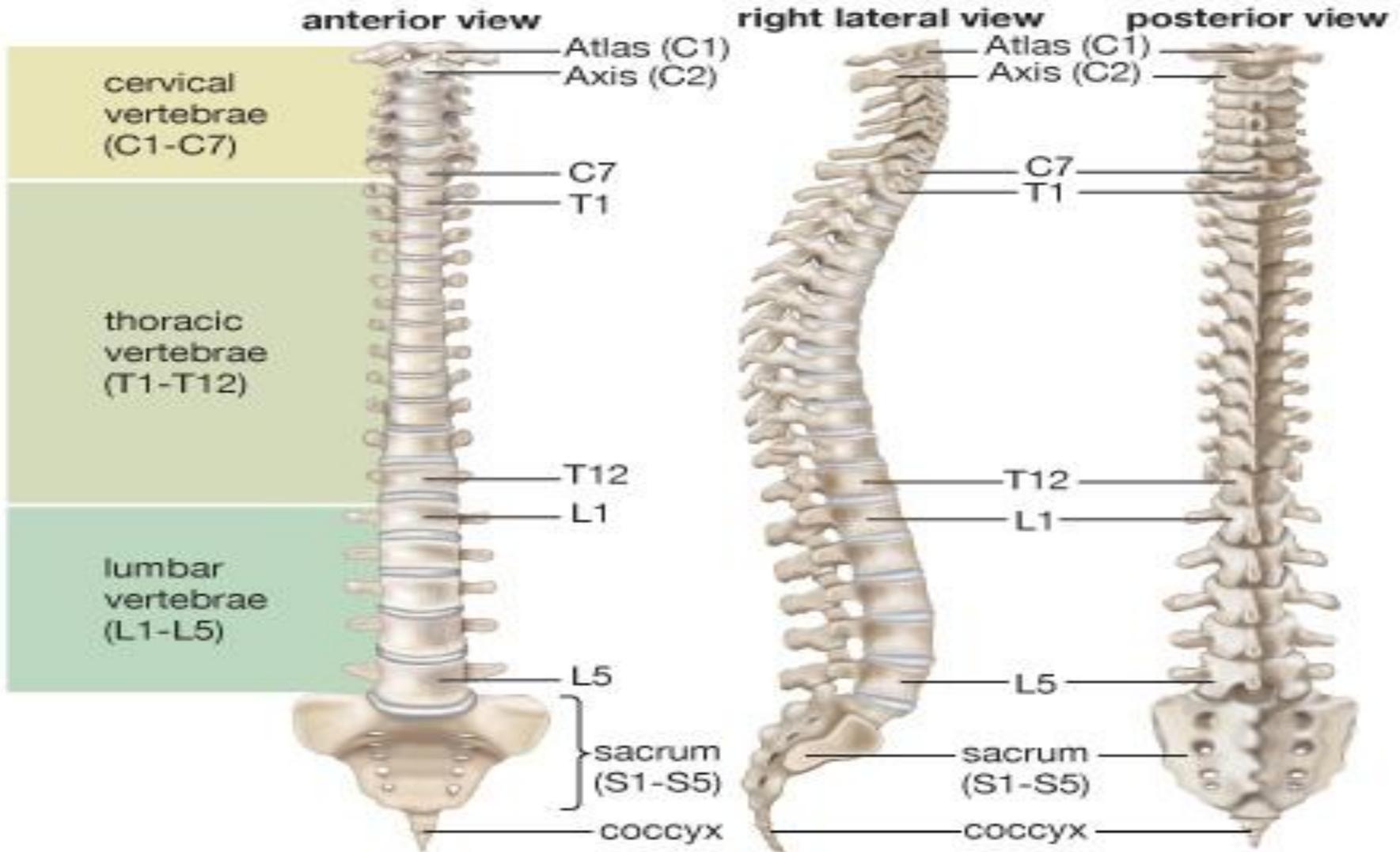


آسیب تروماتیک
ستون فقرات

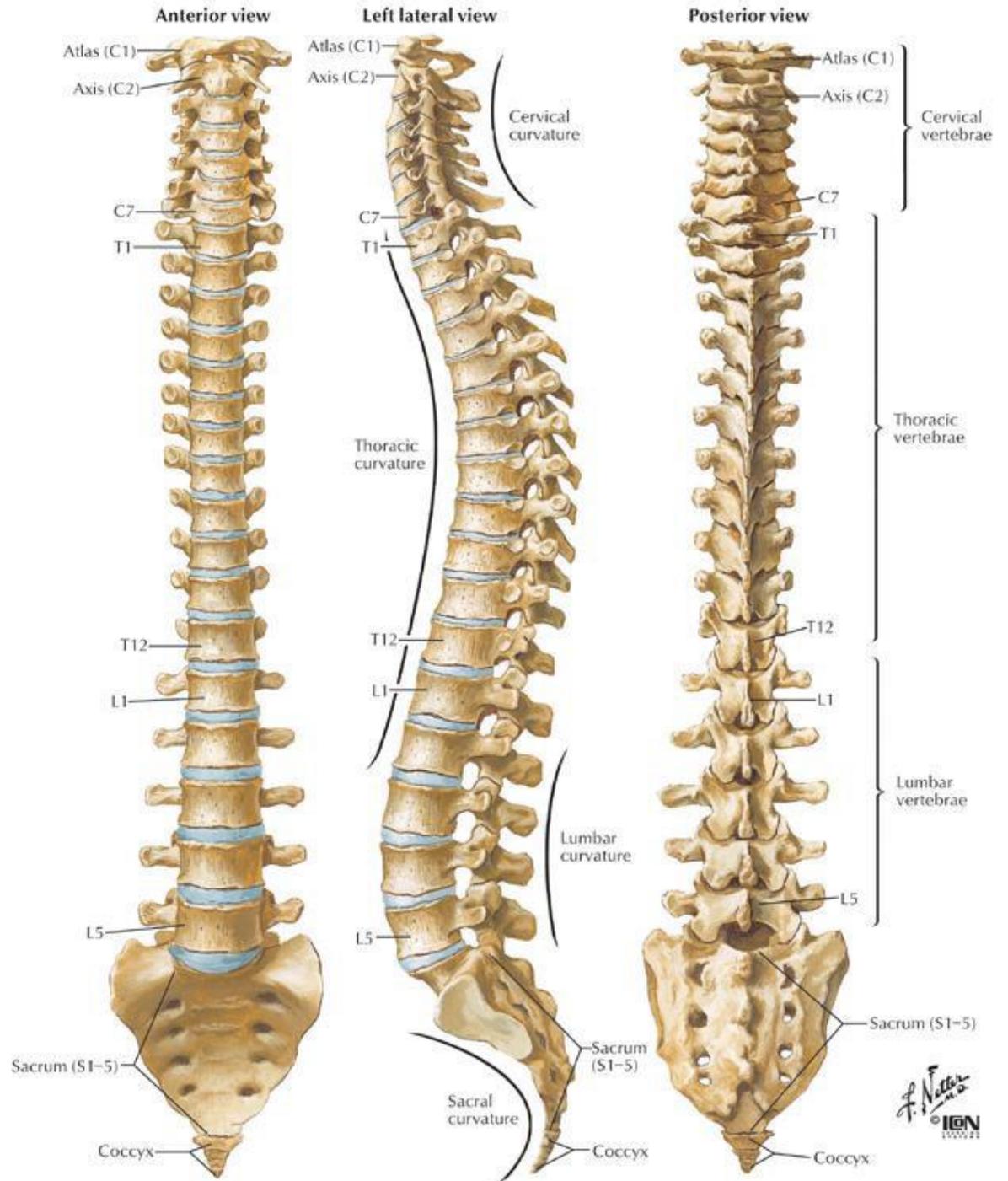
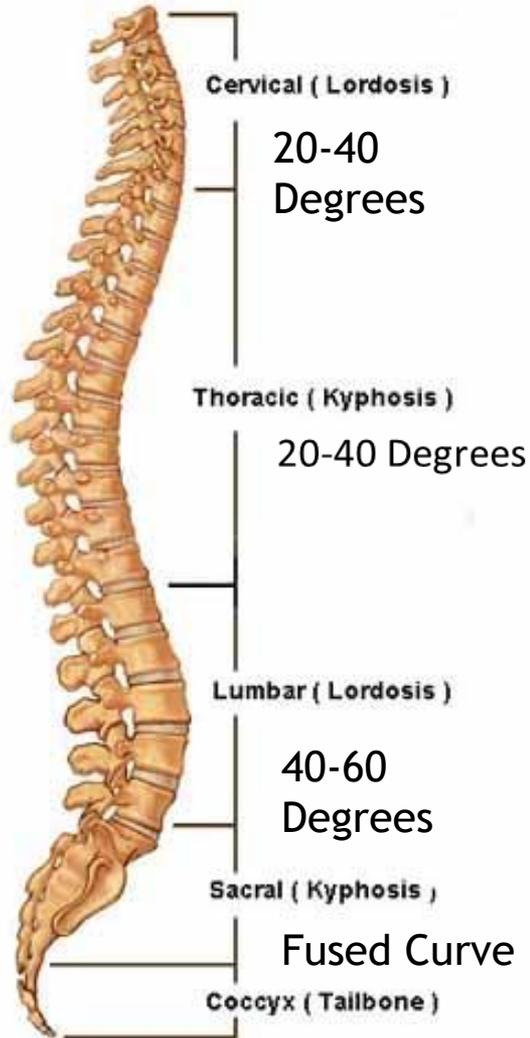
Definitions

Spinal Column

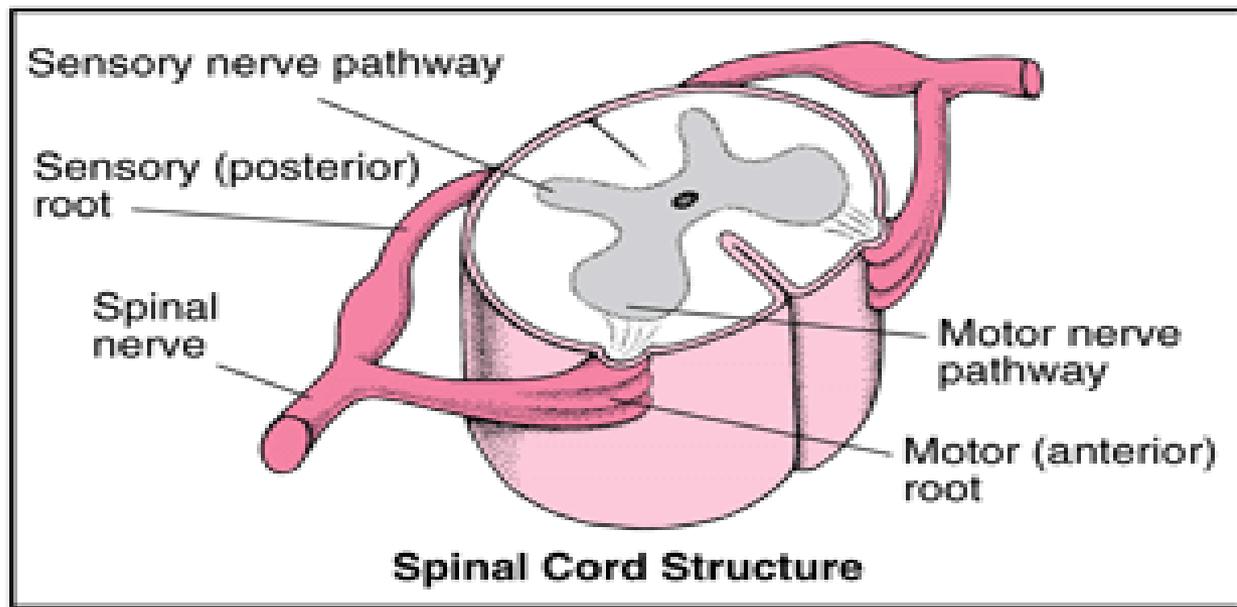
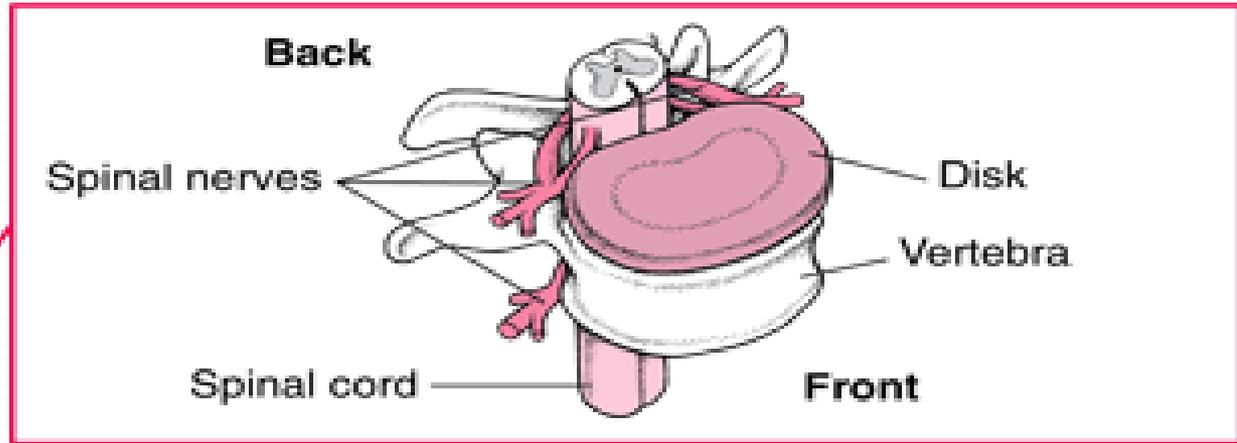
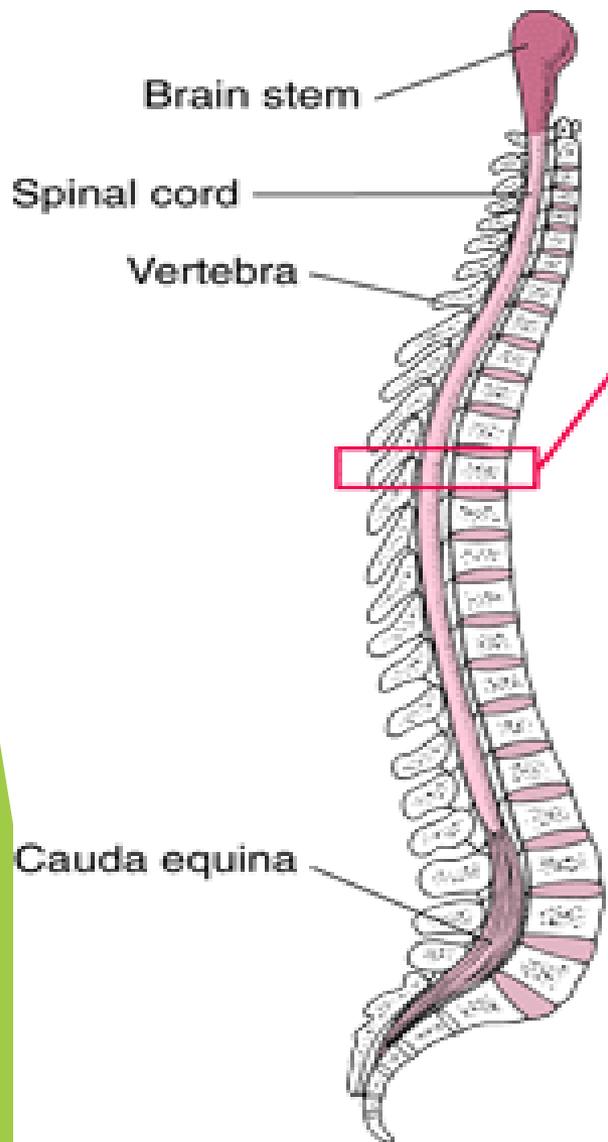


Spinal Normal Curvatures:

Lateral (Side) Spinal Column



Spinal Cord association with Spinal Column



Definitions

► Spinal Trauma can cause:

I. Spinal column fracture or dislocation

II. Cauda or Root injury

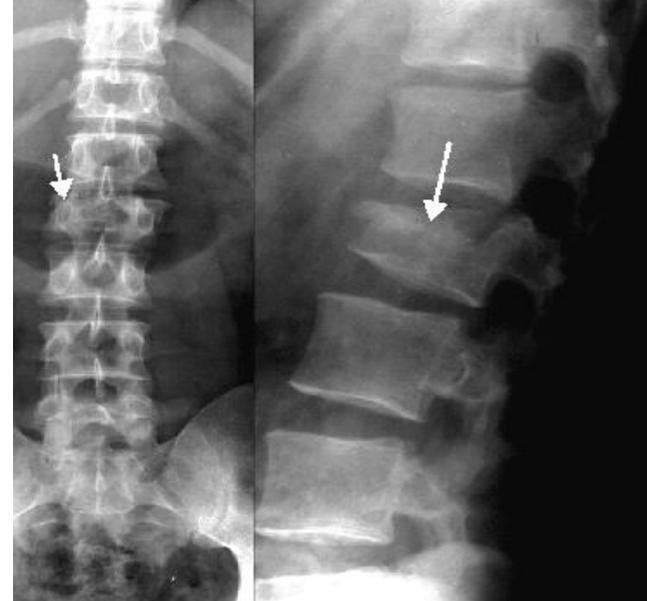
III. Cord injury



Spinal column fracture or dislocation

I. Pure uni-column fractures

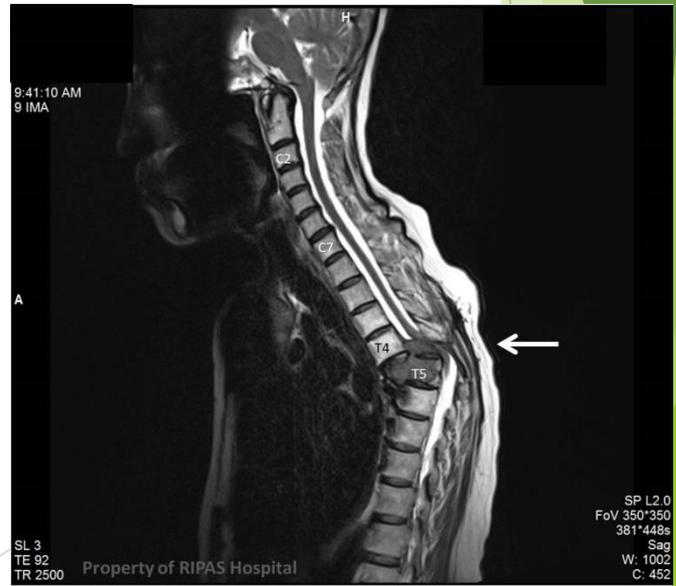
II. Two column fractures (Burst Fracture)



III. Dislocation with only ligamentous injury



on



- ▶ Injuries to the cranial cervical junction
 - ▶ are often missed
 - ▶ are associated with high mortality and instability
 - ▶ should be treated with a high index of suspicion.
- ▶ Traumatic atlantooccipital dislocation
 - ▶ extremely unstable injury
 - ▶ associated with a high rate of neurological damage
 - ▶ an increased risk for mortality
- ▶ Atlas fractures
 - ▶ commonly associated with other injuries, including odontoid fracture

Spinal cord injury

Definition of terms

- ▶ AIS: ASIA (American Spinal Injury Association) Impairment Scale:
 - ▶ five classifications A-E.
- ▶ Neurogenic shock:
 - ▶ hypotension because of bradycardia and vasodilation due to loss of **thoracic sympathetic innervation** following SCI.
 - ▶ Profound at level of T6 or above.
 - ▶ Most dramatic effects in **the first few weeks**
 - ▶ most patients stabilizing in **7-10 days**.

▶ Paraplegia:

- ▶ dysfunction of lower body, bowel & bladder due to SCI in the thoracic, lumbar, or sacral region.

▶ Quadriplegia (also referred to as tetraplegia):

- ▶ dysfunction of arms, legs, bowel & bladder due to SCI in the cervical region.

▶ Spinal shock:

- ▶ Temporary areflexic state with loss of autonomic control, and muscle tone below the level of the injury
- ▶ which lasts **up to six weeks after injury.**
- ▶ It usually occurs in spinal cord injury to **cervical & upper thoracic spinal cord.**
- ▶ Functional recovery may improve after spinal shock resolves.

Signs & symptoms of acute SCI

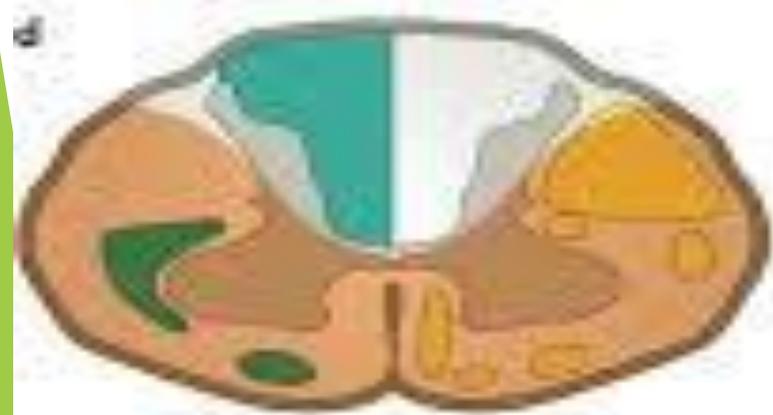
- ▶ Flaccid paralysis below level of injury
- ▶ Loss of spinal reflexes below level of injury
- ▶ Loss of sensation (pain, touch, proprioception, temperature) below level of injury
- ▶ Loss of sweating below level of injury
- ▶ Loss of sphincter tone and bowel & bladder dysfunction

Complete/incomplete injury

- ▶ A complete SCI
 - ▶ loss of all motor and sensory function below the level of injury (AIS A).
- ▶ An incomplete SCI
 - ▶ results in preservation of sensory function below the level of injury (AIS B),
 - ▶ Or a combination of varying degrees of sensory and motor preservation below the level of injury (AIS C or D)

Cause of injury

- ▶ transection, distraction, compression, bruising, haemorrhage, or ischaemia of the cord
- ▶ or by injury to blood vessels supplying it.
- ▶ Concussion of the spinal cord can result in temporary loss of function for hours to weeks.



POSTERIOR



4

ANTERIOR



3



NORMAL

BROWN -
SEQUARD



1

CENTRAL



2

Spinal cord injury

Complete cord injury

Complete loss of motor, sensory, proprioceptive below the injury level

Incomplete cord injury

Partial sensory preservation of motor or sensory function below the spinal cord injury
 Anterior, Central, Brown-Sequard, Posterior

Anterior cord syndrome

Mechanism: Flexion

Loss

- motor, sensory, proprioceptive below

Preserve

- proprioceptive and vibratory sensation

Central cord syndrome

Mechanism: Flexion hyperextension injury

Loss

- motor, sensory, pain, temperature, proprioception, vibration, touch, dorsal/ventral

Preserve

- sacral sparing

Brown-Sequard cord syndrome

Mechanism: Penetrating trauma

Loss

- ipsilateral loss of motor, proprioception, sensation, temperature, vibration, touch, dorsal/ventral, pain, temperature, vibration, touch, proprioception

Preserve

- ipsilateral motor, proprioception, temperature, vibration, touch, dorsal/ventral, sensation, vibration, sensation, proprioception

Posterior cord syndrome

Very rare

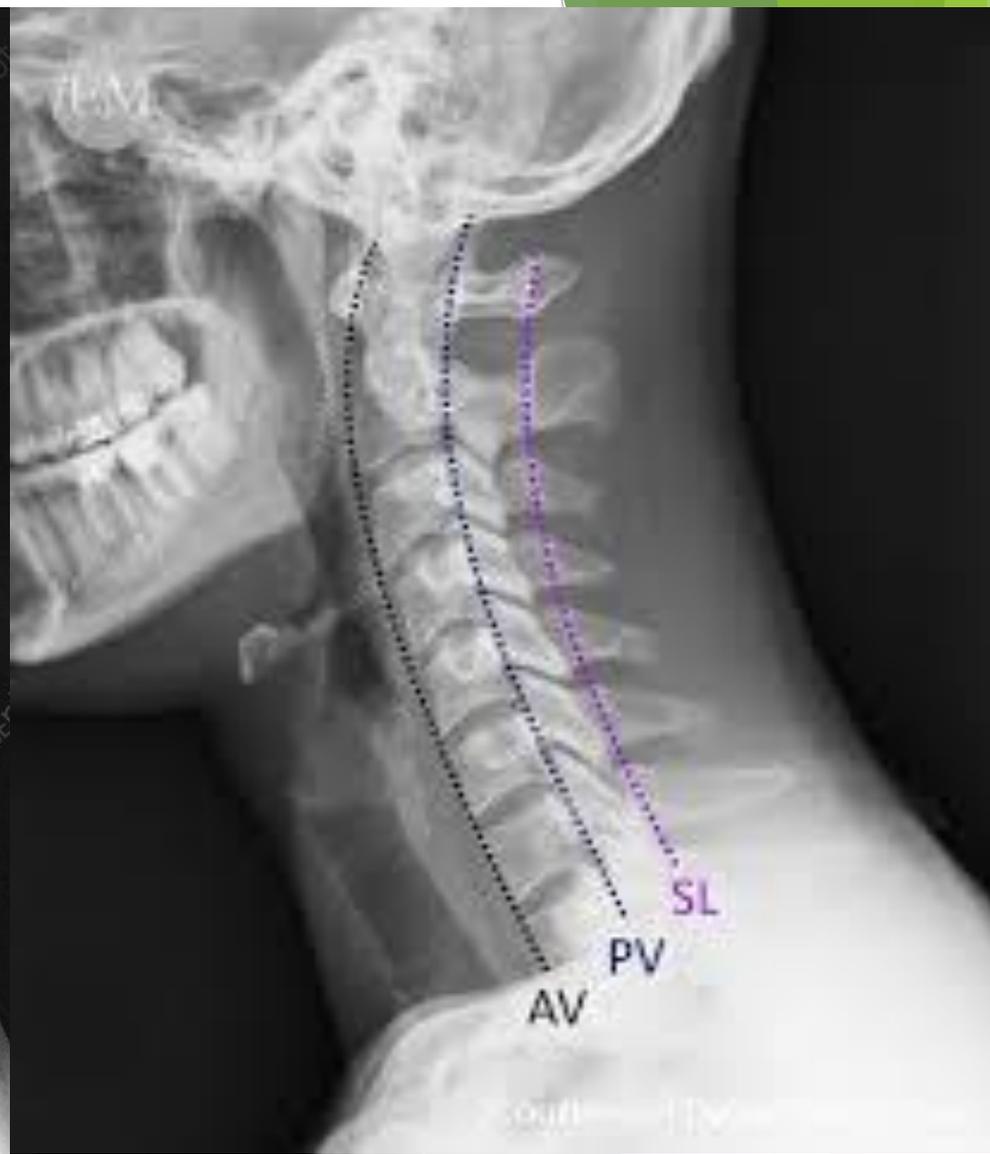
Loss

- sensory, proprioception, vibration, touch

Preserve

- pain, light touch, temperature

تشخیص آسپ
تروماتیک ستون
فقرات





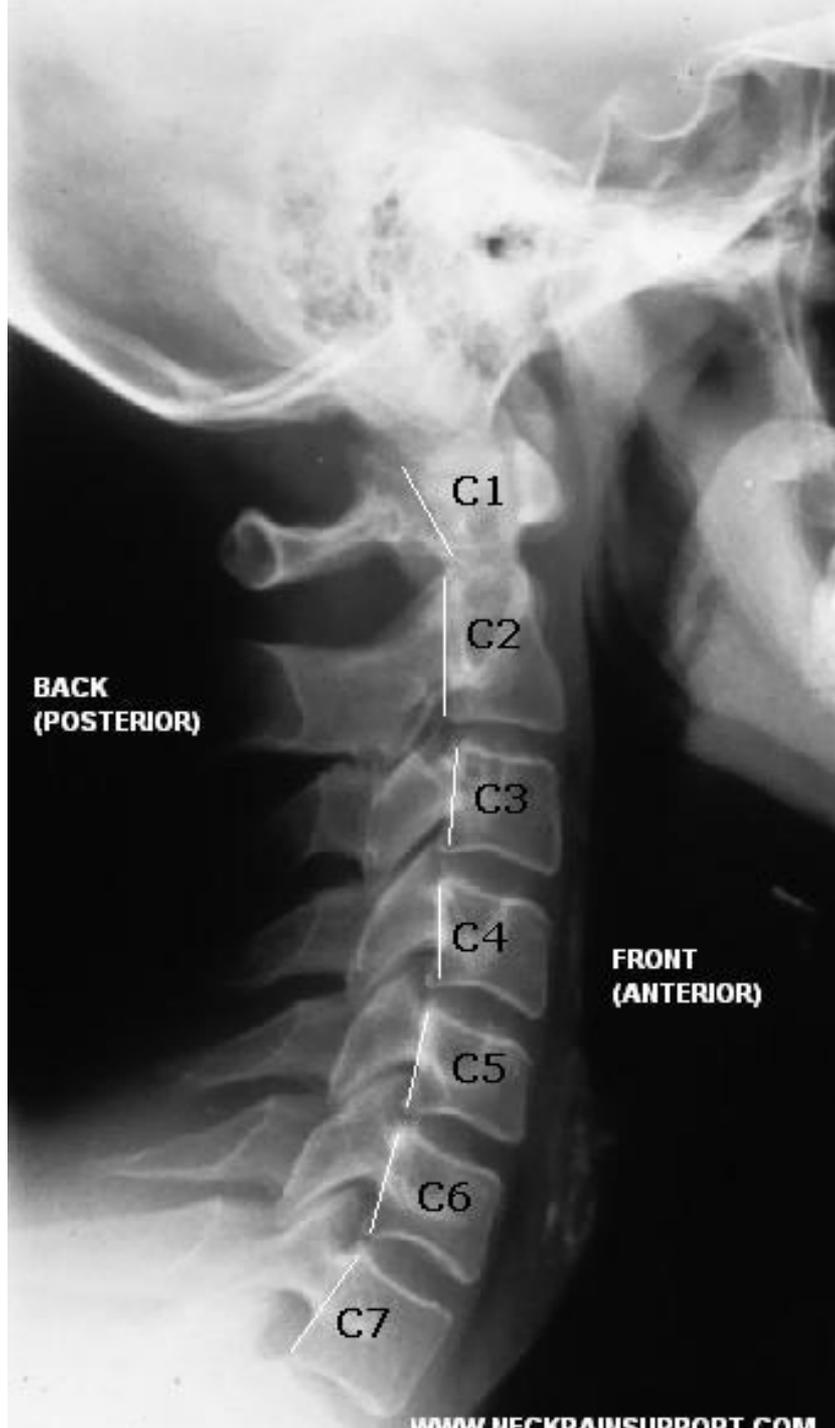




Figure 1



Figure 2

Bone Integrity

Fracture/cortical buckling

Disrupted posterior vertebral body line

Anterior wedging

Disrupted C2 ring ("fat" C2 sign)

Soft Tissue

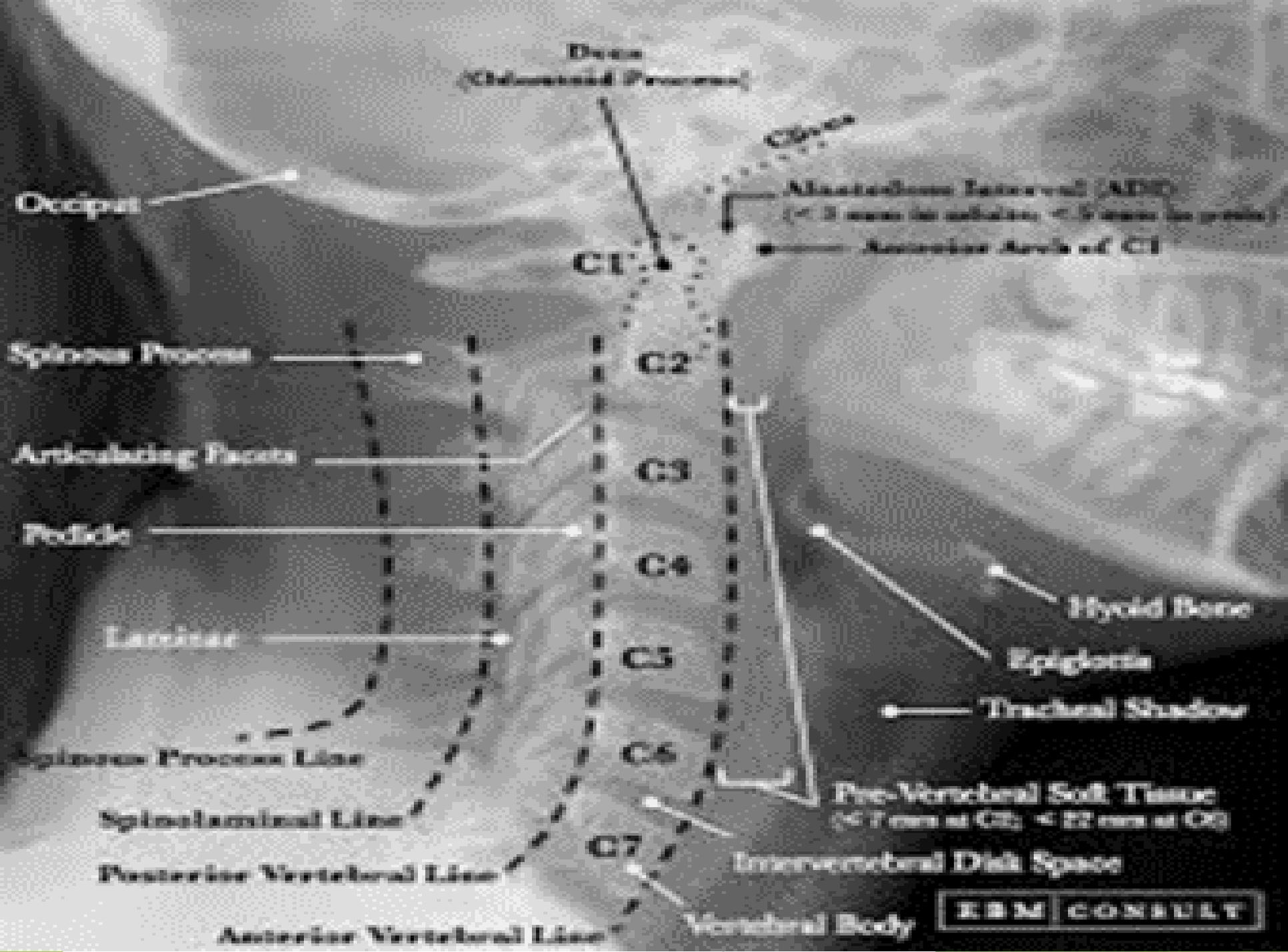
widened prevertebral space

Displaced prevertebral "fat" strip

Vacuum disc phenomenon

Deviated airway





Dens
(Odontoid Process)

Clivus

Occiput

Atlantoaxial Interval (ADI)
(≈ 2 mm for children, ≈ 3 mm for adults)

Anterior Arch of C1

C1

Spinosus Process

C2

Articulating Facets

C3

Pedicle

C4

Laminae

C5

Spinosus Process Line

C6

Spino-laminar Line

C7

Posterior Vertebral Line

Anterior Vertebral Line

Hyoid Bone

Epiglottis

Tracheal Shadow

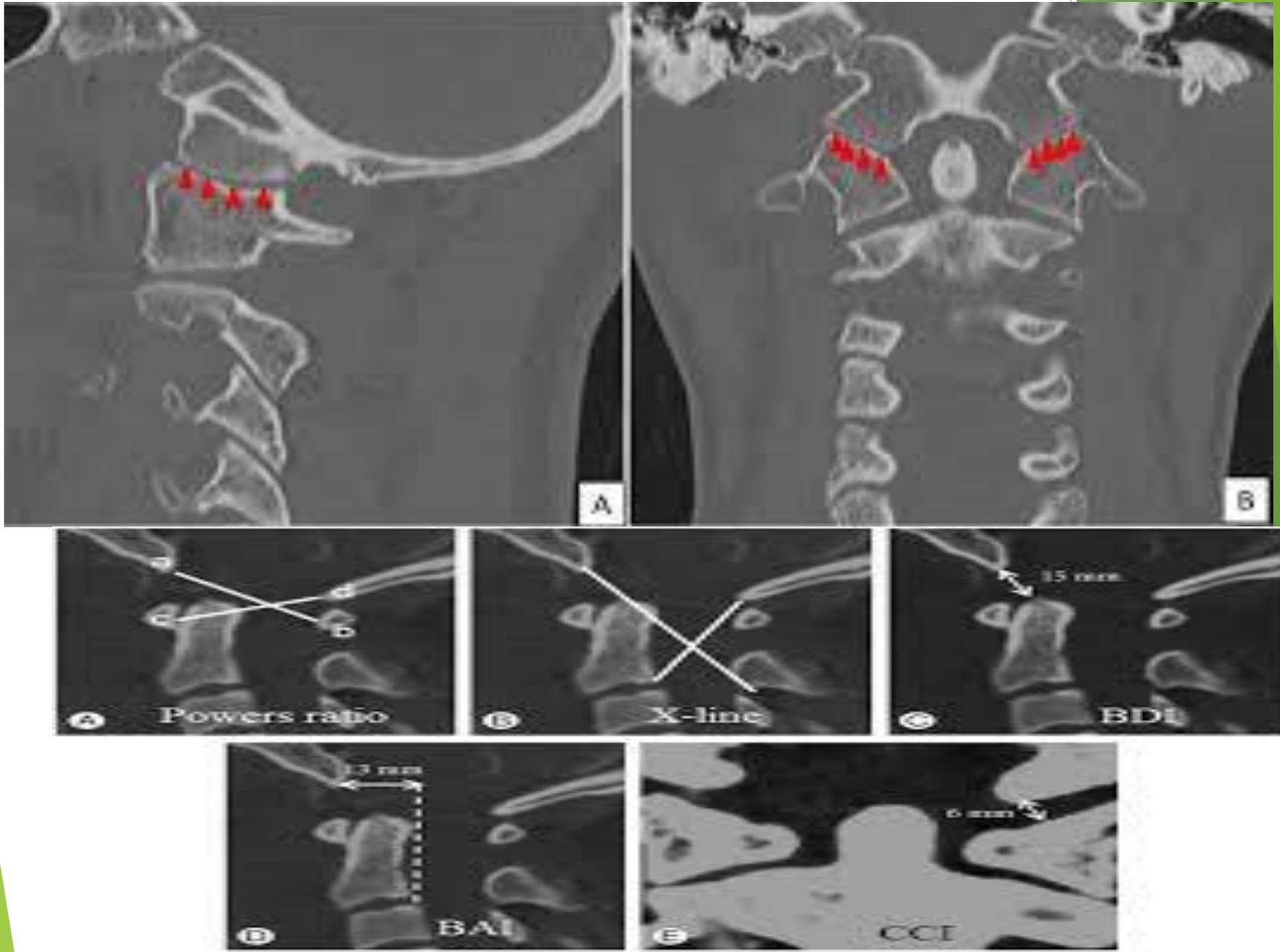
Pre-Vertebral Soft Tissue
(≤ 7 mm at C6; ≤ 22 mm at C7)

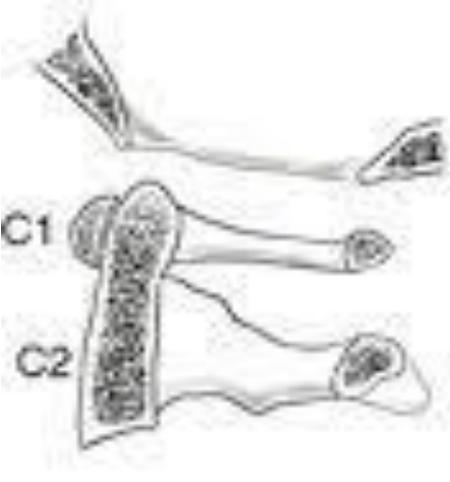
Intervertebral Disk Space

Vertebral Body

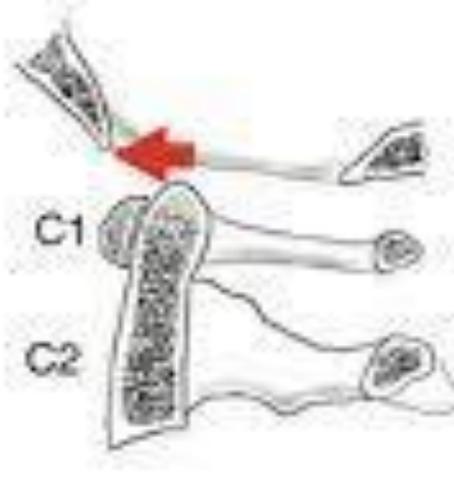
IBM CONSULT

Occipitoatlantal Dislocation

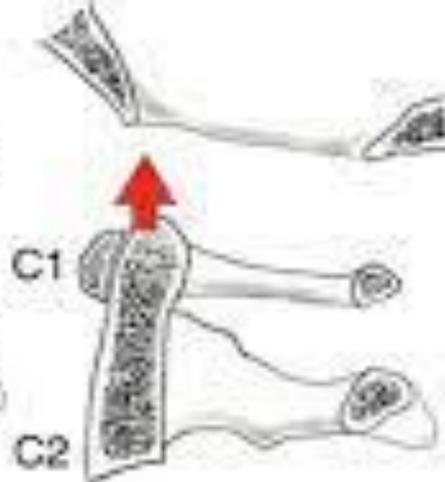




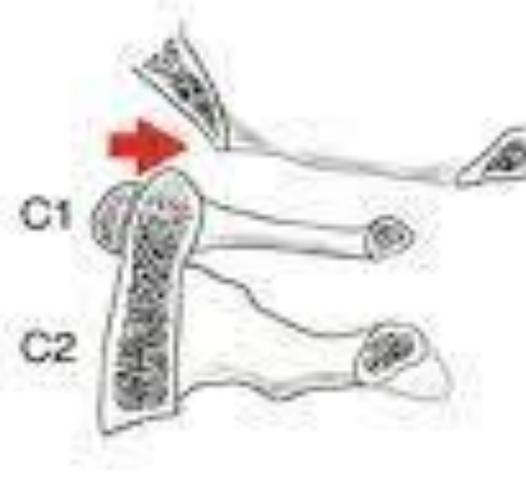
Normal



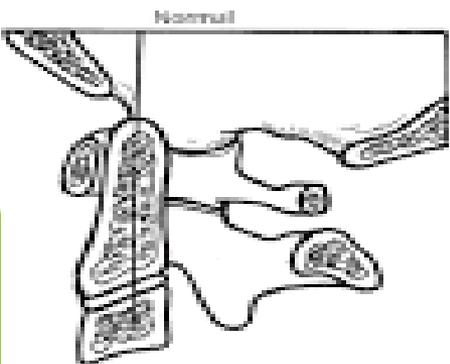
Type I
Anterior dislocation



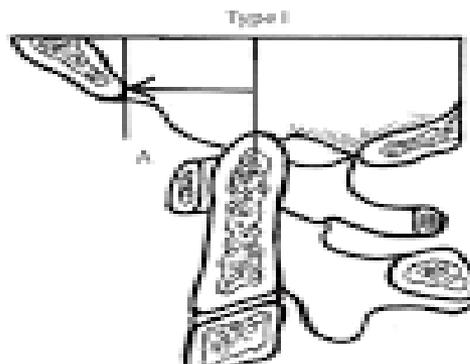
Type II
Longitudinal distraction



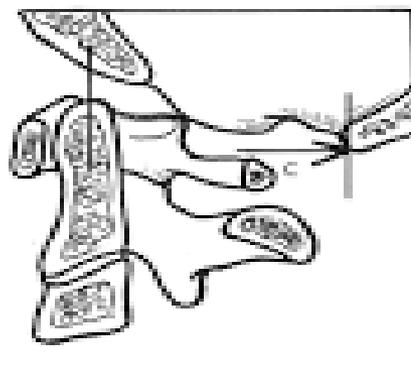
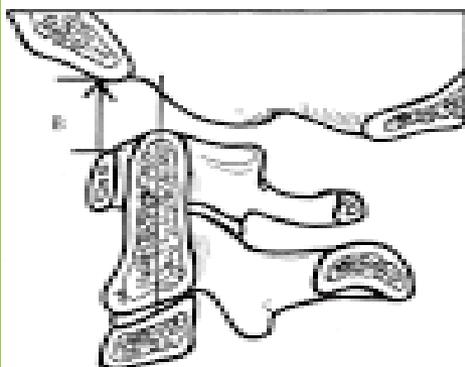
Type III
Posterior Displacement



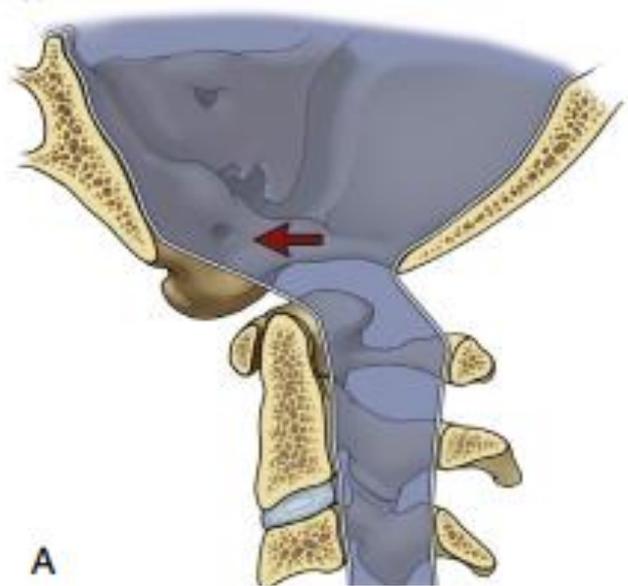
Type II



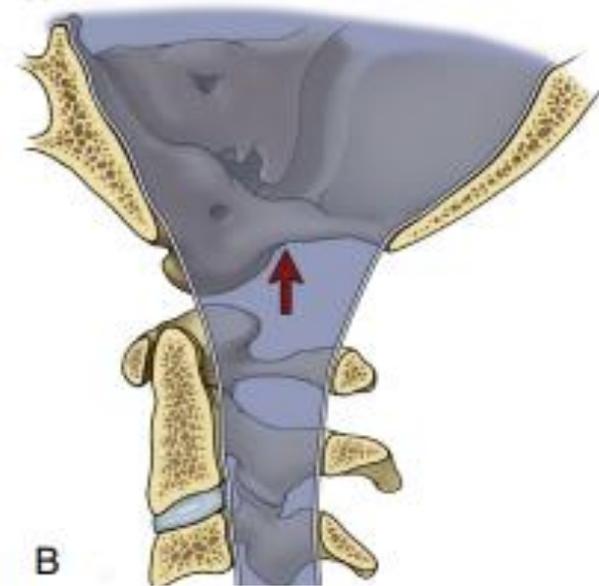
Type III



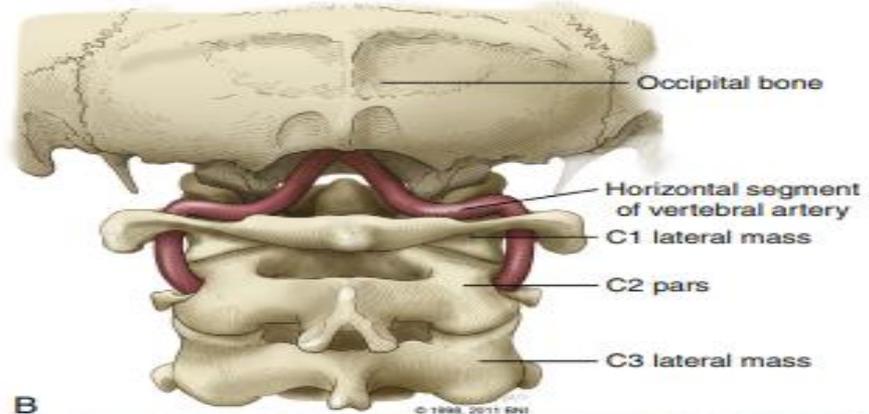
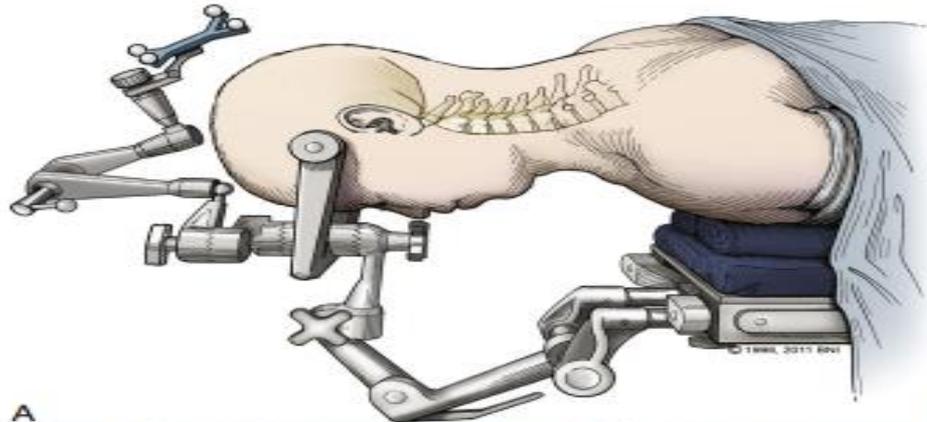
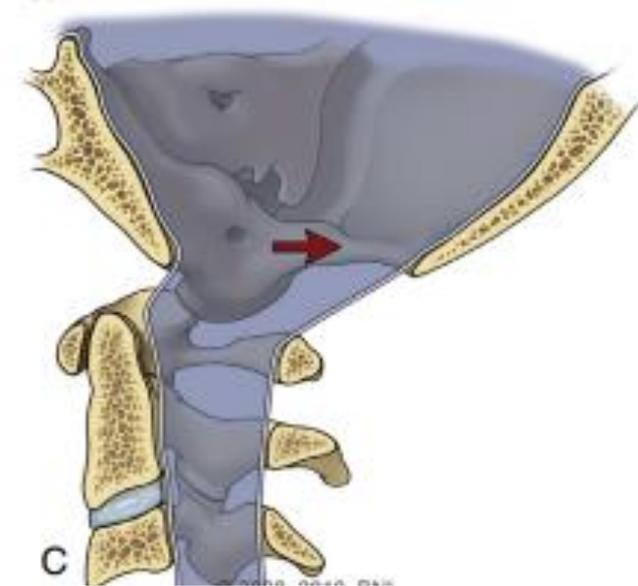
Type I



Type II

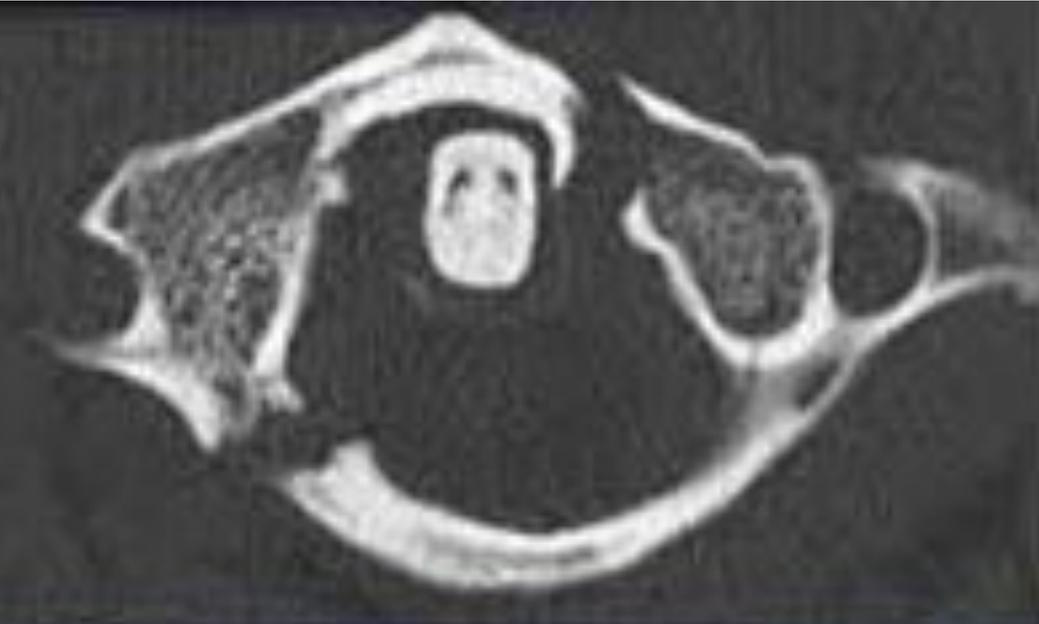


Type III





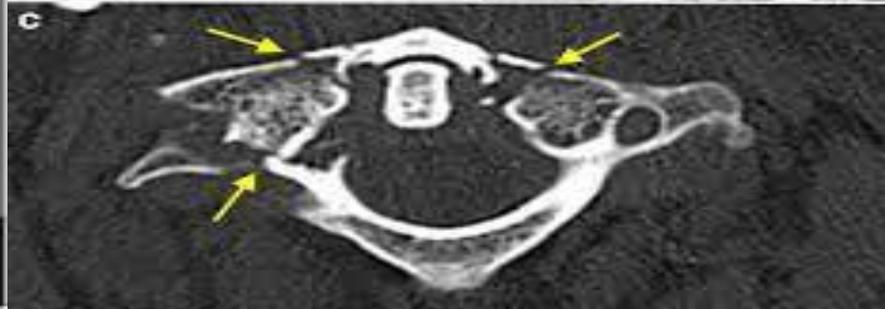
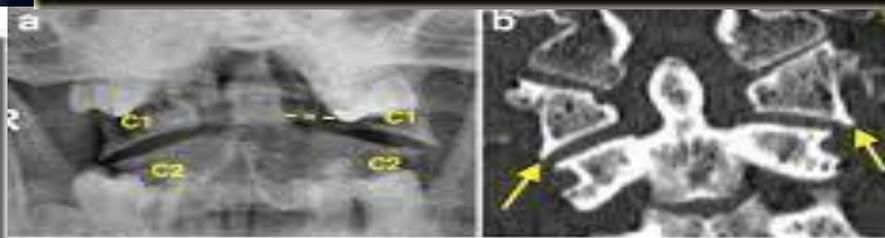
C1 FX



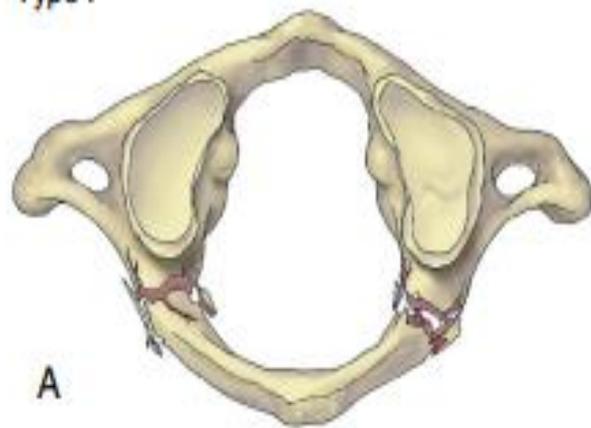
Jefferson Fracture



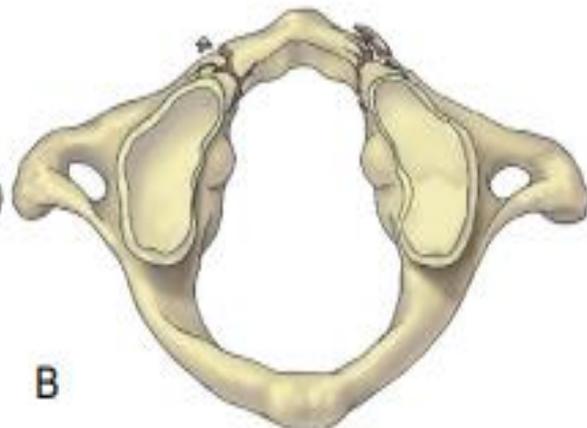
Jefferson fracture



Type I

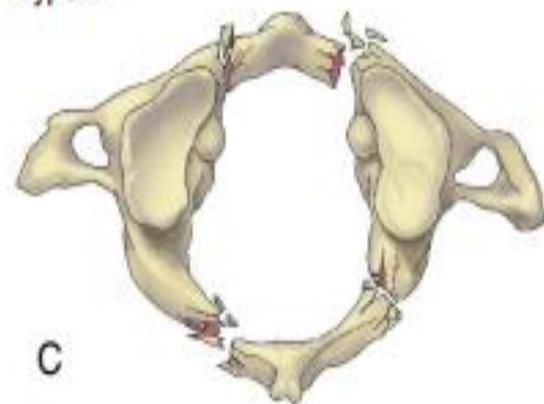


A

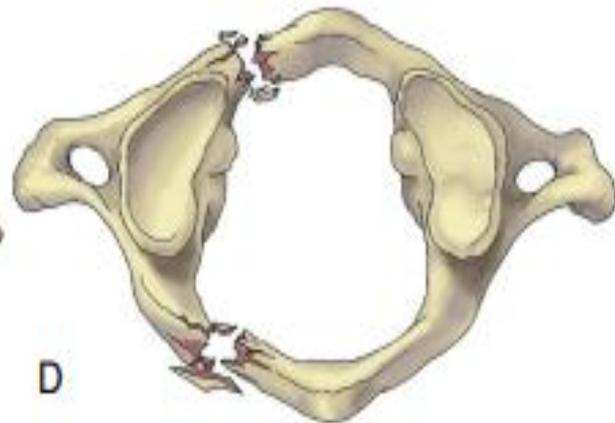


B

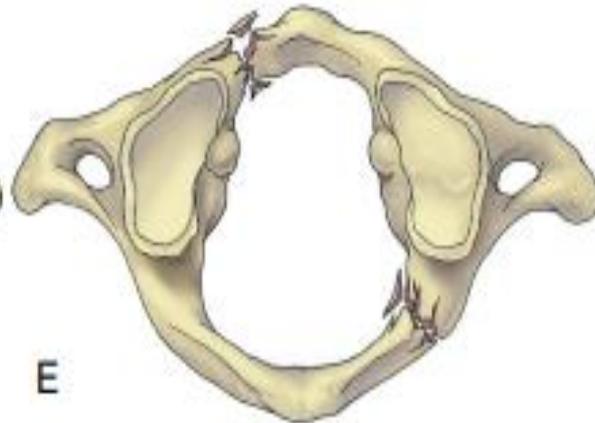
Type II



C

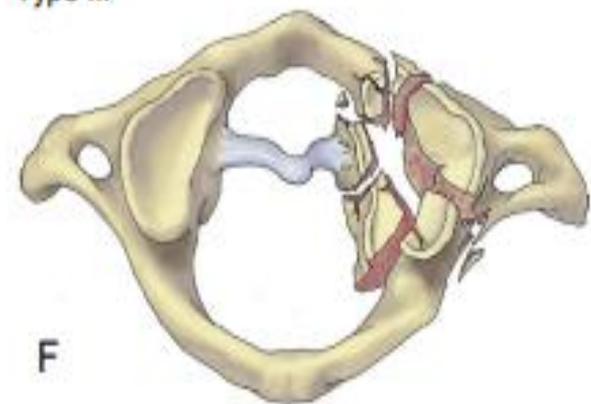


D

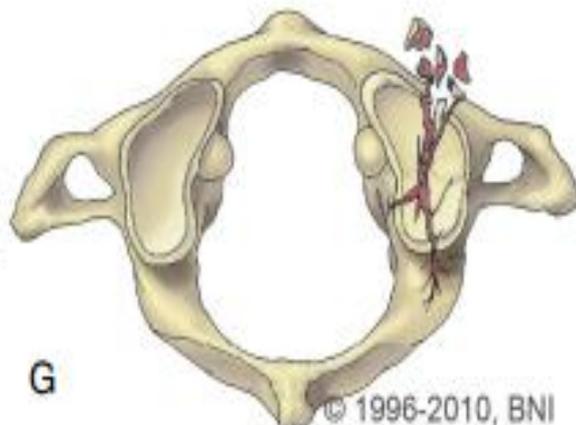


E

Type III



F



G

C2 FX

Odontoid fracture classification



Type I :

Fracture of the upper part of the odontoid peg ; it's rare and potentially unstable

Type II :

Fracture at the base of the odontoid ; unstable, and has a high risk of non-union

Type III :

Through the odontoid and into the lateral masses of C2 ; best prognosis for healing

Hangman's Fracture (traumatic spondylolisthesis of the axis)

C2

Hangman's fracture is a bilateral fracture of the pars Interarticularis.



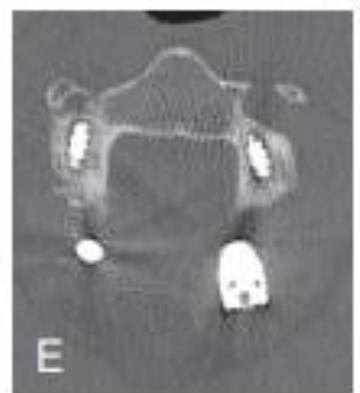
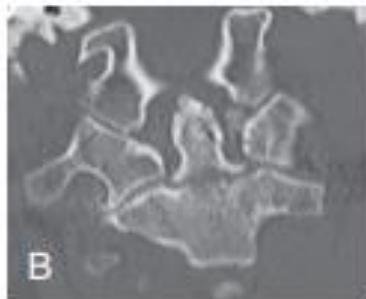


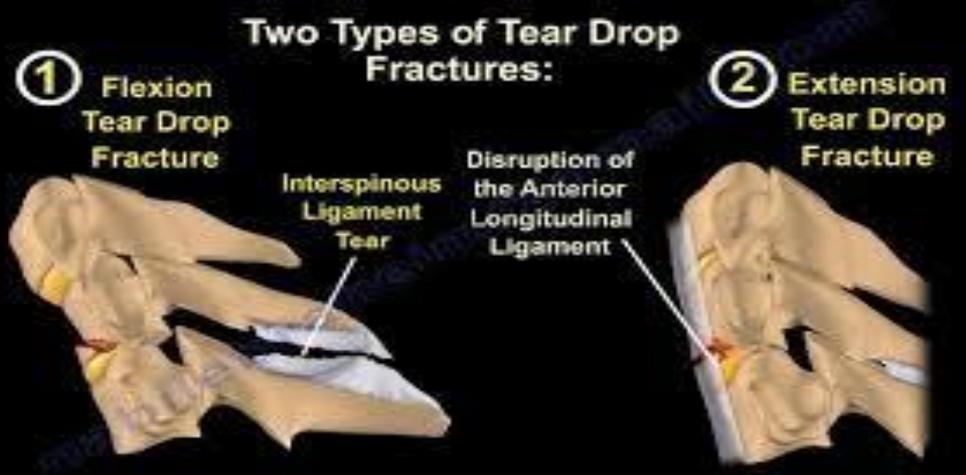


Figure 339.7. Hangman's fracture. (A) Sagittal computed tomography displaying hangman's fracture. (B)

Subaxial Cervical (C3-C7) Injuries



tear drop fx



clay shoveler fracture



cervical burst fracture



unilateral facet lock



Disrupted



Perched



Locked



FIG. 5

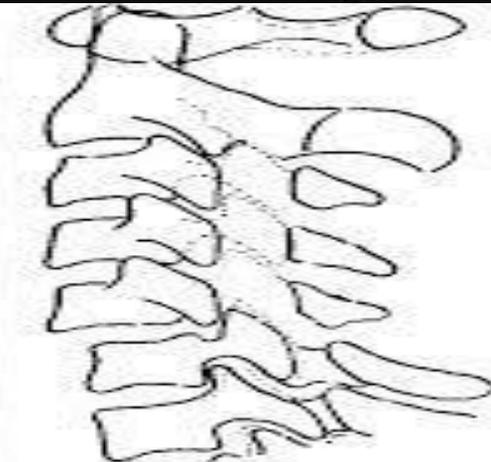


FIG. 6

bilateral facet lock

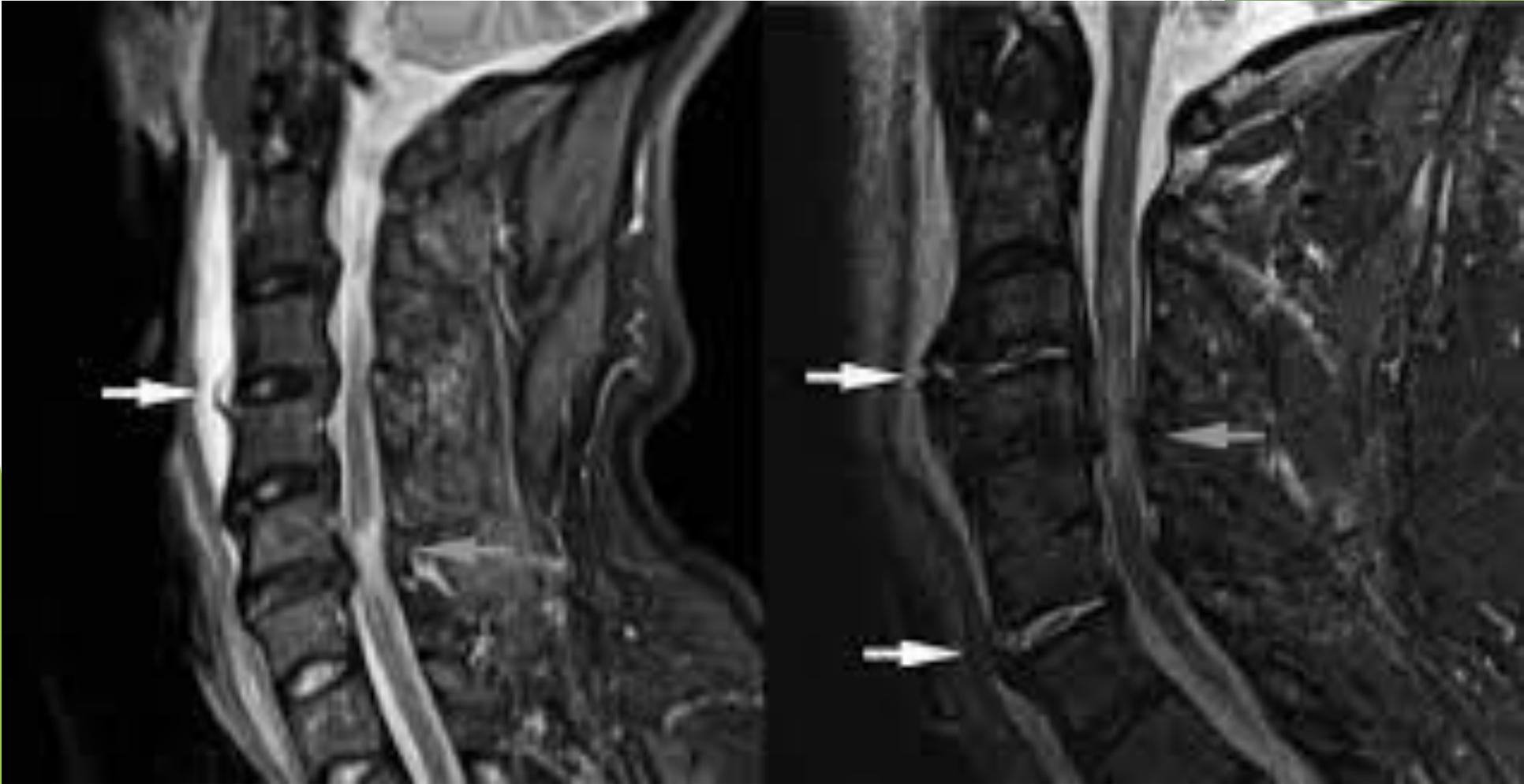


cervical fracture dislocation





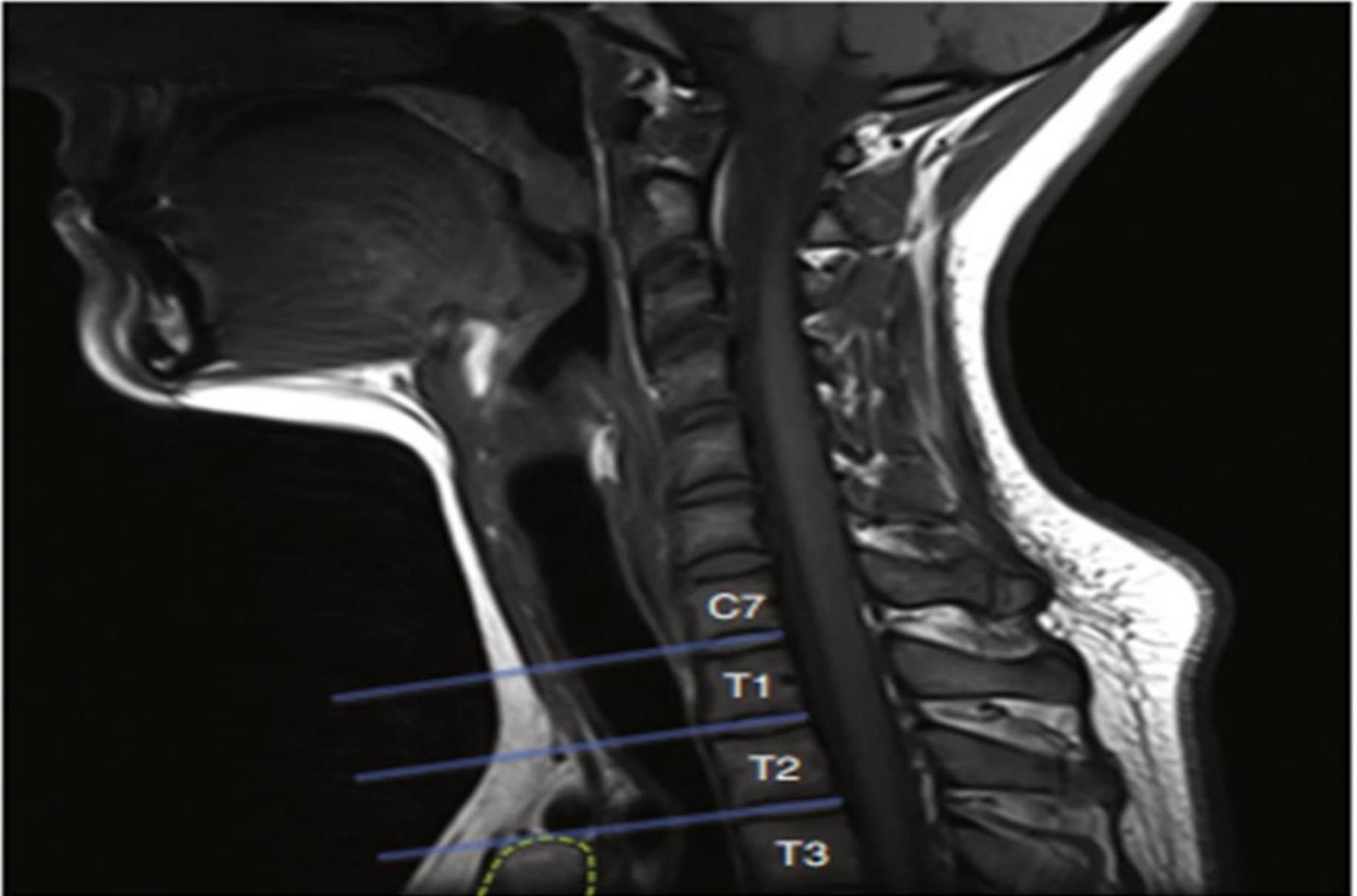
Trauma to the stenotic







Cervicothoracic Junction Injuries





Thoracic FX



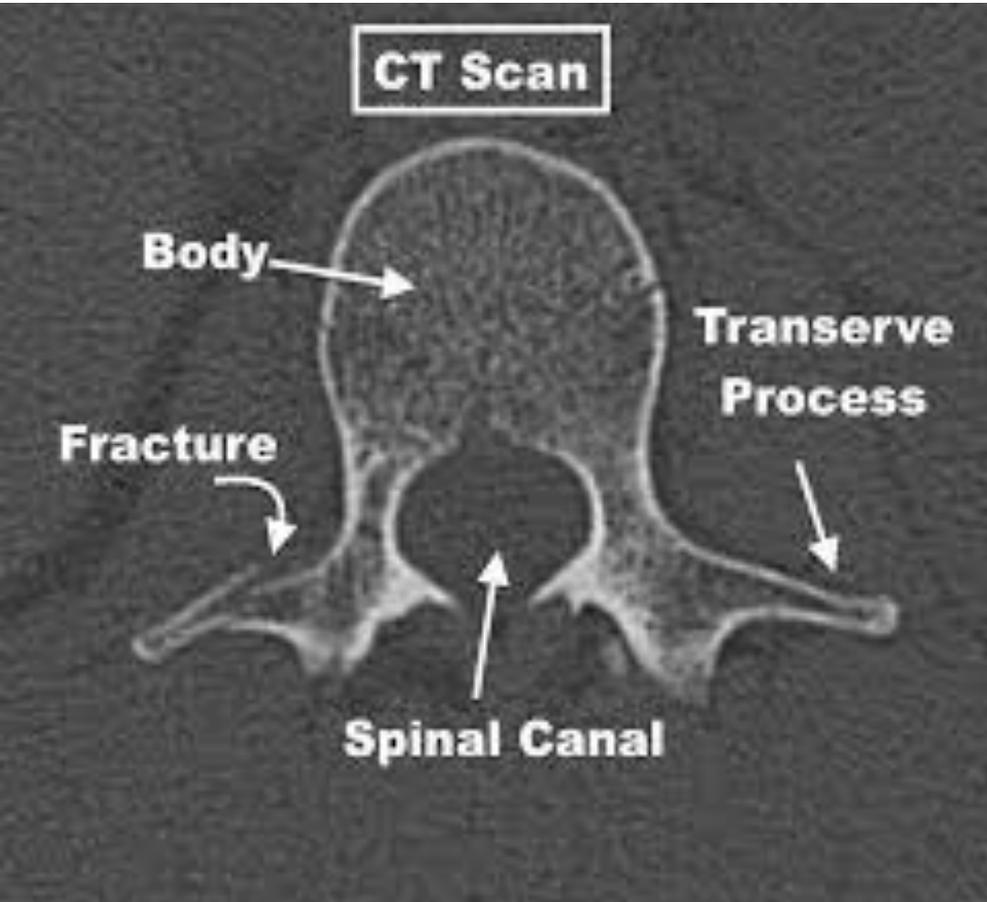




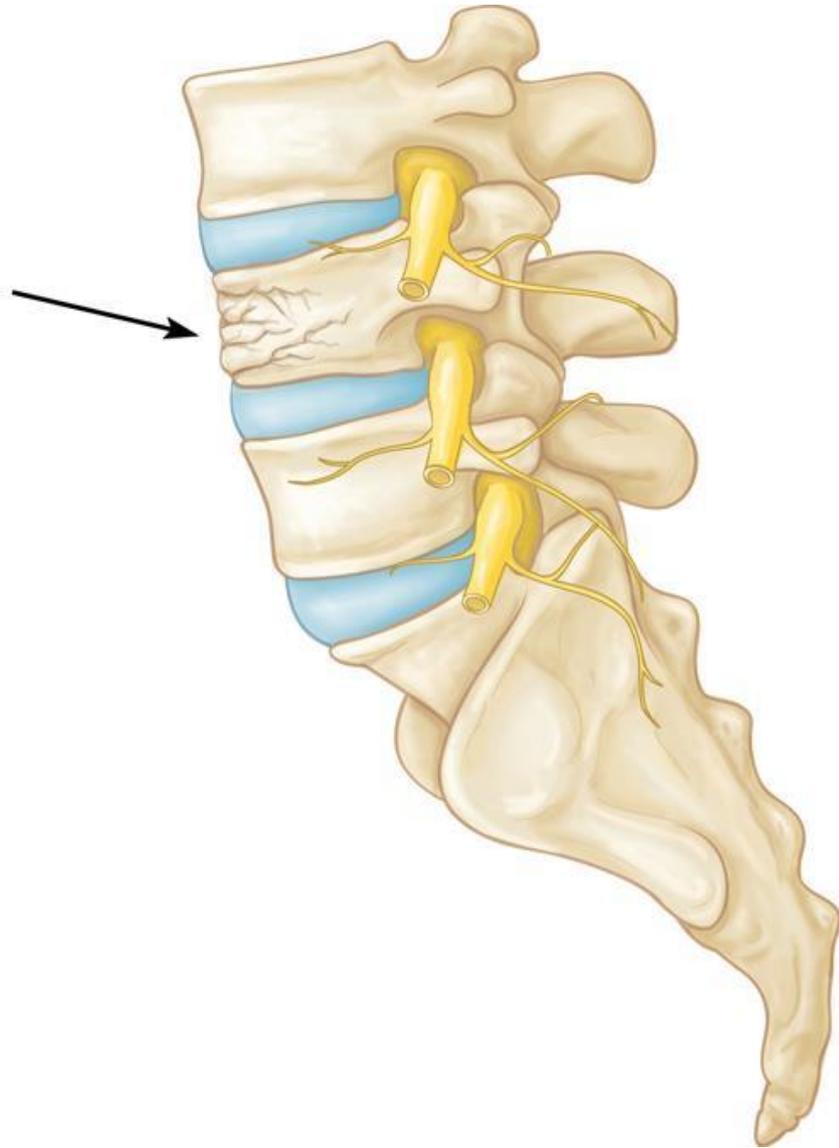
Lumbar Fx

The slide features a white background with the text 'Lumbar Fx' in a green, sans-serif font. On the right side, there are several overlapping, semi-transparent green geometric shapes, including triangles and polygons, creating a modern, abstract design.

Transverse Process Fracture

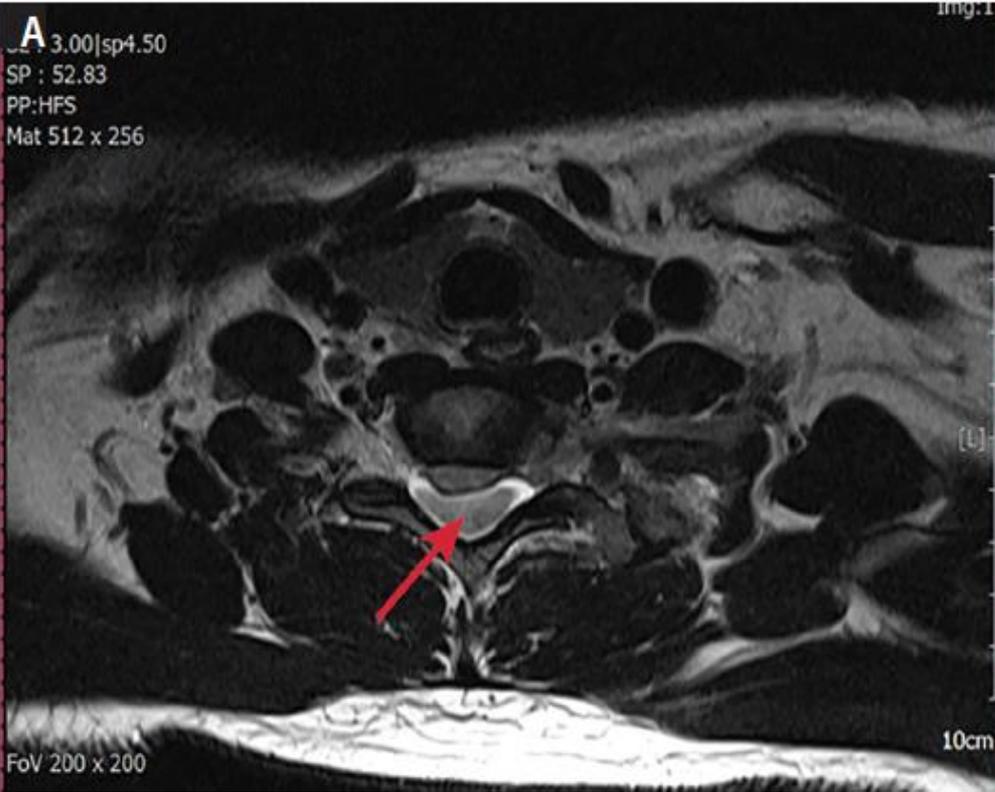






Others

Spinal EDH



Hyperflexion Sprain: MRI



Signs and Symptoms

► Spinal Trauma can cause:

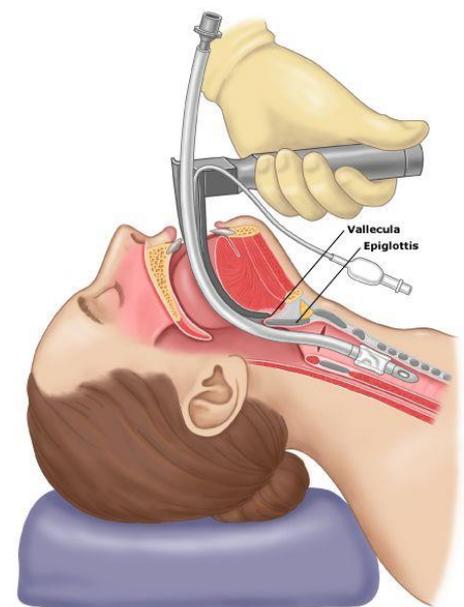
- I. Pain
- II. Deformity
- III. Plegia
- IV. Paresis
- V. Sensory level
- VI. Sphincter disturbance
- VII. Sexual dysfunction
- VIII. Respiratory dysfunction
- IX. Cardiac dysfunction

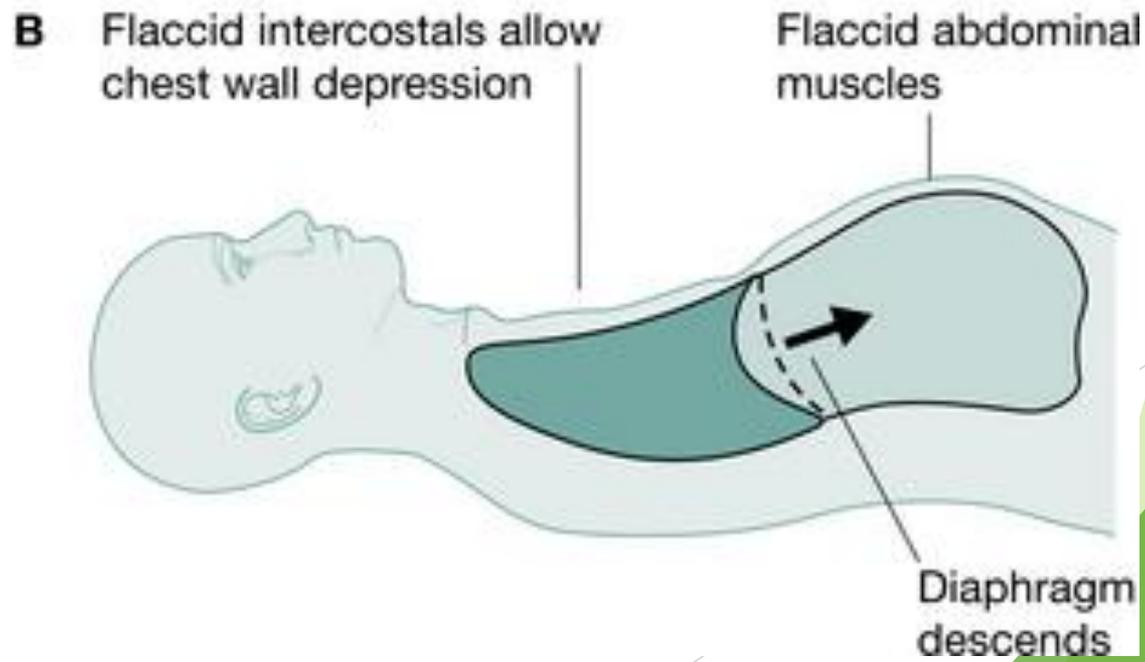
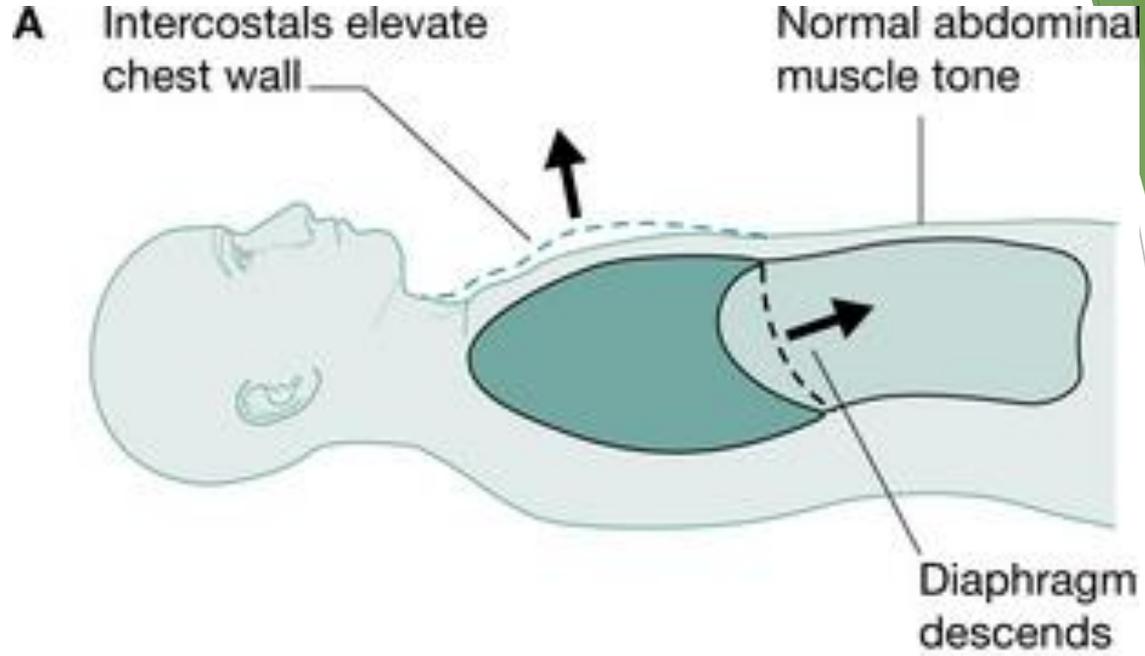


Signs and Symptoms

▶ Cervical spine trauma can cause:

- I. Respiratory Failure due to intercostal muscle palsy (cord injury below C4)
Abdominal respiration →
- II. Respiratory Arrest due to phrenic nerve palsy concomitant with intercostal muscle palsy (cord injury at C4 level and above it)
- III. Both above conditions need Intubation, urgently or as soon as possible





Precautions

- ▶ In cases of Spinal Trauma, we must do:
 - I. Use external fixator (Brace or collar)
 - II. Minimal displacement (Intubation)
and only transferring with
Backboard.
 - III. Multiple intermittent exam
of vital signs and limbs forces



IV. Deep Vein Thrombosis Prophylaxis (Drug or Devices)



V. Bladder training in cases of spinal cord injury and in the postoperative period (Foley clamped-off)



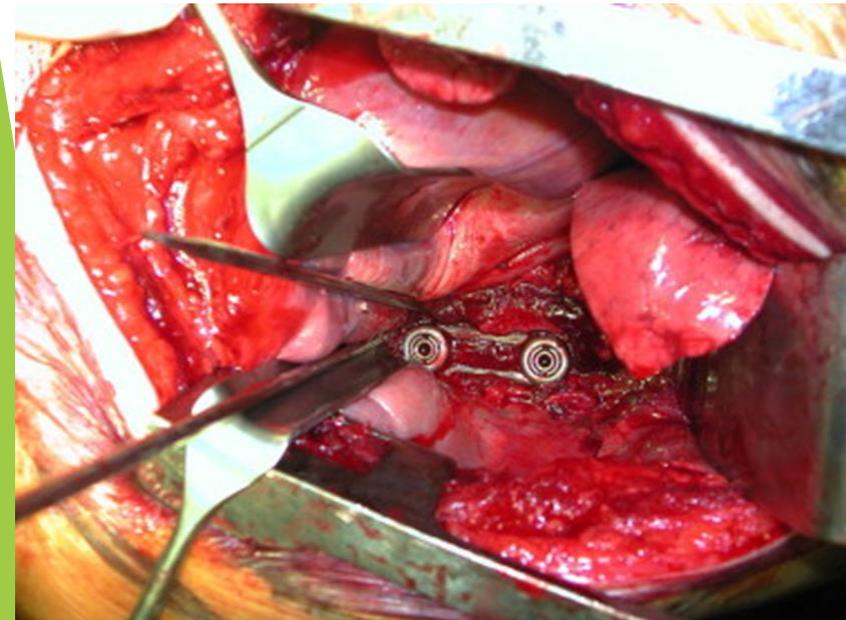
VI. Physical Therapy in Cases of cord injury and in the postoperative period



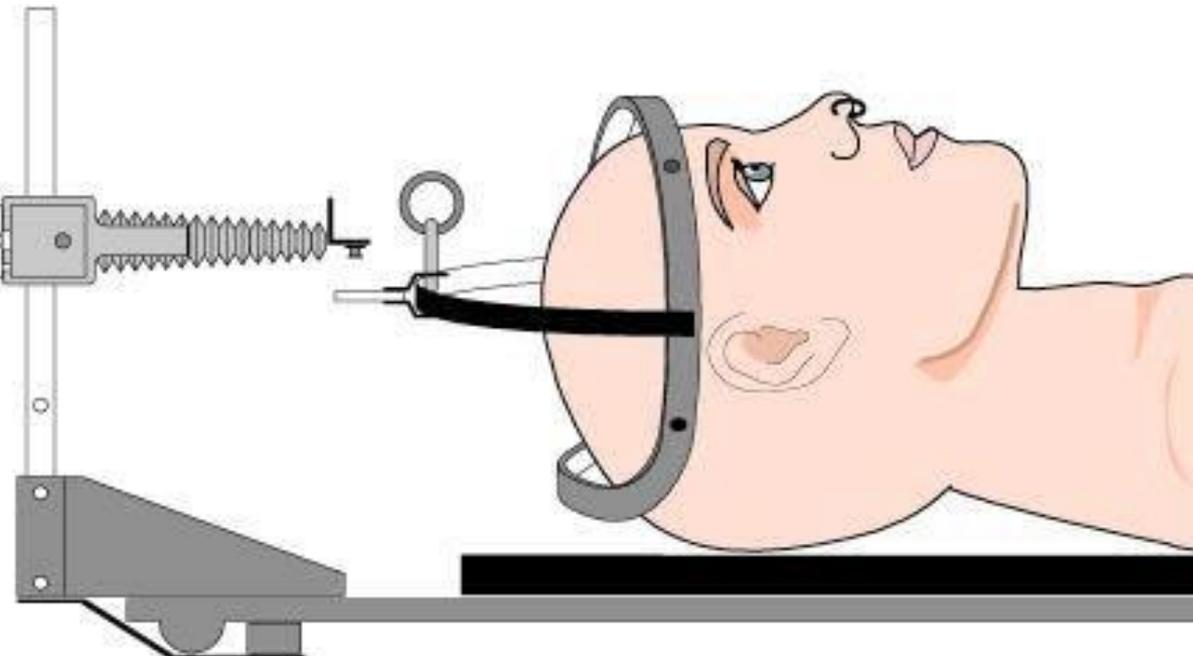
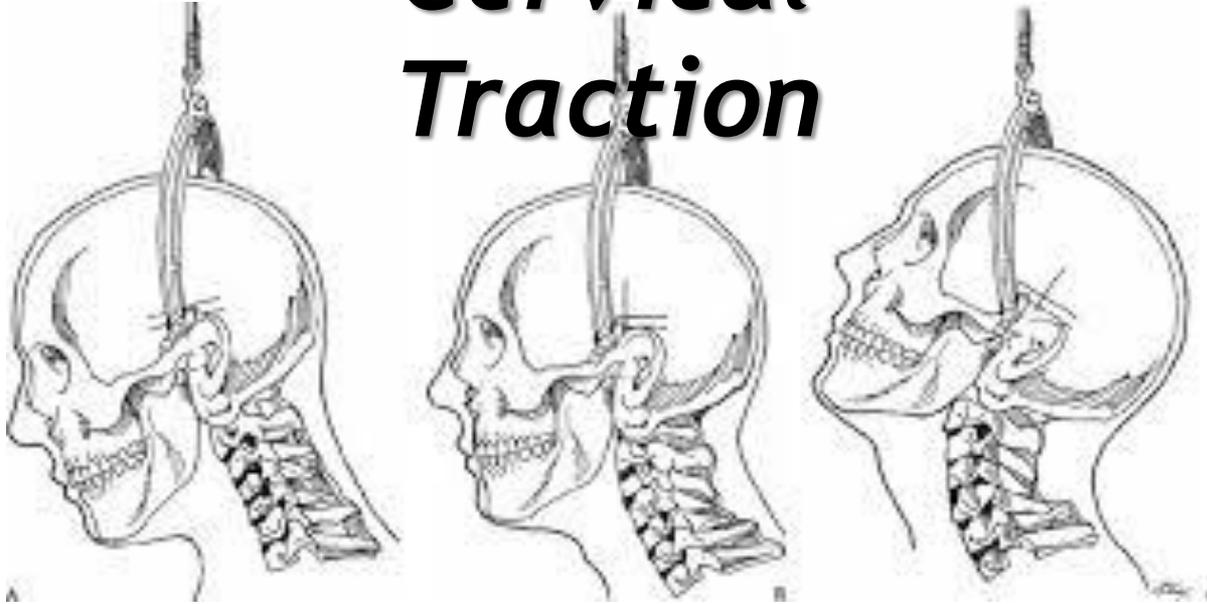
Treatment

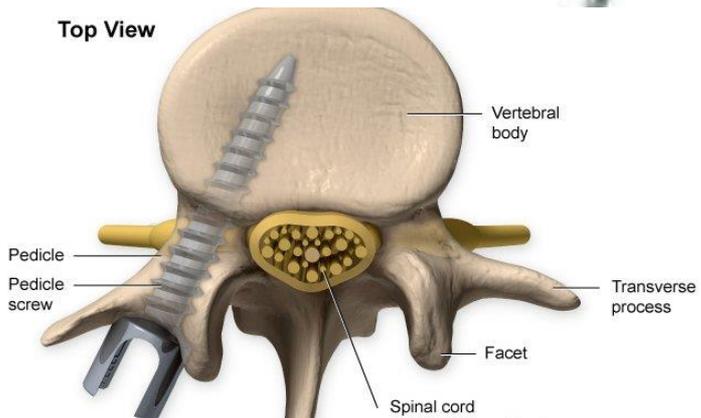
► Treatment options are:

- I. Conservative
- II. Surgical



Cervical Traction

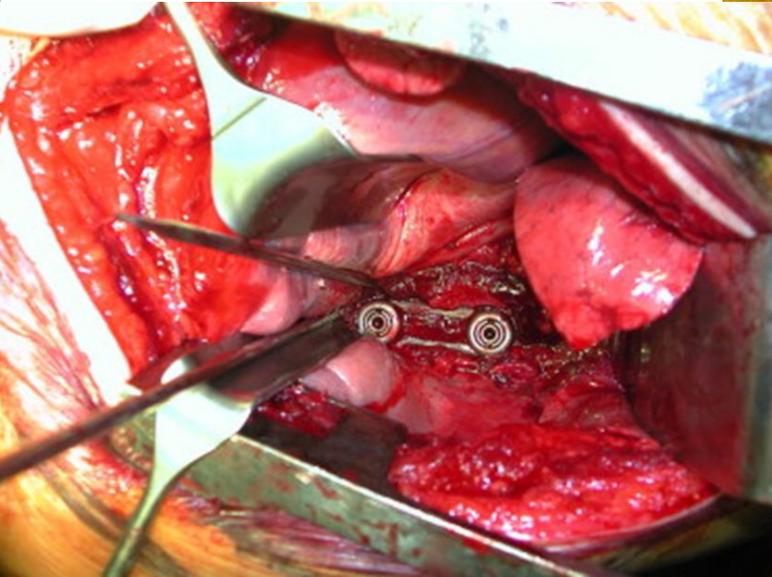
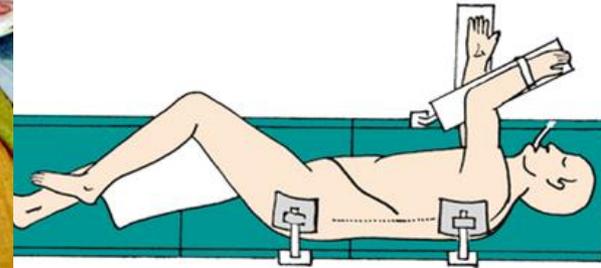
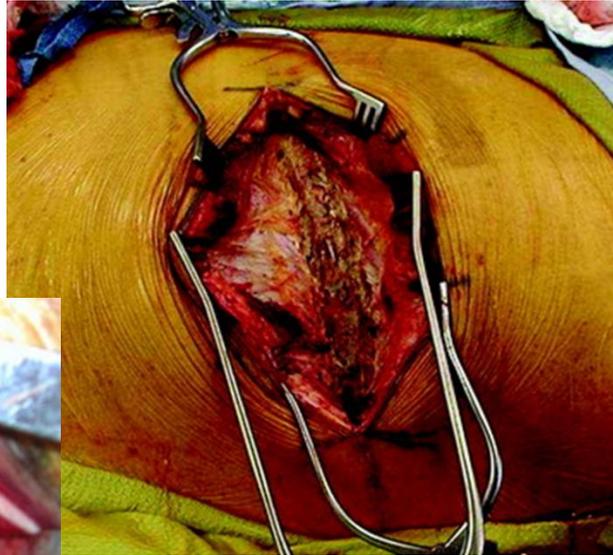
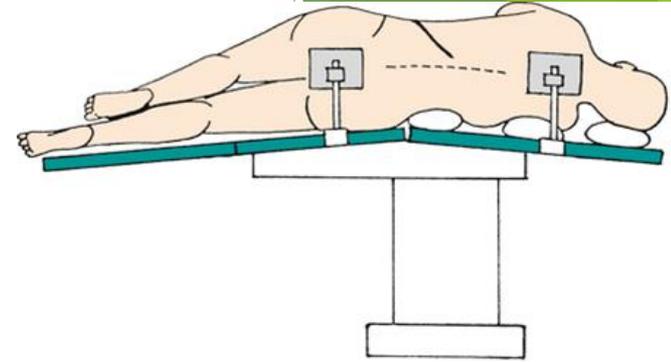


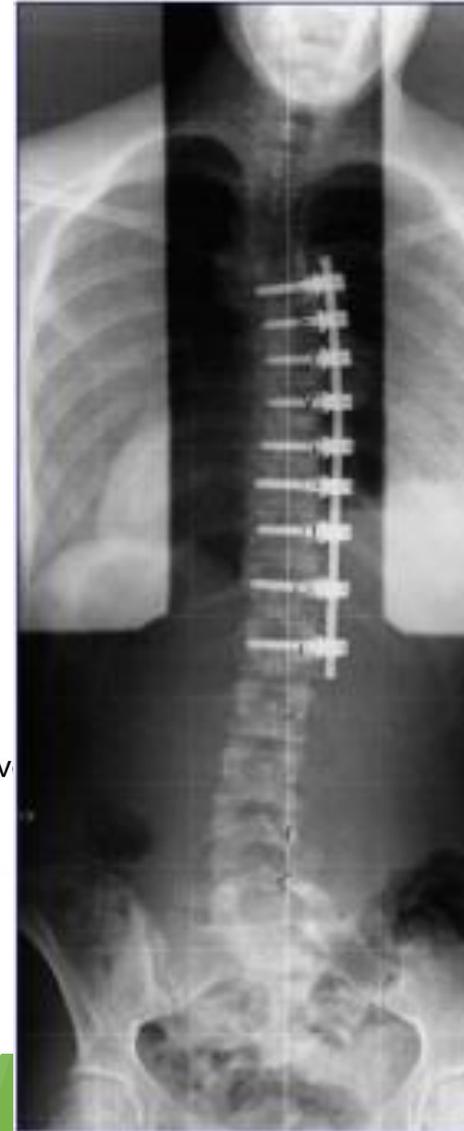
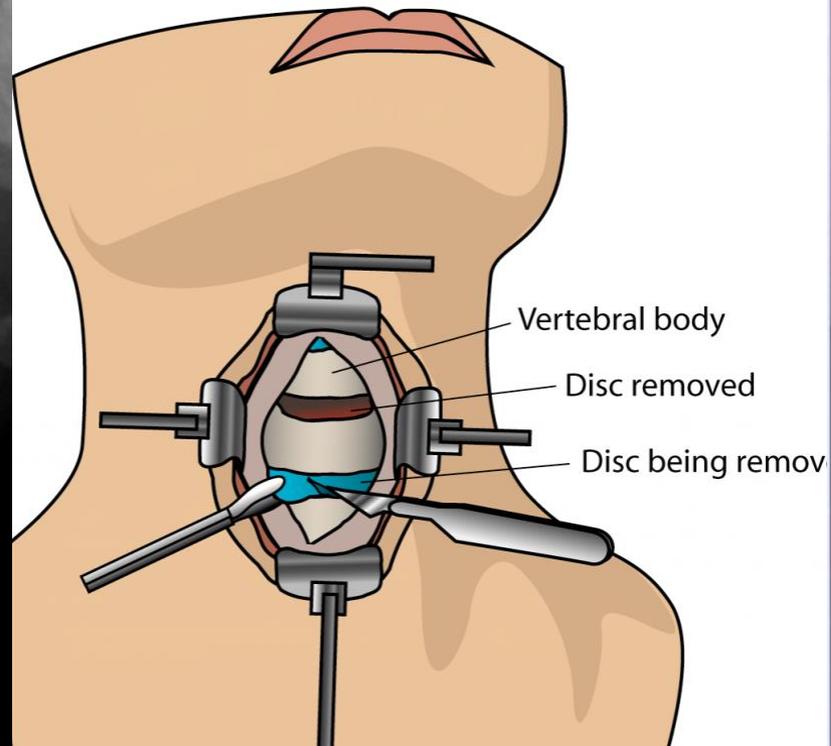


Treatment

► Surgical treatment:

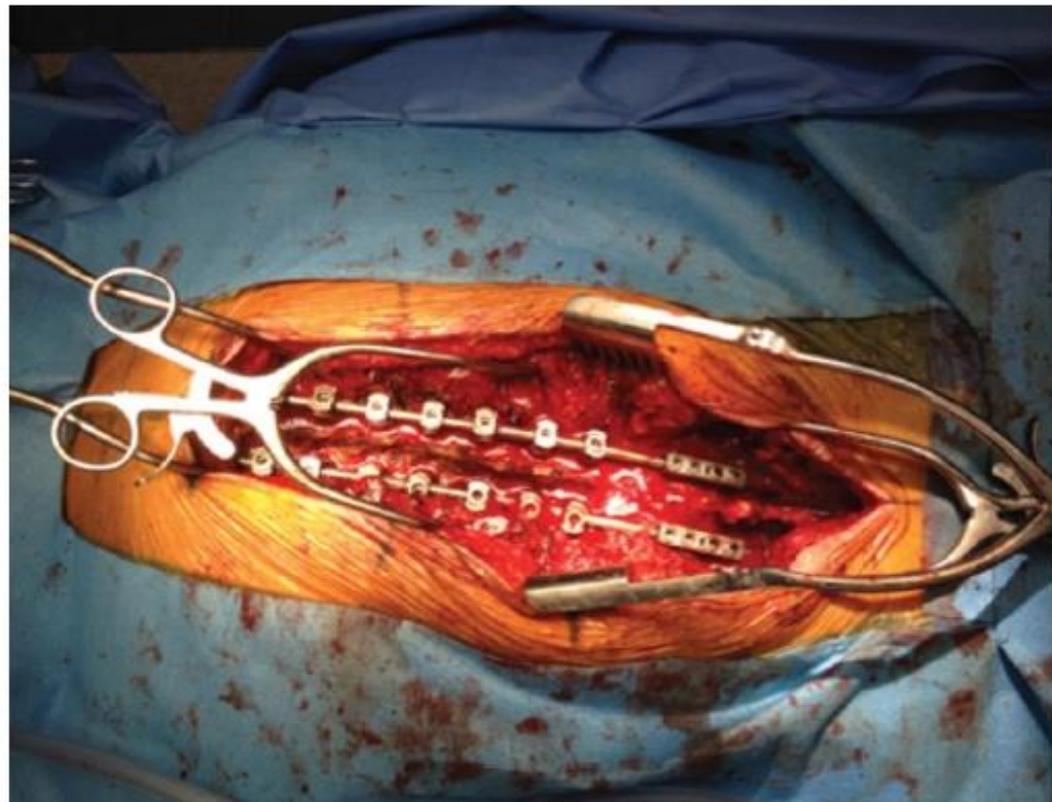
1) Anterior Approach:

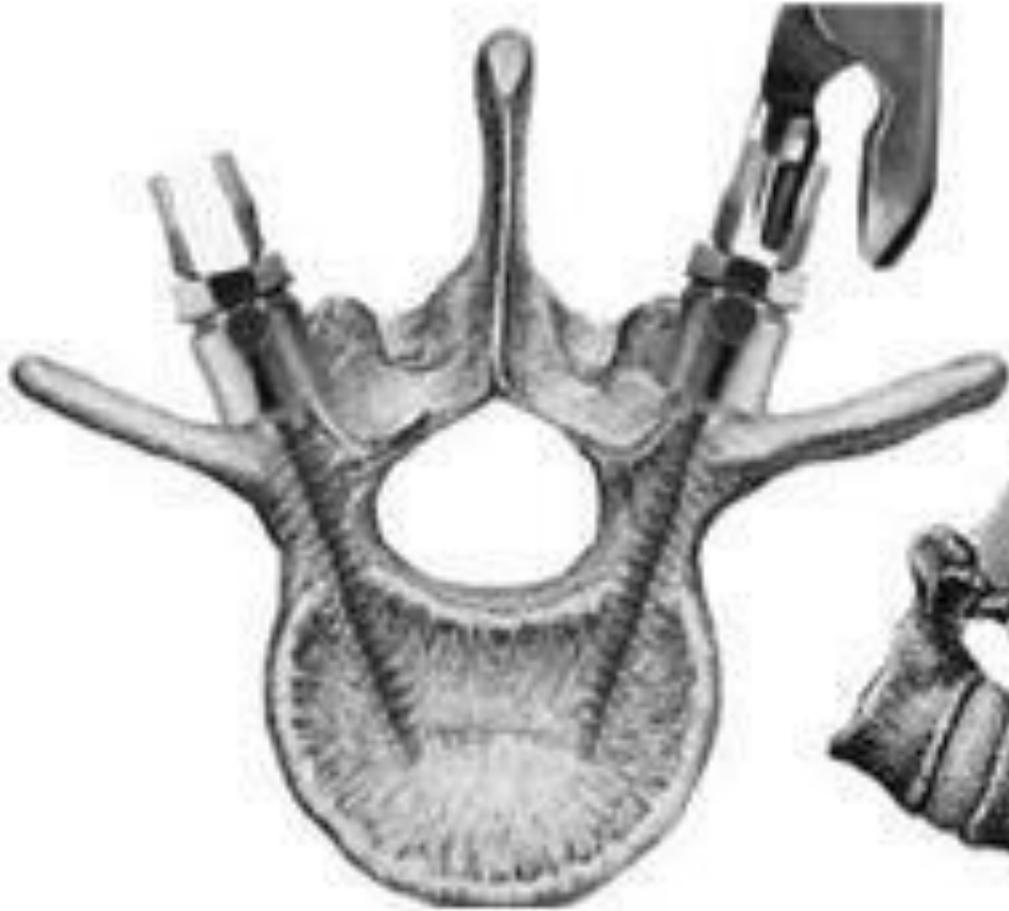


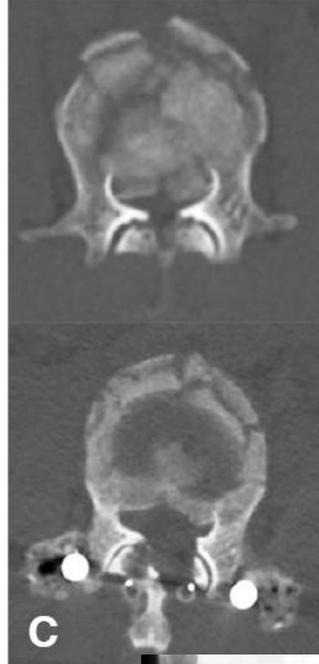
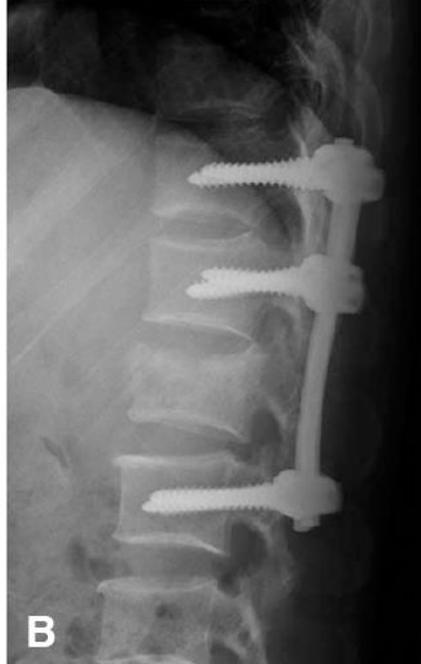


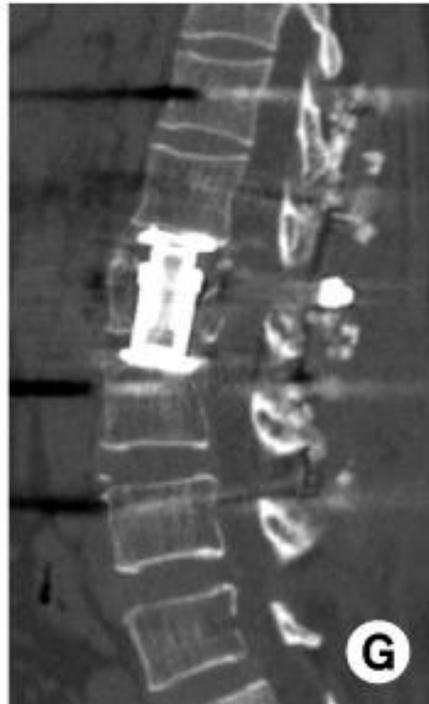
Treatment

- ▶ Surgical treatment:
 - 2) Posterior Approach: Posterior Segmental Fixation (PSF)



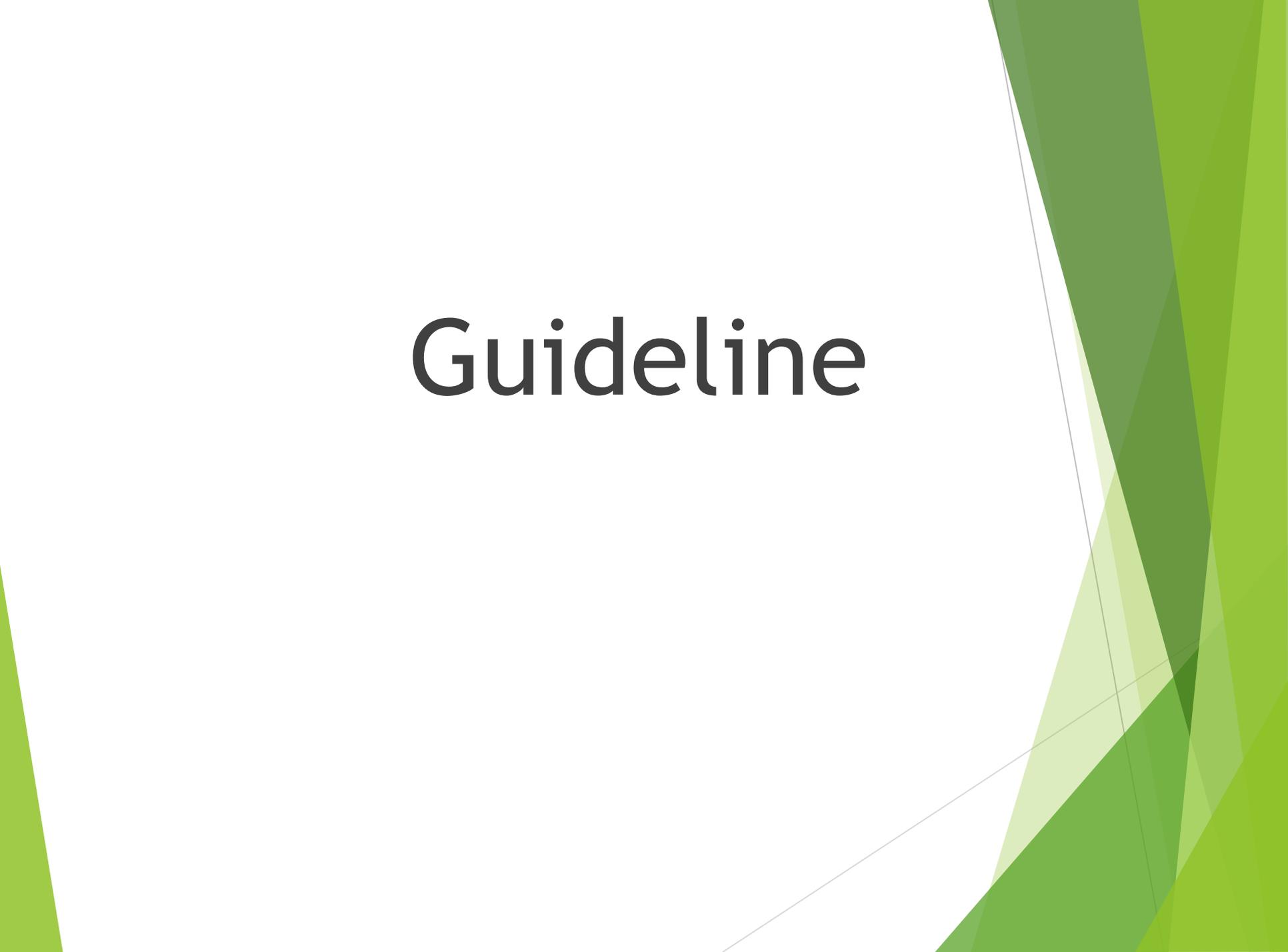






***Both
Approaches
:
Anterior
+
Posterior***

Guideline

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Initial assessment

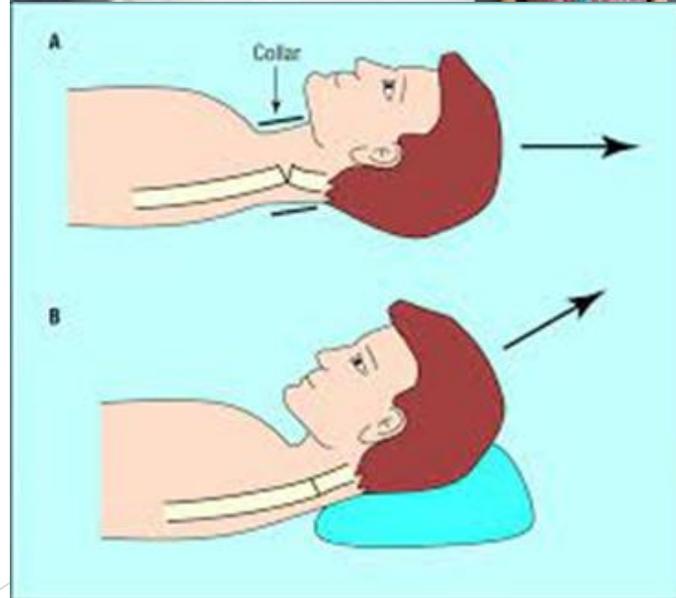
- ▶ loss of thoracic sympathetic innervation (T1-T5)
 - ▶ may inhibit tachycardia and vasoconstriction as signs of hypovolaemia.
- ▶ Thus haemorrhagic injuries may not be indicated by the usual signs.

Spinal immobilisation

- ▶ Immobilize the entire spine of any patient with known or potential SCI.
- ▶ Use log roll with adequate personnel to turn patient while maintaining spine alignment.



For children < 8 years of age use a Thoracic Elevations Device to promote neutral cervical spine position.
Remove from spinal board on arrival in ED or as soon as resuscitation allows.
Maintain neck in neutral position by use of a foam collar



Imaging

- Multiple levels of injury in the spine are common.
- In the under 8 age group especially
 - missed cranio-cervical injuries
 - with/ without associated cranial nerve involvement.
- ▶ Plain film imaging of the entire cervical, thoracic and lumbar spines.
 - an urgent MRI of the entire spine CT scan may be used

Neurological assessment

- Neurological assessment including:
 - Sensory level
 - Motor function
 - Glasgow coma score
 - Pupil response
- Perform hourly for 1st 24 hours
- then decrease to 4 hourly if condition stabilised
- Note evidence of brain injury as well as spinal cord injury.

Vital signs (and autonomic control)

- Vital signs can be quite abnormal following SCI.
- usual causes in trauma such as:
 - Pain
 - Bleeding
 - Distress
- ▶ Also:
 - ▶ **loss of autonomic control,**
 - ▶ particularly in **cervical or high thoracic injuries.**
- The autonomic nervous system controls our HR, BP temperature etc.
- Autonomic instability is most acute in the first few days to weeks of the injury.

Heart rate

- Bradycardia can easily occur
 - on endotracheal tube or tracheostomy suction
 - due to unopposed vagal activity (Thoracic sympathetic input may have been damaged).
- continuous HR monitoring in ICU or ward
- anticholinergic medication is often required.

Blood pressure

- Loss of autonomic control results in loss of vasomotor tone.
- Patient may be quite vasodilated and hypotensive.
- neurogenic shock can last up to several weeks.
- Hypotension should be treated to prevent secondary poor perfusion of the spinal cord.

- Blood pressure monitoring should be:
 - Continuous in ICU.
 - At least hourly in the ward.
 - adequately fluid resuscitated but not overloaded
 - vasopressor drugs such as
 - ▶ nor-adrenaline
 - ▶ or intravenous fluids
 - ▶ to maintain BP (but excessive fluids will cause pulmonary

Temperature

- The loss of temperature control e.g., ability to sweat, shiver, vasodilate, vasoconstrict or position self to maintain temperature.
- Hypothermia is common.
- performed 4hrly in the acute stage of admission.
- adequate clothing or bedding in cool environment.
- artificial cooling in a hot environment.

Breathing

- Respiratory difficulty is common in the early stages of spinal shock
- will ultimately depend on injury level.
 - C1-C4: paralysis of diaphragm and intercostal muscles
 - ▶ need mechanical ventilation via endotracheal intubation or tracheostomy
 - ▶ May need long-term ventilation of phrenic/diaphragm pacing.
 - C5-T6: paralysis of intercostals, diaphragm OK
 - ▶ may need some form of respiratory support.
 - T6-12: abdominal muscles paralysed,
 - ▶ may have some decreased function.

- Asses respiratory status
 - pattern, effort, ability to cough, auscultate chest, Monitor SpO2 ETCO2, ABG
- Intubate & ventilate if respiration is inadequate.
- head up, but tilt entire bed so that spine remains in line & immobilised-do not just simply raise head of bed up.
 - **Note at later stage of admission when patient is allowed to sit up, that if abdominal muscles are paralysed, breathing difficulty may be worsened when sitting up and eased when semi-recumbent.**
- Give O2 as required.
- Ensure abdomen not distended (NG should be inserted).
- Refer to physiotherapist to chest physiotherapy

Skin

- ▶ SCI is at high risk of damage to their skin integrity.
- ▶ loss of sensation of pain, pressure & temperature.
- ▶ lost motor control and have poor autonomic nervous system function.
- ▶ the result is a lack of sensory warning mechanisms
 - ▶ A baseline skin assessment
 - ▶ For all patients a Pressure Injury Prevention Plan
 - ▶ Pressure mattress (low air loss or alternating pressure) or gel mat if approved.
 - ▶ Reposition 2 hourly.
 - If skin breakdown occurs it can progress rapidly. Pressure must be kept off this area.
 - Take care with water temperature for washes, and use of hot or cold devices against skin.

- Hygiene

- Daily wash to keep skin clean.
- Dry thoroughly after washing.
- Do not leave patient in damp/wet bed.
- Hard collar needs to be removed & skin underneath checked & washed daily.
- Refer to surgeons & orthotics for advice on access to skin under halo jackets and braces.
- Adequate nutrition
- Enteral nutrition is preferred.
- Skin should be fully inspected once per shift.

Bladder

- ▶ The muscles and sphincters of the bladder are normally controlled by neurological input and spinal reflexes.
- ▶ Loss of normal neurological control of the bladder: neurogenic bladder.
- ▶ The aim of bladder care is to
 - ▶ prevent infections,
 - ▶ minimise and contain incontinence and
 - ▶ find an appropriate way to empty the bladder.
- Bladder dysfunction depends on the level of spinal cord injury.
 - contractile/reflex bladder which contracts when the bladder muscle (detrusor) is under a certain amount of pressure.
 - ▶ Depending on the urethral sphincter function these patients will leak in between catheters.
 - Some patients will have an acontractile/flaccid bladder that stretches and holds a large volume of urine but the bladder muscle (detrusor) does not contract and
 - ▶ bladder emptying occurs usually by overflow.
 - a combination bladder.
- In the early acute phase of the SCI an indwelling urinary catheter will be used.
- Once patient has stabilised and opioids reduced consider change to intermittent catheter 4-6/24.
- Refer to Urology to enable Stomal therapy involvement to assist in establishing a routine.

Bladder

- Long term management
 - clean intermittent catheterization/condom drainage/bladder tapping/suprapubic catheter.
- mitrofonoff stoma might be considered
 - if clean intermittent catheterisation is difficult or impractical
- Oxybutin to reduce bladder spasm & thus increase holding capacity & continence between catheters.
- Complications:
 - Recurrent urinary tract infection (UTI).
 - Renal & bladder calculi.
 - Vesico ureteric reflux.
 - Latex allergy development due to increased latex exposure: use latex free catheters.
- Prevention of complications:
 - Maintain good hydration to reduce the risk of UTI & Kidney stones.
 - Good hand hygiene by carers and patient's perineal
- Priapism (erection) may occur in boys and is usually self-limiting & not a contraindication to catheterisation.
- Referral to urology if priapism prolonged.

Bowels

- ▶ Bowel function will be affected by
 - ▶ loss of neurological control of its function (neurogenic bowel).
 - ▶ In addition, medications such as antibiotics and opioids,
 - ▶ immobility,
 - ▶ alterations in food, fibre and fluid intake may affect function.
- ▶ Patients are at risk of constipation, impaction, and diarrhoea.

- ▶ Constipation is not only troublesome but can also trigger major complications such as autonomic hyper-reflexia (dysreflexia).

- Commence bowel management as soon as bowel sounds are present and enteral/oral feeds begin.

- Bowel dysfunction:
 - Some have a 'reflex' bowel.
 - ▶ Although peristalsis will move stool through bowel, the anal sphincter may not relax.
 - ▶ It may need stimulation to relax & allow passage of stool.
 - Some have a 'flaccid' bowel.
 - Reflexes that move stool through the bowel are impaired and the anal sphincter is relaxed preventing stool being held in the rectum.
 - Some patients have a combination of bowel function problems.

Bowels

- Constipation
 - Caused by insufficient fluid & fibre intake, insufficient aperients, ineffective evacuation of stool, medications (anticholinergics, opioids), immobility.
 - Treatment: increase fluids & fibre, increase aperients.
- Impaction
 - Caused by chronic constipation. Will often have liquid overflow.
 - Treatment: contact stimulant, Movicol® or osmotic laxative; Assisted evacuation only if necessary
- Diarrhoea
 - Change in diet, antibiotics, bacteria, excess aperients, high impaction.
 - Treatment: adjust diet, reduce aperients, stool specimen, abdominal x-ray if impaction suspected; possibly consider probiotics.
- Type of bowel management aperients:
 - Contact stimulants
 - Bulking agents
 - Softeners
 - Iso-osmotic laxative
 - Osmotic laxative
 - Suppositories & enemas can stimulate bowel action & lubricate faeces for easier evacuation
 - Other: if above management suggestions are ineffective discuss with stoma therapy to consider peristeen bowel washout system or Malone stoma-bowel washouts

Nutrition

- Insert naso/oro gastric tube early to limit risk of vomiting and aspiration
- NG placement also allows for enteral feeding to commence.
- Refer to Dietician early
- Consider gastric ulcer prophylaxis.
- Re-introduce oral feeding after ensuring ability to swallow and protect airway.
- Gastrostomy may be required.

Thromboprophylaxis

- Refer to the Clinical Haematology
- Consider the use of antiembolic stockings or sequential calf compression devices (SCCD)

Postural hypotension

- ▶ Patients with SCI are at risk for postural hypotension when moving from supine to sitting upright.
- ▶ This is due to loss of sympathetic autonomic nervous system innervation
- ▶ include an inability to regulate BP normally with vasoconstriction.

- ▶ To avoid problems with postural hypotension:
 - Anti embolic stockings and/or SCCD's will encourage venous return from the legs.
 - Abdominal binders encourage venous return through the IVC.
 - Orthotics can make these to fit.
 - Slowly increase bed angle to sitting position, rather than in one quick move
 - Involve physiotherapy team in this process.

Joint contractures

- ▶ Abnormal muscle tone and lack of movement can result in joint contractures.
- ▶ Referrals should be made to Physiotherapy, Occupational Therapy and Orthotics within 1-2 days of admission:
 - Physiotherapy: for range of movement exercises & positioning patient in good alignment.
 - Orthotics: splints for ankles.
 - Occupational Therapy: splints for hands.

Autonomic hyperreflexia (Dysreflexia)

- a **MEDICAL EMERGENCY**
- needs immediate recognition and action.
- those with injuries T6 or higher
- generally won't occur until a few weeks post injury (after spinal shock has subsided).
- has an abnormal excessive response to noxious stimuli below the level of the injury.

- Common causes of stimuli include
 - full bladder or bowel (ineffective emptying or constipation),
 - pressure sores,
 - tight clothing,
 - fractures,
 - surgery,
 - pain.

- Signs & symptoms include:
 - Hypertension
 - Sudden and severe nature which requires immediate recognition and treatment.
 - Hypertension may be the only manifestation of dysreflexia.
 - Bradycardia.
 - Severe pounding headache.
 - Skin rash (flushed, blotchy, transient).
 - Vasodilation above the level of the injury or sweating.
 - Vasoconstriction below level of injury: pale, cool skin with goosebumps and/or piloerection.
 - Blurred vision/ pupillary dilation.
 - Anxiety.
 - Nasal congestion.
 - Nausea.

- Manage by:
 - Remove noxious stimuli where possible:
 - loosen clothing, remove compression stockings, abdominal binder.
 - perform urinary catheterisation using lignocaine gel, ensure catheter not blocked.
 - bowel disimpaction using lignocaine gel.
 - look for pressure areas, ingrown toenails, evidence of fracture.
 - Position sitting upright or with head of bed elevated.
 - Monitor BP & HR 5 minutely.
 - Antihypertensive agents may be prescribed if not responding to above measures within a few minutes, or cause cannot be found.

Psychological

- SCI is often devastating for patient and families.
- There are frequently preconceptions
- Make appropriate referrals:
 - Social work
 - Clinical psychology
 - Victorian Paediatric Rehabilitation Service
 - Link to support groups or other children with similar injury



***Good
Luck***