤ Surgical procedure: instrumented PSF⁶ 		<p>❖ ADULT ISTHMIC SPONDYLOLISTHESIS</p> <ul style="list-style-type: none"> ○ defect in pars interarticularis causing a forward translation or slippage of one vertebra on another usually at L5-S1, less commonly at L4-5. <p>● Mechanism:</p> <ul style="list-style-type: none"> ○ congenital (children), degenerative(adults), traumatic, pathological, teratogenic. <p>● Clinical Features:</p> <ul style="list-style-type: none"> ○ lower back pain radiating to buttocks relieved with sitting ○ neurogenic claudication. ○ L5 radiculopathy. ○ Meyerding Classification (percentage of slip). <p>● Investigations :</p> <ul style="list-style-type: none"> ○ x-ray (AP, lateral, obliques flexion-extension views), MRI. <p>● Treatment:</p> <ul style="list-style-type: none"> ○ non-operative: activity restriction, bracing, NSAIDS ○ operative.
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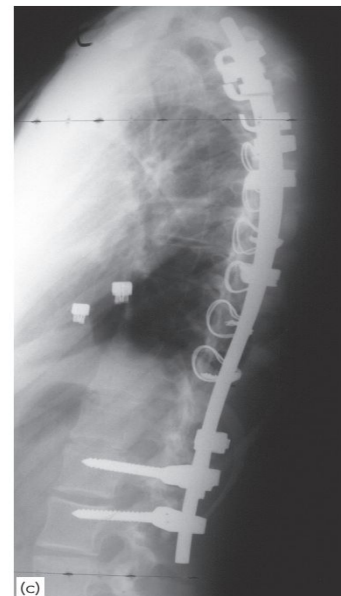
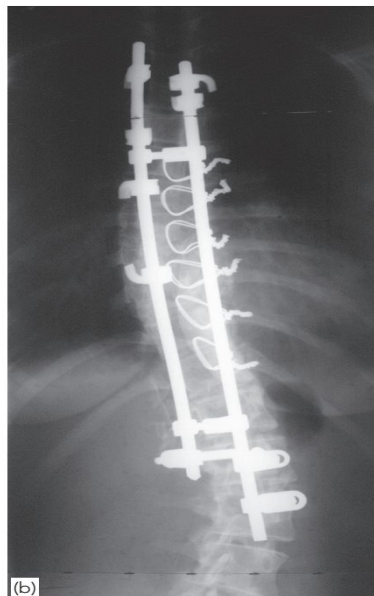
⁶ Posterior Spinal Fusion

ADOLESCENT IDIOPATHIC SCOLIOSIS : Extra from “Appley concise”

- ❖ This is the commonest type, occurring in **90%** of cases, mostly in **girls**. Primary thoracic curves are usually convex to the right, lumbar curves to the left. Progression is not inevitable; most curves of **less than 20 degrees** either resolve spontaneously or remain unchanged. However, once a curve starts to progress, it usually goes on doing so throughout the remaining growth period.
- ❖ Treatment: The aims of treatment are:
 - (1) to prevent a mild deformity from becoming severe.
 - (2) to correct an existing deformity that is unacceptable to the patient.
- Non-operative treatment: If the patient is approaching skeletal maturity and the deformity is acceptable (less than **30 degrees** and well balanced), treatment is probably unnecessary unless x-rays show definite progression.
- Operative treatment:

The indications for surgery are:

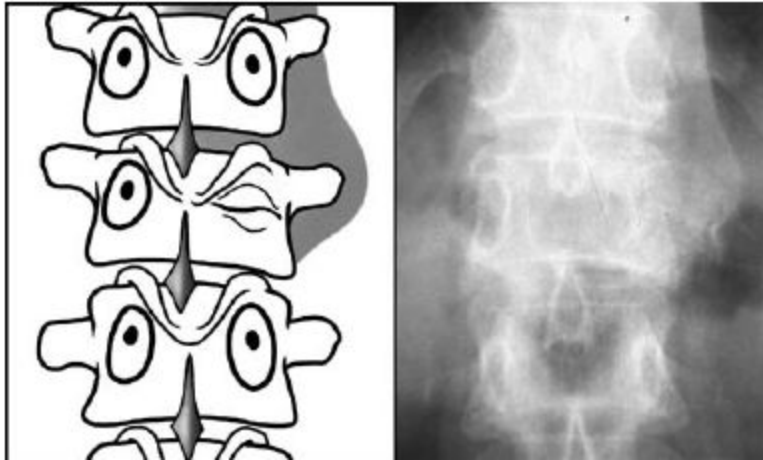
 - (1) curves of **more than 30 degrees** that are cosmetically unacceptable, especially in prepubertal children who are liable to develop marked progression during the growth spurt;
 - (2) milder deformity that is deteriorating rapidly. Balanced, double primary curves require operation only if they are greater than 40 degrees and progressing.



18.10 Scoliosis – posterior instrumentation Idiopathic scoliosis treated by posterior double-rod fixation.

❖ Pathologic fracture

- Low-energy fractures
- Osteoporotic is common
- Usually due to infection or tumour
- X-rays: “winking owl” sign



❖ Spine Pathology Red Flag Conditions, Beware of:

- Cauda Equina/severe neurologic injury (perianal numbness, decreased rectal tone, loss of movement in the extremities)
- Tumour weakening the vertebrae (causing cord compression or vertebral fracture).
- Infection weakening bone (causing disc/vertebral destruction or cord compression).
- Traumatic Spine Fracture (causing vertebral angulation, pain, or neuro compromise).

Remember that spine fracture can occur without trauma.