

Lumbar Spine

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Part I- Thoracolumbar Spine Injuries:

- Contents:
 - INTRODUCTION
 - BASIC SCIENCE
 - ANATOMY
 - NEUROLOGY
 - TRAUMA
 - MACHANISM
 - CLASSIFICATION

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Thoracolumbar Spine Injuries:

- Contents:
 - INITIAL MANAGEMENT
 - RETRIEVAL
 - RESUSCITATION
 - NEUROLOGICAL ASSESSMENT
 - RADIOLOGICAL ASSESSMENT
 - USE OF STERIOD
 - DEFINITIVE MANAGEMENT
 - OPERATIVE Vs NONOPERATIVE
 - REHABILITATION

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Anatomy

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Introduction:

- From Paul Meyer:
 - of 470 TL junction injuries....
 - 29.4%complete neurological deficit
 - 43.6%incomplete neurological deficit
- Outlook for patients with incomplete neurological injuries can be enhanced if an optimal environment for neurological recovery is provided...

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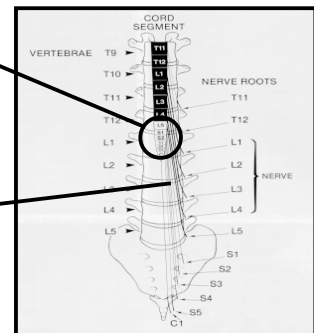
Anatomy:

CONUS MEDULLARIS:

- A segment of spinal cord contains the cell bodies and dendrites exiting to L5 and S5 nerve roots

CAUDA EQUINA:

- L1 nerve rootsT10 level



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Anatomy:

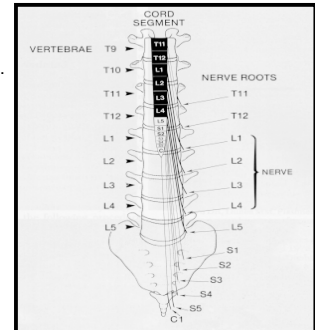
- CAUDA EQUINA
 - includes both motor and sensory roots
 - L1 nerve rootsT10 level
 - *these roots are less likely to be injured*
 - more room in the canal
 - being not tethered to the same degree as the cord
 - being more resilient to trauma

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Anatomy:

- SKELETAL INJURY
 - at or above T10..... cord damage
 - between T10 and L1both cord and root
 - below L1entirely root damage



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Mechanism

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Mechanism of Neurological Injuries:

- PRIMARY INJURIES
 - occur at the time of injury
- SECONDARY INJURIES
 - result from reactive processes

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Mechanism of Neurological Injuries:

- Primary Injuries:
 - CONTUSION
 - COMPRESSION
 - STRETCH
 - LACERATION

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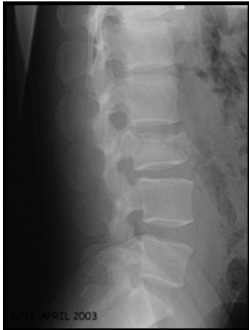
Mechanism of Neurological Injuries:

- Secondary Injuries:
 - are result ofreactive processes
 - ISCHAEMIA
 - SWELLING

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Mechanism ?



- Contusion
- Compression



Mechanism- Late sequelae:

- Late sequelae of spinal injuries:
 - chronic pain and / or
 - delayed neurological deterioration
- Both of these may be secondary to
 - progressive spinal deformity,
 - scar formation, +/-
 - posttraumatic syringomyelia

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Classification

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Classification:

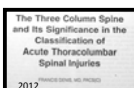
- BOEBLER (1929)
- WATSON- JONES (1931)
- HOLDSWORTH (1963)
- DENIS F (1983)
- McAFEE PC (1983)
- GERTZBEIN SD (1994)

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Classification:

- Denis classification:
 - Three column theory
- Types:
 - compression
 - burst
 - seat-belt
 - fracture-dislocation



» Denis F. Spine
1983

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Classification:

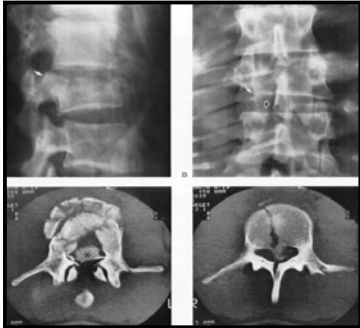
- Magerl F (1990) + Harms J, Gertzbein SD (1994):
 - Three mechanisms of injury:
 - A: COMPRESSION
 - B: DISTRACTION
 - C: ROTATION

» Gertzbein SD et al. Eur Spine J 1994

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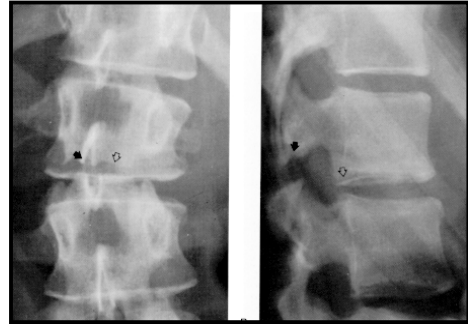
Burst Fracture:



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Chance fracture:



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Fracture dislocation:



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Management

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Management- Trauma Call:



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Principles of Initial Management:

- ABCDE:
 - Airway
 - Breathing
 - Circulation
 - Neurological Disability / (Drugs)
 - Exposure for detailed Examination
 - » Paul R Meyer. Surgery of Spine Trauma 1989

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Principles of Initial Management:

- Initiate a trauma call
 - Advanced Trauma Life Support
 - resuscitation and proper immobilization
 - Efficient, systemic and thorough assessment
 - include other systems
 - Accurate documentation of neurological status
 - Spinal stability assessment

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Resuscitation – Beware:

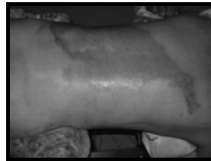
- Neurogenic shock:
 - Hypotension associated with bradycardia
 -it is a result of traumatic disruption of sympathetic outflow (T1-L2) and unopposed vagal tone
 -above T6....
 - avoid overinfusion and possible development of pulmonary edema

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Physical Examination – Beware:

- After resuscitation...
 - Log-rolled to allow inspection and palpation of the spinal column
 - Areas of localized tenderness, gaps between the spinous processes, swelling and gibbous deformities



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Physical Examination – Beware:

- Abdominal examination....
 - in patients with seat belt injury (Chance Fractures)



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Principles of Neurological Assessment:

- Systemic evaluation and documentation of results
 - motorincluding anal sphincter
 - sensory...including proprioception
 - deep tendon reflexes presence and quality
 - long tract signs
 - presence of sacral sparing....incomplete
 - bulbocavernosus reflex
- Key is to distinguish between *complete and incomplete neurological deficits +/- progression*

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Neurological Assessment:

- Can use various forms to facilitate clear documentation

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Neurological Assessment:

- Sacral sparing:

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Neurological Assessment:

- Sacral sparing:
 - triad of perianal sensation, rectal tone and great toe flexion
 - presence of scaral sparing may be the only remaining neurological function in patients with incomplete spinal cord injuries.... optimizing chances for neural recovery
 - on the other hand, its absence may be the only neurological deficit on examination
 - documentation of of its presence or absence is essential

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Neurological Assessment:

- The bulbocavernosus reflex (S2 and S3)

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Neurological Assessment:

- The bulbocavernosus reflex (S2 and S3)
 - A reflex arc that can function without using ascending or descending white-matter, long tract axons
 - After spinal shock is over, and if the level of the reflex arc is both physiologically and anatomically intact , the reflex will function in spite of complete spinal cord disruption at higher level

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Neurological Assessment:

- The bulbocavernosus reflex (S2 and S3)
 - Importance:
 - its return indicates end of spinal shock (99% have returned within 24 hours)... complete neurological deficit
 - no bearing on lesions below the level of the conus

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Neurological Assessment:

- Importance of Differentiation:
 - An **incomplete** neurological deficit has a good prognosis for at least some functional motor recovery....
 - Where as functional motor recovery is seen in only 3% of **complete injuries** in the first 24 hours, and virtually never after 24 to 48 hours...
 - **Any Progression:** need immediate action

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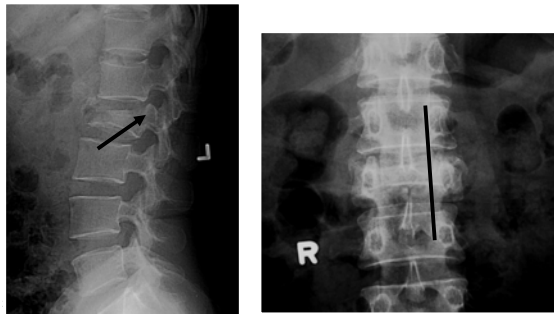
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Radiographic Assessment

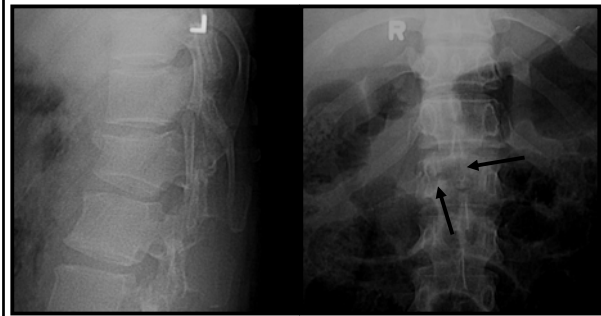
Radiographic Assessment:

- XR:
 - AP and Lateral
 - in particular the junctional areas of the spine
 - beware of concomitant noncontiguous spine fractures....10% to 30% of patients

Radiographic Assessment:



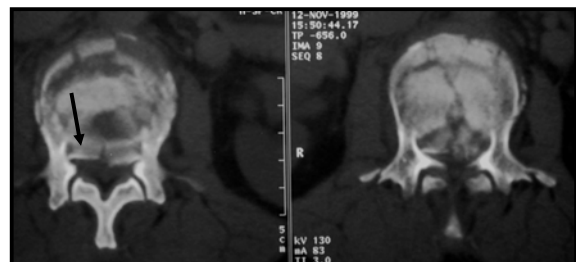
Radiographic Assessment:



Radiographic Assessment:

- CT
 - for the middle column and the subtle posterior injuries
 - recommended for majority of patients with TL fractures

Radiographic Assessment:



Radiographic Assessment:



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Radiographic Assessment:

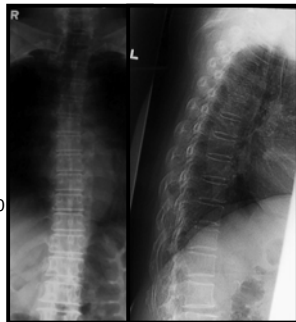
- MRI
 - RARELY REQUIRED
 - indicated in patients with
 - progressive neurological deterioration,
 - incongruous neurological and skeletal injury,
 - and unexplained neurological deficit

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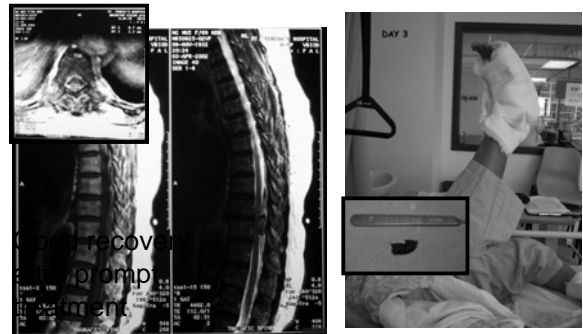
Radiographic Assessment- SSEH:

- Case II.1:
 - F/69
 - Sudden onset of back pain + paraplegia
 - No trauma
 - P/E:
 - Back: normal
 - Neurological deficit: T10 downwards
 - Complete neurological deficit



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Radiographic Assessment- SSEH:



Definitive Treatment- Choices and Principles:

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Definitive Treatment- Treatment goals:

- To maximize neurological recovery,
- To reduce fractures and dislocations,
- To produce a painless, stable spinal column (reestablishing or maintain stability)
- To allow early patient motion...avoiding complications, decreasing hospitalization time, facilitate nursing care.
- To restore the patient to the highest level of function....rehabilitation

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Definitive Treatment- Choices and Principles:

- NONOPERATIVE TREATMENT:
- OPERATIVE TREATMENT:
 - Posterior instrumentation with or without decompression
 - anterior decompression and fusion
 - combination
- Choice of treatment *depends on fracture type, degree of neural injury, and the level of skeletal injury*

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Definitive Treatment- Non-operative Treatment:

- POSTURAL REDUCTION:
 - by Sir Ludwig Guttman at the Stoke Mandeville Hospital (1944)
 - consists of rotating beds supplemented by pillows and rolls placed under the patients' backs to support a reduced position
 - Duration.... 10-13 weeks
 - a supportive plastic jacket for several weeks

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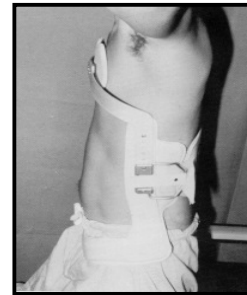
Definitive Treatment- Non-operative Treatment:

- Others have reported that up to 70 % of all displaced TL spine fractures are able to be closely reduced.
 - (NB an “acceptable” reduction may be variably defined, depending on the author and the area of analysis)
- Neurological recovery after closed reduction has been well documented

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Definitive Treatment- Non-operative Treatment:



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Conservative Treatment of “Stable” Burst Fracture:

- A case series study:
 - A period of strict recumbence in a standard hospital bed then ambulation with a custom molded TLSO
 - Average F.U. 2 years
 - Non-operative Mx yields acceptable results
 - *bony deformity progresses marginally
 - *good canal area remodeling
 - *incidence of subsequent neurological deficits is low
- » Joe Mumford et al. Spine 1993. The North American Spine Society 1992 Acromed Award.

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- Case II.2:
- M/52, Factory Owner, 1999
 - Fell from height in Mainland China
 - Burst Fracture L1
 - No definite neurological deficit
 - Treated in a local hospital in China with bed rest for about 2/12+
- First consulted us at outpatient clinic was 4/12 after the injury



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- Now around post-injury 5 years
- Mild back pain (no need for analgesics)
- ADL full
- No further collapse
- Some tightness of both LL
- Some urinary problem
- XR in 2004:



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Definitive Operative Treatment:

- Primary Goals:
 - to reduce fractures and dislocations,
 - to stabilize the injured segment,
 - and to decompress the neural elements.

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Treatment Algorithm:

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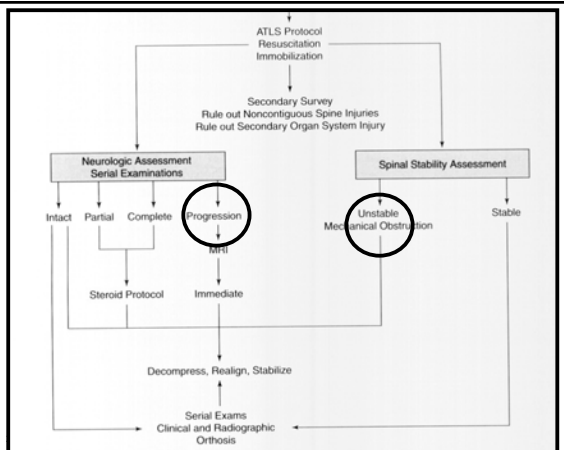
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Factors:

- Training, Experience, Institutional Preference, Available instruments and implants, Medical support
- Polytrauma ?
- Age ?, Pulmonary function status ?
- Fracture factors:
 - Exact diagnosis, say highly unstable #/D case Vs a relatively stable Burst # without posterior element involvement
 - Anterior Load Sharing Status
- Cx: Neurological status
 - Chapman JR et. al. Current Opinion Orthopaedics 2003

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Examples

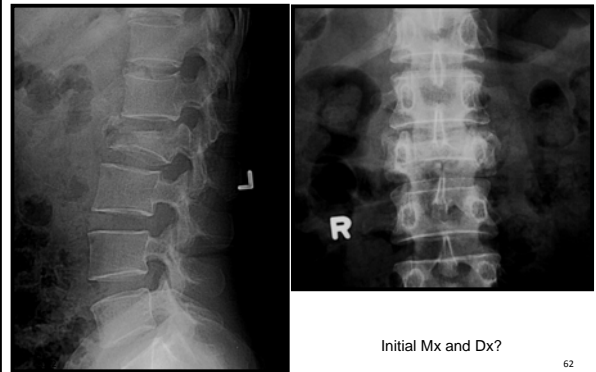
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- Case II.3
- F/45, Housewife
 - Fell from height (1st floor), in China, landed on buttock
 - Severe back pain with some subjective bilateral LL weakness
 - No bowel nor bladder problem
 - No heel nor knee pain
- P/E:
 - Mild back pain
 - LL:
 - Sensation:
 - decreased light touch over anterolateral aspect of both thigh
 - Otherwise: no definite neurological deficit
 - Perianal examination:
 - Anal tone: +

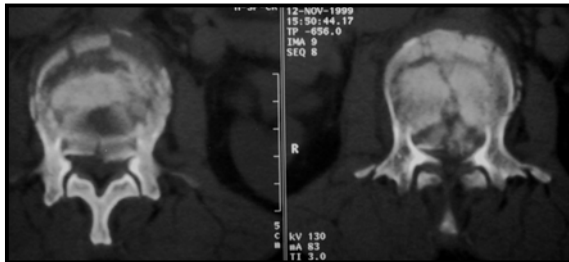
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Initial Mx and Dx?

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Exact Dx ?

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- Radiological:
 - Burst # L2:
 - Denis Classification: Burst B
 - Harms Classification: A3
 - Anterior Vertebral Body Collapse: >60%
 - Canal compromise > 50%
- Clinical: no neurology
- Treatment: why and how ?



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Indications for Operative Treatment:

Table 27-1 — THE UNSTABLE BURST FRACTURE

1. Progressive neural deficit
2. Posterior ligamentous complex disruption
3. Kyphosis progressing 20 degrees or more with neural deficit
4. More than 50% loss of vertebral body height with facet joint subluxation
5. Computed tomographic demonstration of free bony fragments within a compromised spinal canal associated with incomplete neural deficit

From McAfee PC, Yuan HA, Lasda NA: The unstable burst fracture. Spine 7:365, 1982.

- Other relative indications:
 - Collapse of body: > 40% Jacobs 1984
 - Canal compromise: >50% Willen 1985

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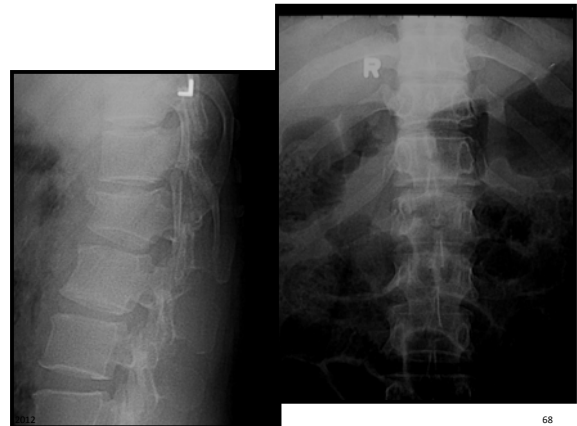
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- Case II.4
- F/44, HW
 - RTA in Mainland China
 - Turned up-side-down
 - Severe back pain
 - No LL complaint
 - No other abdominal pain
- P/E:
 - Abdomen: soft
 - Back: Sharp tenderness upon palpation
 - No neurological deficit of LL
 - Anal tone: +



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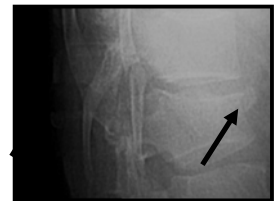
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- # L1:
 - Denis Classification: Flexion-Distractor Injury
 - Gertzbein Classification: B2.3. (+Compression #)
- Anterior Vertebral Body Collapse: less than 35%
- No canal compromise



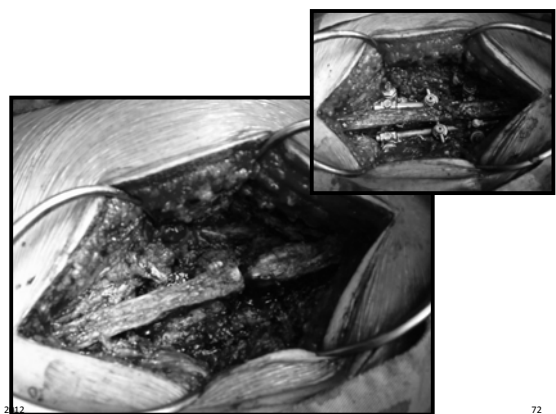
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- Flexion-distraction Injuries:
 - Typically incurred by automobile passengers who suffer frontal impact to their vehicle while wearing seat belts
 - are three column injuries that are often highly unstable
 - » Baldwin NG et al. Techniques in Neurosurgery 2003
- Treatment:
 - How and why ?

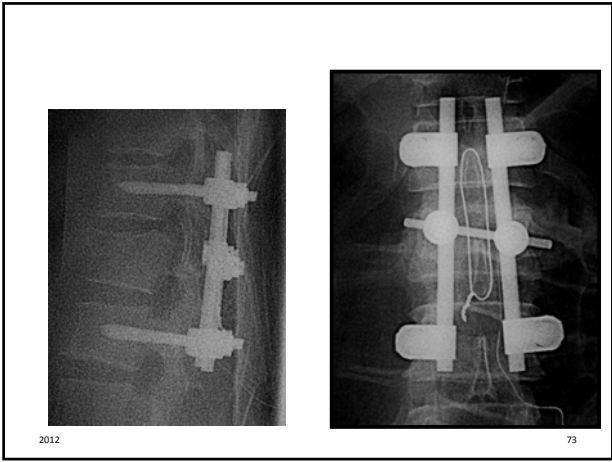
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- Implants removed
- Mild residual back pain
- ADL independent

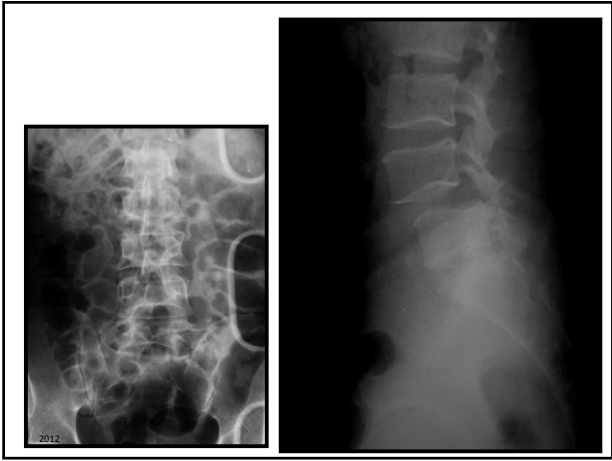
2012 Sept 2003 74

- Case II.5:
- M/41, Owner of a factory in China
 - Driver of a private car
 - RTA in China (Speed ?)
 - Thrown out of the car (Mechanism ?)
 - Head injury, LOC with Retrograde Amnesia
 - Severe back pain
 - Left LL mild numbness

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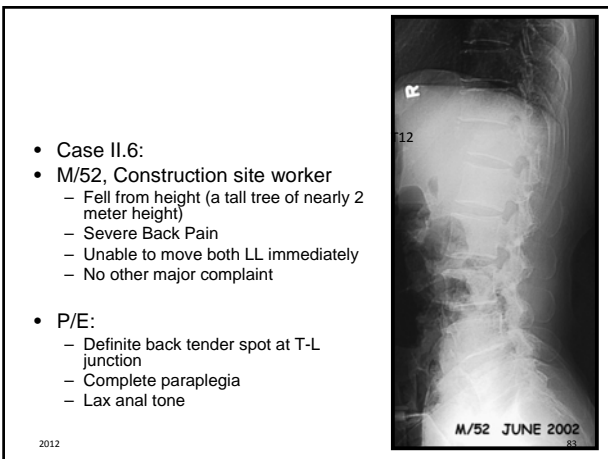
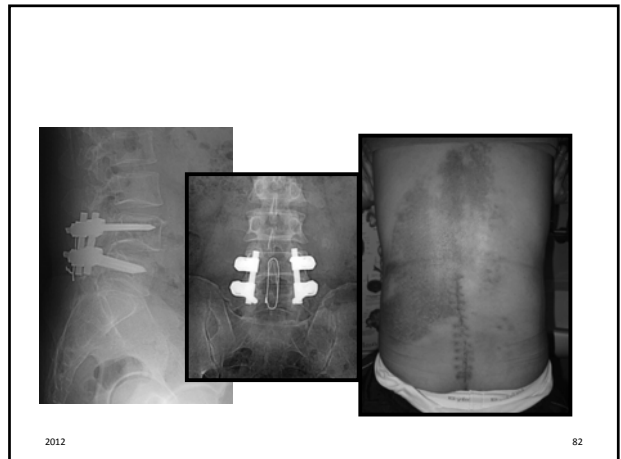
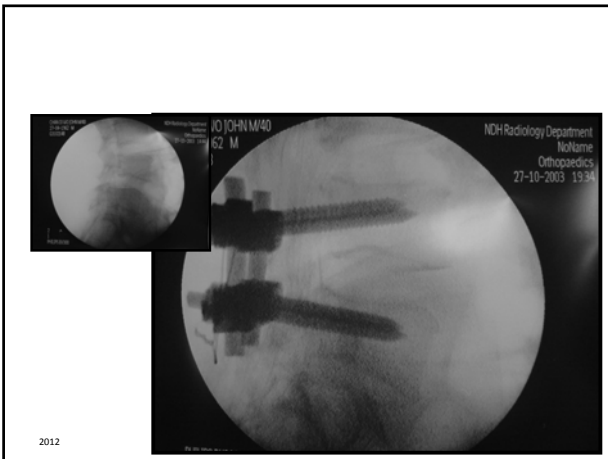
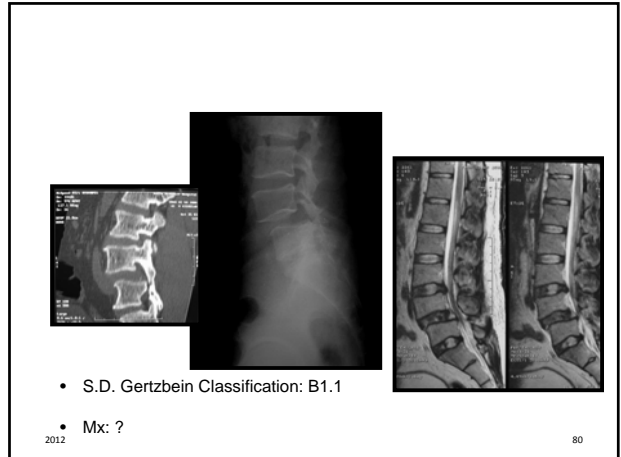
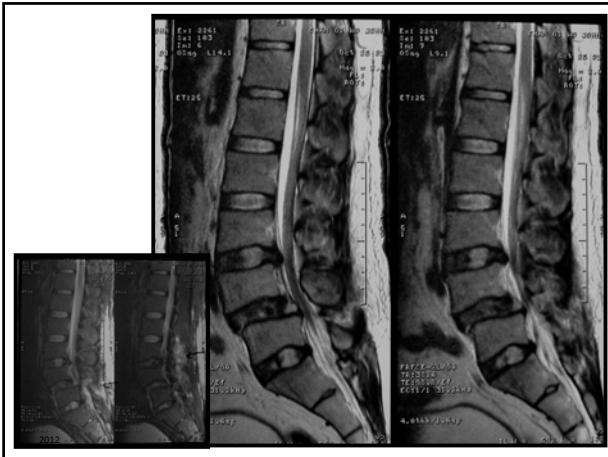
- P/E:
 - Conscious and alert
 - Abdomen: soft and non-tender
 - Multiple abrasions: over forehead and back
 - Definite tenderness at lower lumbar spine
 - Decreased light touch of left L4 and L5 dermatomes
 - Left ankle dorsiflexion: 4+/5
 - Anal tone: +

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Additional Ix: ??? and Mx ?

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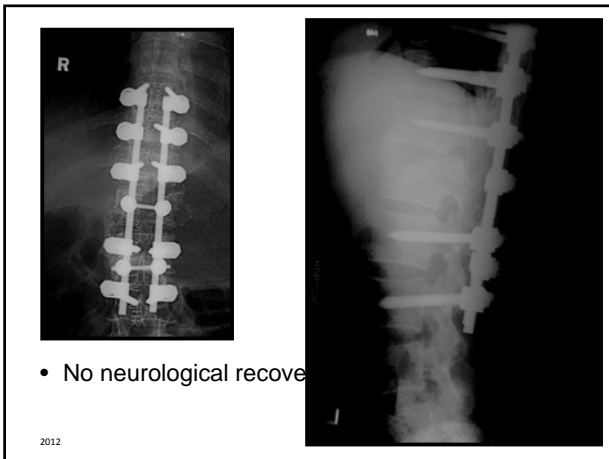
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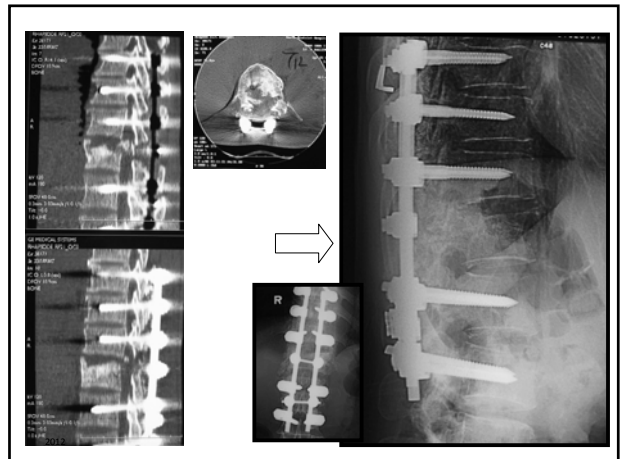
- Radiological:
 - Dennis Classification:
 - Fracture dislocation
 - S.D. Gertzbein classification:
 - Type C3 (Rotational-shear injuries)
- Clinical:
 - Complete paraplegia
- Treatment ?

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Remember:

- Gertzbein SD (1994) classification-
 - three basic mechanisms of injury:

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Remember:

- Both history and P/E is of great use....
- Radiological approach, depending on both XR and CT:



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LBP- Introduction:

- Introduction:
 - Adult: >70% reported back pain
 - only 10% had more than minimal functional problems (Cassidy JD et al. Spine 1998;23:1860-6)
 - even in persons with co-morbidities for development of disability, only <10% experienced any work loss greater than 1 week over 5 years prospective observation
 - » E Carragee et al. Spine 2005;5(1):24-35

LBP- Approach:

- Approach:
 - Not: why someone might have backache
 - Real question: why common backache is such a serious problem for this particular person.

 - Actual situation: more commonly, the cause of the apparently severe LBP illness is obscure
 - » Eugene J. Carragee et al. Current Orthopaedics 2007

LBP- Approach- Local pain generator:

- Little consensus: 2 approaches

- **(A)** focused on the identification & treatment of occult, **local 'pain generator'**:
 - Assume there is specific patho-anatomic finding in the spine
 - Conclusion: this approach has limitations
 - » Charles Pither. Current Orthopaedics 2007;21:1-8

MRI- LBP:

- MRI- Prevalence of common changes:
 - In adult subjects without serious LBP illness
 - High Intensity Zone: ~20%
 - Annular fissures: ~30%
 - Disc Protrusion: ~50%
 - Disc Degeneration: ~60%
 - Poor correlation between MR findings of spinal degenerative changes & symptoms in adults

LBP- Approach- "Other factors":

- **(B)** Search for a specific 'pain generator' is misplaced
 - The difference in clinical manifestation is due to **'other factors'**
 - **Central pain process, psychological factors, social disincentives, poor coping strategies etc**
 - Treatment:
 - is directed at restoring function & supporting adaptive techniques
 - opposed to medical or surgicac treatment of the common spinal changes
 - » Charles Pither. Current Orthopaedics 2007;21:1-8)

LBP- Approach- "Other factors":

- Such pain is better thought of as a **functional disturbance** rather than an anatomical lesion
- 3 levels of local pain => disturbance
 - (i) spinal cord neurotransmission
 - (ii) central pain processing in the limbic system (unpleasantness of pain)
 - (iii) higher level of influences of mood, fear etc. (negative thinking & depressed affect inform suffering--> influence motivation, self-worth)

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P/E- Lumbar spine:

- Inspection:



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P/E- Lumbar spine:

- Inspection:

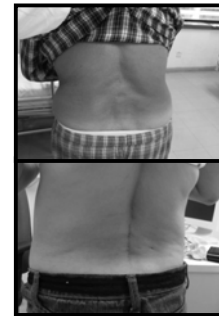


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P/E- Lumbar spine:

- Inspection:



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P/E- Lumbar spine:

- Movements:
 - Active

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P/E- Lumbar spine:

- Movements:
 - Passive

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P/E- Lumbar spine:

- Movements:
 - Resisted

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P/E- Lumbar spine:

- Sensation:

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P/E- Lumbar spine:

- Motor:
 - L5:
 - Hip abduction (gluteus medius: L5)
 - EHL
 - Posterior tibial jerk (L5)

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P/E- Lumbar spine:

- Motor:
 - S1:
 - Hip extension (gluteus maximus S1)
 - Plantar flexion
 - (peroneus L and B, gastroc / superficial peroneal nerve: S1)
 - Calcaneal tendon reflex (S1)

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P/E- Lumbar spine:

- Straight leg raising test:

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P/E- Lumbar spine:

- Babinski's sign:
 - Strong and forceful stroke
 - +ve: big toe extends
- Oppenheim's test:
 - Downward squeezing along the crest of the tibia
 - +ve: big toe extends

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LBP- Rest ?:

- Bed rest Vs Stay active:
 - Growing evidence showing that bed rest is not beneficial for people with LBP
 - Review 1: For people with acute LBP, advice to rest is clearly less effective than advice to stay active (at 3/52 & at 12/52 weeks FU)
 - Review 2: For patients with confirmed nerve root involvement, there are few or no difference between bed rest & stay active at 3/52 & at 12/52 weeks FU
 - » Hagen Kare B et al. The updated Cochrane Review of bed rest for LBP & sciatica. Spine 2005;30(5):542-546

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LBP- Rest ?:

- LBP- Sick leave:
 - For simple LBP:
 - High quality evidence that advice to rest in bed will increase the length of sick leave during the first 12/52 compared to advice to stay active
 - For acute sciatica:
 - moderate quality evidence that advice to rest in bed has little or no effect on the length of sick leave compared to advice to stay active
 - » Hagen Kare B et al. The updated Cochrane Review of bed rest for LBP & sciatica. Spine 2005;30(5):542-546

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LBP- Predictors of poor outcomes:

- Factors (at initial evaluation for LBP):
 - high fear-avoidance of pain,
 - psychological distress,
 - compensation claims,
 - personal injury litigation,
 - job dissatisfaction => poorer outcomes + tend more commonly to develop chronic LBP illness than those without these risk factors.
 - » E Carragee et al. Spine 2005;5(1):24-35

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LBP- Specific precipitating activities:

- Subjects perceiving that they have been injured through another's fault, especially if pursuing compensation, did much worse
 - if **perception**: own fault or no one's fault => the recovery potential was actually better
 - » Carragee E et al. Spine 2006;31 (2006 ISSLS price in clinical research)

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LBP Illness:

- LBP- Key:
 - Cause of serious LBP illness in the absence of serious spinal diseases such as instability, infection or neoplasm is not well understood
 - Non-structural factors such as central pain intolerance, psychological distress & economic issues of compensation & participation, appear to act as co-morbidities to LBP illness impairing recovery

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Common Degenerative Conditions:

- Management strategies for common degenerative conditions:
 - Non-surgical interventions:
 - have been occasionally shown to be more effective than placebo or 'usual care', but these effects are most commonly small and often of doubtful clinical relevance
 - » Carragee EJ. N Engl J Med 2005;352:1891-8
 - Non-surgical methods: usually of relatively low risk morbidity.



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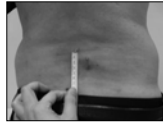
Common Degenerative Conditions:

– Surgical methods for back pain (in the absence of serious structural disease):

- still controversial
- by its nature is associated with real risks + sizable cost.



2012 Laminectomy 20 years ago



MIS Nowadays

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Common Degenerative Conditions:

- Key:

– RCTs of surgical Vs non-operative care:

- lumbar fusion surgery for common degenerative changes appears to offer only limited relative benefits over intensive rehabilitation.

– Cohort studies of highly selected subjects have somewhat better outcomes

» Eugene J. Carragee. Current Orthopaedics 2007

2012

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Back pain an indication for spinal surgery ?

- Back pain is a symptom, not a diagnosis
- Surgery: not indicated for nonspecific LBP
 - Caution is crucial:
 - when indication is pain, because complaint of pain is subjective & personal &
 - surgical results are uniformly poor when issues of secondary gain exist

2012

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Back pain an indication for spinal surgery ?

– But LBP may be a symptom for:

- neural impingement +/- instability +/- spinal deformities
- Appropriate Assessment + surgical procedures may be of use
- Fusion in selected degenerative disorders

2012

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- Case II.7a

– Laminectomy done 20 years ago



2012

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- Case II.7b

– Case of spinal stenosis L3/4 and L4/5

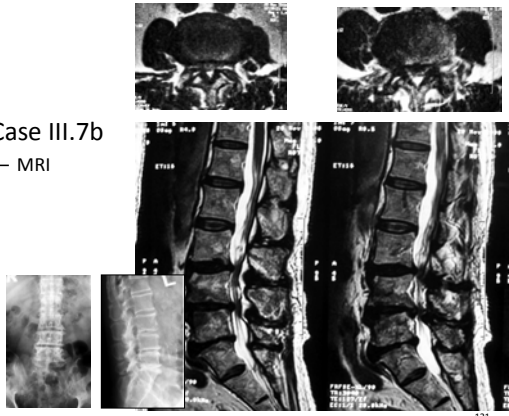
– Causing limited walking tolerance of 10 minutes



2012

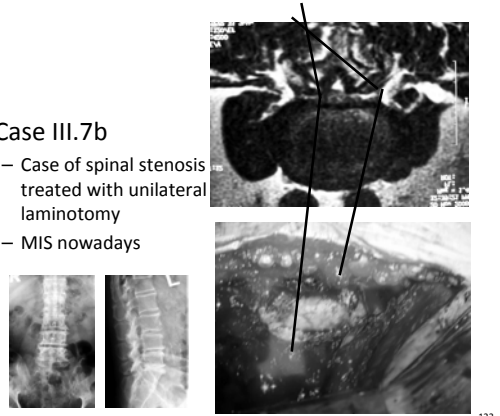
120

- Case III.7b
 - MRI



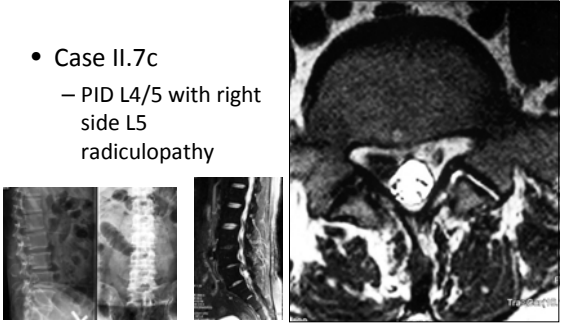
2012 121

- Case III.7b
 - Case of spinal stenosis treated with unilateral laminotomy
 - MIS nowadays

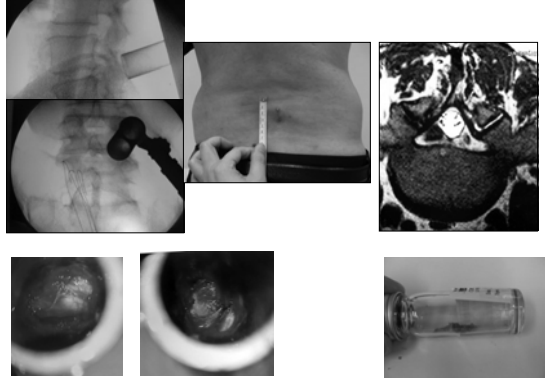


2012 122

- Case II.7c
 - PID L4/5 with right side L5 radiculopathy




2012 123



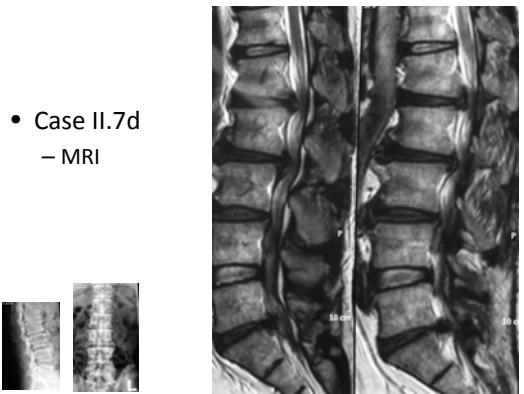
2012 124

- Case II.7d
 - Left side foot drop
 - Bowel and bladder disturbance



2012 125

- Case II.7d
 - MRI



2012 126

- Case III.7d

2012 127

- Case III.7d
- Laminectomy + instrumentation
- Good recovery

2012 128

Best result after spinal surgery ?

- Best result possible only if:
 - (i) Appropriate assessment
 - (ii) + following Adequate nonsurgical treatment
 - (iii) + A definite noiceptive focus identified
 - (iv) + Without negative psychological factors
 - (v) + No secondary gain

2012 129

- Case II.7e
- PID L3/4 with right side foot drop

2012 130

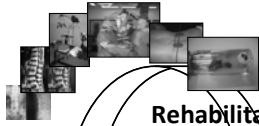
Assessment:

2012 131

Operation:

2012 132

Good Result...:



Rehabilitation (PT and OT)



2012

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Thank you

2012

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