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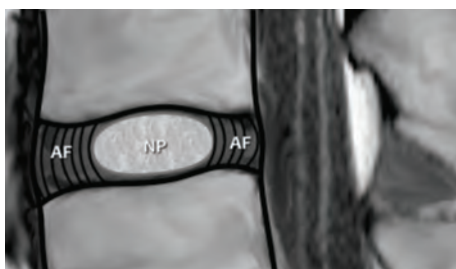
Degenerative Spine Diseases & Spine Fractures

I Pevalence of Lumbar Degenerative Disease

1. 70-80% of all individuals will experience low back pain at some time in their lives; usually it resolves in some weeks
2. Low pain is the leading cause of disability in people younger than 50 years of age
3. Many sources of pain are described
   3.1 facet joint arthropaty
   3.2 discogenic pain or annular tears
   3.3 spondylolisthesis
   3.4 spinal stenosis

II Disc Components

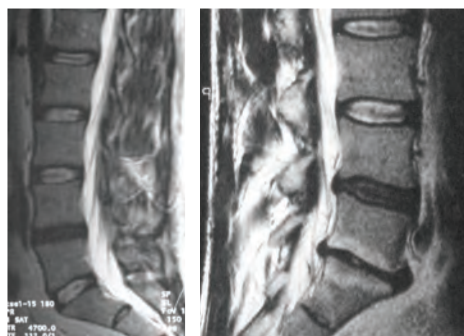
The disc consist of a fibrous outer annulus fibrosus with obliquely oriented collagen I molecules, and softer inner core called nucleous pulposus, which cushions force predominantly type II collagen molecules. Reduced water and glycosaminoglycan content and increased non-collagen glycoprotein are considered characteristics features of degeneration of a disk.



A. L4 –L5 selective DDD   B. Modic Changes in L5-S1

III Dark Disc Disease DDD

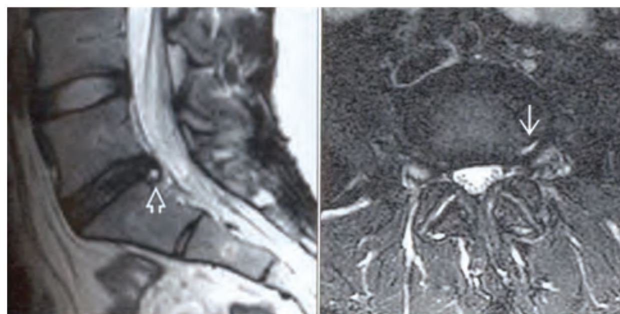
1. MRI image with a degenerative disk disease degree IV
2. Participates in the degenerative and physiologic cascade starting from 30 years old
3. When appearing in a precocious time, in young people, could be symptomatic
4. Structural and biochemistry changes put up with alteration of biomechanics properties
5. Modic changes in MRI describes different situations around DDD



A. L4 –L5 selective DDD   B. Modic Changes in L5-S1

Modic type	T1 signal	T2 signal
Modic I	EDEMA decrease	Increase
ModicII	FAT DEGENERATION increase	Increase
ModicIII	ESCLEROSIS decrease	Decrease

6. HIZ changes: High Intensity Zone in T2 localized annulus posterior or posterolateral layer



Images of annular tears corresponding with HIZ in L5-S1

Disk tear lesion predictor, vascularized granulomatous tissue, highlighted with Gadolinium Strong relationship with positive discography but not always with clinical significance.

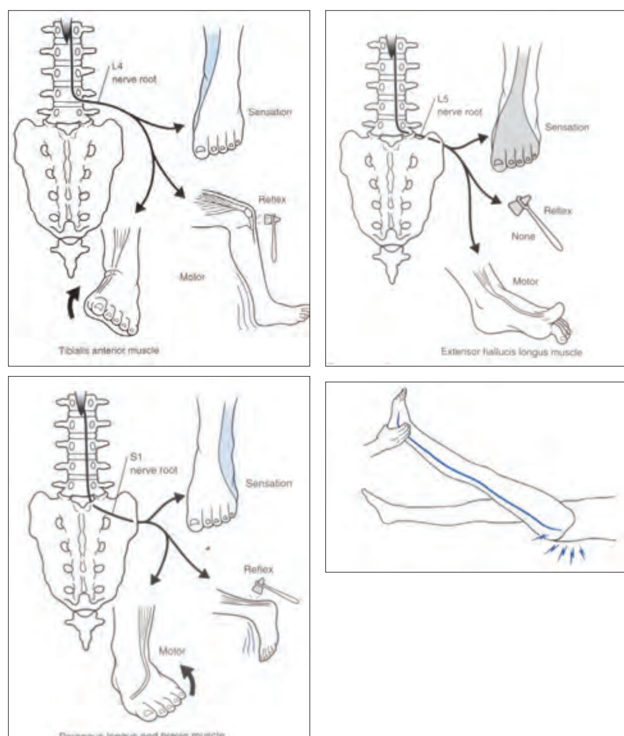
IV Lumbar Disc Herniation

1. General overview
   a. Incidence: 80% of people have some episode of low back pain in life, but only 2-3% have true sciatica
   b. Age: Average starting age 35 years old. Unusual before 20 and after 60 years. Less frequent in old people, more common associated with stenosis.
   c. Sex: Similar in both but delayed one decade in females

2. Anatomy
a. Caudal segments are affected more commonly L5-S1 discreetly more frequent than L4-L5 less frequent in thoracic and high lumbar level
b. Frequently posterolateral
c. Central location will cause lumbar pain without sciatica
d. Foramina location more frequent in elderly people; high levels (L3-L4)
e. Intradural location very unusual

3. Clinical features Radiculopathy
a. Leg pain > lumbar pain
b. Dermatome distribution
c. Increase sitting positions and forward bending
d. Improve with bed rest

4. Physical exam



5. Diagnostic imaging
5A. RNM
a) modality of choice for LHD
b) T2-weighted images most commonly used
c) T1-weighted + Gadolinium can differentiate between scar tissue and herniated disc material
5B. Discography + TAC useful tool in recurrence

6. Treatment
6.1 Non-surgical treatment:
LDH has a favourable prognosis
90% report improvement of symptoms (natural history)
1) Short rest (3-5 days)
2) NSAIDs (more effective than placebo)
3) Physical therapy (extremely beneficial)
4) Epidural steroid injections (50% avoided surgery)

6.2 Surgical treatment: Conventional discectomy
Patient who failed to improve with non-surgical treatment will probably need surgery.
Surgical treatment provided an increase in quality of life in comparison to continued non-surgical treatment.
The Paraspinal splitting approach (Wiltse approach) is recommendable for extraforaminal disc herniation.
Recurrent lumbar disc herniation has been reported in widely varying incidences between 3% and 18% of the patients and depends on the duration of the follow-up.

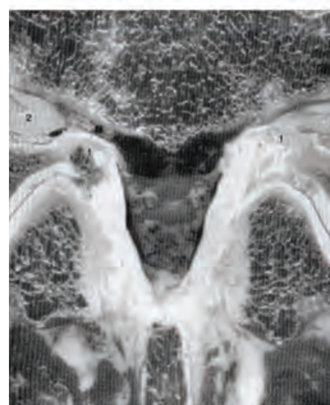
V Lumbar Spinal Stenosis

A. Definition

Spinal stenosis simply means a decrease in the space available for the neural elements, and, in the lumbar spine, the cauda equina. It can occur at different levels: the central canal, the lateral recess or the intervertebral foramen causing neurological compression.

B. Physiopathology

It is the final result of a cascade of events.
- The event that begins the process is thought to be the disc degeneration.
- As the disc height decreases, the loading characteristics of the facet joints are altered.
- Facet joints capsules become incompetent, leading to capsular, ligamentous flavum, and facet hypertrophy.
- The final result of this continuum of changes is a decrease in the diameter of the spinal canal.



C. Diagnostic imaging

- Upright AP, lateral, and flexion-extension radiographs amount of lumbar degeneration, vertebral deformity and instability.
- EMG may be helpful to distinguish peripheral neuropathy from LSS.
- Myelography: useful when deformity exists.
- CT scan: facet joints hypertrophy, disc vacuum, size of disc height and foramen height.

- MRI is currently the recommended advanced imaging modality to evaluate LSS. Non invasive technique. If there is discordance between clinical and lumbar MRI, cervical spine should be reviewed. The association between cervical and lumbar stenosis is common.

D. Treatment

D1. Non-surgical

1) Narcotics, NAIDs, anticonvulsants
2) LS orthotics
3) Physical therapy: flexion-based lumbar stabilization program
4) Steroid injections

D2. Surgical treatment

1) Indications:

Caudal equine syndrome

Severe neurologic deficit or impairment

Failure to improve leg pain and neurogenic claudication after non-surgical treatment.

Persistent and severe worsening in patient quality of life.

2) Natural history

Not well understood.

It is typically favourable with only 15% deteriorating clinically.

Improvement occurs in 30% to 50% of patients.

3) Operative technique

Preoperative medical evaluation

Elderly patients

Coexisting comorbidities

Save blood preoperative techniques

Self-saver postoperative

Laminectomy

Lateral decompression into the lateral recess and into the foramen

Fusion if resection is > 50 % bilateral facets or complete unilateral facetectomy. Incidental dural tear primarily repaired not changing the clinical outcome.

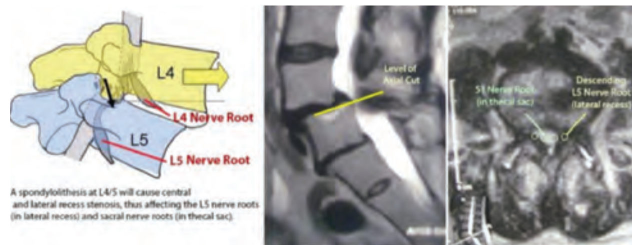
VI. Degenerative Spondylolisthesis

A. Overview

A condition characterized by lumbar spondylolisthesis without a defect in the pars

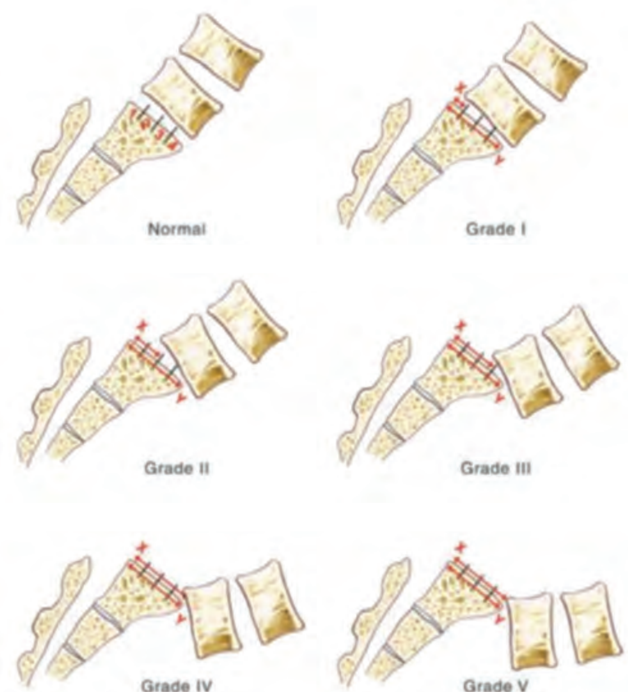
absent of pars defect differentiates from adult isthmic spondylolisthesis

- Epidemiology
  - prevalence
    - 5% in men and 9% in woman
  - demographics
    - more common in African Americans, diabetic patients, and women over 40 years of age
    - 8 times more common in women than men
    - prevalence increased in women due to increased ligamentous laxity related to hormonal changes
  - location
    - degenerative spondylolisthesis is 5-fold more common at L4/5 than other levels
    - this is different that isthmic spondylolisthesis which is most commonly seen at L5/S1
- Pathoanatomy
  - forward subluxation (intersegmental instability) of vertebral body is allowed by
    - facet joint degeneration
    - facet joint sagittal orientation
    - intervertebral disc degeneration
    - ligamentous laxity (possibly from hormonal changes)
  - neurologic symptoms caused by central and lateral recess stenosis



B. Classification

Myerding Classification	
Grade I	< 25%
Grade II	25 to 50%
Grade III	50 to 75% *(Grade III and greater are rare in degenerative spondylolisthesis)*
Grade IV	75 to 100%
Grade V	Spondyloptosis



C. Presentation

- Symptoms
  - mechanical/back pain
    - most common presenting symptom
    - usually relieved with rest and sitting
  - neurogenic claudication & leg pain
    - second most common symptom
    - defined as buttock and leg pain/discomfort caused by upright walking
    - relieved by sitting
    - not relieved by standing in one place (as is vascular claudication)
    - may be unilateral or bilateral
    - same symptoms found with spinal stenosis
  - cauda equina syndrome (very rare)
- Physical exam
  - L4 nerve root involvement (compressed in foramen with L4/5 DS)
    - weakness to quadriceps
    - best seen with sit to stand exam maneuver
    - weakness to ankle dorsiflexion (cross over with L5)
    - best seen with heel-walk exam maneuver
    - decreased patellar reflex
  - L5 nerve root involvement
    - weakness to ankle dorsiflexion (cross over with L4)
    - best seen with heel-walk exam maneuver
    - weakness to EHL (great toe extension)
    - weakness to gluteus medius (hip abduction)
  - provocative walking test
    - have patient walk prolonged distance until onset of buttock and leg pain
    - have patient stop but remain standing upright
    - if pain resolves this is consistent with vascular claudication
    - have patient sit
    - if pain resolves this is consistent with neurogenic claudication (DS)
  - hamstring tightness
    - commonly found in these patients, and must differentiate this from neurogenic leg pain

D. Treatment

- Nonoperative
  - physical therapy and NSAIDS
    - indications
    - most patients can be treated nonoperatively
  - modalities include
    - activity restriction
    - NSAIDS
  - epidural steroid injections
    - indications
    - second line of treatment if non-invasive methods fail
- Operative
  - lumbar wide decompression with instrumented fusion
    - indications
      - persistent and incapacitating pain that has failed 6 mos. of non operative management and epidural steroid injections
      - progressive motor deficit
      - cauda equina syndrome
    - outcomes
      - 79% have satisfactory outcomes
      - improved fusion rates shown with pedicle screws
      - improved outcomes with successful arthrodesis
      - worse outcomes found in smokers

E. Complications

- Pseudoarthrosis (5-30%)
  - CT scan is more reliable than MRI for identifying failed arthrodesis
- Adjacent segment disease (2-3%)
  - incidence is approximately 2.5% a year
- Surgical site infection (0.1-2%)
  - treat with irrigation and debridement (usually hardware can be retained)
- Dural tear
- Positioning neuropathy
  - LFCN
    - seen with prone positioning due to iliac bolster
  - ulnar nerve or brachial plexopathy
    - from prone positioning with inappropriate position
- Complication rates increase with
  - older age
  - increased intraoperative blood loss
  - longer operative time
  - number of levels fusion

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Degenerative Disc Disease

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Questions

1. What is the risk of recurrent herniation's at the same level in surgically treated patients at 5-year follow-up?
2. What is the most common location for lumbar disc herniation?
3. How are extraforaminal disc herniations ideally approached?
4. A 65-year-old man has low back pain and leg pain with standing. Walking endurance is limited to two blocks due to leg cramping. He has a wide-based, unsteady gait and hyperflexia. Lumbar radiographs reveal a degenerative spondylolisthesis at L4-L5, and an MRI scan shows moderate spinal stenosis at this level. The next step in his care should include:
   a. lumbar epidural steroid injections.
   b. lumbar decompression with fusion.
   c. a lumbar epidurogram.
   d. interspinous distraction.
   e. cervical MRI.
5. An incidental dental dural tear was primarily repaired with a watertight closure during an otherwise uncomplicated laminectomy. After surgery, the patient should be informed that:
   a. the chance of resolution of the preoperative symptoms will be decreased.
   b. there is a greater risk of a wound infection.
   c. the clinical outcome will be unaffected.
   d. strict bed rest for 2 weeks is recommended.
   e. a compression dressing must be maintained for 7 days.

Answers

1. 3-18%
2. Caudal segments are affected more commonly, L5-S1 slightly more frequent than L4-L5. Less frequent in thoracic and high lumbar level
3. Wiltse approach
4. a
5. c

VII. Spinal Cord Injury

A. Background

1. The annual incidence of SCI is approximately 40 cases per 1 million people in the United States, or 11.000 new cases per year.
2. 55% of SCIs occur in the cervical spine. The remaining injuries are equally distributed through-out the thoracic, thoracolumbar, and lumbosacral spine.
3. Motor vehicle accidents account for half of reported SCIs. Fall and recreational sport injuries are responsible for most of the remaining SCIs.
4. Neurologically, most patients sustain incomplete tetraplegia (34%), followed by complete paraplegia (25,1%), complete tetraplegia (22,1%) and incomplete paraplegia (17,5%).

B. Emergency department evaluation

1. Respiratory pattern: SCI above C5 is more likely to require intubation, because of fatigue of the accessory respiratory muscles. Complete tetraplegia is more likely to require intubation than incomplete tetraplegia.
2. Hemodynamic evaluation: neurogenic shock, defined as circulatory collapse resulting from neurologic injury, is caused by an interruption of the sympathetic output to the heart and peripheral vasculature. This collapse gives rise to the bradycardia and loss of vascular and muscle tone below the level of the SCI.

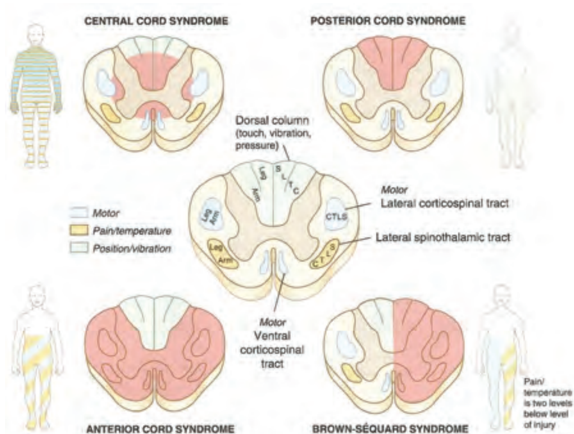
C. Neurological Examination

1. The American Spinal Injury Association (ASIA) standards of neurological testing provides a concise and detailed method for evaluating spinal cord and peripheral nerve root function. (Table 1)
2. In traumatic cord injury the main classification distinguishes between paraplegia (impairment or loss of motor and/ or sensory function in the thoracic, lumbar or sacral neural

Table 1. ASIA Impairment Scale
ASIA A: sensory and motor complete
ASIA B: sensory incomplete, motor complete
ASIA C: sensory and motor incomplete, motor function below the level of lesion in mean M3
ASIA D: sensory and motor incomplete, motor function below the level of lesion in mean >M3
ASIA E: no relevant sensor/motor deficit, minor functional impairments of reflex-muscle tone changes

segments T2-S5) and tetraplegia (impairment or loss of motor and / or sensory function in the cervical segments C0-T1).

3. A further differentiation is made in regards to the completeness of the lesion as: complete or incomplete. The distinction between complete and incomplete is based on the preservation of any sensory or motor function within the last sacral segments S4-S5.
4. Recognition of patterns of neurological deficits can help determine prognosis: Brown-Séquard carries the best prognosis, Central cord syndrome is the most common, Anterior cord syndrome carries the worst prognosis and Posterior cord syndrome.



D. Imaging Evaluation

1. Computed tomography (CT) scanning with coronal and sagittal reformatted images is useful to further define bony anatomy of the lesion.
2. Magnetic Resonance Imaging (MRI) is used in all cases of neurological compromise or to better visualize soft-tissue anatomy, that is, neural compressive lesions such as disc herniation, epidural hematomas or traumatic ligamentous injuries.
3. Radiological examination includes standard anteroposterior and lateral plain x-ray films of the cervical, thoracic and lumbosacral spine, if the patient conditions allow. Remember that 10%-15% of patients have non-contiguous spinal column fractures.

E. Pharmacologic intervention

1. Respiratory, cardiac, and hemodynamic monitoring is necessary for SCVI patients. Hypotension (systolic blood pressure < 90mm Hg) should be avoided and a mean arterial blood pressure of 85 to 90 mm Hg should be maintained for the first 7 days.
2. To avoid deep venous thrombosis and pulmonary embolism, prophylactic use of low-molecular- weight heparin, a rotating bed, and pneumatic compression stockings or combination therapy are recommended.
3. Many clinicians believe there is insufficient evidence to support any pharmacologic therapies as a stand of care in the management of acute spinal cord injury. Criticism has recently been directed at the interpretation and conclusions of NASCIS II and III studies.
4. Methylprednisolone was indicated to improve the motor scores in post-traumatic SCI when patients were delivered within 8 hours of injury (NASCIS III).
5. Less than 3 hours after injury, a 30 mg/Kg bolus of methylprednisolone is administrated, followed by 5,4 mg/Kg/h for 23 hours.
6. Between 3 to 8 hours after injury, the 30 mg/Kg bolus is followed by 5,4 mg/Kg/h for the next 47 hours.

F. Timing of Surgery

1. Data for the timing of surgical treatment of spinal cord injury has not been shown conclusively to support either early or late intervention.
2. Proponents of early surgical decompression advocate timely normalization of the intracellular environment and recovery of capillar perfusion by removing external pressure from the spinal cord and establishing spinal stability.
3. There is substantial class 2 and 3 evidence (non prospective, nonrandomized and uncontrolled) that surgical decompression provides better outcomes tan late or nonsurgical therapies.

VIII. Cervical Fractures

A. Epidemiology

1. Cervical spine injuries account for about one-third of all spine injuries. C2 was the most common level of injury, one – third of which were odontoid fractures. In the subaxial spine, C6 and C7 were the most frequent
2. A neurological injury occurs in about 15% of spine trauma patients.
3. Functionally, the cervical spine is divided into the upper cervical (occiput C0-C1-C2) and the lower (subaxial) cervical spine (C3-C7). The C0-C1-C2 complex is responsible for 50% of all cervical rotations while 80% of all flexion/extension occurs in the lower cervical spine. The C5-C6 level exhibits the largest ROM.

B. Instability of the cervical spine

1. One of the problems has been the absence of a clear definition based on reliable radiological criteria. Therefore White and Panjabi (Table 2) defined clinical instability of the spine as: The loss of the ability of the spine under physiological loads to maintain its pattern of displacement so that there is no initial or additional neurological deficit, no major deformity and no incapacitating pain.

Table 2. Criteria for C0-C1-C2 instability (According to White and Panjabi)
>8° axial rotation C0–C1 to one side
>1mm translation of basis on to dens top (normal 4–5 mm) on flexion/ extension
>7mm bilateral overhang C1–C2
>45° axial rotation (C1–C2) to one side
>4mm C1–C2 translation measurement
<13mm posterior body C2 – posterior ring C1 avulsion fracture of transverse ligament

C. Initial Treatment

1. Early recognition of injury begins in the field. A collar is placed and a spine board is applied.
2. Neurological examination should include the assessment of cranial nerves, motor and sensory function, reflexes, and rectal tone.
3. The level of neurological function is graded according to the ASIA classification and reflected in clinical history.
4. Avoid the "chin lift" method of the securing airway, it may decrease space available for spinal cord.

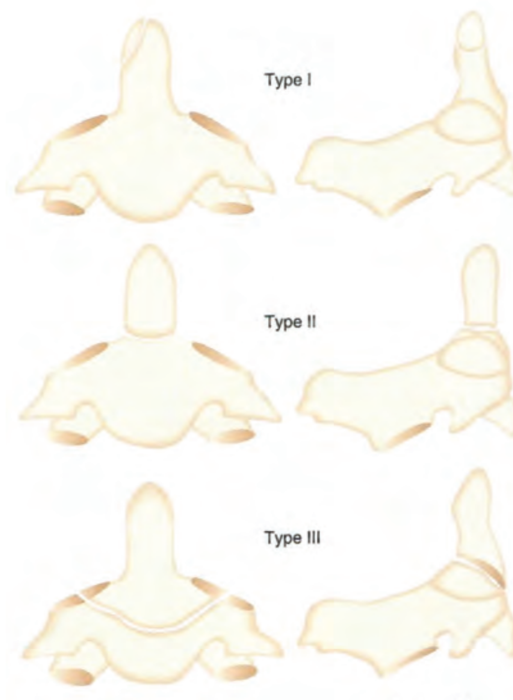
D. Imaging Studies

1. Symptomatic patients require radiographic studies to rule out the presence of a traumatic cervical spine injury before the cervical spine is cleared. A cervical spine injury is found in 2-6% of all symptomatic patients.
2. Radiography remains the imaging modality of first choice. The lateral view should extend from occiput to T1. Do not miss injuries at the cervicocranial and the cervicotorathic junctions.
3. CT is the first choice for unconscious patients. Most large trauma centers now perform multislice CT scans for the assessment of polytraumatized patients. The reason why CT has surpassed radiography include the ease of performance , speed of study, and most importantly, the greater ability of CT to detect fractures other than radiography.
4. MRI should be performed in addition to CT for specific diagnostic assessments.
5. Magnetic resonance is the imaging study of choice to exclude discoligamentous injuries. And it is the modality of choice for evaluation of patients with neurological signs or symptoms to assess soft-tissue injury of the cord , disc and ligaments.

E. Upper Cervical Trauma

1. Atlas Fractures (C1):
- 7% of cervical spine fractures
- Neurological injury is rare because of the wide spinal canal at that level, but cranial nerve injuries are frequently observed.
- Classic Jefferson (burst) fractures are bilateral fractures of the anterior and posterior arches of C1 resulting from axial load.
- Long-term stability depends on the mechanism and healing of the transverse ligament.
- Treatment: all stable fractures without transvers ligament injury can be treated non surgically, with 6 to 12 weeks of external immobilization
- Jefferson fractures with an intact transverse ligament are considered stable fractures and can also be treated with external immobilization with halo.
- On unstable Jefferson fractures surgical options may be considered.

2. Axis fractures (C2):
- Odontoid fractures are the most common type of axis fractures
- Type 1 fractures are avulsion fractures of the tip of the odontoid
- Type 2 fractures occur through the waist of the odontoid process.
- Type 3 fractures extend into the C2 vertebral body.
- Treatment of Type 1 and Type 3 , typically stable fracture, should be treated with a cervical orthotics for 6 to 12 weeks



- Treatment of type 2 fractures, correlates with increased risk of non-union if the initial translation is greater than 6 mm of failed reduction, age greater than 50 and angulation greater than 10°.
- These type 2 fractures should be considered for early C1-C2 fusion in elderly patients.
- In young people type 2 fractures not displaced could be treated with halo vest immobilization. For fractures in which reduction cannot be achieved or maintained, surgical treatment should be considered. Anterior odontoid screw placement is an option for minimally comminuted fractures or C1-C2 posterior stabilization and fusion.

3. Traumatic Spondylolisthesis of the Axis:
- This injury is characterized by bilateral fractures of the pars interarticularis (Hangman's fracture)
- Most patients can be treated successfully with external immobilization in a halo vest or cervical orthosis for a 6 to 12 weeks.
- Surgical indications include fractures with severe angulation or with disruption C2-C3 disk and/or facet dislocation. Surgical options include C2-C3 interbody fusion, posterior C1-C3 fusion or bilateral C2 pars interarticularis screws.

F. Subaxial Cervical Trauma

Apply the Allen and Ferguson classification of subaxial cervical trauma (Allen et al. 1982) for fractures and dislocations of cervical spine C3 through C7.

The classification system is based upon the mechanism of injury; there are six categories divided into stages. It provides probable deficiencies of bony and ligamentous elements.

The three most commonly observed categories are compressive flexion, distractive flexion and compression extension.

1. Compression-flexion:
- failure of anterior column compression and posterior column distraction.
- are caused by axial loading in flexion with failure of the

anterior half of the body without disruption of the posterior body cortex and minimal risk of neurologic injury.
- Treatment: stable undisplaced compression-flexion fractures can be treated conservatively with external immobilization for 6 to 12 weeks with a rigid collar. Kyphosis deformity > 15° should be considered for operative stabilization with anterior cervical fusion.

2. Vertical compression injuries:
- are caused by severe compressive load. These fractures, "burst fractures", are commonly associated with complete or incomplete SCI from retropulsion of fracture fragments into the spinal canal.
- Treatment: patients with neurological deficit are better treated by anterior decompression and reconstruction with strut grafts and platting it. If there is a significant compromise of the spinal canal, it can usually be reduced with traction.

3. Distraction flexion:
- four stages (Allen et al 1982):
- stage I- facet subluxation in flexion and widening of the interspinous distance. < 25% subluxation of facets
- stage II- unilateral facet dislocations
- stage III- bilateral facet dislocation with < 50% anterior vertebral body translation.
- stage IV- bilateral facet dislocation with 100% anterior translation of the vertebral body.
- Treatment: Rotational injuries are considered very unstable and are therefore usually treated operatively. Aware and alert patient can safely undergo closed reduction with progressive traction. Development of new or worsening neurologic deficits is an indication to cease closed reduction.
- Patients who have undergone successful awake reduction should undergo an MRI to verify that no disc material or hematoma remains.
- A combined antero/posterior technique provides the best outcome although in selected cases (e.g. unilateral dislocation) either a single anterior or posterior approach may be sufficient.

G. Complications

- Overall, 5% of patients with compressive injuries of the subaxial cervical spine had persistent instability after non-operative treatment.
- Kyphosis or subluxation develops in about 10% of patients who are treated with posterior fusion.
- Operative complications are more common in patients treated with posterior fusion procedures (37%), compared with anterior fusion procedures (9%).
- Graft displacement is the most common complication found in patients treated with anterior cervical fusion without anterior fixation (9%).

IX. Thoracolumbar Fractures

A. Epidemiology

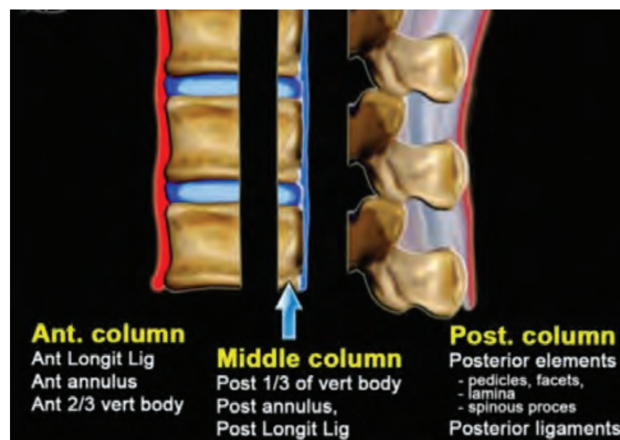
1. The thoracolumbar spine is the most common site of spinal injuries.
2. Usually they are the result of a significant force impact, such as a motor vehicle accident or fall.
3. Most injuries (52%) occur between T11 and L1 followed by L1 throgh L5 (32%) and T1 through T10 (16%).
4. The increased incidence of fractures of the thoracolumbar junction is the result of its location at the biomechanical transition zone between the rigid thoracic rib cage and the more flexible lumbar spine. Contiguous and non-contiguous spine injuries are present in 6% to 15% of patients.
5. Associated injuries include intra-abdominal bleeding from liver and splenic injuries, vessel disruption, and pulmonary injuries (20% of patients).
6. In thoracolumbar fractures neurological deficiencies were reported between 22% and 35%. In the thoracolumbar transition (T10-L2) neurological deficiencies occur in 22-51% depending of the fracture type.

B. Radiologic Evaluation

- Plain X-ray film is the initial screening modality with computed tomography (CT) scanning or magnetic resonance imaging (MRI) used as an adjunct, depending upon whether the surgeon needs to further evaluate bony or soft-tissue anatomy.

C. Classification Methods

1. Denis (1983) chose to divide the anterior column into two, making three columns in total, the middle of which was felt to be the biomechanical key, which means, disruption here was thought to render the fracture instable. Major injuries include compression fractures, burst fractures, flexion-distraction injuries and fracture dislocations.



2. Magerl et al (1993) introduced a complex hierarchical classification system based on pathomorphologic criteria, of increasing injury and instability. This system divides thoracolumbar spinal fractures into three general groups. Type A compression injuries, Type B distraction injuries and Type C torsional injuries. The complexity of the system certainly enables researchers to accurately compare fracture types in follow-up.
3. Vaccaro et al (2005) have proposed recently, a novel new Thoracolumbar Injury Classification and Severity Score (TLISS) based in three parameters: the morphology of the fractured vertebrae, the neurologic status and the integrity of the importance PLC, now visible on MRI.

Points	
Fracture Mechanism	
Compression fracture	1
Burst fracture	1
Rotational fracture	3
Splitting	4
Neurological Involvement	
None	0
Nerve root	2
Medulla spinalis, conus medullaris; incomplete	3
Medulla spinalis, conus medullaris, complete	2
Cauda equina	3
Posterior Ligamentous Complex	
Intact	0
Possibly injured	2
Injured	3

D. Non-operative treatment

1. Most thoracolumbar spine fractures are stable and do not require surgery.
2. Non operative treatment with a well-molded brace or hyperextension cast has been shown in numerous studies to be very effective.
3. Simple compression or stable burst fracture without neurologic complications can typically be treated with off-the-shelf braces or well-molded orthoses that permit early ambulation.
4. Upright radiographs of the patient, in brace or in cast, should be obtained before discharge.
5. Significant increases in the fracture angle (>10°) or significant increases in pain have been suggested as an indication for operative treatment.

E. Operative treatment

1. Operative treatment does offer a few advantages: immediate mobilization, earlier rehabilitation and may restore sagittal alignment more reliably in certain situations.
2. The benefits of surgical treatment must be carefully weighed against the potential morbidity associated with the operation.
3. Compression fractures: Coronal split type fractures frequently fail to unite and may be a source of painful non-union. Operative treatment is, more commonly considered, especially in the lower lumbar spine.
4. Burst fractures: instability should be considered whenever large degrees of axial compression (>50%) or more than 25° of angulation.
   - The decision of surgery depends on the location of the fracture, the degree of vertebral destruction, any neurologic involvement, the degree of kyphosis, and the stability of the posterior column structures.
   - It has been demonstrated in numerous reports that retropulsed bony fragments do resorb and the canal remodels up to 50% of the occlusion over time.
   - Posterior pedicle screw fixation has been shown to be efficient, reliable and safe for the reduction and stabilization of most traumatic fractures.
   - The proportion of vertebral body damage, spread of the fracture fragments, and degree of kyphosis are tabulated to predict failure, that is, suggesting the need for additional anterior column support/surgery. In this situation anterior reconstruction with structural graft or plate instrumentation and short-segment posterior pedicle screw fixation has been shown to be effective.
5. Flexion-distraction injuries:
   - Because the injury in these fractures is mainly linked to the posterior osteoligamentous complex, it is best treated with a posterior compression type construct and fusion to restore the normal sagittal contour.
   - Most specialists advise postural reduction by positioning, gentle compression and lordosing rod.
6. Fractures-dislocation:
   - Fracture-dislocations are often the result of very high-energy trauma and are the fracture type most often associated with neurological damage and associated skeletal injuries.
   - Because of the severe nature of the bony disruption, realignment and fixation are best accomplished through posterior positioning, reduction, multilevel instrumentation, and fusion.

F. Complications

The reported complications rate in the literature varies largely and ranges from 3,6% to 10%. Postoperative neurological complications range from 0,1% to 0,7%. Only honest and accurate assessment of complications will lead to scientific and clinical progress.

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Questions

1. A 44-year-old farmer involved in a rollover accident on his tractor sustained a L1 burst fracture with 20% loss of vertebral body height, 30% canal compromise, and 15° of kyphosis. He remains neurologically intact. The preferred initial course of action should consist of
   a. posterior spinal fusion with instrumentation
   b. a thoracolumbarsacral orthosis (TLSO) extension brace and early mobilization.
   c. Bed rest for 6 weeks followed by inmobilization in a cast
   d. Anterior L1 corpectomy and fusion with instrumentation
   e. Anterior corpectomy followed by posterior fusion with instrumentation

2. What is the prognosis for ambulation, from best to worst, for patients with an incomplete spinal cord injury?
   CCS = Central Cord Syndrome.
   ACS = Anterior Cord Syndrome
   BSS = Brown-Sequard Syndrome
   a. CCS, ACS, BSS
   b. CCS, BSS, ACS.
   c. BSS, ACS, CCS
   d. BSS, CCS, ACS
   e. ACS, CCS, BSS

3. Which is the most common site of spinal fractures?

4. Which mark be fitting with a incomplete sensory deficit and complete motor deficit in ASIA Impairment Scale?

5. Which classification of thoracolumbar fractures MRI is used to identify PCL injury Posterior Ligament Complex?

Answers

1. b
2. d
3. Thoracolumbar spine
4. ASIA B
5. TLICS Thoracolumbar injury classification and severity score