Spine Injury

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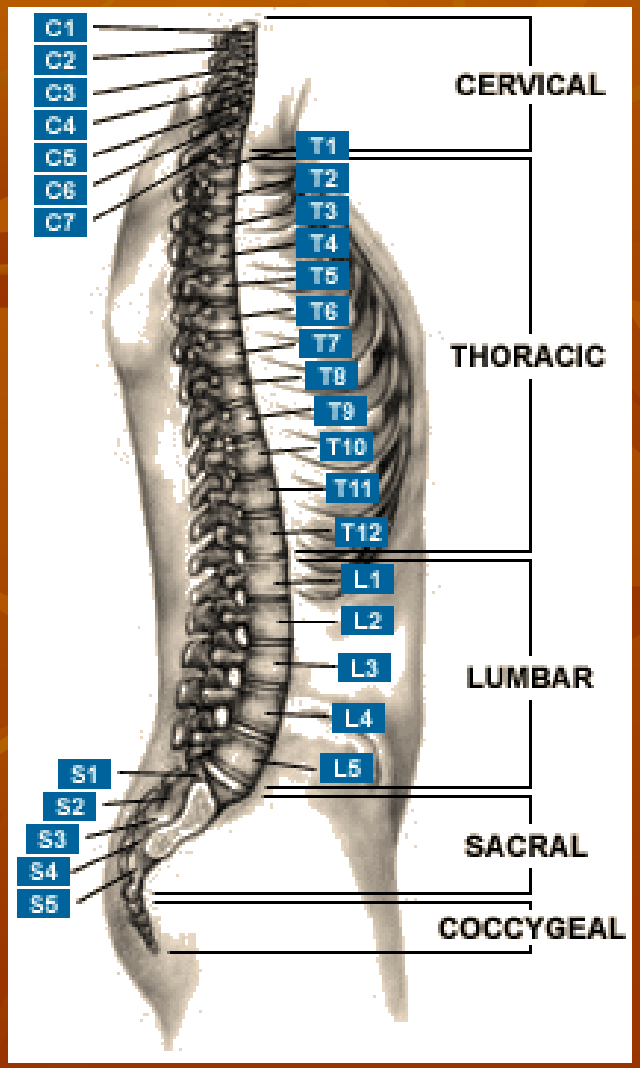
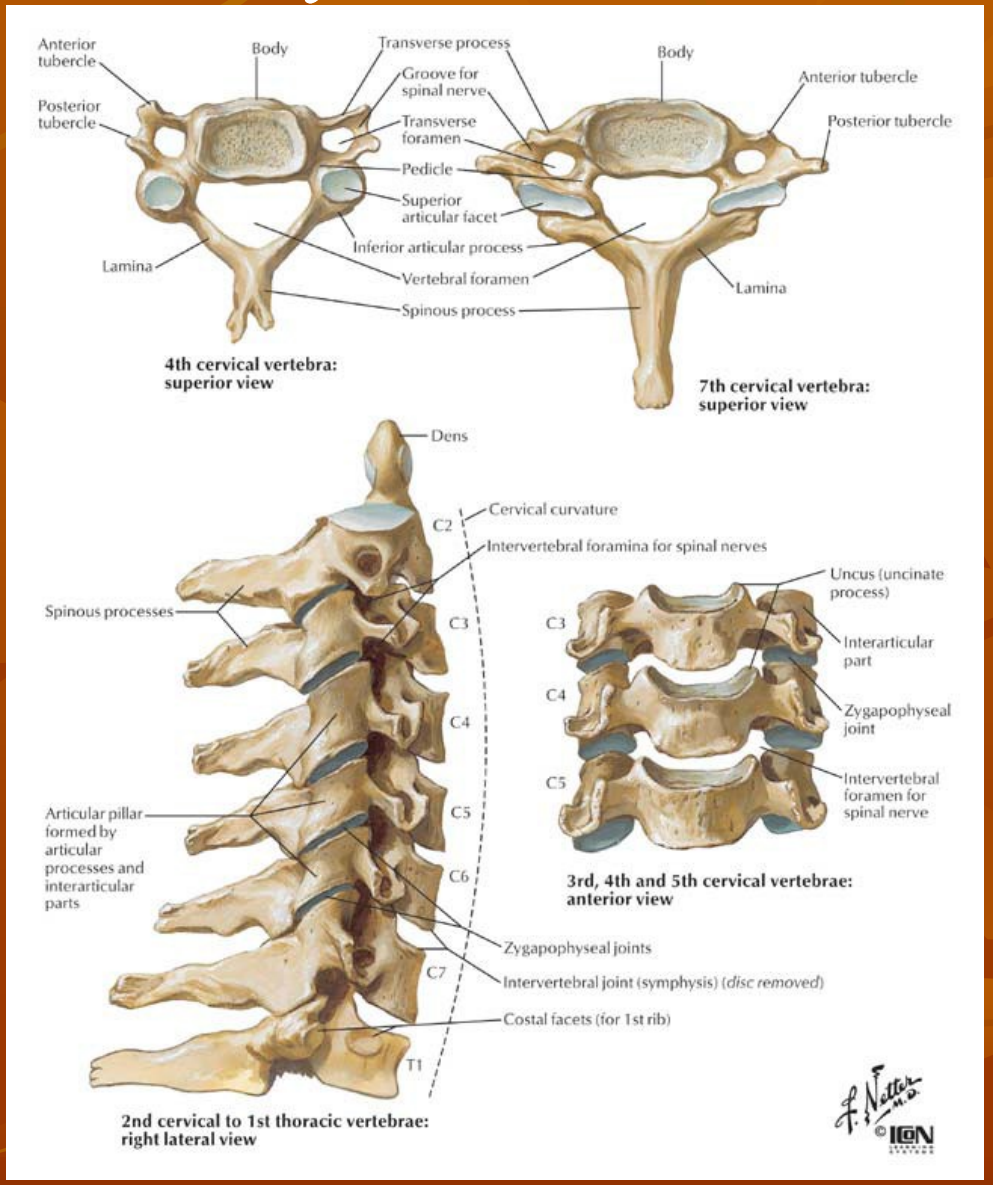
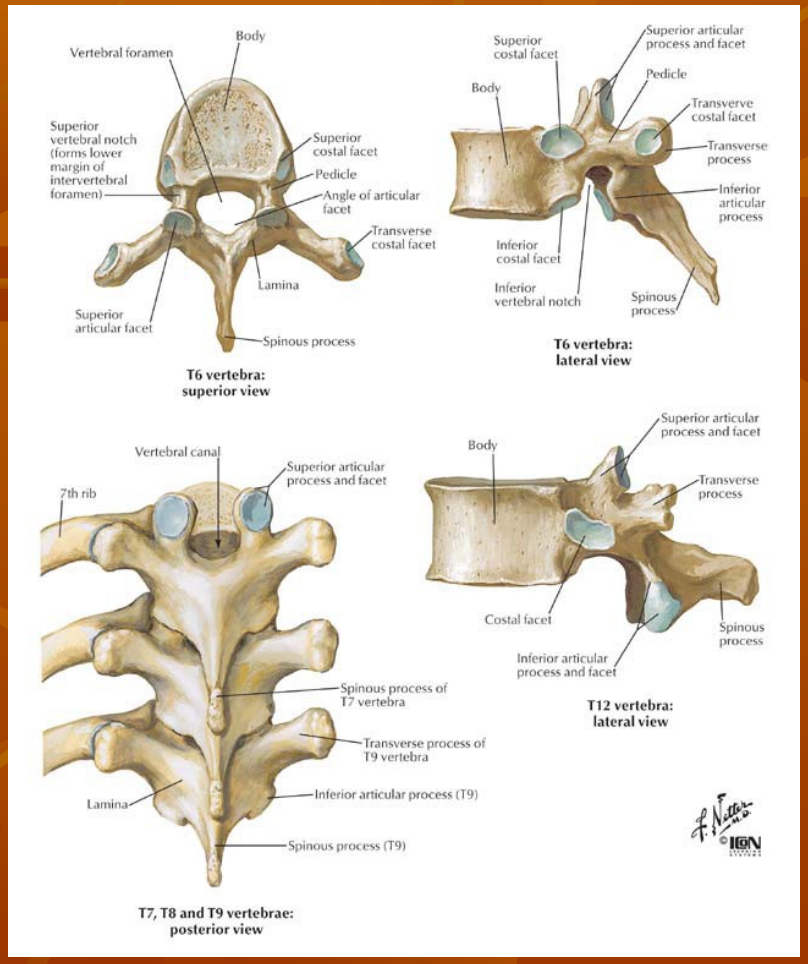
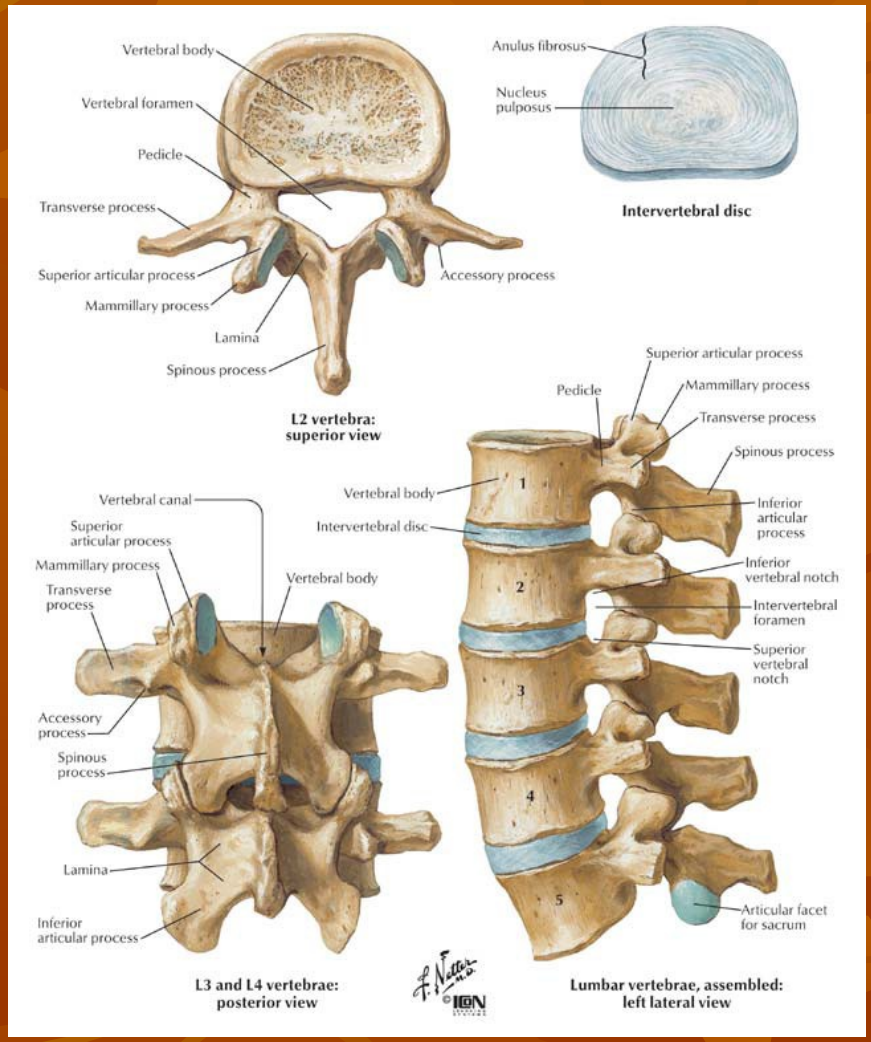
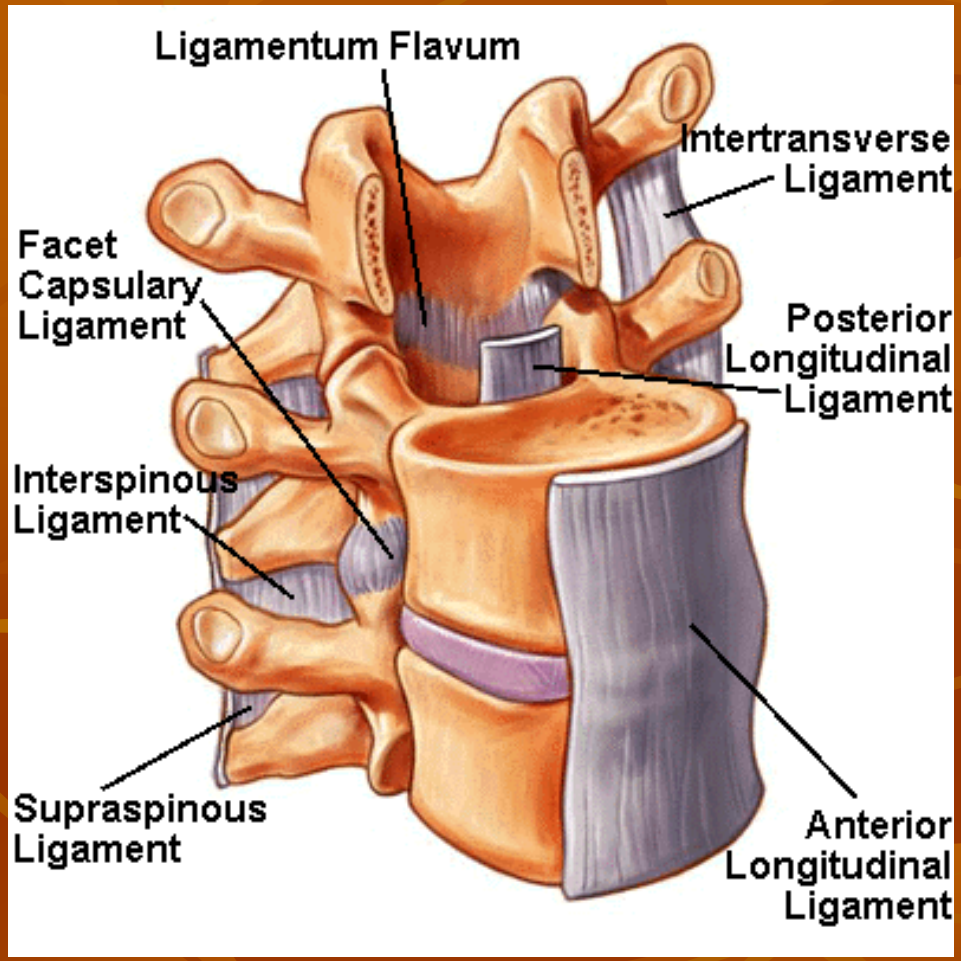
Anatomy

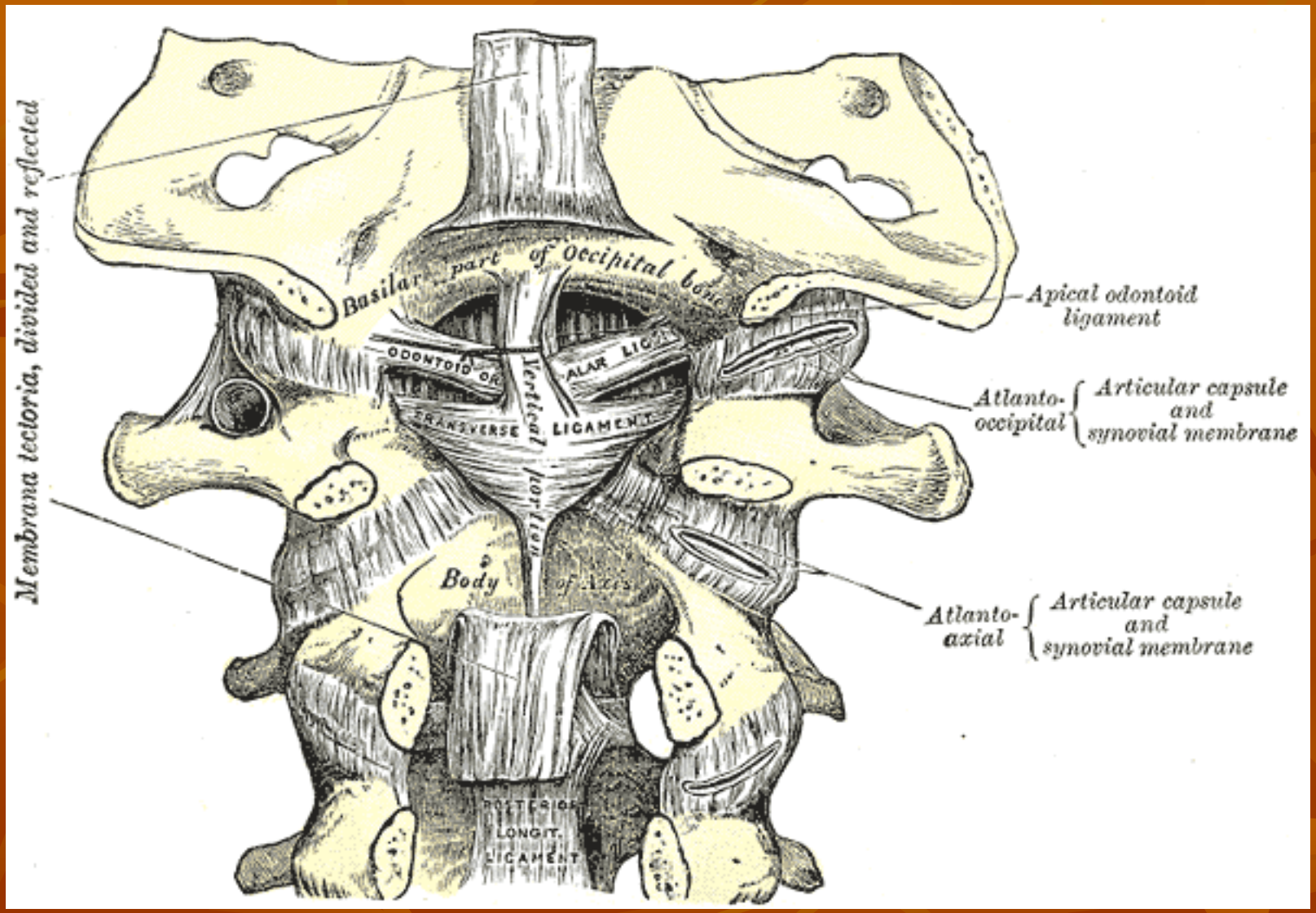

C1
C2
C3
C4
C5
C6
C7
CERVICAL
T1
T2
T3
T4
T5
T6
T7
T8
T9
T10
T11
T12
THORACIC
L1
L2
L3
L4
LUMBAR
L5
S1
S2
S3
S4
S5
SACRAL
COCCYGEAL


Anterior tubercle
Body
Transverse process
Groove for spinal nerve
Posterior tubercle
Transverse foramen
Pedicle
Superior articular facet
Inferior articular process
Lamina
Vertebral foramen
Spinous process
4th cervical vertebra: superior view
Body
Anterior tubercle
Posterior tubercle
Lamina
7th cervical vertebra: superior view
Dens
Cervical curvature
Intervertebral foramina for spinal nerves
Spinous processes
Articular pillar formed by articular processes and interarticular parts
C2
C3
C4
C5
C6
C7
T1
Zygapophyseal joints
Intervertebral joint (symphysis) (disc removed)
Costal facets (for 1st rib)
2nd cervical to 1st thoracic vertebrae: right lateral view
Uncus (uncinate process)
Interarticular part
Zygapophyseal joint
Intervertebral foramen for spinal nerve
3rd, 4th and 5th cervical vertebrae: anterior view


Body
Vertebral foramen
Superior vertebral notch (forms lower margin of intervertebral foramen)
Superior costal facet
Pedicle
Angle of articular facet
Transverse costal facet
Lamina
Superior articular facet
Spinous process
T6 vertebra: superior view
Superior costal facet
Superior articular process and facet
Body
Pedicle
Transverve costal facet
Transverse process
Inferior articular process
Inferior costal facet
Inferior vertebral notch
Spinous process
T6 vertebra: lateral view
Vertebral canal
Superior articular process and facet
7th rib
Spinous process of T7 vertebra
Transverse process of T9 vertebra
Lamina
Inferior articular process (T9)
Spinous process (T9)
T7, T8 and T9 vertebrae: posterior view
Body
Superior articular process and facet
Transverse process
Costal facet
Spinous process
Inferior articular process and facet
T12 vertebra: lateral view


Vertebral body
Vertebral foramen
Pedicle
Transverse process
Superior articular process
Mammillary process
Lamina
Spinous process
Accessory process
L2 vertebra: superior view
Anulus fibrosus
Nucleus pulposus
Intervertebral disc
Vertebral canal
Superior articular process
Mammillary process
Transverse process
Vertebral body
Accessory process
Spinous process
Lamina
Inferior articular process
L3 and L4 vertebrae: posterior view
Superior articular process
Pedicle
Mammillary process
Transverse process
Spinous process
Vertebral body
Intervertebral disc
Inferior articular process
Inferior vertebral notch
Intervertebral foramen
Superior vertebral notch
1
2
3
4
5
Articular facet for sacrum
Lumbar vertebrae, assembled: left lateral view


Ligamentum Flavum
Intertransverse Ligament
Facet Capsulary Ligament
Posterior Longitudinal Ligament
Interspinous Ligament
Supraspinous Ligament
Anterior Longitudinal Ligament


Membrana tectoria, divided and reflected
Basilar part of Occipital bone
Apical odontoid ligament
ODONTOID OR
ALAR LIG.
Vertical portion
TRANSVERSE LIGAMENT
Atlanto-occipital { Articular capsule and synovial membrane
Body of Axis
Atlanto-axial { Articular capsule and synovial membrane
POSTERIOR LONGIT. LIGAMENT

- Goals in the Spine-Injured Patient
- Save life
- Restore and maintain spinal cord function preventing secondary injury
- Decompress, realign and stabilise the spinal column
- Programmed rehabilitation

- Follow ATLS protocol
- Index of suspicion for spinal injury – especially in coma patients and the drunk; particularly the C-spine is assumed injured and unstable until proven otherwise
- Do no harm and good protection of the C-spine. Clinical and X-ray assessment – and check for deformity and step
- Beware of problematic areas, e.g. cervicothoracic junction (CTJ)
- Maintain perfusion and oxygenation
- Complete examination

- Cervical X-ray Assessment

- Lower part of C-spine = one vertebral width (retro-pharyngeal space > 7 mm, or retro-tracheal space > 14 mm; displaced prevertebral stripe ± deviation of trachea should be noted)

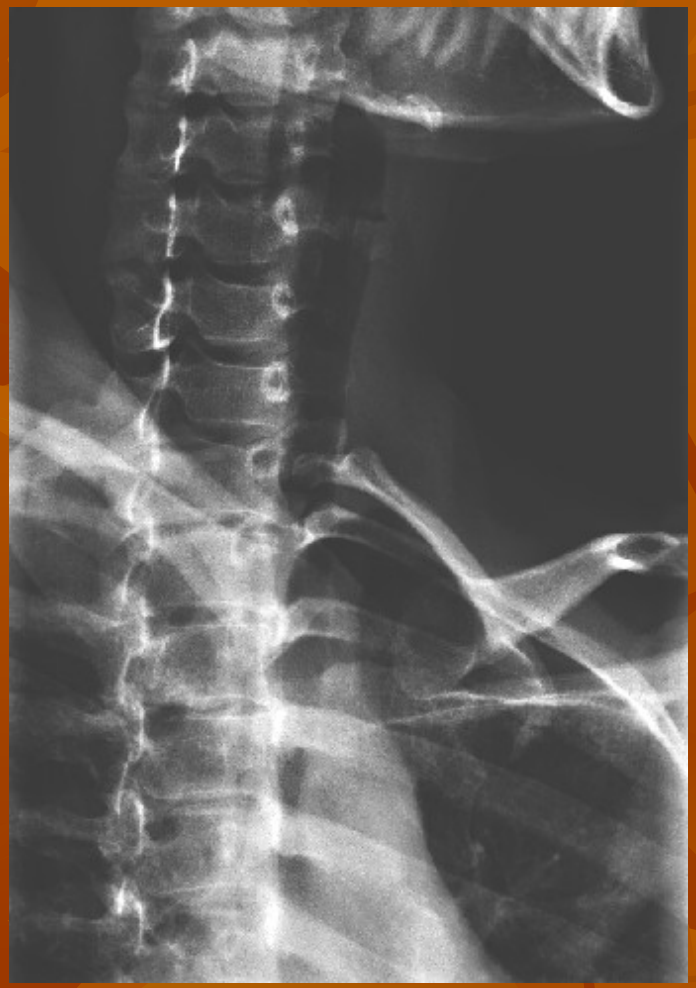
- Alignment: look for any lordosis, acute kyphosis, torticollis, widened interspace, axial rotation of the vertebrae

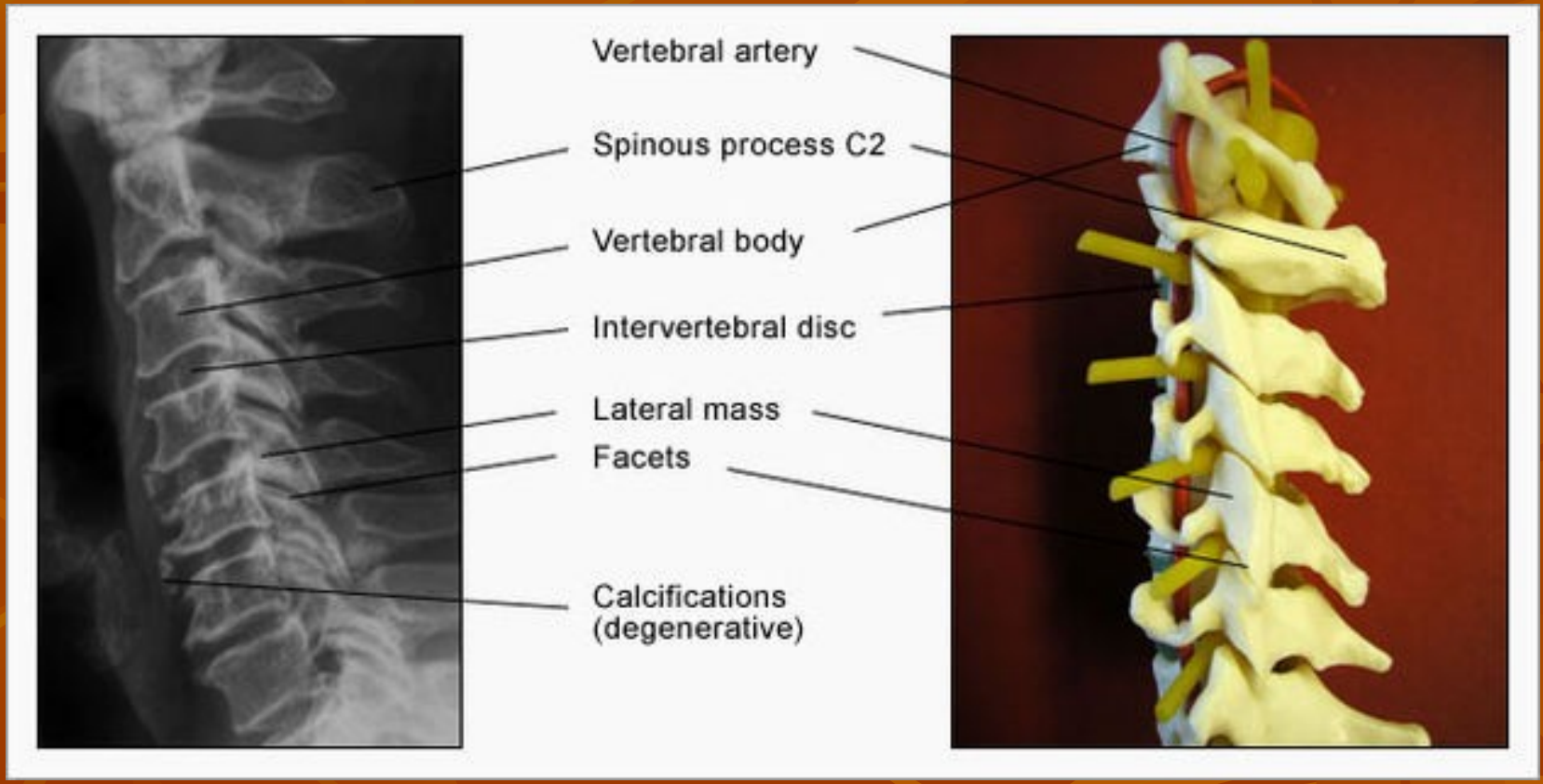
- Adult Atlas-Dens interval (ADI) > 4 mm abnormal (5 mm in children) narrow/widened disc space, wide facet joint, and look for facet dislocation – unilaterally, can check oblique view if unsure

- The ATLS course teaches that the cervical spine lateral film done as part of the trauma series is 75% sensitive. This means we will be missing 25% of injuries.


R


R



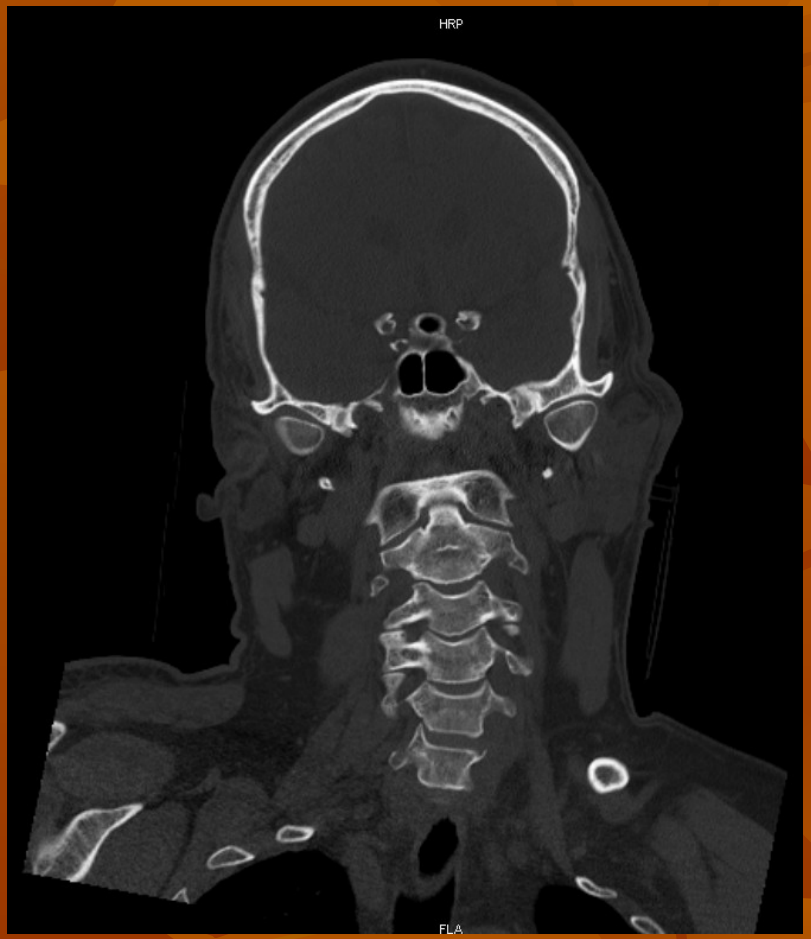

Vertebral artery
Spinous process C2
Vertebral body
Intervertebral disc
Lateral mass
Facets
Calcifications
(degenerative)

X-rays in maximum flexion and extension allow the range of motion to be determined.

- CT:
- Occult fracture (e.g. lateral masses)
- Degree of retropulsion
- Double vertebra sign suggestive of fracture dislocation
- 3D reconstruction, as well as coronal/sagittal reconstructions

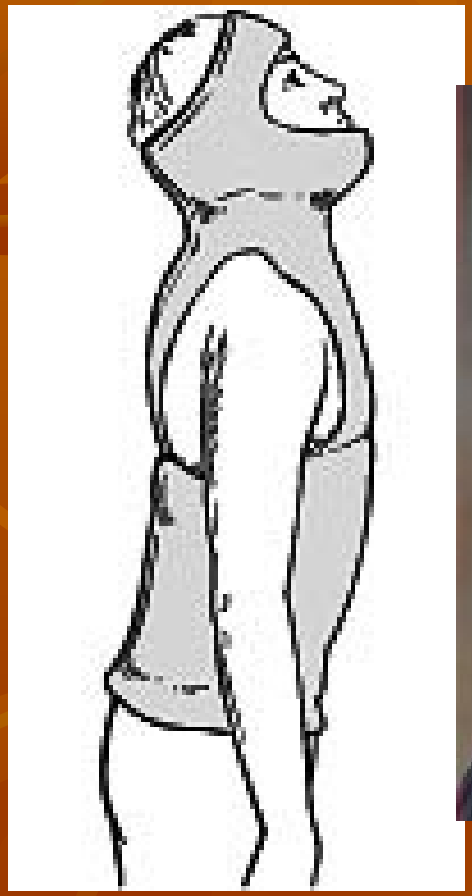
- MRI – advantages can assess:
- Disc
- Cord (oedema, bleeding)
- Ligament (integrity)
- Haematoma (e.g. epidural)

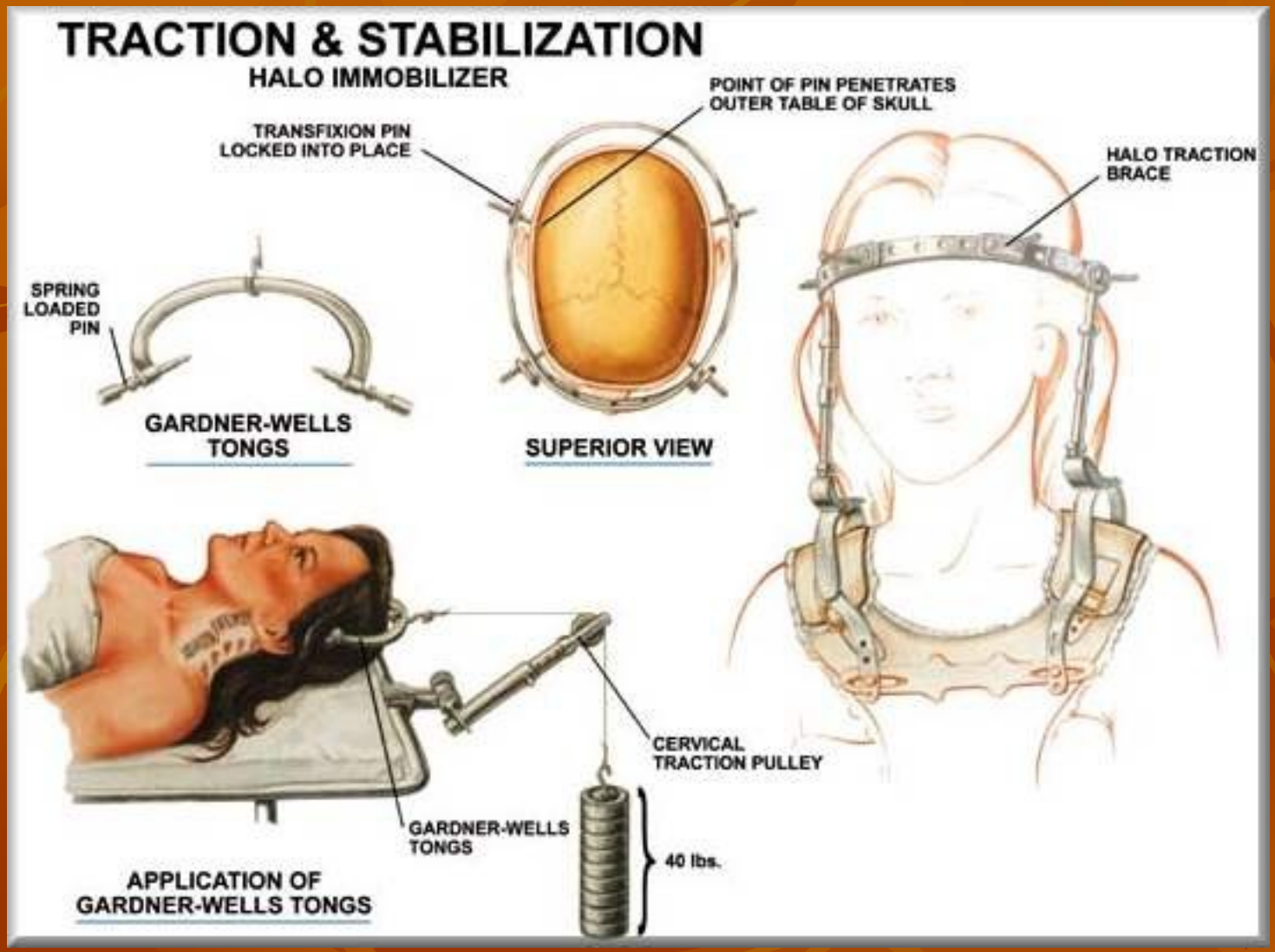

HRP


HRP
FLA

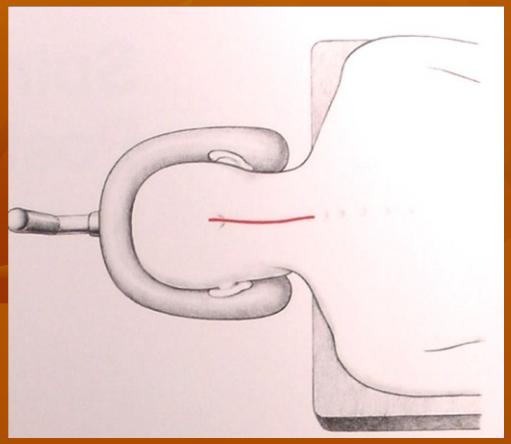
Common mechanism

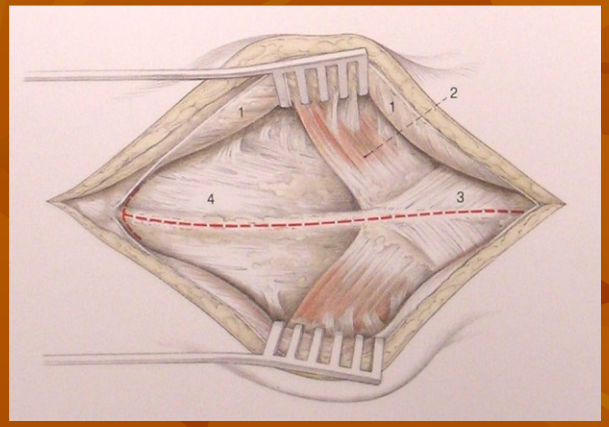
- Compression
- Flexion
- Extension
- Rotation
- Lateral bending
- Distraction
- Penetration

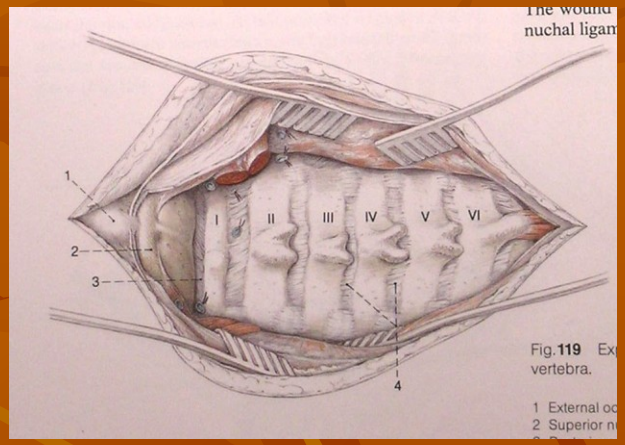


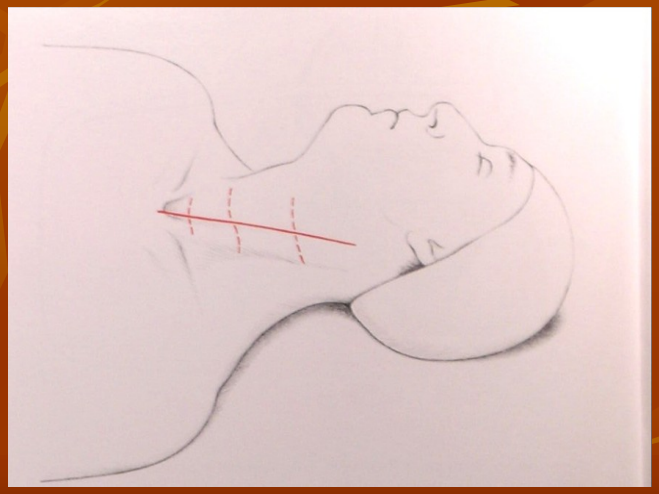

TRACTION & STABILIZATION
HALO IMMOBILIZER
TRANSFIXION PIN LOCKED INTO PLACE
POINT OF PIN PENETRATES OUTER TABLE OF SKULL
HALO TRACTION BRACE
SPRING LOADED PIN
GARDNER-WELLS TONGS
SUPERIOR VIEW
CERVICAL TRACTION PULLEY
GARDNER-WELLS TONGS
40 lbs.
APPLICATION OF GARDNER-WELLS TONGS

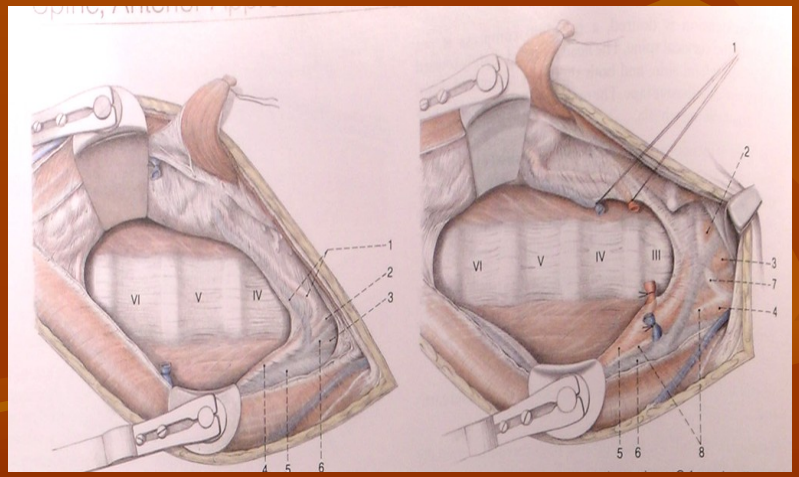
approaches



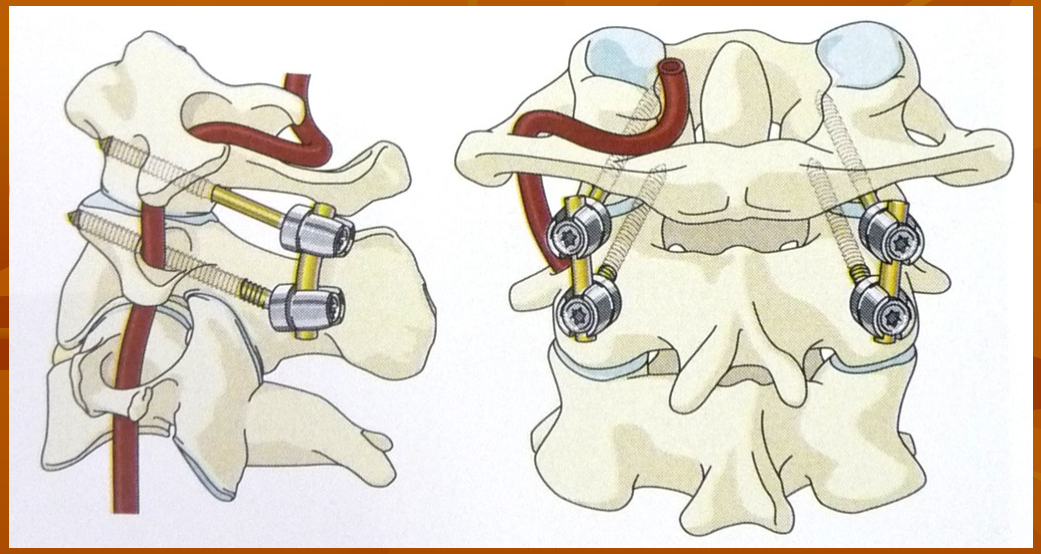

1
1
2
4
3

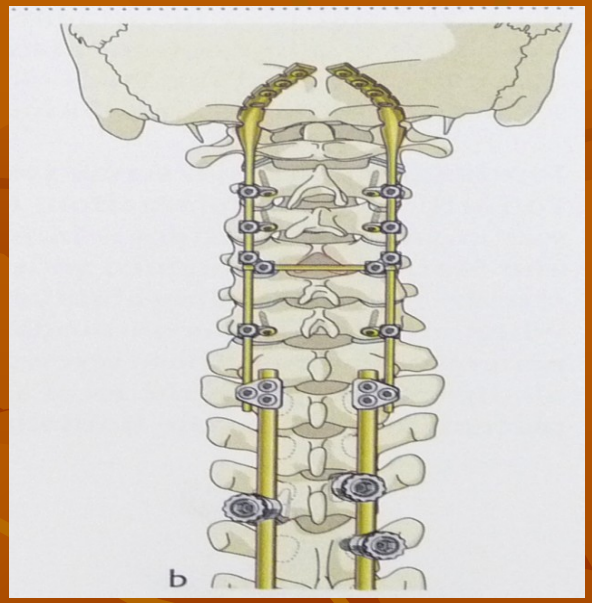

nuchal ligam
1
2
3
I
II
III
IV
V
VI
4
Fig. 119 Ex
vertebra.
1 External oc
2 Superior n

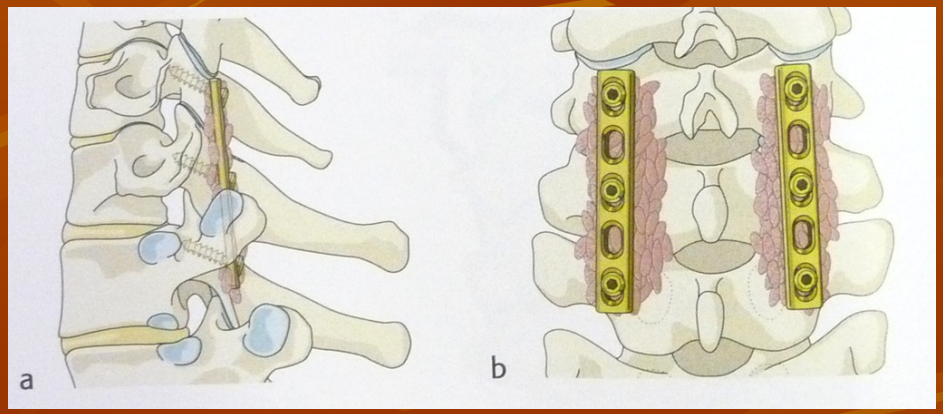


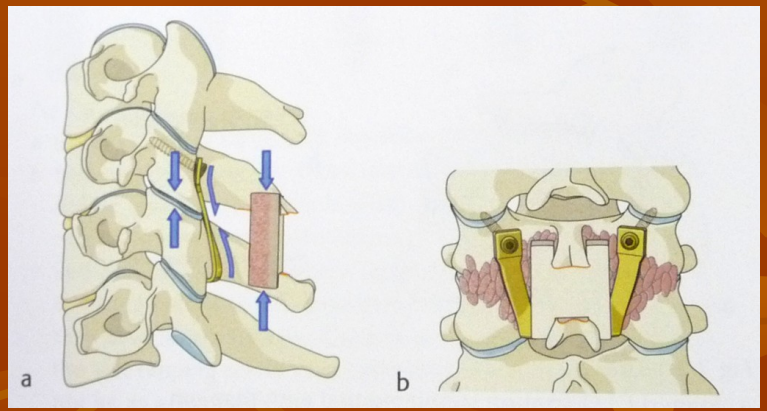

VI
V
IV
1
2
3
4
5
6
1
2
VI
V
IV
III
3
7
4
5
6
8

Posterior stabilization

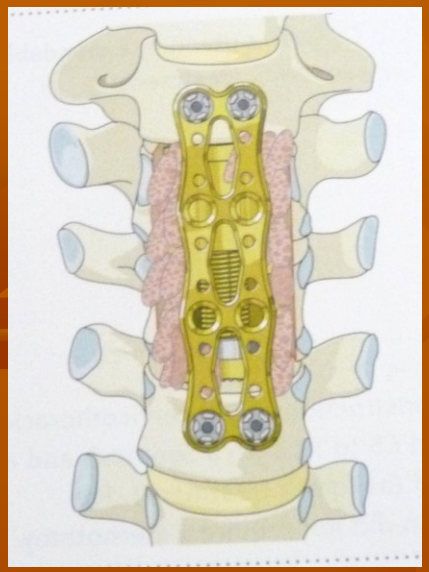


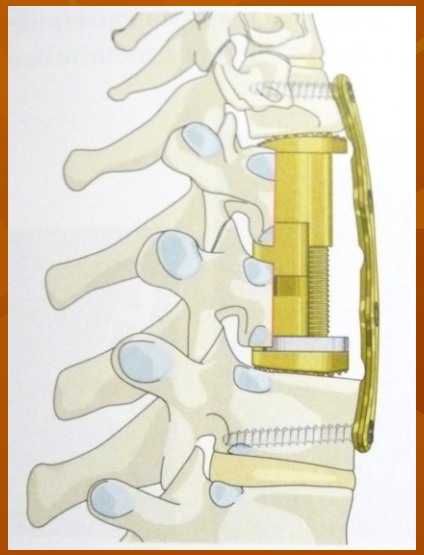


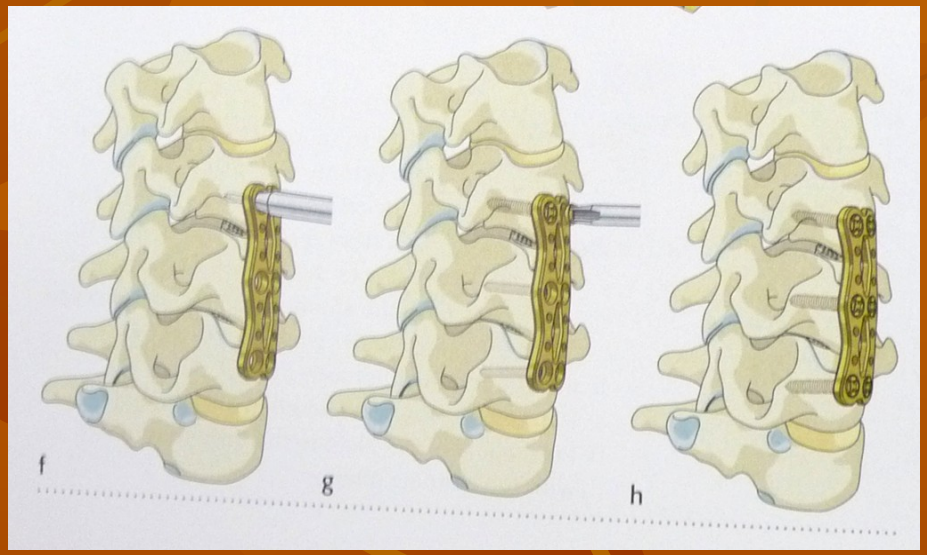


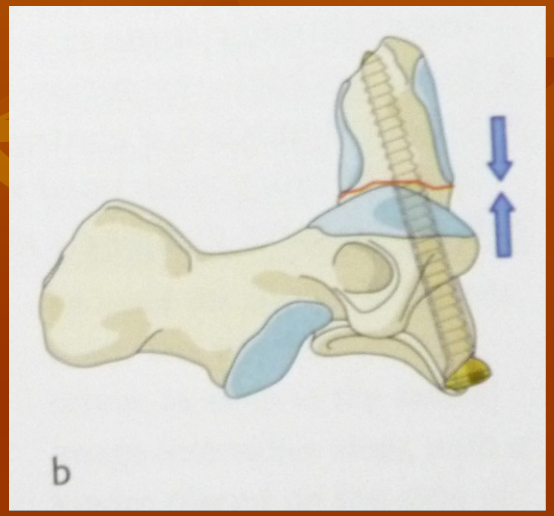


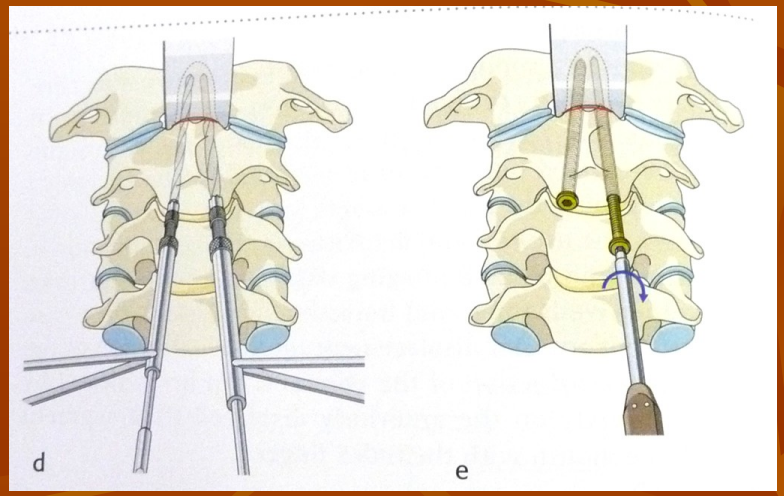
Anterior stabilization











- Fractured Occipital Condyle
- Most result from direct blow in association with head injury
- Easily missed on X-ray, may need CT for Dx
- *Anderson and Montesano Classification*

  Type 1: impacted fracture with comminution

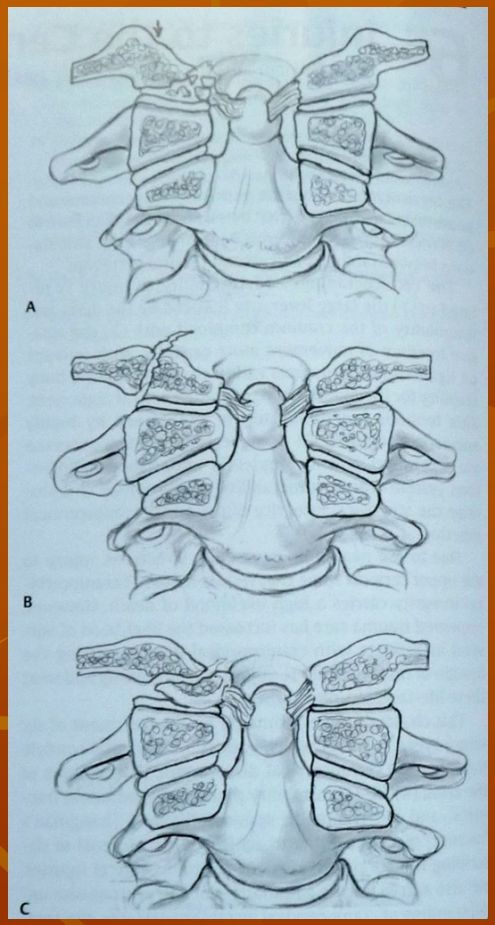
  Type 2: associated with fractured base of skull

  Type 3: avulsion fracture of alar ligament attachment

  Treatment

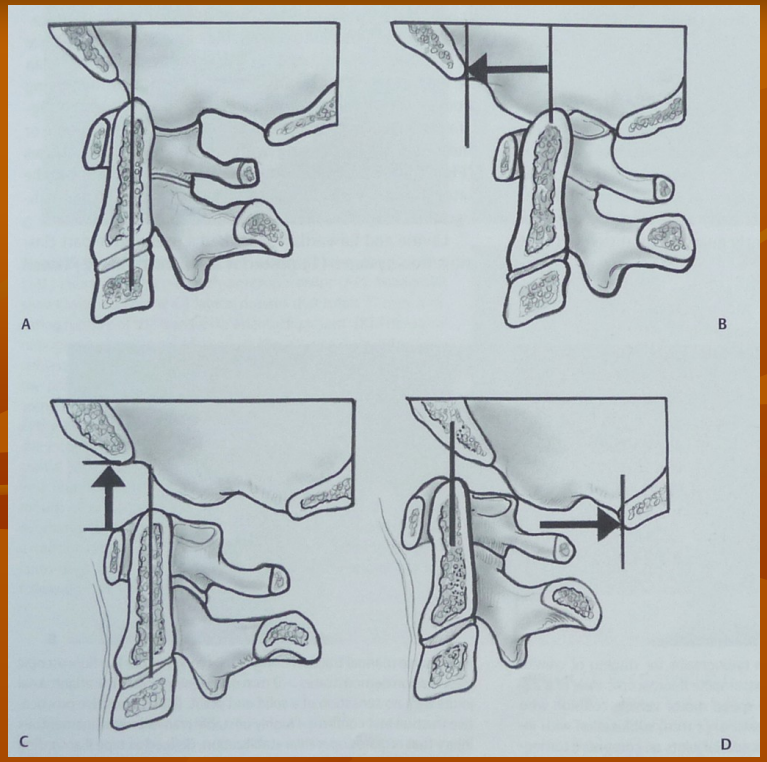
  Types 1 and 2: stable, rigid collar halo

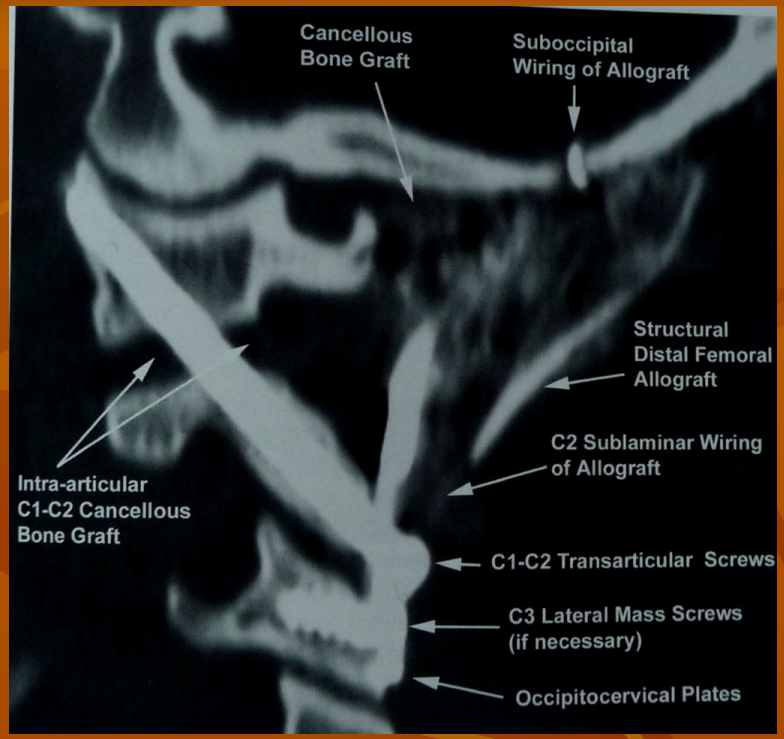
  Type 3: unstable, needs halo immobilisation


A
B
C

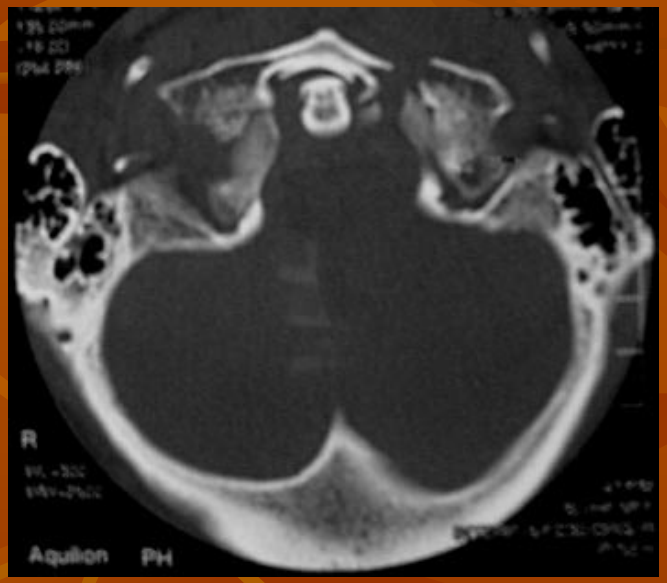
- Occipitocervical Instability/Dislocation
- The incidence of occiput–C1 is higher in children, since the lateral masses (articulating with the occipital condyles) are flatter. Important soft tissue supports in this region include: alar ligament, tectorial membrane, joint capsule and apical ligament. many are fatal

  Treatment
- Acute situation: halo traction contraindicated in type II. Then elective occipital-cervical fusion (mostly by occipito-cervical plating), beware of Cx like vertebral artery injury and that of cranialnerves


A
B
C
D


Cancellous
Bone Graft
Suboccipital
Wiring of Allograft
Structural
Distal Femoral
Allograft
C2 Sublaminar Wiring
of Allograft
Intra-articular
C1-C2 Cancellous
Bone Graft
C1-C2 Transarticular Screws
C3 Lateral Mass Screws
(if necessary)
Occipitocervical Plates

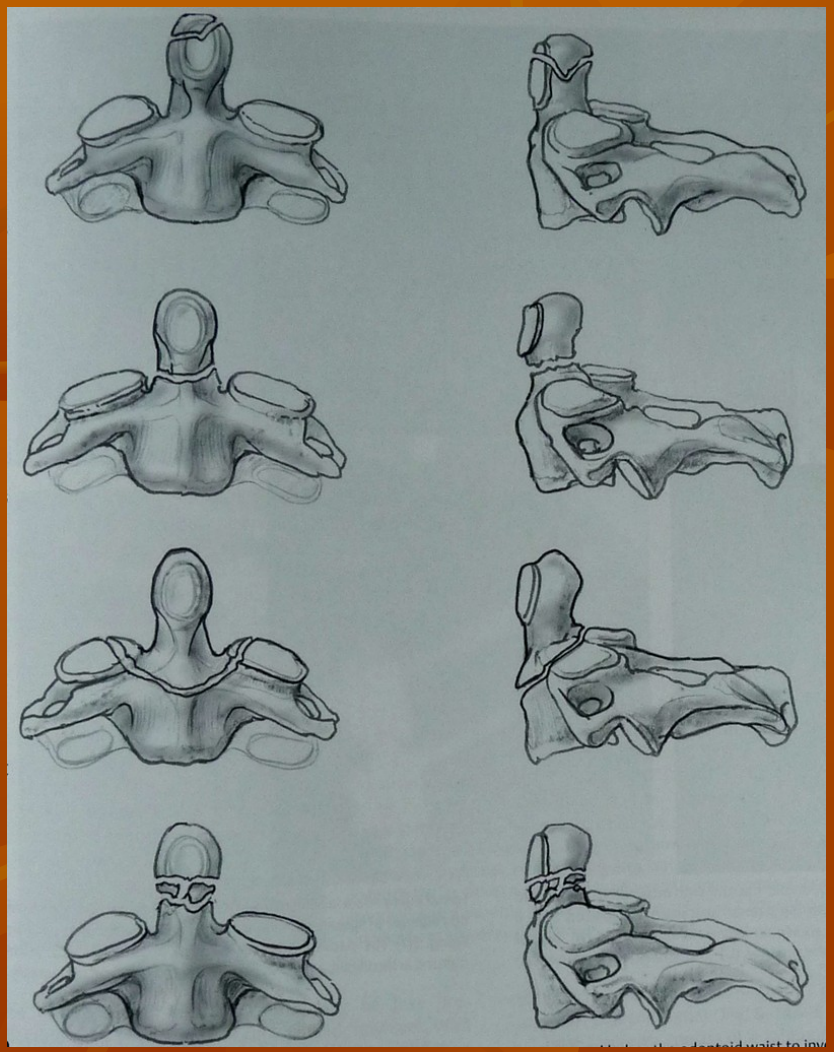
- Fracture Atlas C1
- Injury mechanism: axial loading and frequently hyperextension
- Canal is spacious here, neural deficit rare
- *Levine Classification of C1 Fractures*
- Type 1: fractured posterior arch
- Type 2: fractured lateral mass
- Type 3: classic Jefferson's burst fracture
- Treatment
- Types 1 and 2: halo treatment,
- Type 3: operative fusion

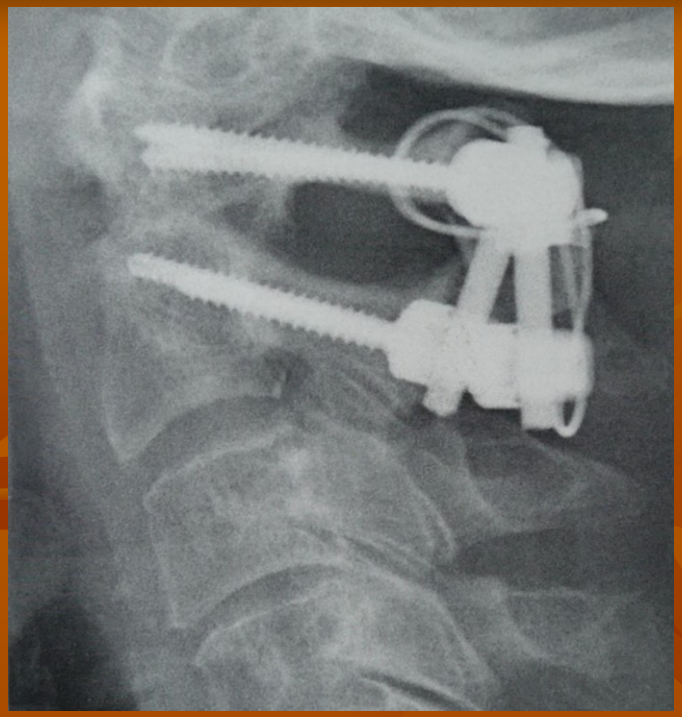

R
Aquilion
PH

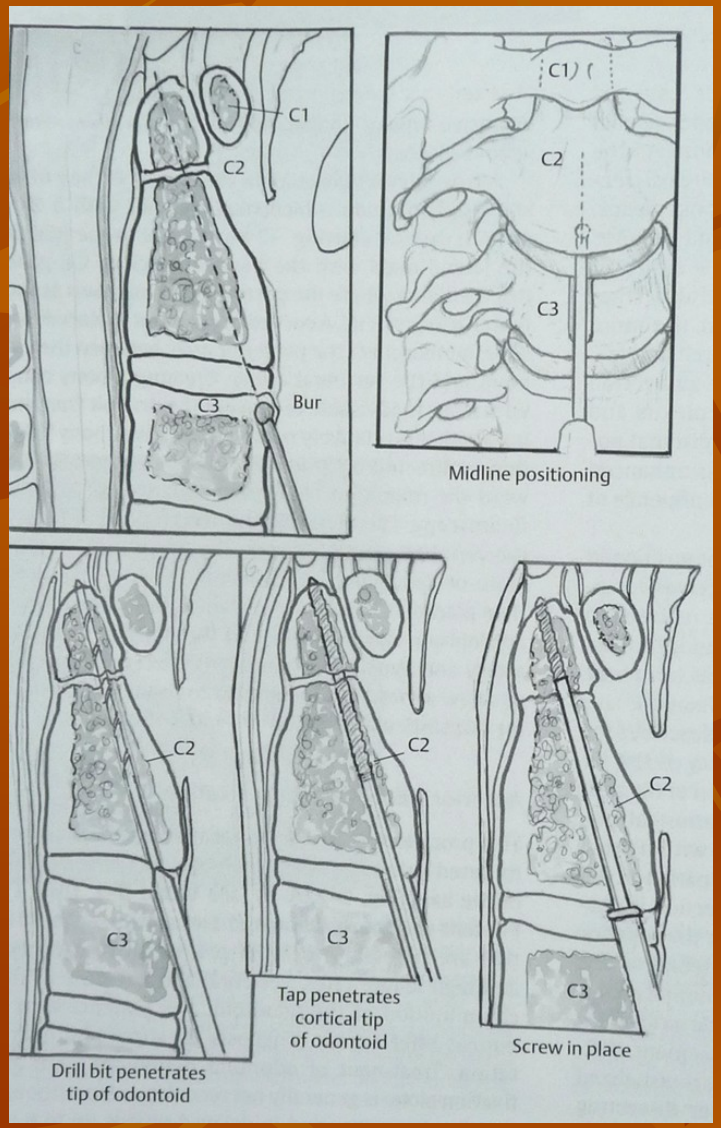
- **Fractured Odontoid C2**
- 20% cervical spine injuries
- More in elderly from simple falls. In younger individuals, may result
- from a blow to the head high speed accidents
- Present with suboccipital pain, neural deficit uncommon, but can
- vary from neuralgia to quadriparesis

- ***Anderson and D'Alonzo Classification***
- Type 1: Only the tip is fractured – essentially an avulsion injury of
- the apical and alar ligaments. Rule out distraction-type injury
- Type 2: Waist fracture – non-union risk increased in: smokers,
- > 5 mm displacement, advanced
- Type 3: Base / Isthmus

- ***Treatment***
- Type 1: orthosis adequate if no distraction injury
- Type 2: consider halo if undisplaced, displaced cases either anterior
- odontoid screw (one or two screws), or posterior C1–C2 fusion
- Type 3: depending on the fracture personality, either Minerva or
- halo, seldom require surgery

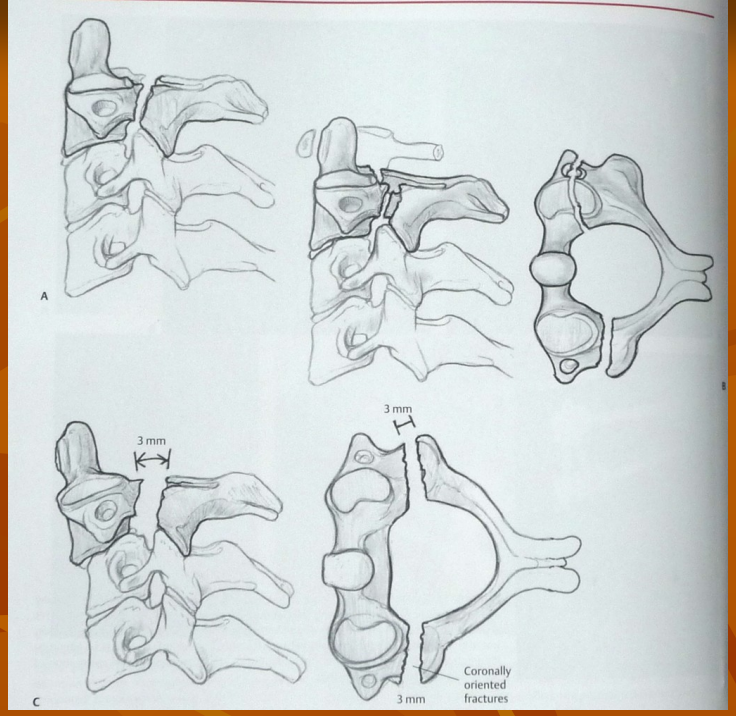





C1
C2
C3
Bur
C1
C2
C3
Midline positioning
C2
C3
Drill bit penetrates
tip of odontoid
C2
C3
Tap penetrates
cortical tip
of odontoid
C2
C3
Screw in place

- Traumatic Spondylolisthesis of Axis (Hangman's Fracture)
- Normal stress on the pars is great because the axis acts as a transition vertebra between the upper and lower cervical spine
- Usual mechanism: involves hyperextension, flexion usually element of axial loading.
- *Treatment*
- Collar, halo-vest for 12 weeks, surgery

(C2–C3 fusion, sometimes posterior C1–C3 fusion)



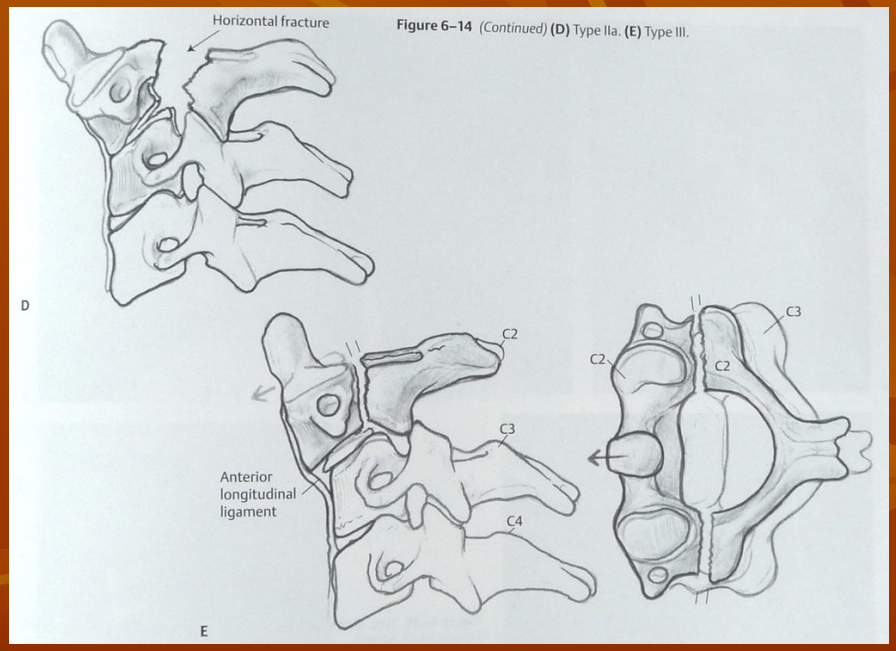
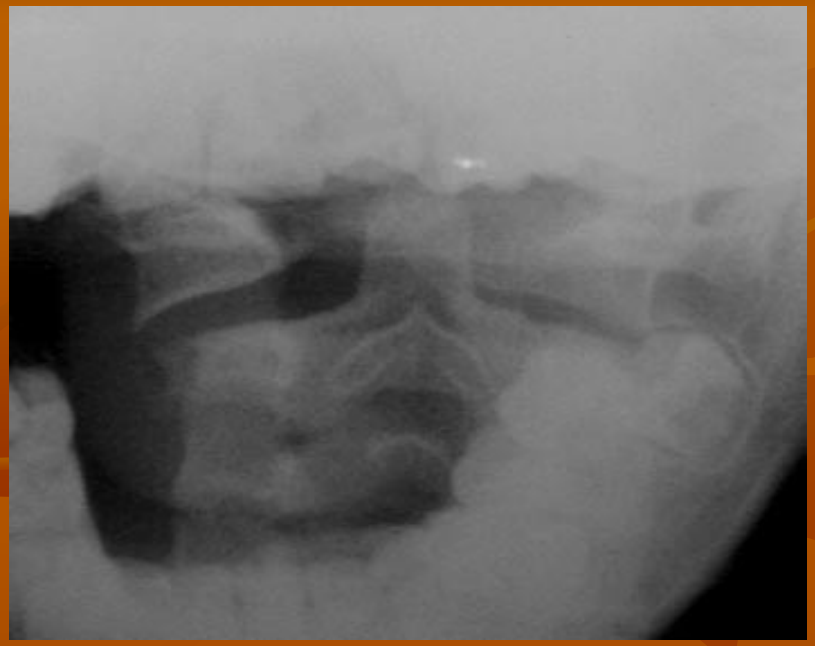
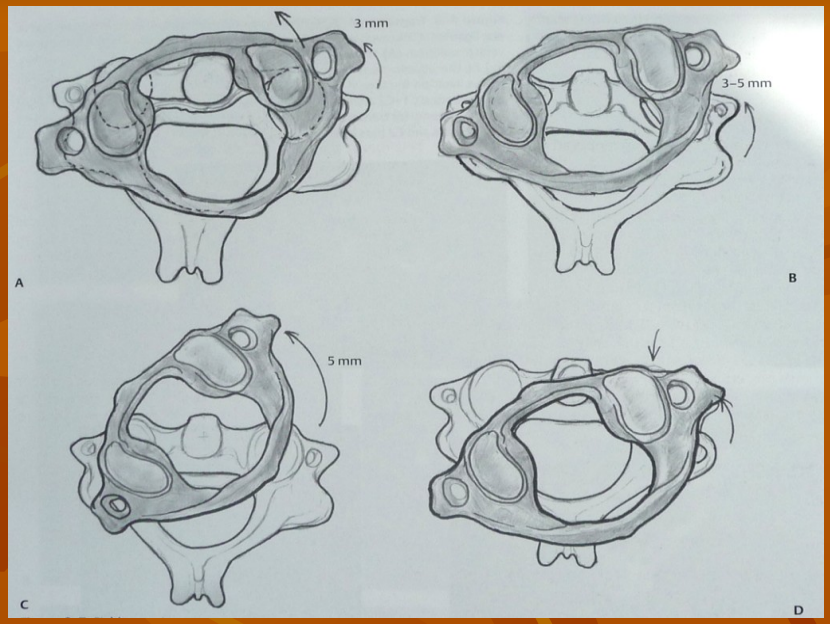


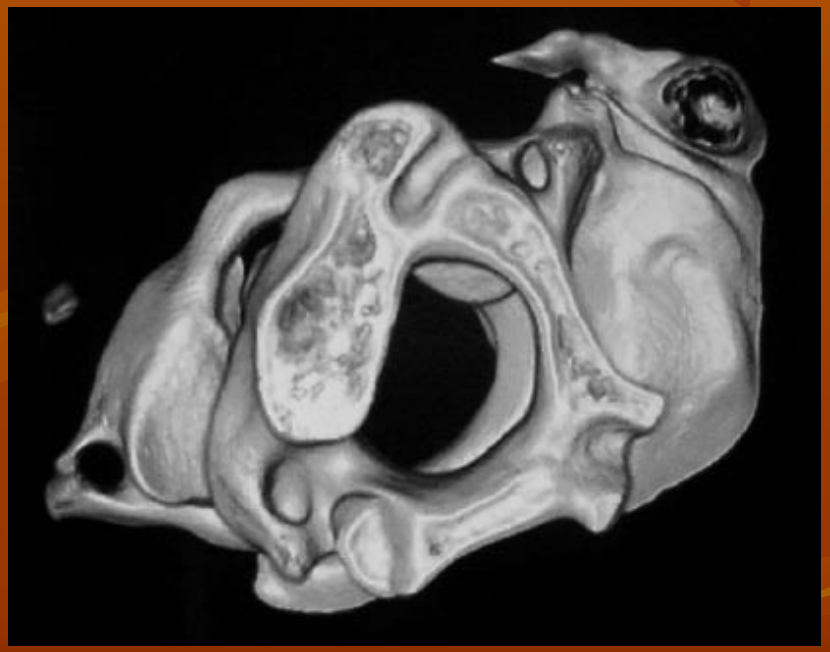
Figure 6–14 *(Continued)* **(D)** Type IIa. **(E)** Type III.

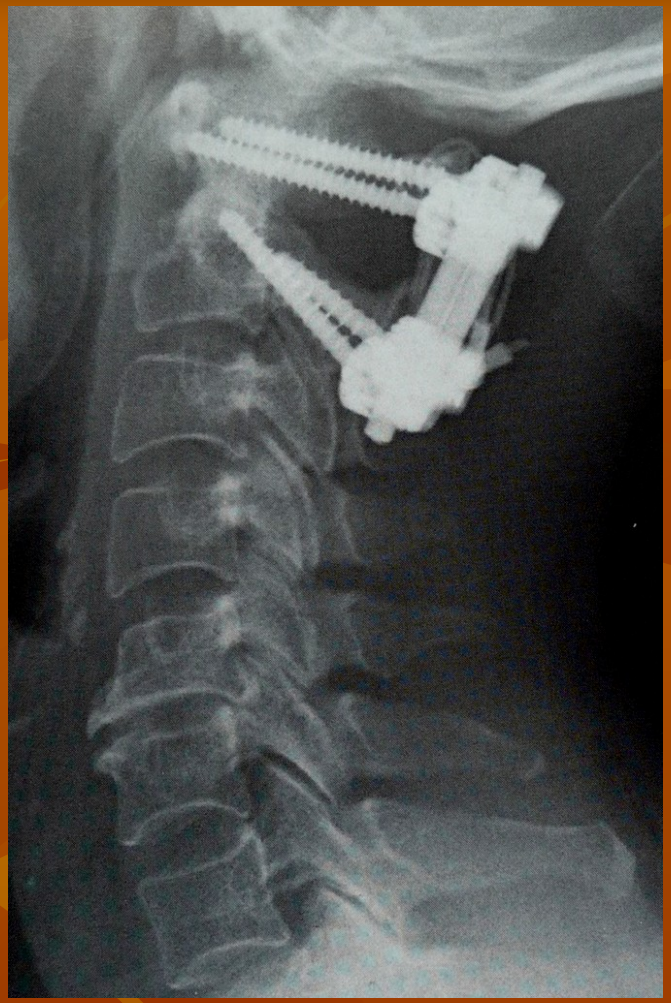

RIGHT
X-TBL

- C1–C2 Subluxation: DDx
- Can be seen with ruptured transverse ligament, or rotatory subluxation
- C1–C2 subluxation may also be associated with atlas or odontoid
- fractures
- *Rotatory Subluxation*
- More often seen in children
- Clinically, the head is tilted towards the side of fixation, while the
- chin is pointed in the opposite direction. Open-mouth X-ray view is
- useful
- *Hawkins and Fielding Classification*
- Type 1: rotational displacement only, no anterior translation
- Type 2: rotational displacement and anterior translation 3–5 mm
- Type 3: rotational displacement and anterior translation >5 mm
- Type 4: posterior translation and rotation




3 mm
3–5 mm
A
B
5 mm
C
D

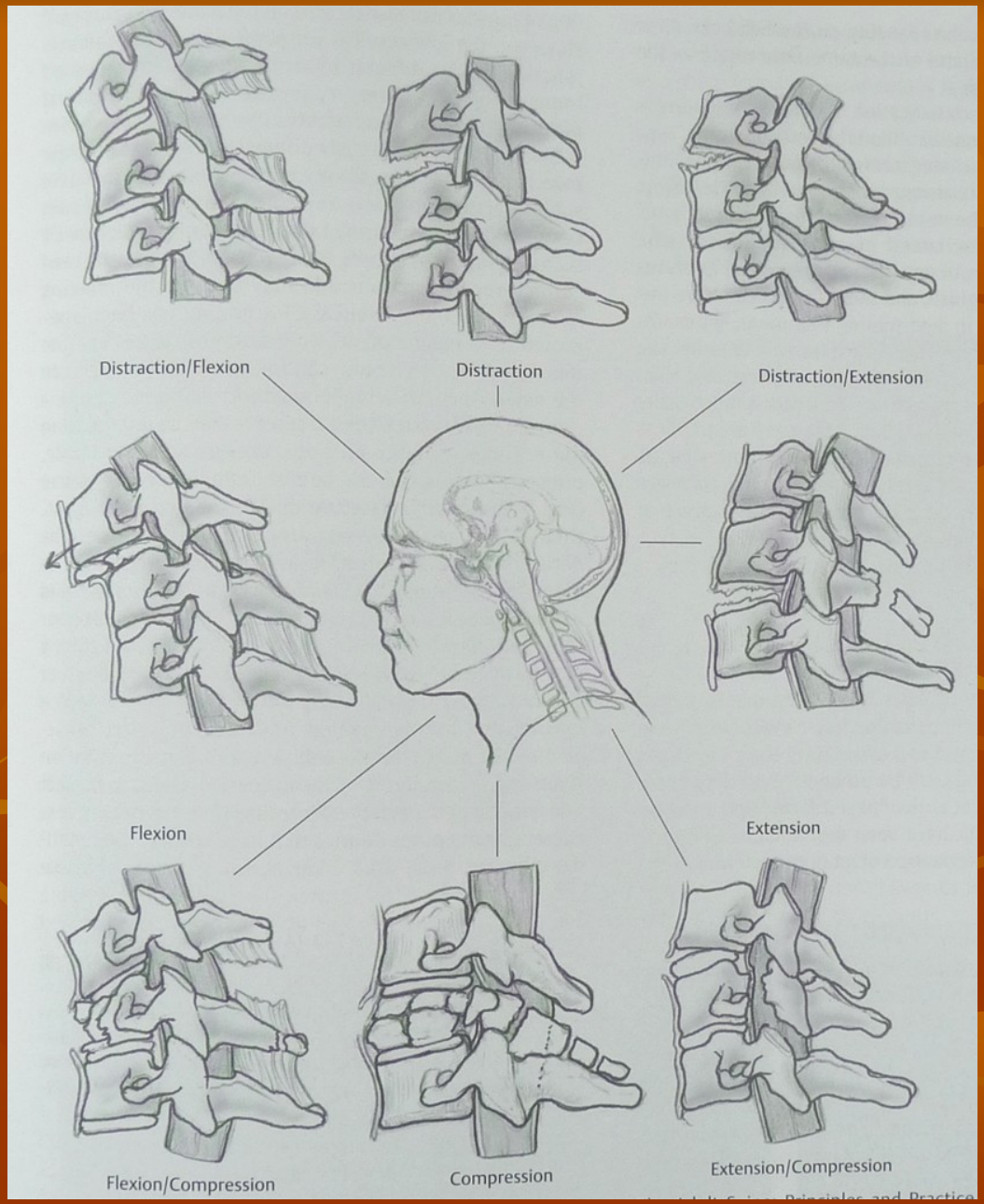


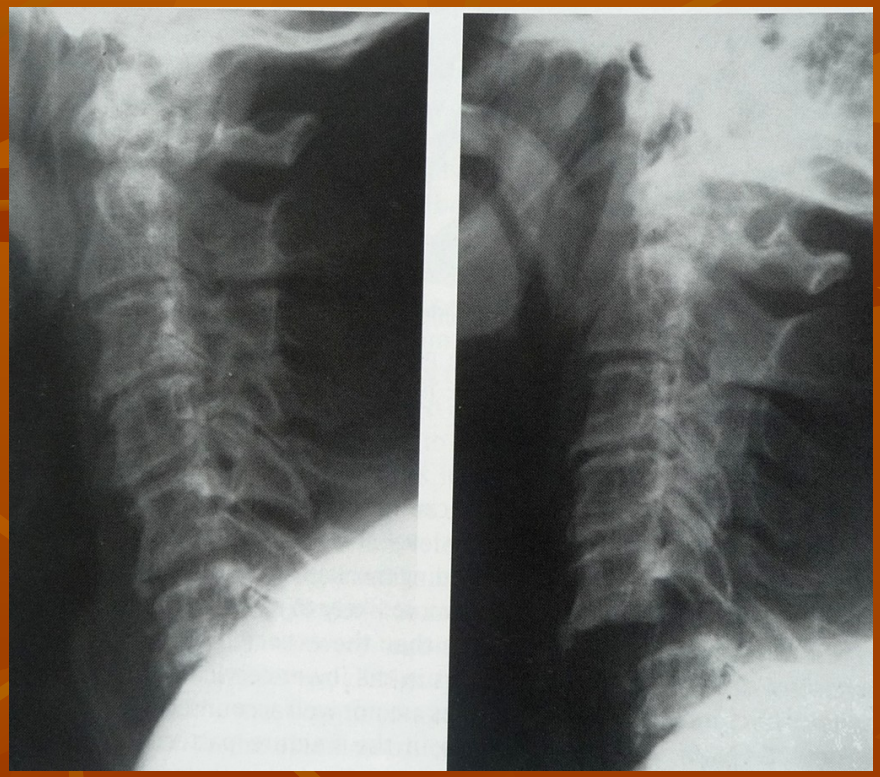


- Injury to the Sub-axial Cervical Spine
- *Normal Structural Constraints*
- Most of the flexion/extension movements of the cervical spine occur at the most mobile segment, C3–C7,
- Resistance to hyperextension is offered by: anterior longitudinal ligament (ALL), annulus fibrosis, anterior two-thirds of the vertebra
- Resistance to hyperflexion is offered by: facets and capsule, ligamentum flavum, the supraspinous and interspinous ligament

- *Criteria for Cervical Spine Instability (Panjabi and White)*
- This was based on biomechanical laboratory experiments on cadavers
- The following parameters are assessed and a score of ≥5 implies instability.
- However, if the spine is obviously unstable (e.g. fracture
- dislocation), no need for such calculations
- Anterior element destroyed or cannot function: 2 points
- Posterior element destroyed or cannot function: 2 points
- Sagittal plane translation > 3.5 mm: 2 points
- Sagittal plane rotation > 11: 2 points
- Positive stretch test: 2 points
- Damage to cord: 2 points
- Damage to root: 1 point
- Abnormal disc narrowing: 1 point
- Anticipate dangerous loading: 1 point

- *Allen's Mechanistic Classification*
- Vertical compression
- Compressive flexion
- Distractive flexion
- Lateral flexion
- Compressive extension
- Distractive extension


Distraction/Flexion
Distraction
Distraction/Extension
Flexion
Extension
Flexion/Compression
Compression
Extension/Compression



- ***Vertical Compression***

- Mostly from diving injuries or car accidents

- *Treatment*
  rigid cervical orthosis, halo immobilisation, operation especially if neural compromise by anterior decompression, grafting and anterior posterior instrumentation frequently added

- ***Compressive Flexion***

  There are five stages in Allen's classification, with increasing vertebral compression/comminution, and disruption of the posterior tension band.

- Caused by axial loading injuries as in diving and vehicle collisions

- *Treatment*
  cervical orthosis, halo immobilisation anterior decompression, bone grafting and instrumentation. (Posterior stabilisation considered if significant disruption of the posterior tension band)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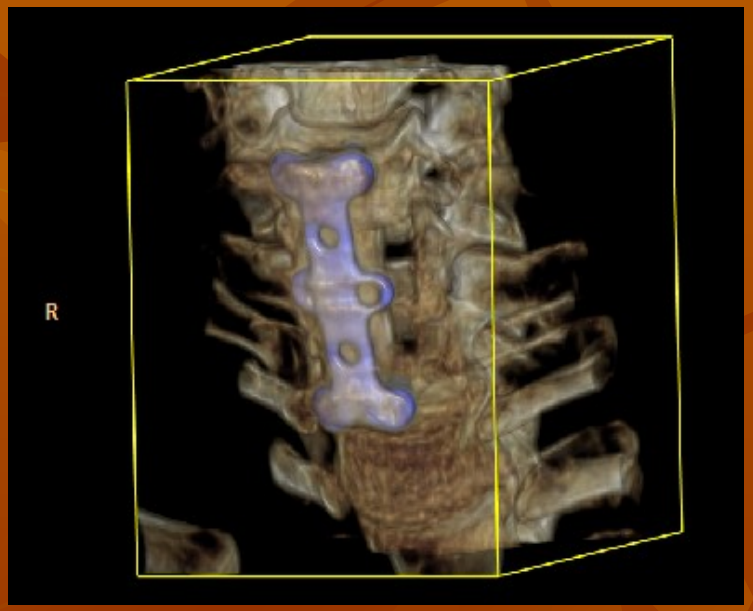

R

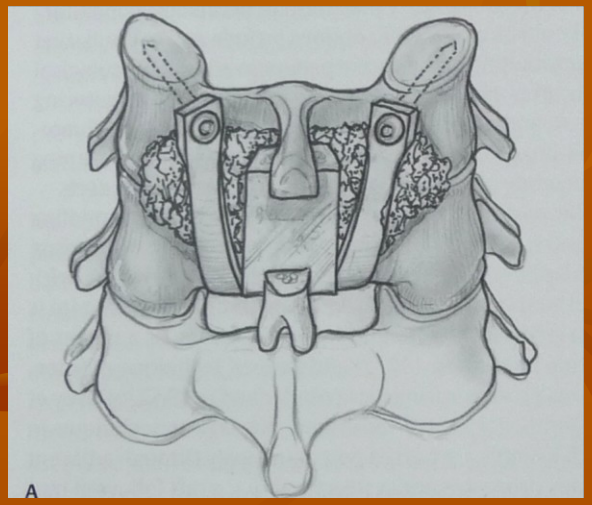
- ***Lateral Flexion***
- Stage 1: ipsilateral fracture of the centrum and posterior arch
- Stage 2: ipsilateral fracture of the vertebral body and contralateral
- bone/ligament failure
- Most of these injuries need traction reduction and surgical stabilisation

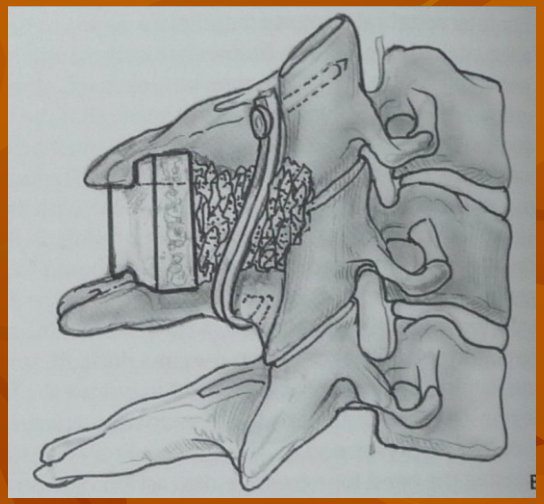
- ***Compressive Extension***

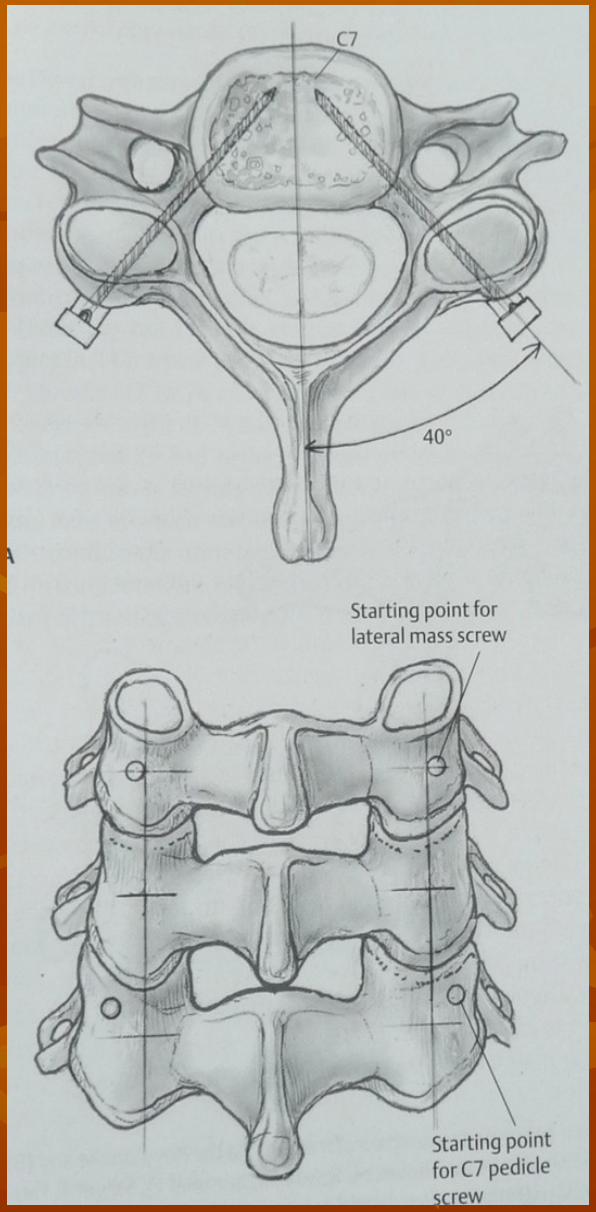
- Most severe end of the spectrum involves fractured vertebral arch
- and 100% anterior displacement of the vertebral body. Fracture dislocations need combined anterior and posterior surgery

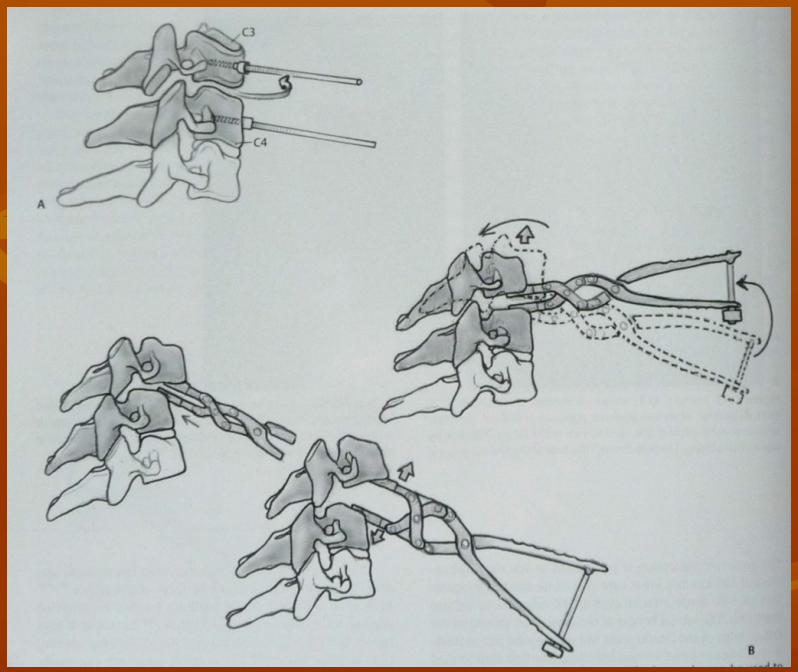
- ***Distractive Extension***

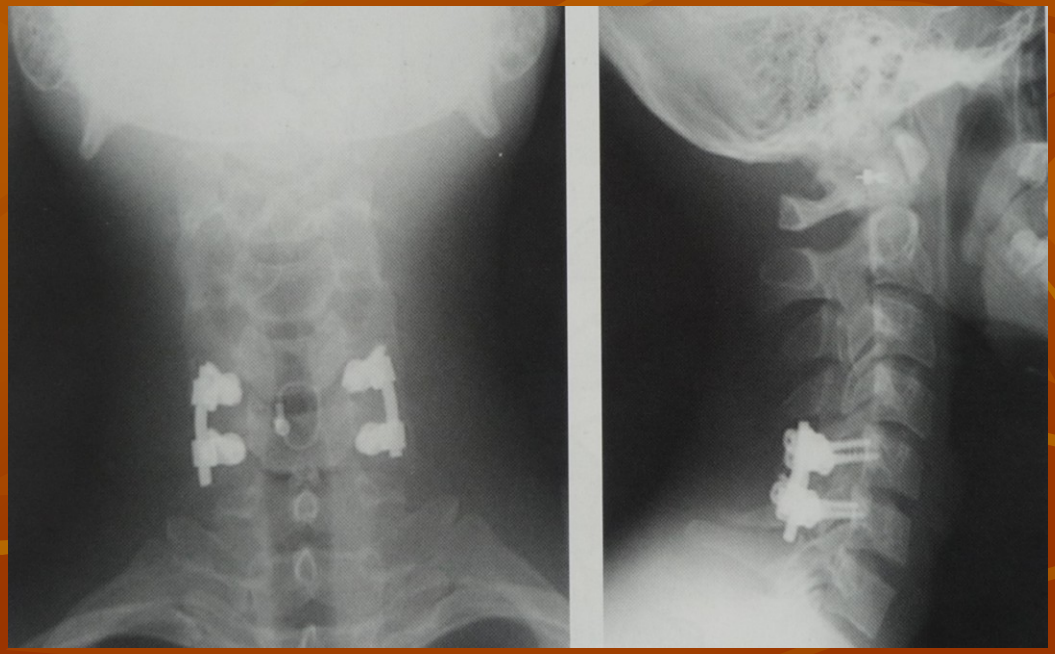
- Characterised by a spectrum of disruption of anterior constraints
- (ALL and anterior annulus) to the posterior annulus and
- posterior longitudinal ligament (PLL). May try halo, especially if
- bony rather than ligamentous failure is involved. Operative fixation
- usually involves plating and anterior reconstruction


A


B


C7
40°
A
Starting point for lateral mass screw
Starting point for C7 pedicle screw


C3
C4
A
B



- **Thoracolumbar Fractures**
- It is commonly mentioned that most thoracolumbar injuries result from high energy trauma
- While this is still true, be aware of the sharp rise in the incidence of wedge compression fractures in the elderly osteoporotic population.

- Three Functional Regions
- Thoracic spine: stability enhanced by the rib cage, but has a narrow canal and blood flow watershed near the mid-thoracic spinal cord.
- Hence, although thoracic fracture is less common than in the other two regions, there is a higher chance of cord injury if fracture occurs.
- The cord:canal ratio is 40% for the thoracic spine, compared with 25% in the C-spine
- Thoracolumbar junction: region of high stress as there is change in sagittal profile and the spine transitions from the stiff thoracic region to the mobile lumbar region; 50% of fractures occur in this region.
- Depending on the location of the conus, neural injury can present as upper or lower motor neuron pattern or mixed. The relative incidence of thoracolumbar fractures according to Gertzbein: T1–T10 16%, T11–L1 52%, L1–L5 32%
- Lumbar spine: notice L3–L5 vertebrae lie below the pelvic brim with added stability from the iliolumbar ligament. For this and other reasons, the success rate of non-operative treatment of fractures in this region is higher than at the TLJ. Neural deficit is seldom complete because of wider spinal canal, and the cauda equina is more resistant to compression than the cord.

- Clinical Assessment
- Assess vital signs and general assessment
- Local spinal assessment of the acute trauma patient follows the ATLS
- protocol, remember to log roll the patient, check for palpable steps,etc.
- Assess any neurological deficit and carry out per rectum examination
- Associated injuries (of the axial skeleton or otherwise) are common in those suffering from high energy trauma

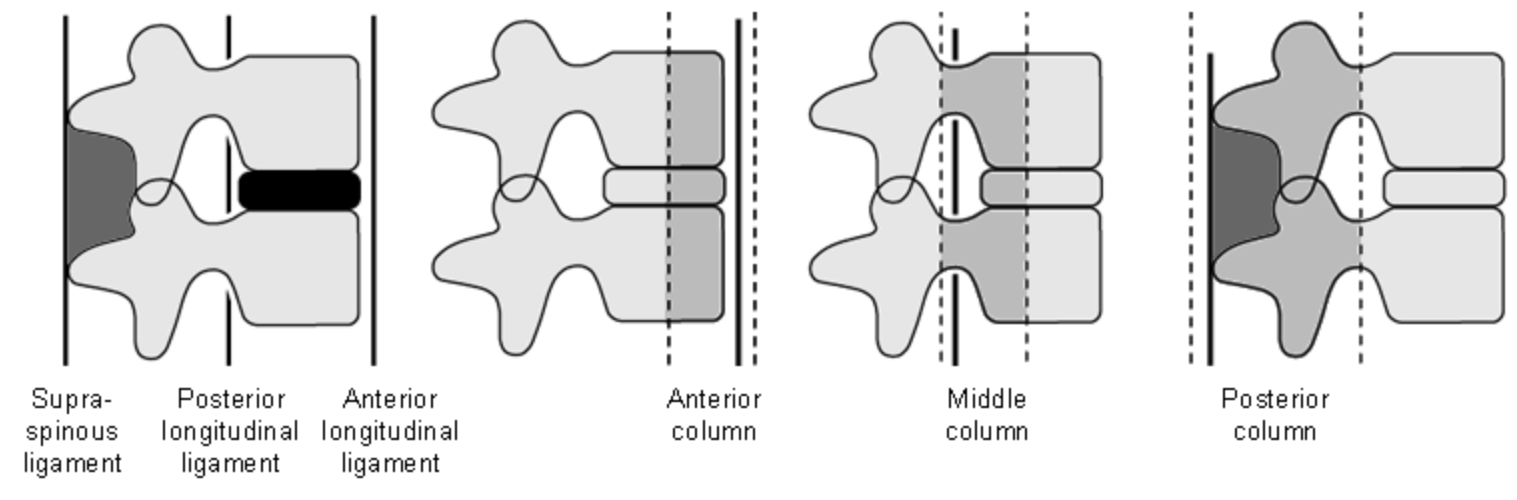
- Radiological Assessment
- X-ray: assess overall coronal and sagittal alignment, soft tissue
- shadows,
- amount of vertebral height loss and of translation or rotation.
- Check the posterior vertebral line or profile to detect any middle column involvement. X-ray of the entire spine in two views recommended in high energy trauma
- CT: good to see bony details, e.g. useful in assessing the middle column in suspected burst fracture, assessing the degree of retropulsion,
- MRI: good to assess ligamentous injuries, e.g. suspected ligamentous chance fractures; and for assessing spinal cord injuries


H
F

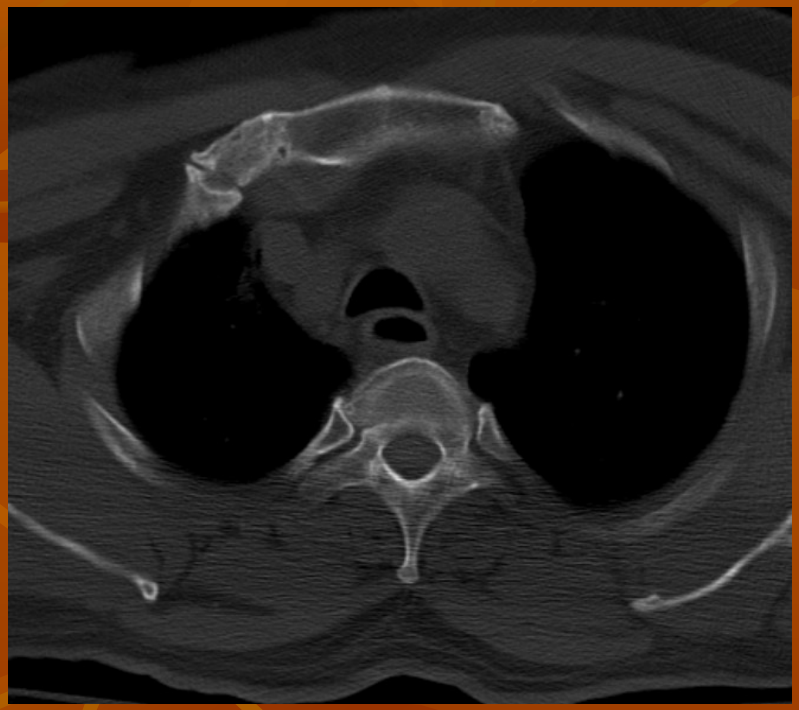

H

Denis Concept of Three Columns

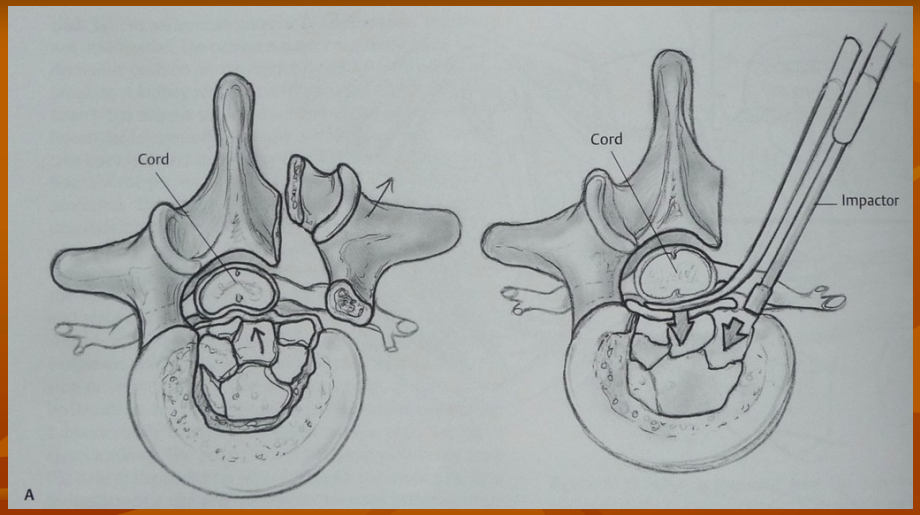
- Anterior column: include mainly the ALL, anterior vertebral body,
- anterior annulus
- Middle column: includes mainly the PLL, the posterior vertebral
- body and posterior annulus
- Posterior column: includes mainly the posterior capsuloligamentous complex, facet, pedicles

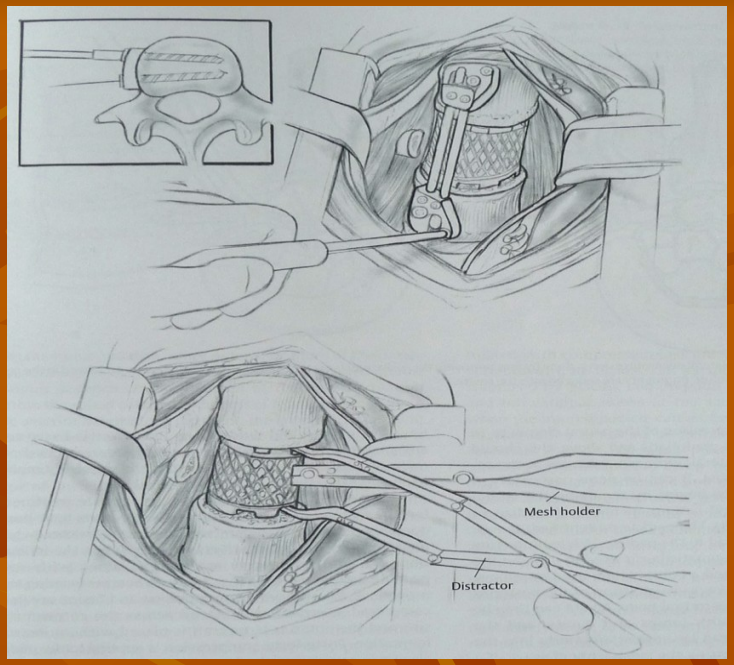


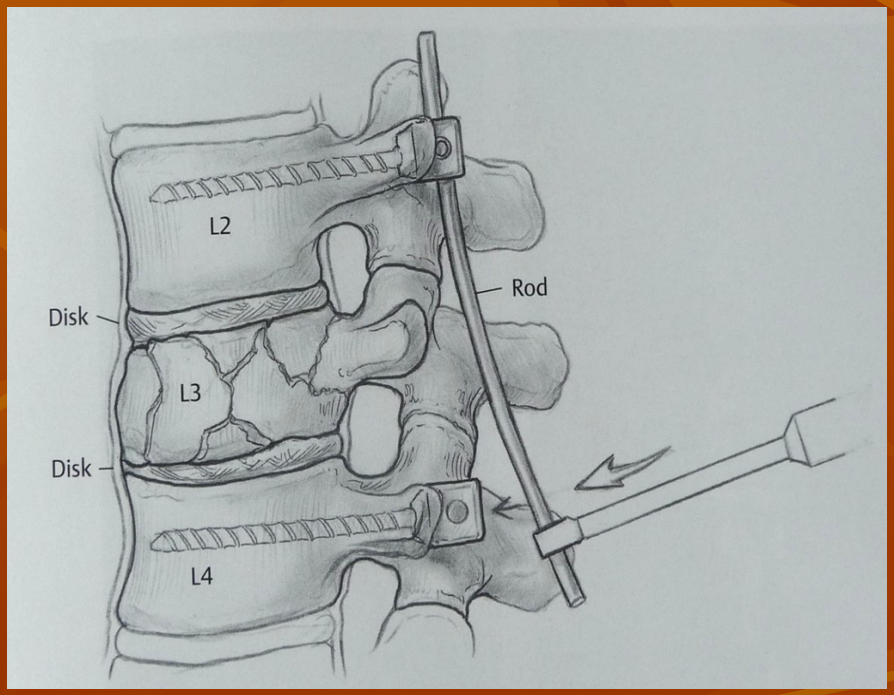
- What Constitutes Instability?
- It is clinically useful to consider instability being present
- if: Marked neurological deficit (some spinal fractures or subluxations can spontaneously reduce after injury. If, during the moment of impact, the spine deforms sufficiently to cause significant injury to the neural elements, it is highly likely the spine is unstable)
- Risk of deformity progression (radiologic clues include: >25− kyphosis,
- >50% vertebral height loss, >40% canal compromise)
- ≥ Two Denis's columns disrupted, especially if the middle column is not intact

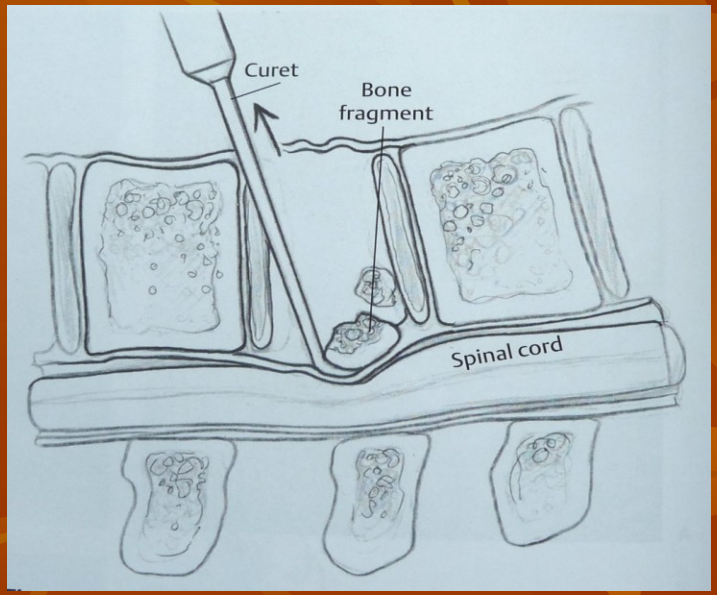


- Goal of Treatment
- Correction or prevention of further deformity
- Restoration of stability
- Neural decompression if necessary
- If fusion anticipated, attempt to achieve stability with fusion of as few as possible motion segments
- General Approach
- Classify the fracture
- Can the fracture be treated conservatively?
- If operation required, what approach should we use?
- What are the deforming forces, and how can we go about reducing
- the fracture?
- What instrumentation is needed, if any?


Cord
Cord
Impactor
A


Mesh holder
Distractor


L2
Rod
Disk
L3
Disk
L4

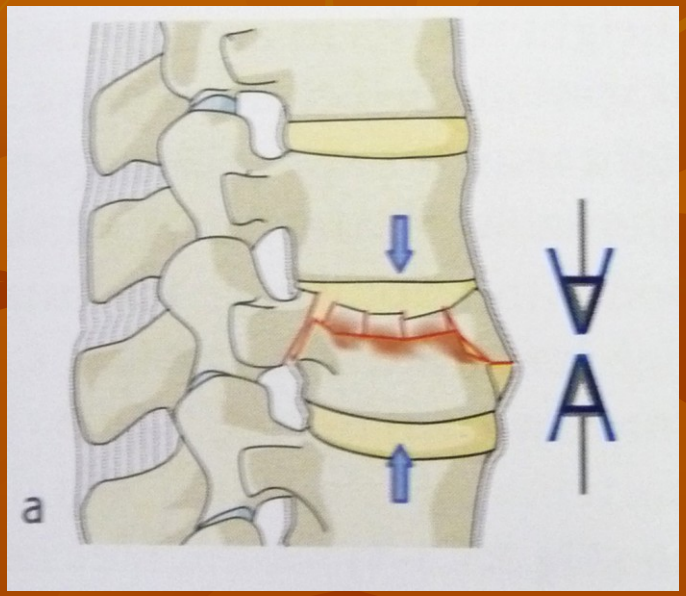

Curet
Bone
fragment
Spinal cord

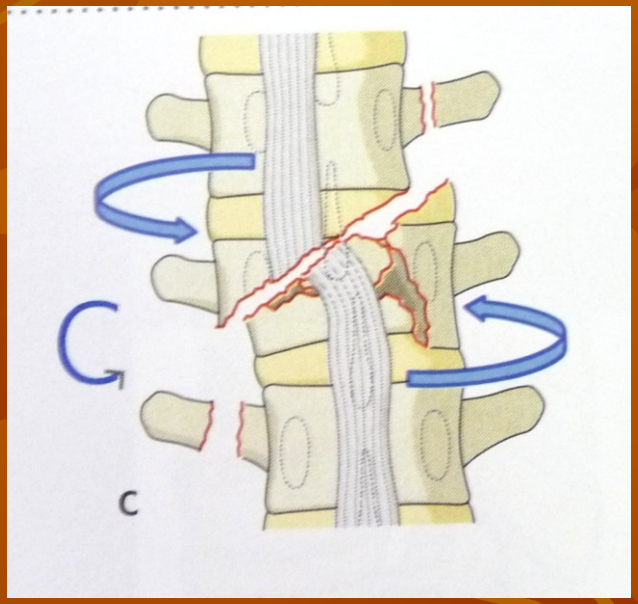
Classifications

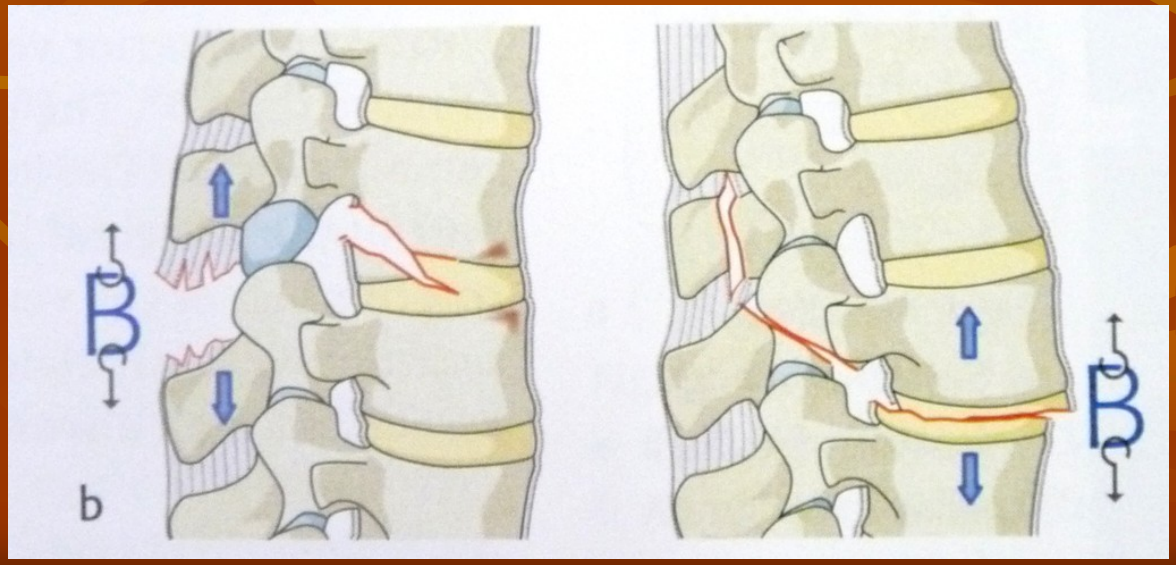
- *Denis Classification (an X-ray Classification)*
- Minor injuries: include fracture of transverse process, spinous process, pars, facet articulations, etc.
- Major injuries:
- Compression fracture
- Burst fracture
- Flexion distraction injury
- Fracture dislocation

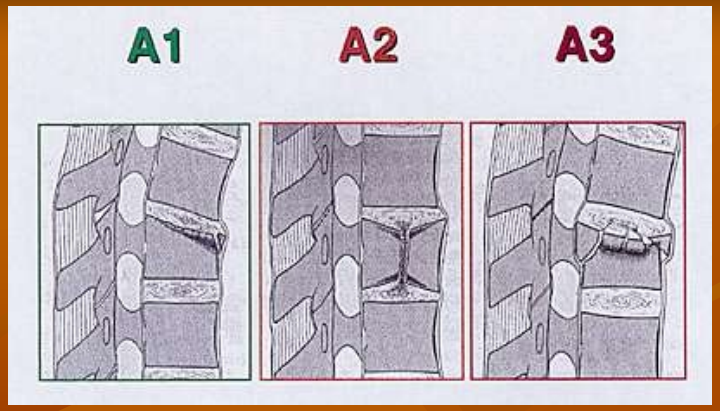
- *McAfee Classification (a CT Classification)*
- Wedge compression fracture
- Stable burst fracture
- Unstable burst fracture
- Chance fracture
- Flexion distraction injury
- Translational injury

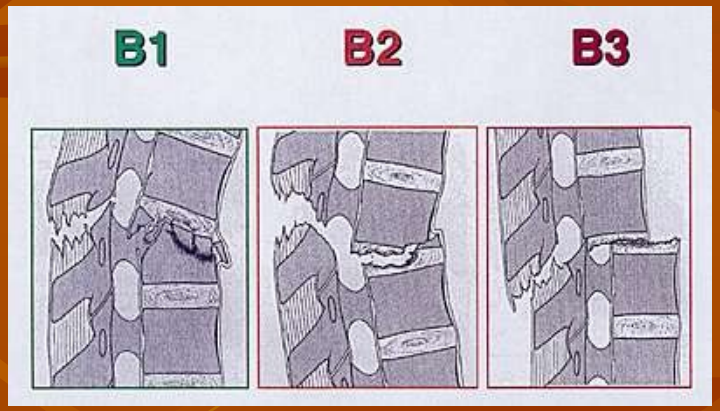
AO classification

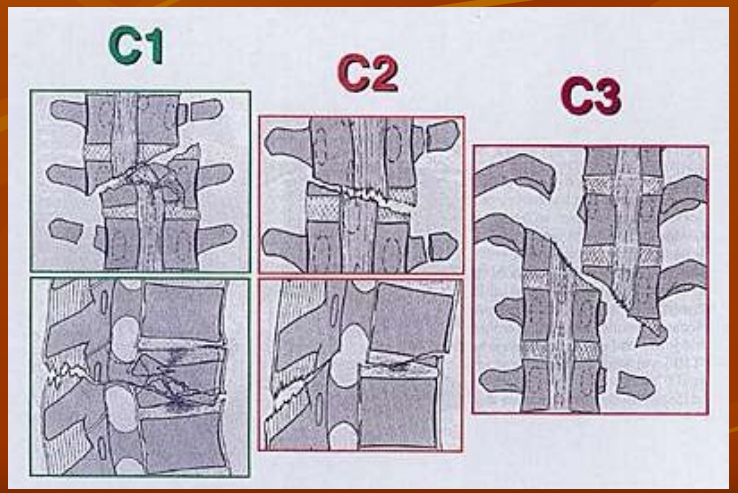










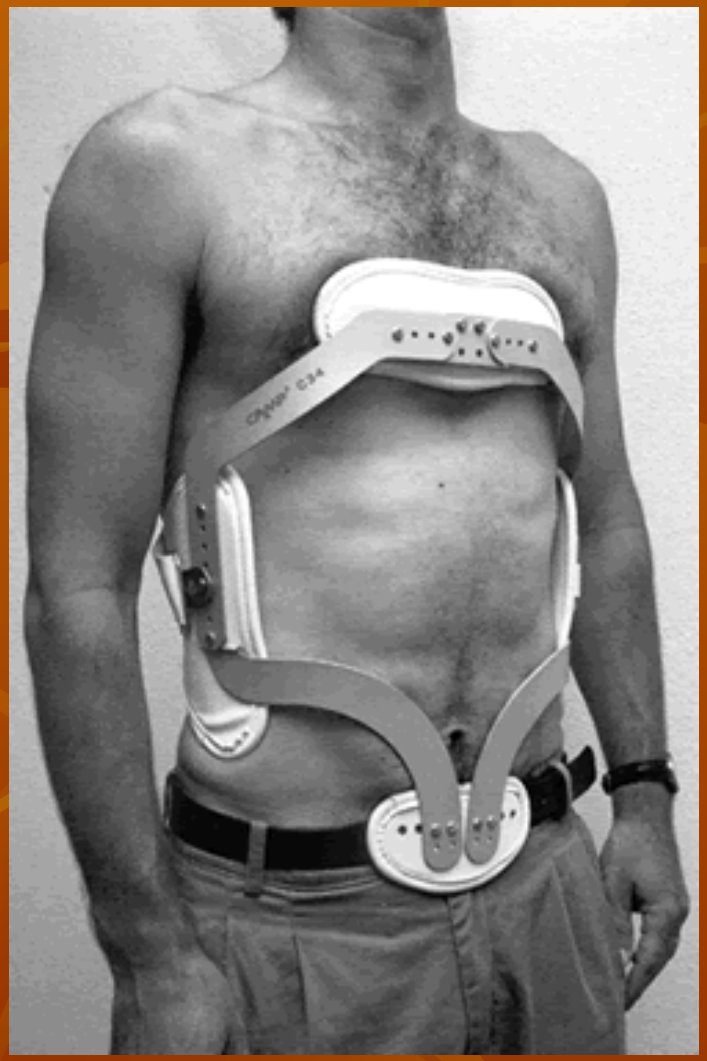


Type A, vertebral body compression injury :
A1, vertebral body wedge impaction fracture
A2, split fracture
A3, comminuted fracture or burst fracture.

Type B, anterior and posterior element injuries with distraction :
B1, predominantly ligamentous posterior flexion-distraction injury;
B2, predominantly osseous posterior flexion-distraction injury;
B3, injury involving hyperextension and shearing through the disc.

Type C, anterior and posterior element injuries with rotation :
C1, type A injury with rotation;
C2, type B injury with rotation;
C3, oblique fracture with rotational shear

- Conservative Versus Surgical Treatment
- The previously mentioned concept of instability is very useful here
- Most thoracolumbar fractures can in fact be treated conservatively,especially if there is no significant deformity or neurological deficit
- A recent study in a group of stable burst fracture patients without neural deficit revealed comparable clinical outcome with either conservative or operative treatment



- ***Anterior, Posterior or Combined Approach***
- *Indication for anterior approach*:
- Sizable retropulsion fragments causing anterior compression.
- Delayed situations when indirect reduction from posterior approach difficult (thoracolumbar approach for TLJ fractures, retroperitoneal approach for lumbar fractures)
- *Indication for posterior approach*: chance fracture, flexion distraction injury, some unstable burst fractures
- *Combined approach*: fracture dislocation cases, some ligamentous chance fractures

approaches

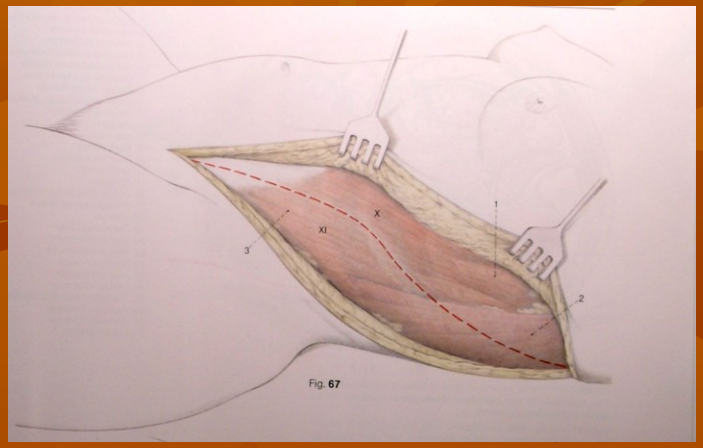
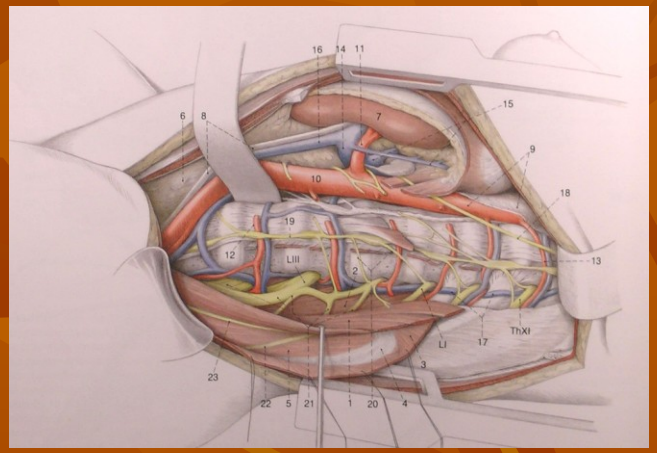
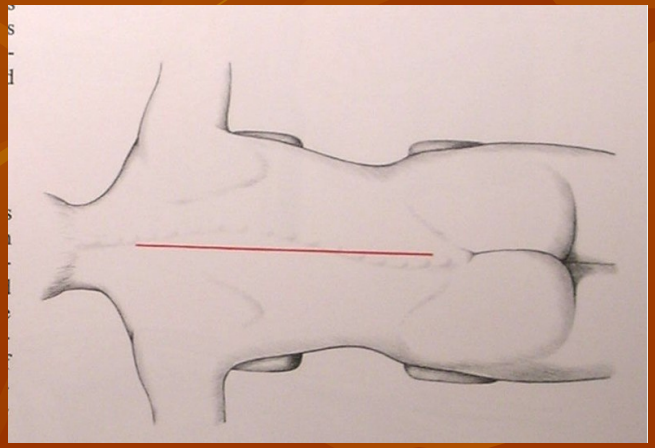
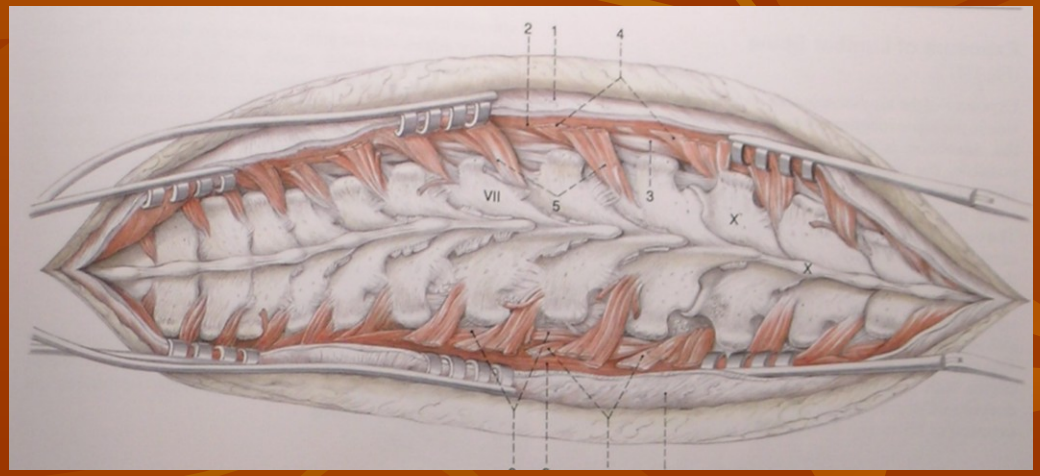
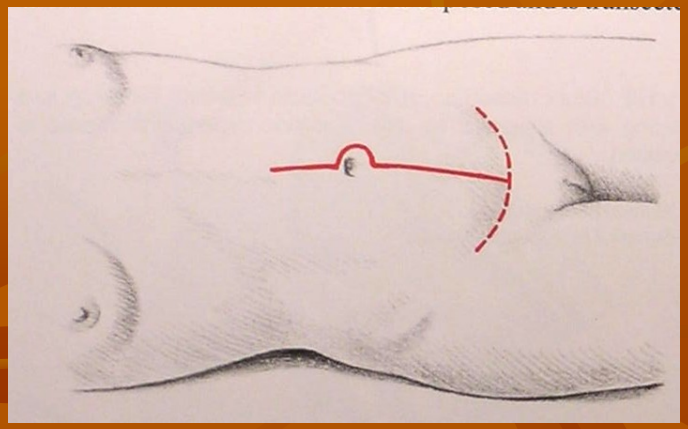


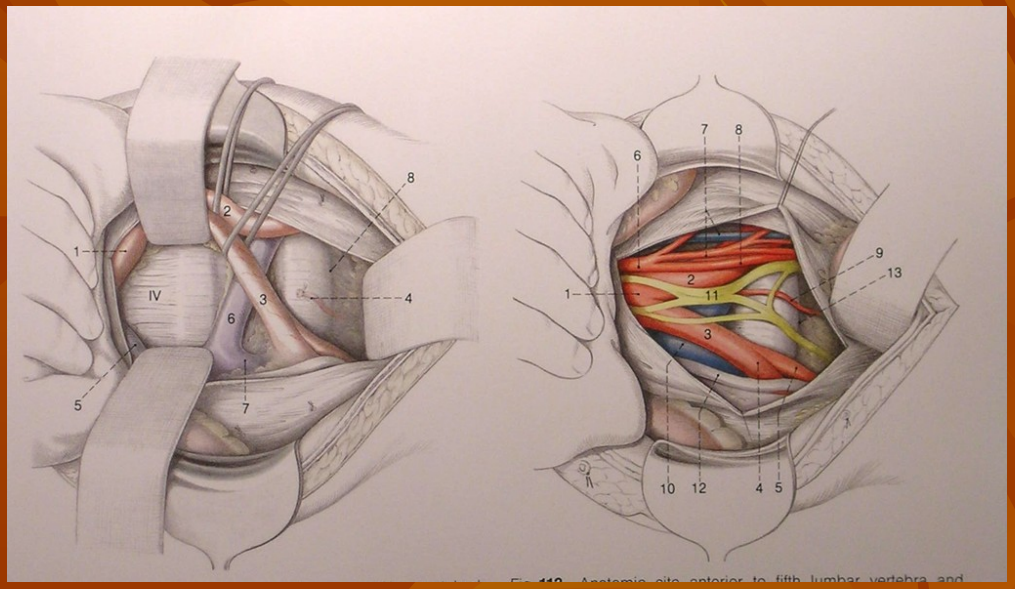
Fig. 67







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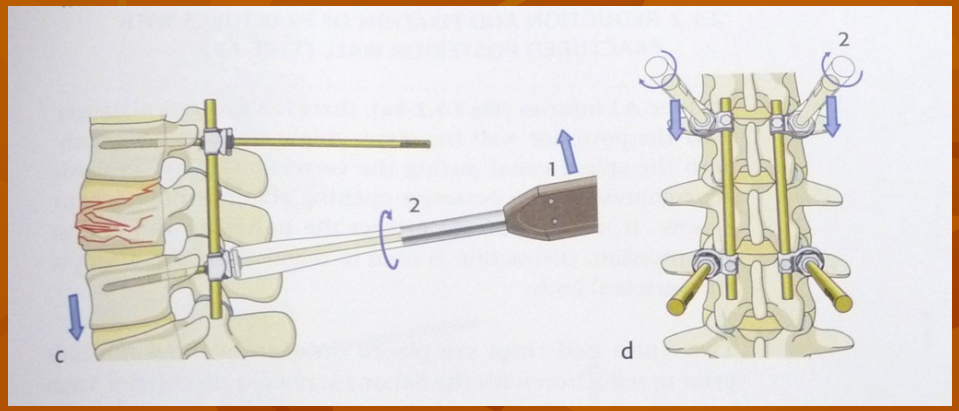
- Selection of Instrumentation
- *What Is the Preferred Posterior Lumbar Fixation?*
- Most posterior instrumentation nowadays uses segmental pedicle screw fixation since it has superior stability as it stabilises all three columns, spans fewer segments and is easier to restore an element of lordosis. If short segment of the spine is spanned, use of cross-links is recommended to confer torsional stability
- *Instruments for Anterior Fixation*
- Commonly used constructs for anterior instrumentation include: Plate-style systems, and rod-style systems,anterior fusion cages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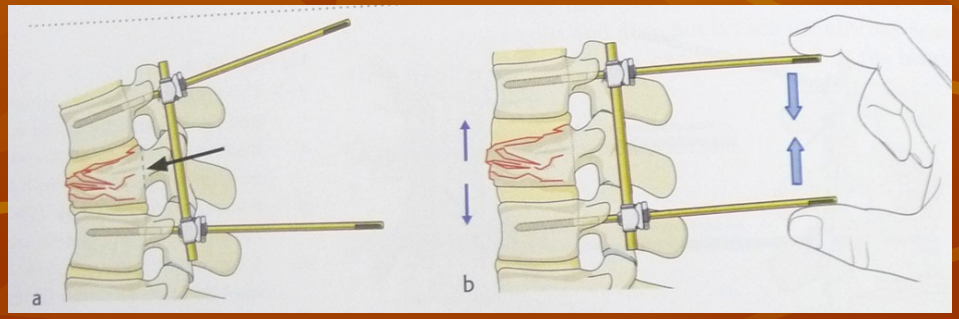
a
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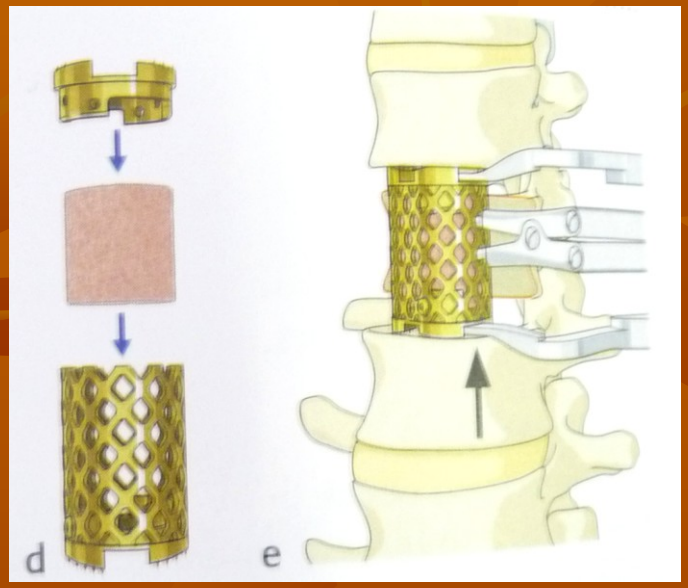
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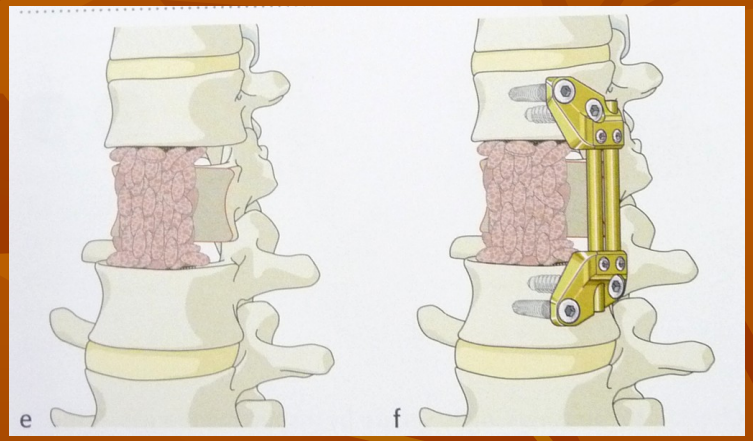
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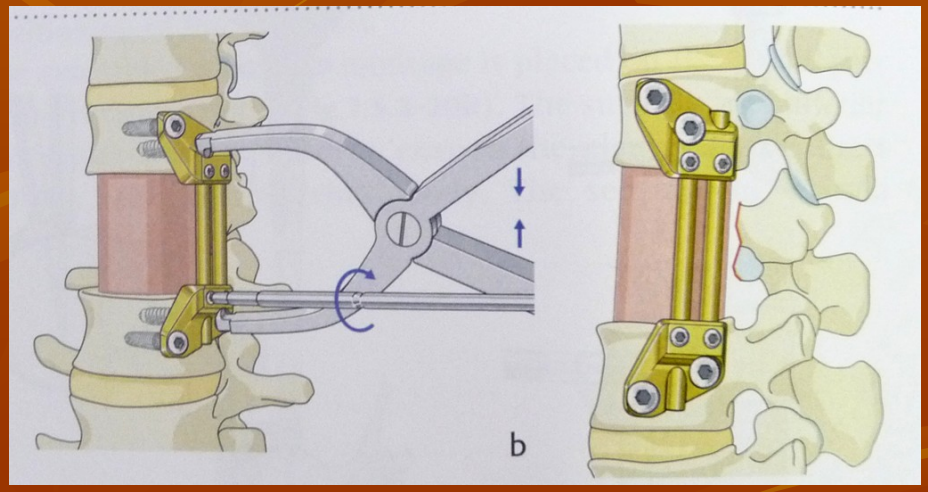
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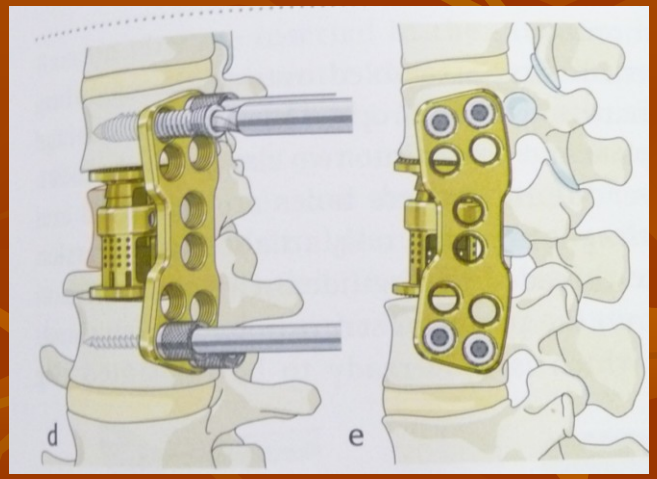
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- *Minor Fractures*
- Minor injuries include fracture of transverse process, spinous process, facet articulations, etc.
- According to Denis, most of these are adequately treated by conservative means such as thoracolumbosacral orthosis (TLSO)
- *Wedge Compression Fractures*
- Mostly occur in osteoporotic elderly, especially females
- Most can be treated conservatively, but a handful with failed conservative treatment may benefit from vertebroplasty or kyphoplasty,provided there is no contraindication

- *Vertebroplasty and Kyphoplasty*
- *Introduction: Osteoporotic Vertebral Fractures*
- Vertebral fracture is the most common of the fragility fractures
- It is not without morbidity, which includes:
- Kyphosis and loss of proper sagittal alignment
- Pain
- Loss of height
- Effect on pulmonary function especially if the thoracic vertebrae are involved

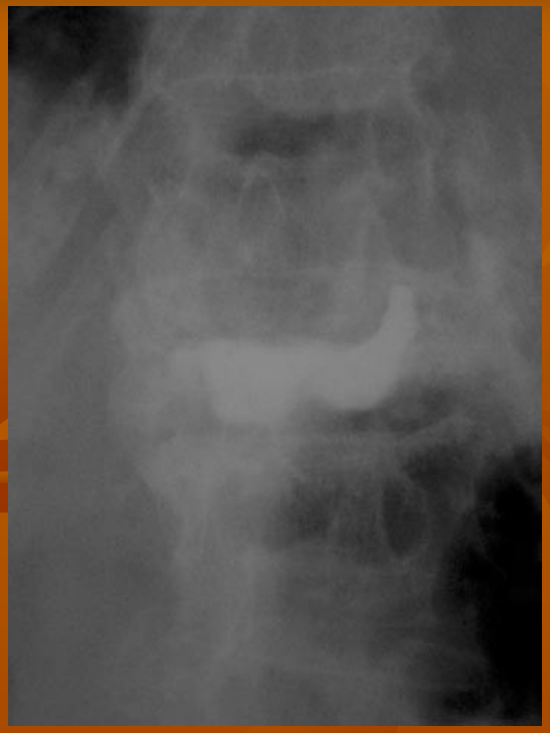
- *What is Vertebroplasty?*
- Vertebroplasty is a surgical procedure in which bone cement is injected
- into a usually collapsed, compressed (osteoporotic) vertebral
- body
- The procedure was first described by French surgeons. The cement is
- injected at high pressure via an 11-gauge needle through the pedicles
- under screening by biplanar fluoroscopy

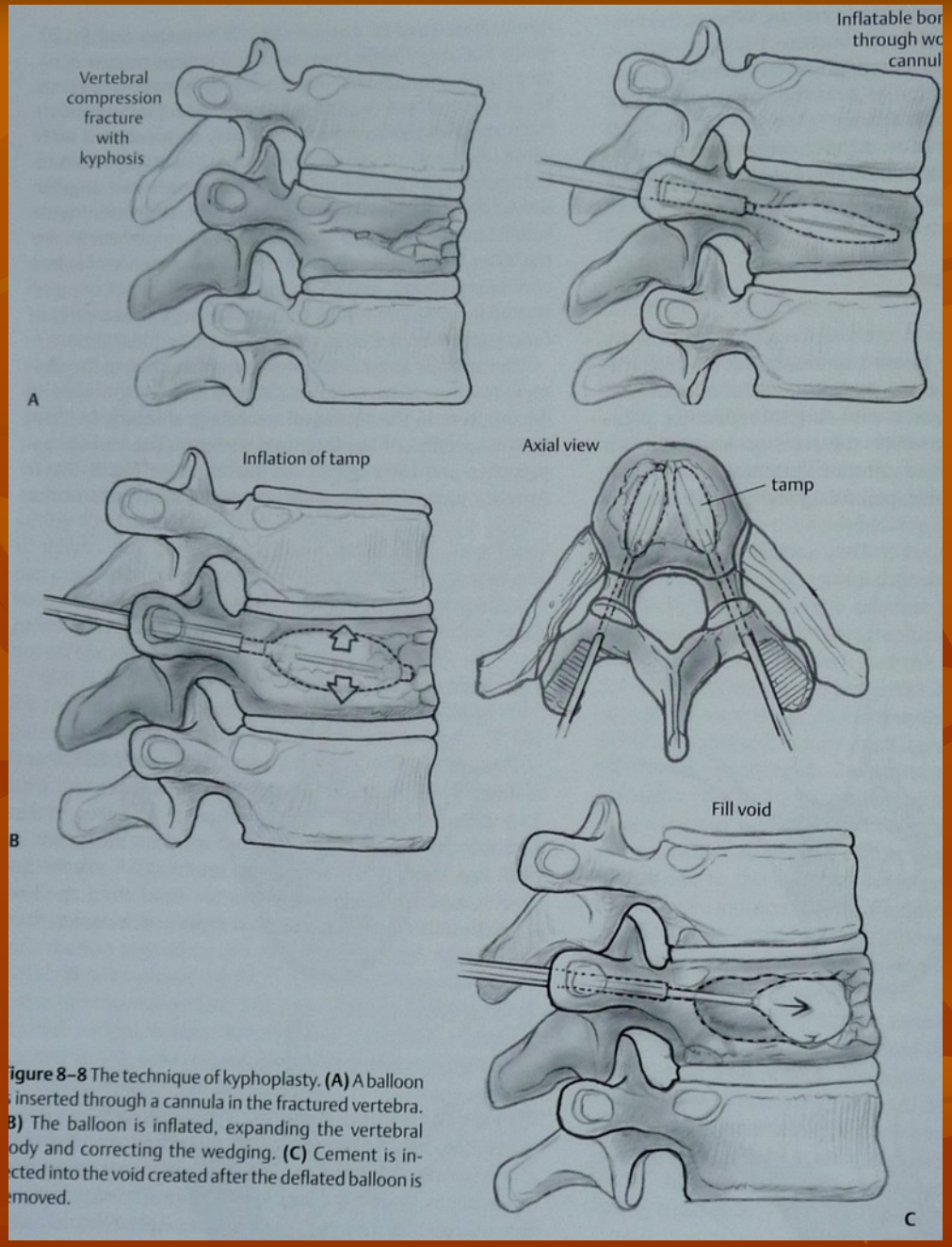
- *What is Kyphoplasty?*
- Essentially similar procedure to vertebroplasty
- The Kyphon Inc. company developed a “bone tamp” that can be inserted through a cortical window via a trans-pedicular route or through the body to attempt reduction of the compressed vertebra
- Reduction is not always straight-forward since conservative treatment is administered for 4–6 weeks before such procedures are underataken, and reduction may not be easy after 6 or more weeks.
- Most successful cases can thus only effect partial reduction

- *Indications for Vertebroplasty and Kyphoplasty*
- Failed conservative management 4–6 weeks
- Clinical pain location corresponds with radiologic abnormalities
- Pathologies that can be so treated:
- Osteoporotic vertebral collapse

- *Advantages of Vertebroplasty*
- Reliable and quick pain relief (within hours)
- Improved force transmission, Early mobilisation, Early hospital discharge

- *Complications of Vertebroplasty*
- Neurological Cx: e.g. radiculopathy
- Cement extravasation into spinal canal
- Cement intravasation as pulmonary emboli and hypotension
- Allergic reactions
- Fractured pedicle or rib reported
- Pneumothorax
- Sepsis
- Epidural haematoma in patients with coagulopathy





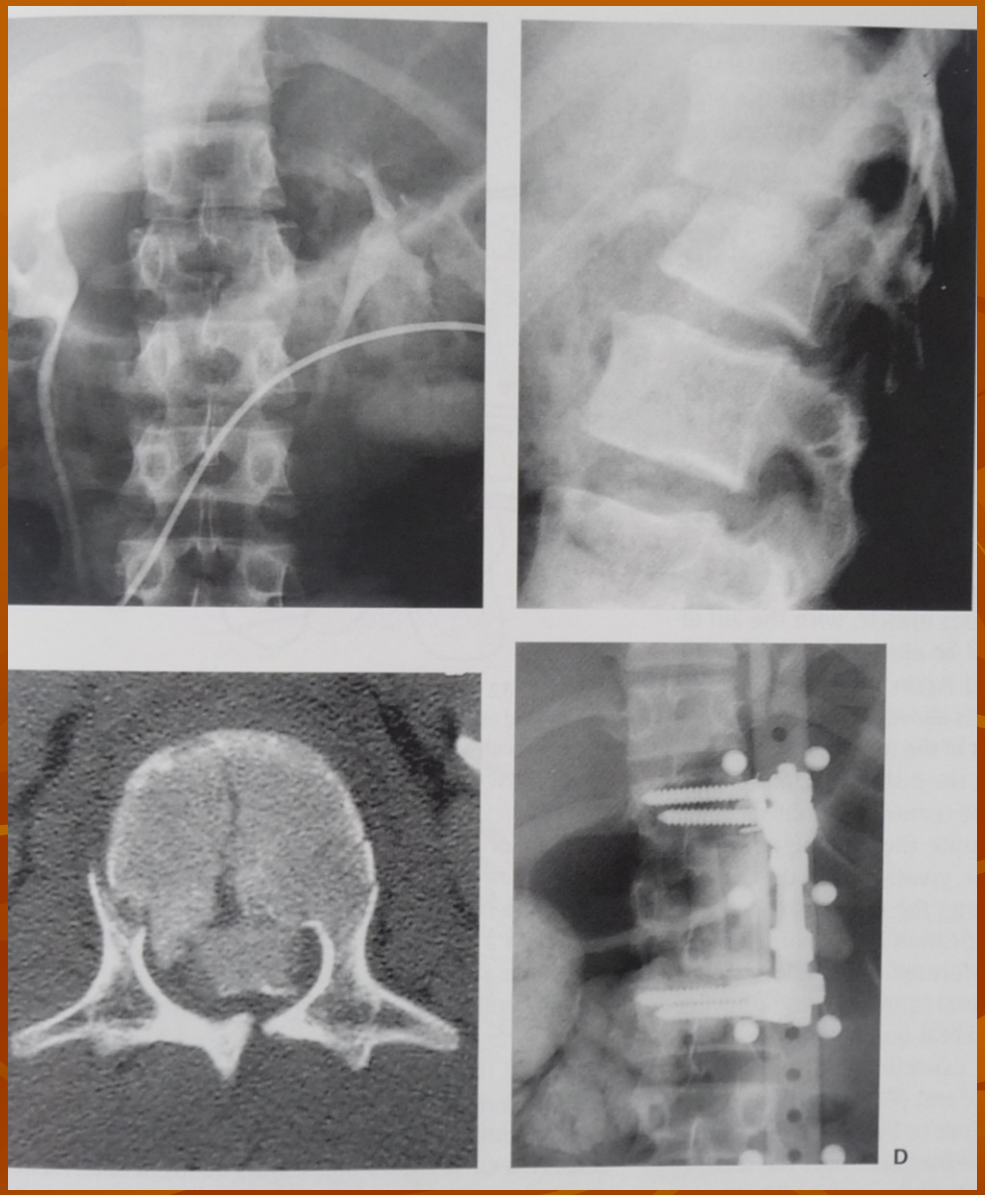
igure 8–8 The technique of kyphoplasty. **(A)** A balloon inserted through a cannula in the fractured vertebra. **B)** The balloon is inflated, expanding the vertebral ody and correcting the wedging. **(C)** Cement is in- cted into the void created after the deflated balloon is moved.

- *Stable Burst Fractures*
- Feature: besides anterior column compressive failure, there is by definition involvement of the middle column
- Radiologically, increased inter-pedicular distance is seen on the AP X-ray; look for a contour disruption of the posterior vertebral
- line on the lateral X-ray. CT is useful in assessing burst fractures

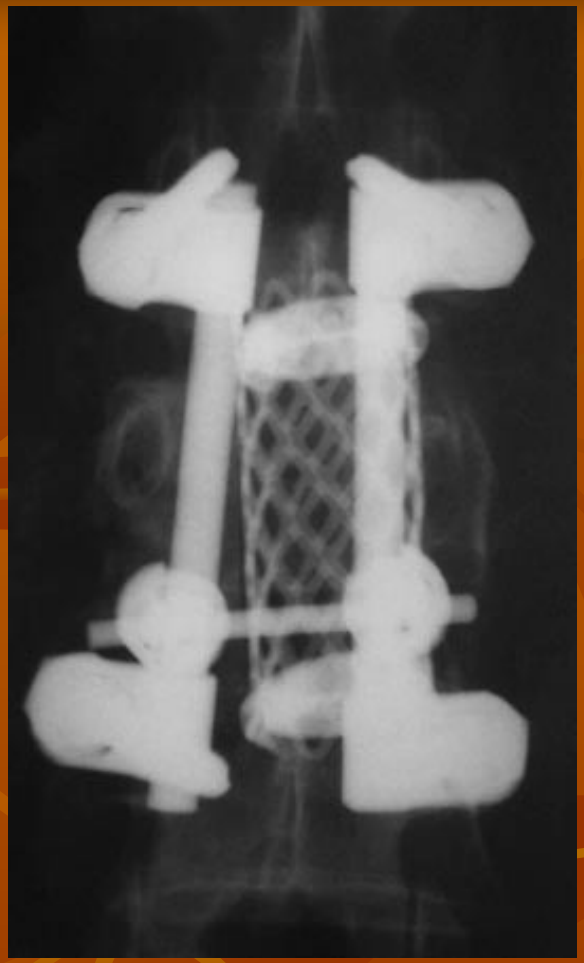
- *Unstable Burst Fractures*
- Feature: besides compressive failure of the anterior and middle
- columns, there is also tensile failure of the posterior column

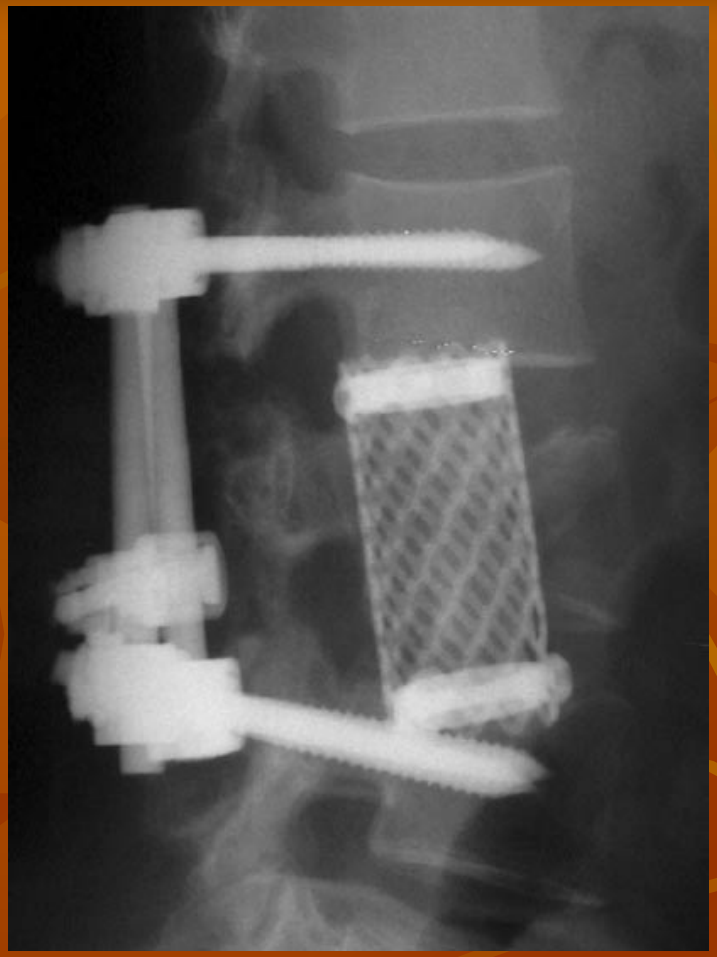
- *Unstable Fractures Without Neurological Deficit*
- Burst fractures are caused by flexion and axial loading forces, operative
- reduction can be attained posteriorly with reduction and fixation
- by extension and distraction
- According to experts like Garfin, operative intervention should be
- considered if: > 25 gr kyphosis, > 50% loss of vertebral height, > 40%
- canal compromise
- *Surgical Approach*
- Posterior instrumentation options include hook-rod systems pedicle
- screw systems
- Anterior approach may be needed to retrieve sizable retropulsed
- fragment or if there has been a delay for several days rendering indirect
- reduction by posterior approach difficult.
- needs to be individualised




D

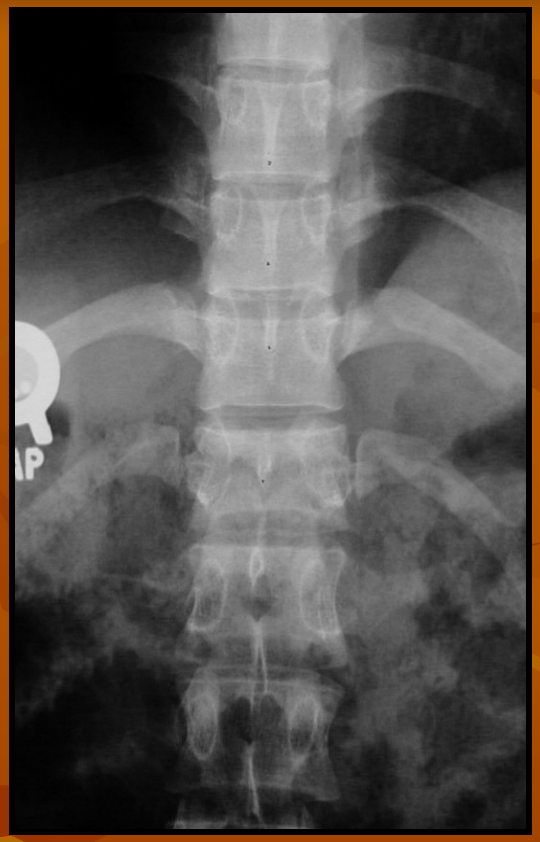
- *Unstable Fracture with Neurological Deficit*
- Anterior approach is logical if feasible to relieve the anterior source of neural compression, especially in the presence of a sizable retropulsed fragment, i.e. direct decompression
- Whether to add on anterior instrumentation like AO Ventrofix depends on factors like quality of the graft obtained, number of segments that need surgery, and whether posterior surgery is planned for any concomitant posterior injury
- *Indirect Reduction and Posterior Surgery*
- Indirect reduction from the posterior approach is based on ligamentotaxis.
- However, it must be noted that the efficacy of indirect reduction decreases after day 5.



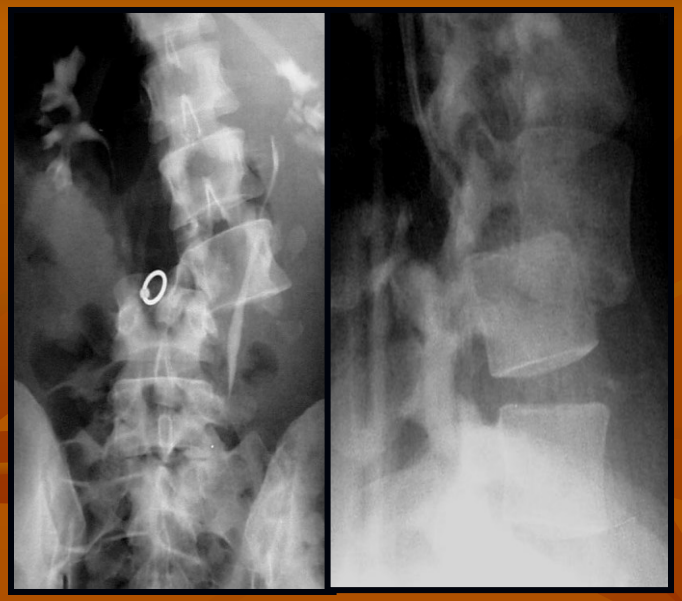


- *Flexion Distraction Injuries*
- Feature: distraction injury of anterior and middle column, and tensile
- failure of the posterior column
- The centre of rotation falls posterior to the ALL sometimes, and in
- such cases the anterior column will have compressive failure
- Level of injury can be either one or two spinal levels
- Injury force can go through bone or ligaments
- Called a “bony chance fracture” if the injury force goes horizontally
- through bone
- Called a “ ligamentous chance fracture” if the injury force goes horizontally
- through ligaments
- Two-thirds of chance fractures are associated with abdominal injuries,
- according to Denis, and may require operative intervention

- *Principles of Treatment*
- Ligamentous chance fractures treated conservatively will usually fail,
- although have been tried with some reported success in children.
- Ligamentous chance fractures in adults all require posterior surgery
- for stabilisation and frequently anterior surgery as well. Preoperative
- MRI to check the disc status is advisable
- Not all bony chance fractures require operation. Fractures with <15−
- kyphosis and no neural deficit have been treated with success by extension
- Casting
- The rest of bony chance fractures require surgery. Most require posterior
- surgery (the injury had already done the dissection for us), but
- not infrequently anterior surgery may need to be added



- *Translational Injuries*
- This group includes fracture dislocation injuries
- Involve facet dislocation or subluxation, the direction of which depends on the direction of the external force. Possibilities include anterior,
- posterior translations frequently with a rotational element
- All are treated surgically via a posterior approach usually with segmental pedicle screw fixation. Intraoperative reduction is necessary before pedicle screw application.
- Remember to tackle the not infrequent finding of *dural tear*

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- *Distraction of Extension Injury*
- Rare
- More common in patients with ankylosing spondylitis
- Caused by an extension force striking the lower back, can cause disruptionc to the anterior tension band (ALL and annulus). In severe cases the posterior elements can be injured as well
- Operative treatment is indicated if the fracture is unstable

- Complications
- Iatrogenic neural injury
- Sepsis
- Loss of reduction
- Hardware problem and failure (e.g. when there is inadequate anterior support and the posterior instrumentation is subjected to cyclic loading)
- Failure of healing of the bony fracture or the ligamentous injury