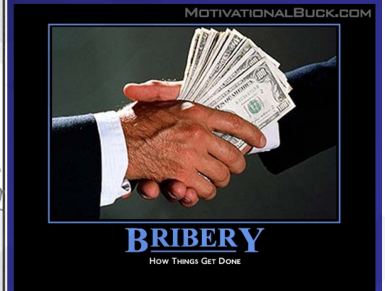


MSc Trauma Surgery: Spinal Injuries

Mr M J H McCarthy
Consultant Spinal Surgeon
Cardiff UK



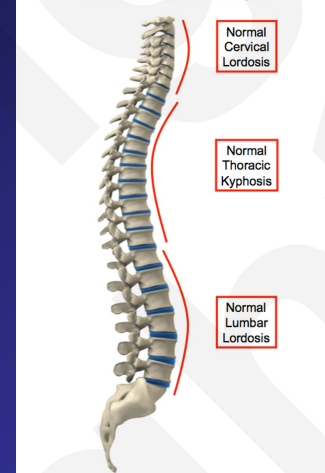
No Disclosures
No Conflicts of Interest



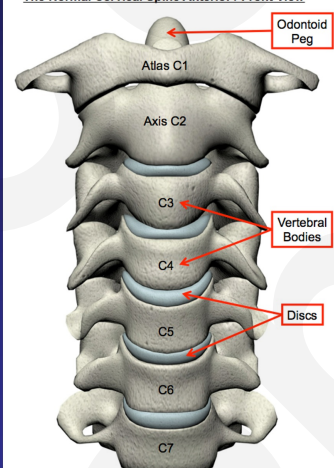
Aims / Objectives

- Anatomy and Biomechanics of the Spine
- Pathophysiology of Spinal Cord Injury
- Investigations
- Initial Management
- Classification and Treatment of Injuries
- Outcome
- Not Covering Pelvis Sacrum, Paediatric or Osteoporotic Injuries

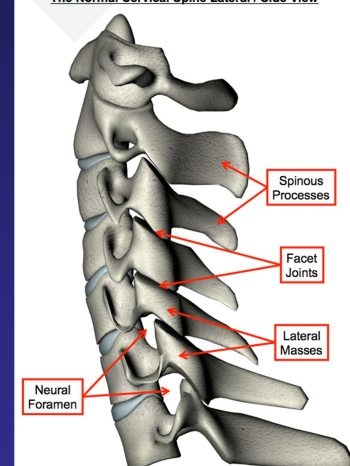
The Normal Curves of the Spine



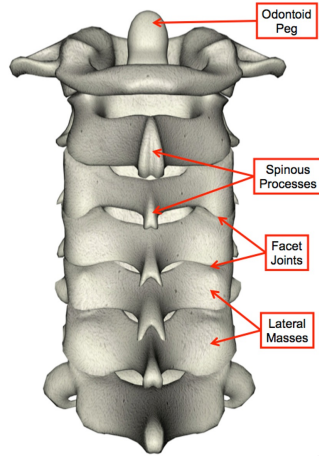
The Normal Cervical Spine Anterior / Front View



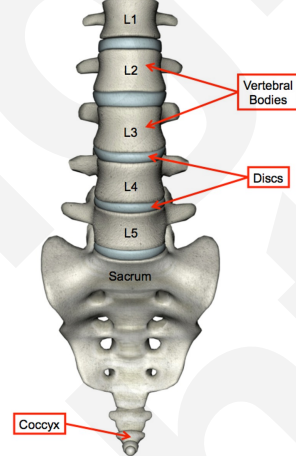
The Normal Cervical Spine Lateral / Side View



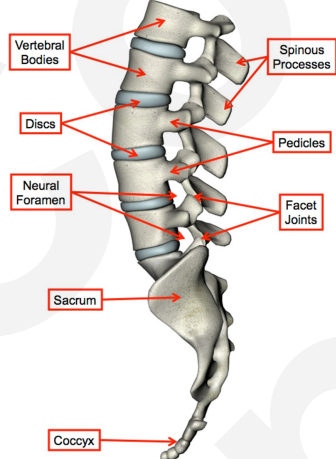
The Normal Cervical Spine Posterior / Back View



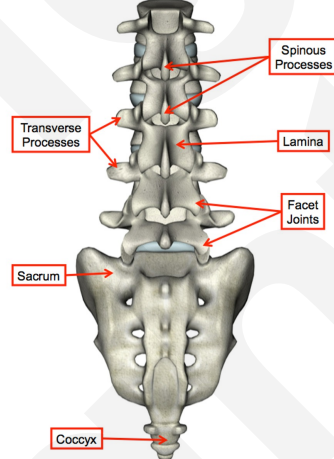
The Normal Lumbar Spine Anterior / Front View



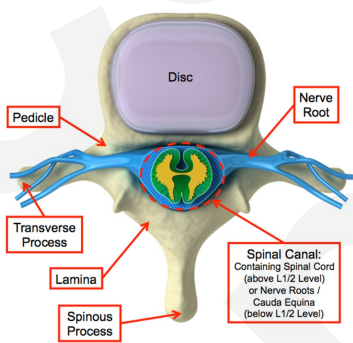
The Normal Lumbar Spine Lateral / Side View



The Normal Lumbar Spine Posterior / Back View



The Normal Spine in Cross Section



Patient Name _____ Date/Time of Exam _____

Examiner Name _____

ASIA **STANDARD NEUROLOGICAL CLASSIFICATION OF SPINAL CORD INJURY** **ISC**

MOTOR

KEY MUSCLES (marking on reverse side)

	R	L
C5	☐	☐
C6	☐	☐
C7	☐	☐
C8	☐	☐
T1	☐	☐
UPPER LIMB TOTAL (MAXIMUM)	(25)	(25)

Comments: _____

Reflexes

	R	L
L2	☐	☐
L3	☐	☐
L4	☐	☐
L5	☐	☐
S1	☐	☐

Voluntary anal contraction (Yes/No) ☐ S4-S5

SENSORY

KEY SENSORY POINTS

	R	L
C2	☐	☐
C3	☐	☐
C4	☐	☐
C5	☐	☐
C6	☐	☐
C7	☐	☐
C8	☐	☐
T1	☐	☐
T2	☐	☐
T3	☐	☐
T4	☐	☐
T5	☐	☐
T6	☐	☐
T7	☐	☐
T8	☐	☐
T9	☐	☐
T10	☐	☐
T11	☐	☐
T12	☐	☐
L1	☐	☐
L2	☐	☐
L3	☐	☐
L4	☐	☐
L5	☐	☐
S1	☐	☐
S2	☐	☐
S3	☐	☐
S4-S5	☐	☐

Any anal sensation (Yes/No) ☐

Pin Prick Score (max 100)

Light Touch Score (max 100)

Neurological Level

The most caudal segment with normal function

ASIA Impairment Scale

Complete or Incomplete

Zone of Partial Preservation

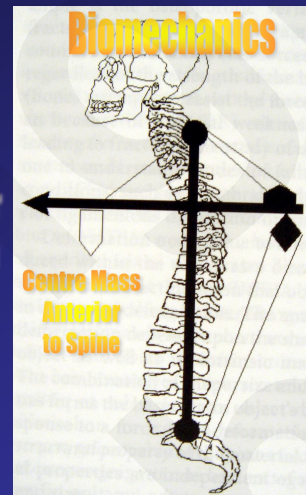
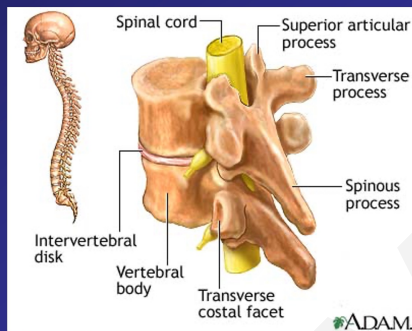
Sensory Motor

Key Sensory Points

This form may be copied freely but should not be altered without permission from the American Spinal Injury Association.

Function

- Support
- Protects cord
- Movement



Suspecting a Spinal Injury

- Mechanism of Injury
- Unconscious
- Neurological Deficit
- Spinal Pain / Tenderness

Goals of Spine Trauma Care

- Protection
- Detection
- Optimize conditions for neuro recovery
- Maintain / restore spinal alignment
- Minimize loss of spinal mobility
- Obtain healed and stable spinal column
- Rehabilitation
- #s = Manage the ass soft tissue injury

Management of Spinal Injury

- ABCDE / ATLS Approach
- Protection - **THINK SPINAL CORD INJURY**
 - Maintain airway with spine control
 - Always aim to have a team of 6 for transfers (min 4 for log rolls)
- Detection
 - Level of injury
 - Complete or Incomplete cord injury
 - Spinal or Neurogenic shock
- Management
 - Conservative or Surgical treatment

Immobilise The Entire Spine



The Spinal Board

- Transport device
- Remove ASAP
- Regular log rolls
- Pressure sores
- Same goes for some collars...

Assessment

- **History**
 - Pain
 - Mechanism
 - Immediate post injury neurology
 - Associated injury
- **Examination**
 - Spine
 - Tenderness
 - Gap
 - Step
 - Marked spasm
 - Spinal cord
- **Imaging**

Examination

- Spinal Cord
- Partial / Complete SCI
 - Sensory level
 - Sensory modality
 - Motor level
 - Sphincter tone
 - Bulbocavernosus reflex

Examination

- **SCI in the Unconscious Patient**
 - Flaccid areflexia
 - Diaphragmatic breathing
 - Pain response above clavicle
 - Bradycardia / Hypotension
 - Priapism



Spinal “Shock”

- Refers to the flacid paralysis, areflexia and lack of sensation secondary to physiologic spinal cord “shut down” in response to injury
- Usually resolves within 24 hours when reflex arcs caudal to injury return
- Lowest that can be tested clinically
 - bulbocavernosus reflex
- Importance of spinal shock
 - determining whether a patient has a complete or incomplete spinal cord injury

Neurogenic Shock

- State of inadequate tissue perfusion and oxygenation due to:
 - Reduced sympathetic outflow (T1-L2) with resultant unopposed vagal tone
- Hypotension due to loss of blood vessel tone with resultant venous pooling
- Bradycardia due to reduced cardiac stimulation
 - distinguishes neurogenic shock from other types of shock (e.g. hypovolaemic, cardiac, anaphylactic)

Spinal Cord Injury

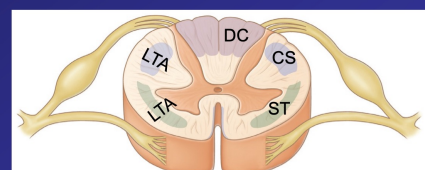
- Primary (at the time of injury)
- Secondary (occurring after the injury)
- Complete spinal cord injury
 - no sensation or voluntary motor function below the level of the injury
- It can only be confirmed after the resolution of spinal shock when reflex activity has returned
- The level of the injury is defined as the first with useful partial neurological function >3/5
- The overall prognosis for recovery of neurological function in complete lesions is poor

Spinal Cord Injury

- Incomplete spinal cord injury means that there is some function caudal to the injury
- In general, the greater the function the faster the recovery and better the prognosis
- Sacral sparing after spinal cord injury
 - the presence of sacral sensation, voluntary rectal tone and great toe movement
 - indicates intact long tract neurones and the potential for recovery
- Prognostic for predicting recovery except in lesions involving the conus medullaris or cauda equina

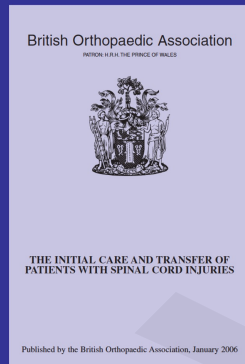
Cord Syndromes

- Anterior
- Posterior
- Central
- Brown-Sequard



Spinal Cord Injury

- Of 569 patients admitted to Spinal Cord Injuries Centre in UK:
 - 9% missed at presentation
 - 5% experienced further avoidable deterioration
 - 1/3 of those missed had significant head injury
- Multiple Fractures in 5%
- Use of Steroids
 - NOT recommended



Spinal Injury Screening

- Clinically
 - Cooperative patient
 - Alert and orientated
 - Able to concentrate on spine
 - Normal neurological exam
 - No spinal pain or tenderness
 - No pain or tenderness with voluntary movement
- Probably not possible in the field

Spinal Injury Screening

- Altered consciousness or symptoms
 - Radiological imaging required
 - Presume the spine is unstable
 - Protect

Spinal Injury Screening

- Lateral Cervical X-Ray
 - Detects 85% cervical fractures
- Image the entire spine
 - 10% with one fracture have another non contiguous injury

Lateral C Spine Assessment

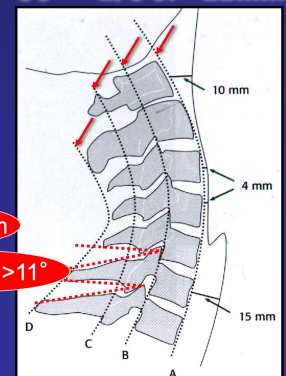
- Name / Age
- Date
- Type of Radiograph
- A : ADEQUACY / ALIGNMENT
- B : BONE
- C : CARTILAGE (Facets / Discs)
- D : DENS
- E : EXTRAAXIAL SOFT TISSUE



DISC SPACE WIDENING

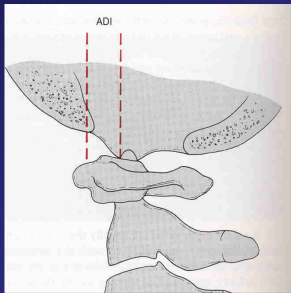


C2 = <1/3 or <5mm
C5 = <2/3 or <22mm



Step >3.5mm

Difference >11°

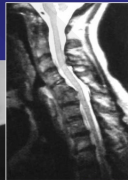
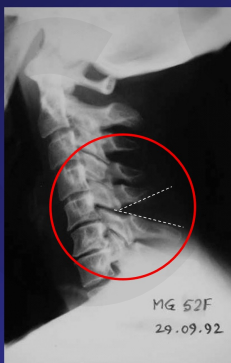
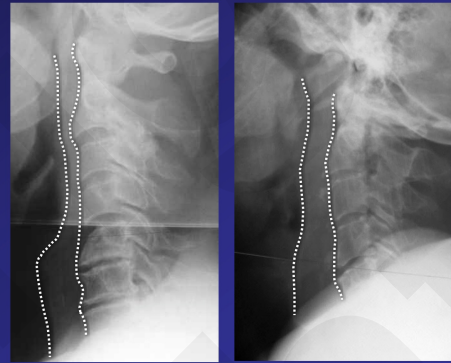


Atlas Dens Interval (ADI)

ADI = 3mm (<5mm)

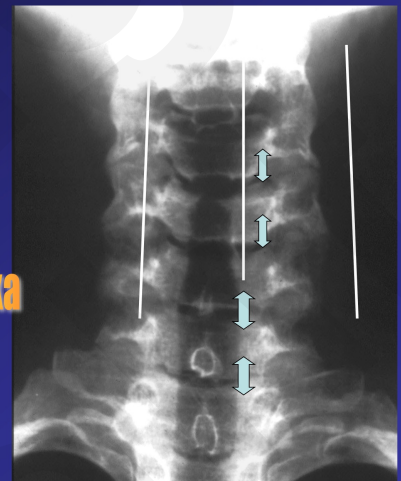
>5mm = Transverse + Accessory ligament rupture

Steels Rule of Thirds



AP View

Alignment
VBs
Lat Masses
IV Joints Luschka
SPs
Discs

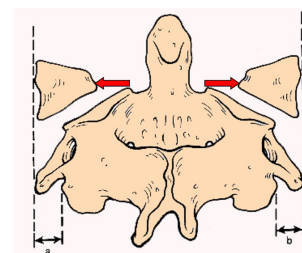


Peg View

Dens
C1 LMs

Adequate or Inadequate?

Instability



$a + b > 7 \text{ mm}$
(transverse ligament rupture)

CT Indications

- Plain Radiographs have failed to visualise all the cervical spine
 - Cervico-thoracic junction
 - Intubated patient (no odontoid peg view) – continue brain CT down to C3
- Plain Radiographs show injury
 - Confirm and further categorise extent of injury

MRI in Spinal Trauma

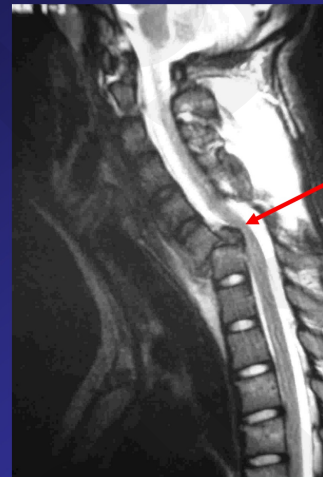
- Overview for exclusion of injury in difficult cases (ankylosing spondylitis)
- Ligamentous injury
- Unexplained neurology
- Prognosis in neurological injury
- Is surgical fixation safe?
 - Extruded disc may be made worse by surgical manipulation

Radiology of Cervical Spine

dislocation with
normal neurology

MRI

reduction



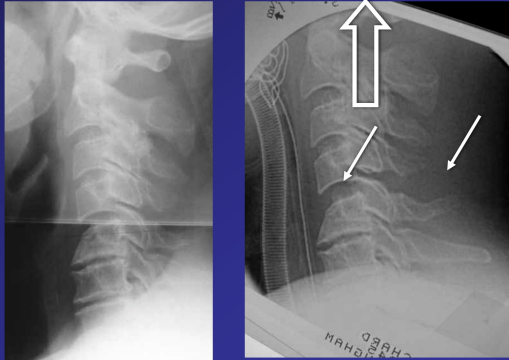
Erect XRs

- Load bearing - physiological
- Normally done in collar
- Useful adjunct after a CT showing a “stable injury” – checks for development of load bearing deformity and ligament injury

Dynamic XRs

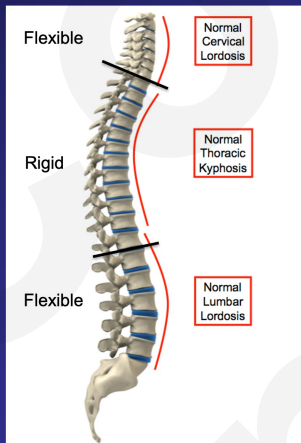
- Physiological
- Normally done at 2 weeks post injury to check for stability or after treatment in a collar to ensure no latent instability

Traction Films



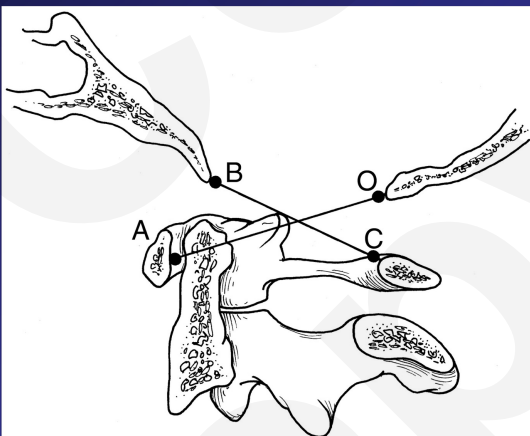
Clinical Instability

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



Upper Cervical Instability

- $>8^\circ$ axial rotation C0-1 to one side
- Powers ratio distance BC / OA > 1 (occipito - cervical dislocation)
- Increased odontoid basion distance - the tip of the odontoid should be in line with basion, with the odontoid basion distance 4-5mm adults and up to 10mm in children
- $>1\text{mm}$ C0-1 translation in flexion / extension (this is a specialist investigation, not in the acute trauma setting)
- $>7\text{mm}$ overhang C1-2 (total left and right)
- $>45^\circ$ axial rotation C1-2 to one side
- Atlantodens interval $>5\text{mm}$ (should be $<3\text{mm}$)



Lower Cervical Instability

- Horizontal vertebral body translation $>3.5\text{mm}$ or 20%
- Difference in intervertebral angulation between adjacent levels $>11^\circ$
- Vertebral body height loss
- Disc space $>1.7\text{mm}$
- Facet fracture, subluxation or widening
- Flexion teardrop – small antero-inferior body fracture

Thoracolumbar Instability

- Neurological deficit
- Clinical posterior tenderness or deformity
- > 20-30° kyphosis (segmental or combined)
- > 30% loss of vertebral height (thoracic)
- > 50% loss of vertebral height (lumbar)
- > 50% canal compromise
- Rotational malalignment
- Fracture dislocation
- Multiple adjacent fractures (combined height loss > 50%)
- Scoliosis > 10°

Consequences of SCI

- Inadequate ventilation
- Abdominal evaluation compromised
- Occult compartment syndrome

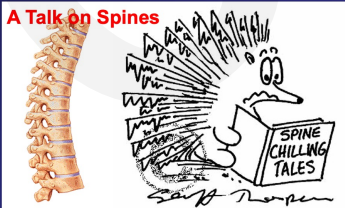
Management of Spinal Injury

- Treat life threatening injuries first
- Ventilation and Oxygenation
- Maintain blood pressure
- Maintain spinal cord perfusion

Management of Hypotension

- Haemorrhagic shock until proven otherwise
- Consider neurogenic shock
- Monitor urine output

A Talk on Spines



=

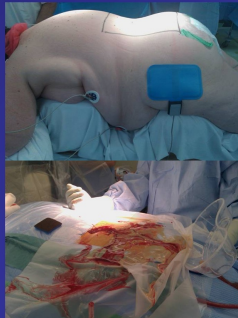


Part 2

- ✓ Anatomy and Biomechanics of the Spine
- ✓ Pathophysiology of Spinal Cord Injury
- ✓ Investigations
- ✓ Initial Management
- Classification and Treatment of Injuries
- Outcome

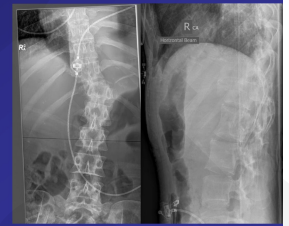
The Personalities

- Personality of the patient
 - Age
 - Comorbidity
 - Bone stock
 - Energy of injury / other injuries
 - Time since injury



The Personalities

- Personality of the fracture
 - Canal compromise
 - Neurologic compromise
 - Kyphosis
 - Anterior collapse
 - Progression



Munted

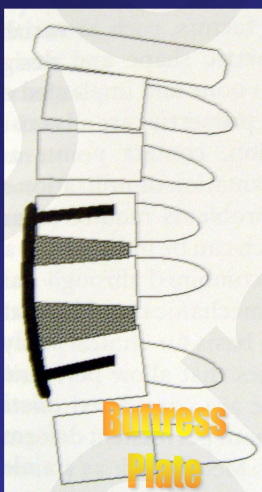
The Personalities

- Personality of the surgeon

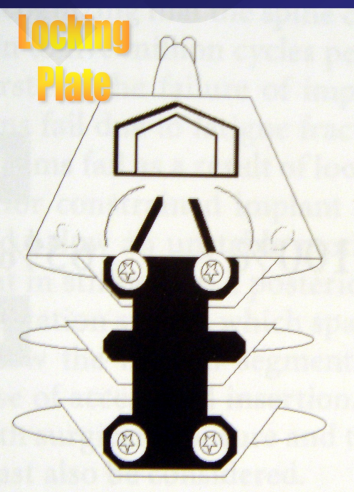


AO Principles

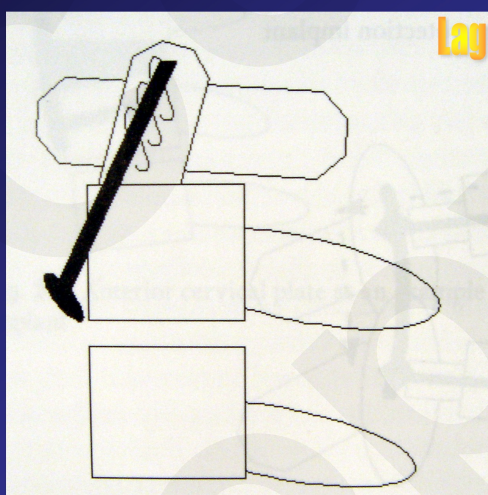
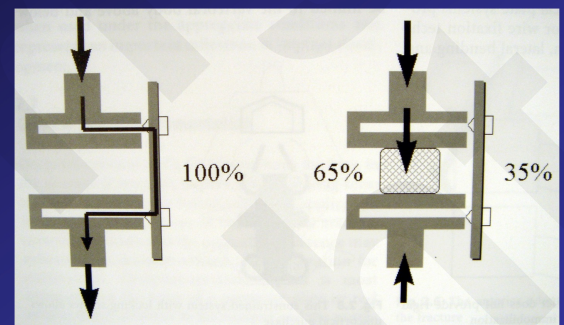
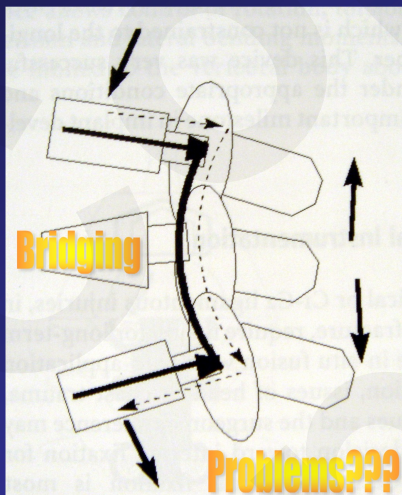
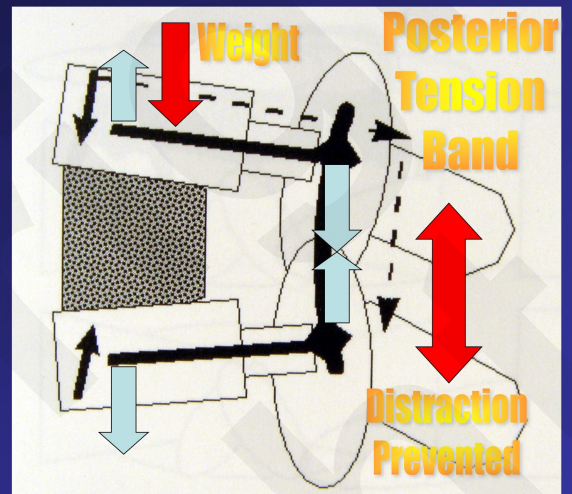
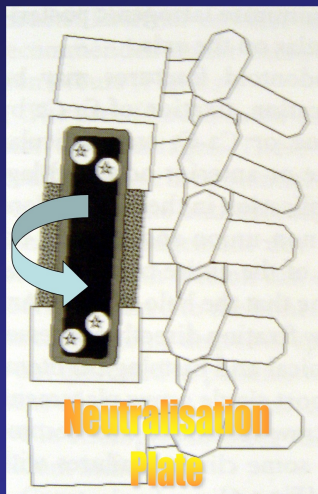
- Anatomic Reduction
- Stable Internal Fixation
- Atraumatic Technique
- Early Active Mobilisation



Buttress Plate



Locking Plate



Why have a classification ?

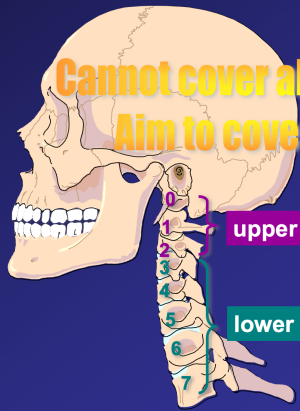
communication
• clinicians

treatment
guidelines

standardisation
• research

prediction
• outcome

Cervical fractures



Cannot cover all C-Spine injuries

Aim to cover some basics

- atypical vertebrae
- distinct injury patterns
- 'typical' vertebrae
- complex injury patterns
- classified together

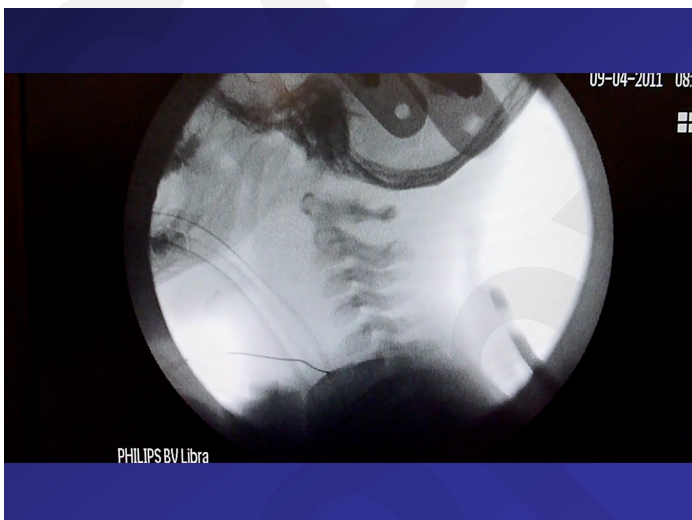
upper cervical spine

lower cervical spine – Sub-Axial

Upper Cervical Spine Injuries

Occipitocervical Injuries

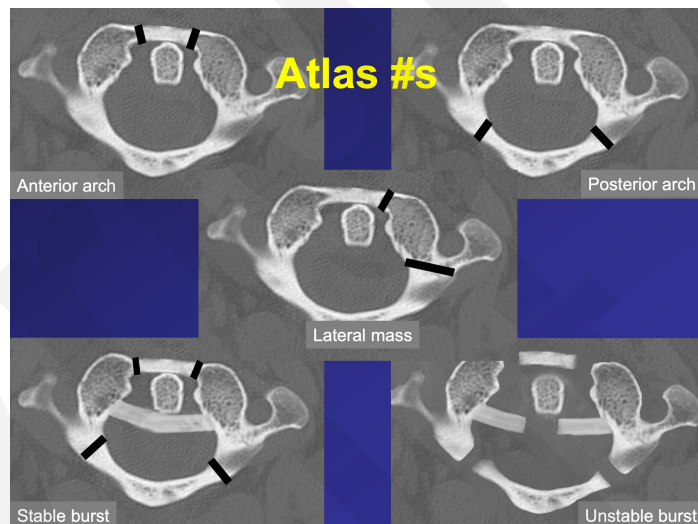
- High energy injury
- Often multiple injuries
- Often missed (head injury)
- High mortality
- Often spinal cord injury
- Early stabilisation recommended



Occipital Condyle #s

- Tuli:
 - 1 Nondisplaced – stable
 - 2a Displaced – stable (2mm)
 - 2b Displaced – unstable – evidence instability
- Comminution / bilateral fractures / ligament injury = unstable
- Risk OC dissociation / cranium may settle on to the axis
- Stable fractures collar
- Minimal displacement halo-vest
- Displaced fractures C0-C2 fusion

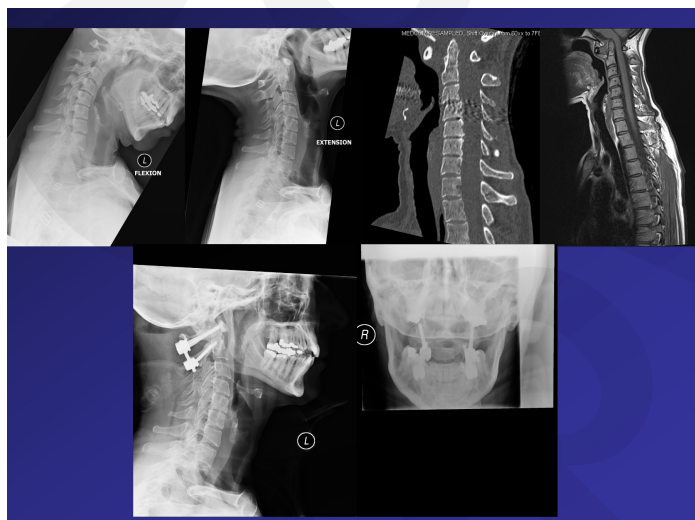
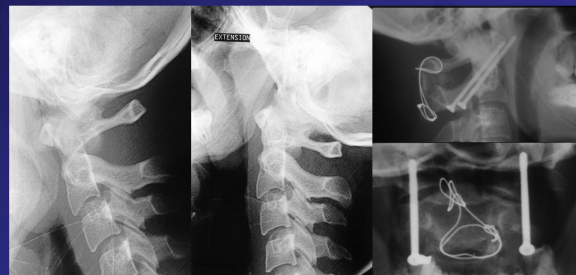
Tuli S, Tator CH, Fehlings MG, Mackay M. Occipital condyle fractures. *Neurosurgery* 1997; 41: 368–377



Management of Atlas #s

Fracture type	Displacement	Transverse Ligament	Management
Anterior/posterior arch	No	Intact	Collar
Lateral mass	Yes	Intact	Halo-vest
		Ruptured	C0-C2 fusion
Comminuted	No	Intact	Halo-vest
	Yes	Ruptured	C1/C2 fusion

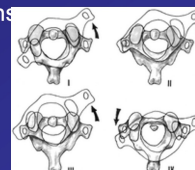
Atlantoaxial Instability



Atlantoaxial Rotatory Instability

- Type 1 - rotatory subluxation around the dens with intact transverse ligament
- Type 2 - associated with transverse ligament injury with ADI from 3-5 mm
- Type 3 - similar to Type II with greater than 5 mm ADI
- Type 4 - rare posterior dislocation where the atlantal arch is posterior to the dens

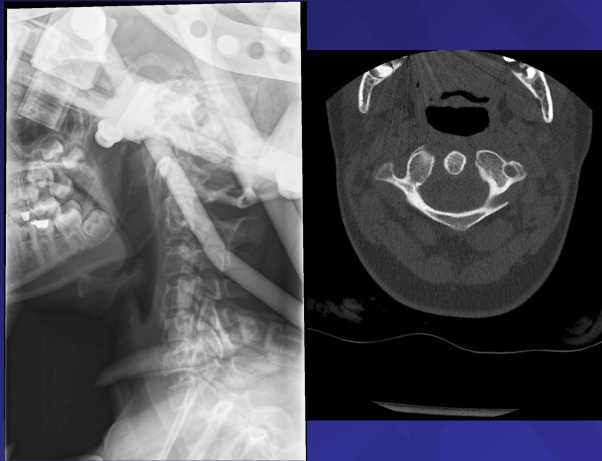
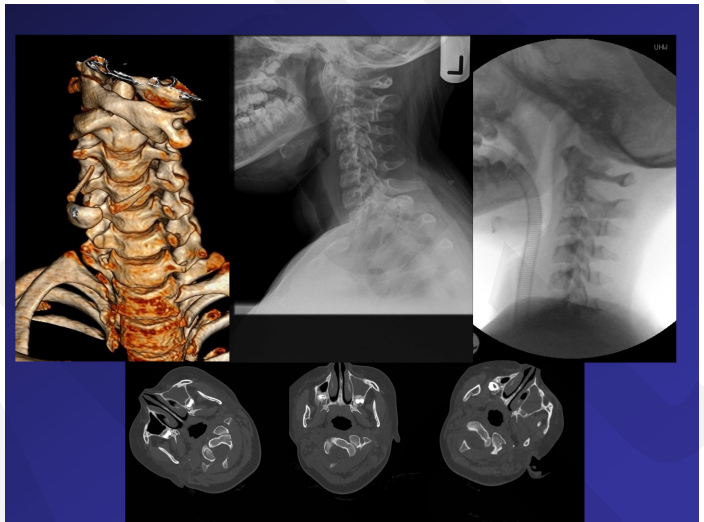
- Mostly Children
- Remodelling



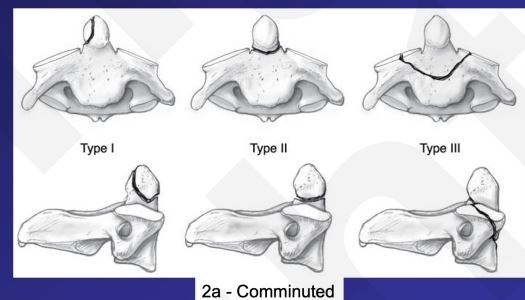
Fielding, Hawkins RJ. Atlanto-axial rotatory fixation. (Fixed rotatory subluxation of the atlanto-axial joint). *Journal of Bone & Joint Surgery - American Volume*. 1977; 59:37-44

Management of AARI

Type	Displacement	Transverse Ligament	Management
1	No	Intact	Traction and / or collar / Halo
2 / 3	Yes	Ruptured	Halo-vest 12/52, may need C0-C2 fusion
4	Yes	Ruptured	C1/C2 fusion



Odontoid Peg #s



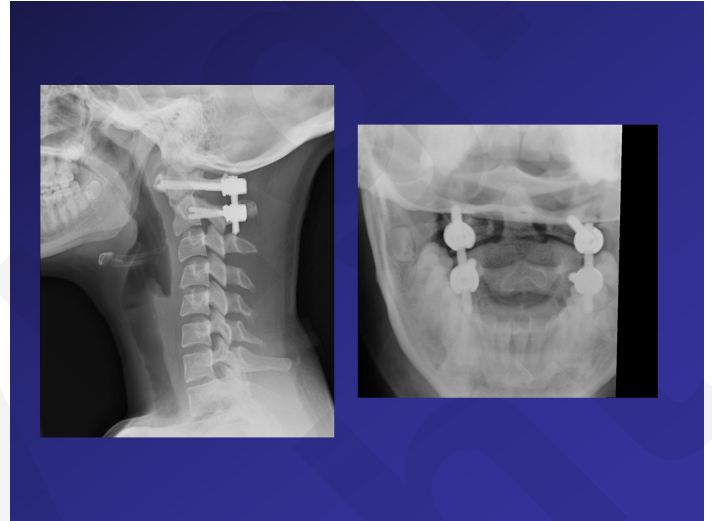
Anderson, D'Alonzo RT. Fractures of the odontoid process of the axis. *Journal of Bone & Joint Surgery - American Volume*. 1974; 56: 1663-1674

Odontoid fractures

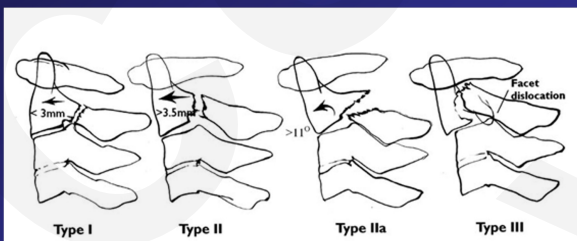
- Majority treated non-operatively
 - Type III
 - Undisplaced Type II
 - Elderly without instability
- Indications for surgery
 - Displaced / Comminuted Type II
 - Ass #s – unstable C1 fracture
 - Multiple injuries
 - Delayed / non-union

Management Peg #s

Type	Displacement	Stable?	Management
1	No Yes	Yes No	Collar C0-C2 fusion
2	<5mm >5mm Elderly Paediatric	No No No No	Collar / Halo / Fixation / C1/2 Halo / Fixation / C1/2 Collar / Halo / Fixation / C1/2 Halo / Minerva
3		No	Halo



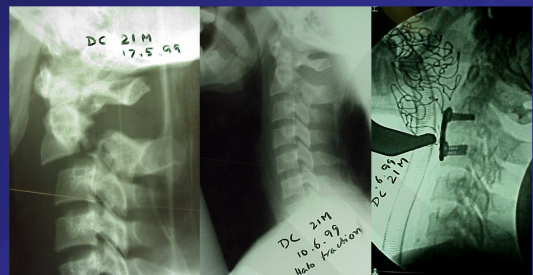
Hangman's #s



Effendi, Roy D, Cornish B, Dussault RG, Laurin CA. Fractures of the ring of the axis. A classification based on the analysis of 131 cases. *Journal of Bone and Joint Surgery British Volume* 1981; 63-B:319-327

Hangman's #s

- Indications Surgery:
 - Irreducible
 - Type II/III
 - Multiple injuries
 - Delayed/non-union



Management Hangman's #s

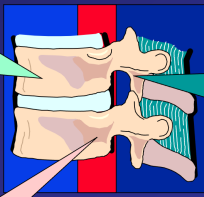
Type	Stable?	Disc / Facet Intact?	Management
1	Yes	Intact	Collar or halo vest
2	No	? Disc Injured	Halo or Fusion C2/3 or Direct repair
2a	No	Disc Injured	As above – avoid traction
3	No	Both injured	C2/3 fusion

Lower Cervical + Thoracolumbar Injuries

The column theory THREE COLUMNS

ANTERIOR COLUMN

- anterior longitudinal ligament
- anterior half of vertebral body
- anterior part of annulus fibrosis



POSTERIOR COLUMN

- neural arch
- ligamentum flavum
- facet joint capsules
- interspinous ligament

MIDDLE COLUMN

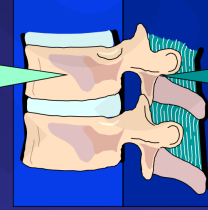
- posterior longitudinal ligament
- posterior half of vertebral body
- posterior part of annulus fibrosis

- Denis 1983
- conceptual rather than anatomical
- based on biomechanical studies

The column theory TWO COLUMNS

ANTERIOR COLUMN

- solid column of vertebral bodies
- compression-resistant

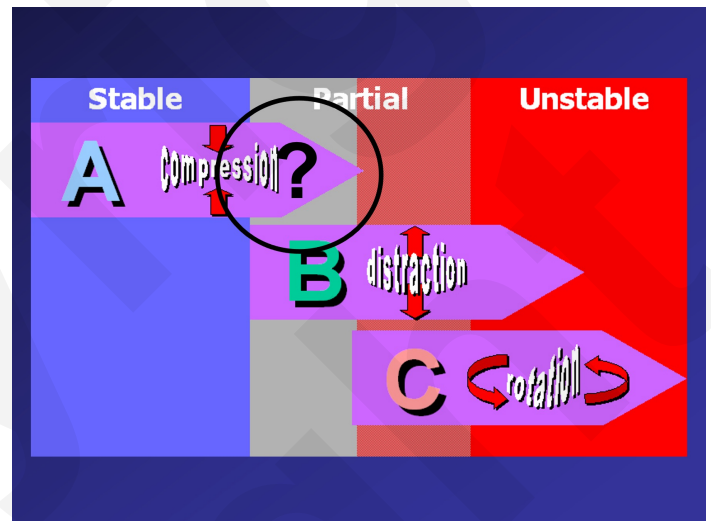
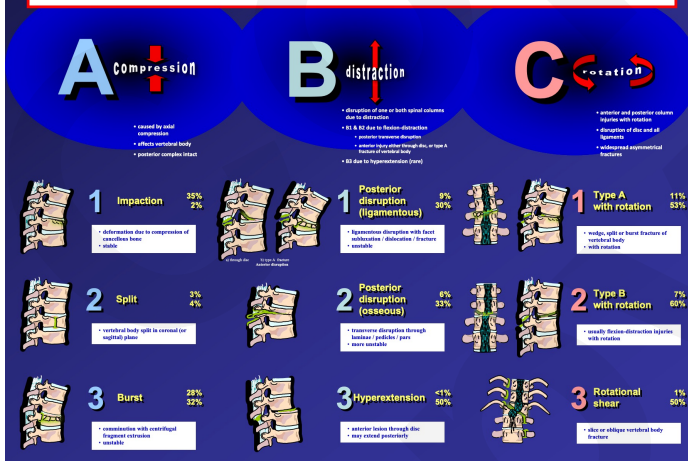


POSTERIOR COLUMN

- hollow column of neural canal
- tension-resistant

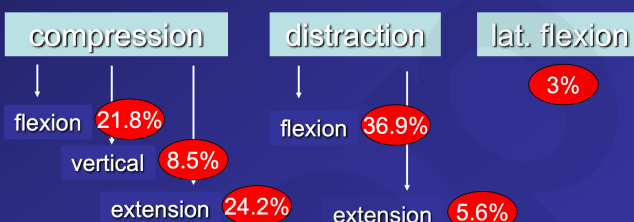
- AO Magerl 1993
- anatomically based concept

AO CLASSIFICATION OF THORACOLUMBAR FRACTURES



Allen & Ferguson

- Injuries divided into families or phylogenies
- Named according to:
Initial dominant force vector
Position of head at time of failure



Allen & Ferguson

- Allen Classification**
- Compressive flexion (shear mechanism resulting in "teardrop" fractures)
 - Stage I: Blunting of anterior body; posterior element intact.
 - Stage II: "Beaking" of the anterior body; loss of anterior vertebral height.
 - Stage III: Fracture line passing from anterior body through the inferior subchondral plate.
 - Stage IV: Inferoposterior margin displaced <3mm into the spinal canal.
 - Stage V: Teardrop fracture; inferoposterior margin >3mm into the spinal canal; posterior ligaments and the 5. posterior longitudinal ligament have failed.
 - Vertical compression (burst fractures)
 - Stage I: Fracture through superior or inferior endplate with no displacement.
 - Stage II: Fracture through both endplates with minimal displacement.
 - Stage III: Burst fracture; displacement of fragments peripherally and into the neural canal.
 - Stage IV: Unilateral facet dislocation; displacement is always <50%.
 - Stage III: Bilateral facet dislocation; displacement >50%.
 - Stage IV: Bilateral facet dislocation with 100% translation.
 - Distraction flexion (dislocations)
 - Stage I: Failure of the posterior ligaments, divergence of spinous processes, and facet subluxation.
 - Stage II: Unilateral facet dislocation; displacement is always <50%.
 - Stage III: Bilateral facet dislocation; displacement >50%.
 - Stage IV: Bilateral facet dislocation with 100% translation.
 - Compressive extension
 - Stage I: Unilateral vertebral arch fracture.
 - Stage II: Bilaminar fracture without other tissue failure.
 - Stage III: Bilateral vertebral arch fracture with fracture of the articular processes, pedicles, and lamina without vertebral body displacement.
 - Stage IV: Bilateral vertebral arch fracture with full vertebral body displacement anteriorly; ligamentous failure at the posterolateral and anteroinferior margins.
 - Distraction extension
 - Stage I: Failure of anterior ligamentous complex or transverse fracture of the body; widening of the disc space and no posterior displacement.
 - Stage II: Failure of posterior ligament complex with displacement of the vertebral body into the canal.
 - Lateral flexion
 - Stage I: Asymmetric unilateral compression fracture of the vertebral body plus a vertebral arch fracture on the ipsilateral side without displacement.
 - Stage II: Displacement of the arch on the anteroposterior view or failure of the ligaments on the contralateral side with articular process separation.

TABLE 1: SLIC Scale

Morphology	Points
No Abnormality	0
Compression	1
Burst	+1 = 2
Distraction (e.g. facet perch, hyperextension)	3
Rotation / Translation (e.g. facet dislocation, unstable teardrop or advanced staged flexion compression injury)	4
Disco-ligamentous complex (DLC)	
Intact	0
Indeterminate (e.g. isolated interspinous widening, MRI signal change only)	1
Disrupted (e.g. widening of disk space, facet perch or dislocation)	2
Neurological Status	
Intact	0
Root Injury	1
Complete Cord Injury	2
Incomplete Cord Injury	3
Continuous Cord Compression in setting of neuro deficit (Neuro Modifier)	+1

Spine
2007

≤ 3 = non op
4 = grey
≥ 5 = op

Table 2

Thoracolumbar Injury Classification and Severity Score

Injury Characteristic	Qualifier	Points
Injury morphology		
Compression	—	1
	Burst	+1
Rotation/translation	—	3
Distraction	—	4
Neurologic status		
Intact	—	0
Nerve root	—	2
Spinal cord, conus medullaris	Incomplete	3
	Complete	2
Cauda equina	—	3
Posterior ligamentous complex integrity		
Intact	—	0
Suspected/Indeterminate	—	2
Disrupted	—	3

+ = 1 additional point given to the morphology

Spine
2005

≤ 3 = non op
4 = grey
≥ 5 = op

Load-sharing classification

McCormack, Gaines et al
spine 1994)

28 pts

COMMINUTION



1. Little
< 30% comminution



2. More
30-60% comminution



3. Gross
> 60% comminution

on sagittal CT

APPOSITION



1. Minimal
minimal spread



2. Spread
< 2mm of < 50%



3. Wide
> 2mm of > 50%

on axial CT

KYPHOSIS



1. Little
< 4° correction



2. More
4-9° correction



3. Most
> 9° correction

on lateral x-ray

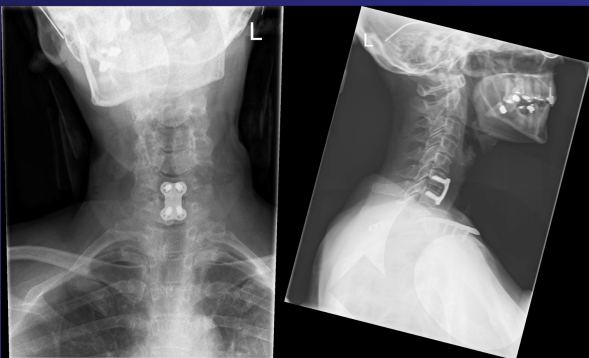
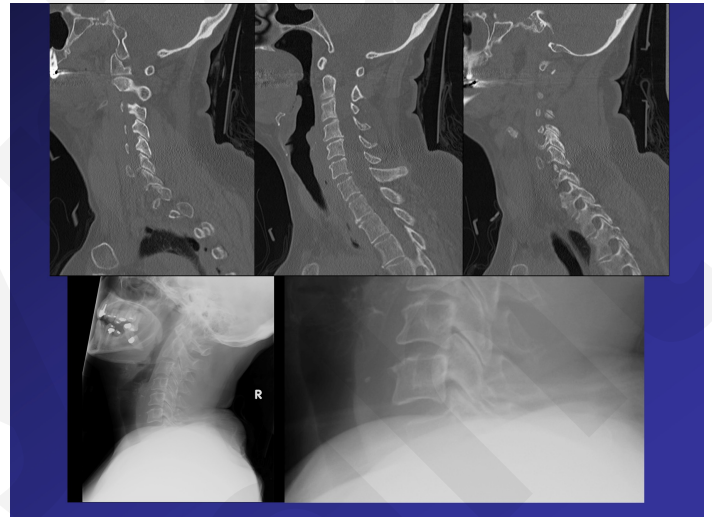
score from 3
to 9

≤ 6 =
posterior
surgery

> 6 =
anterior
surgery

lying vs standing
Prediction of correction
-POST OP

Old Instrumentation
Not Externally Validated





TL - Non Operative Treatment

- Most compression fractures
 - A1
- 2 column burst fractures without neurological deficit
 - A3
- Most bony seatbelt (Chance) injuries ($K < 30^\circ$)
 - B2
- Collar / Halo
- Nothing / Brace

Absolute Indications for Surgery

- Indications for decompression
 - Worsening neurological deficit in the presence of demonstrable neural compression despite attempts at postural reduction
- Indications for stabilisation
 - All cases requiring decompression
 - Complete ligamentous disruption associated with dislocation
- Open Thoracolumbar burst fractures
- Patient with complete neurological deficit
- Multiply injured patient

Relative Indications for Surgery

- Decompression surgery (+ stabilisation)
 - Dynamic neurology
 - Stable incomplete neurology in presence of demonstrable neural compression
- Stabilisation surgery
 - Loss of anterior body height $> 50\%$
 - Kyphosis $> 20-30^\circ$
 - Canal stenosis $> 50\%$
 - Disruption of posterior ligamentous complex

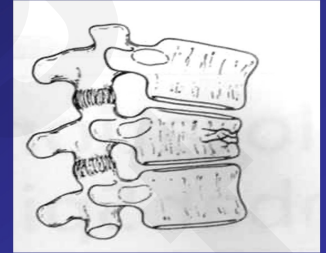
"Accepted" Indications for Surgery Thoracolumbar Burst Fractures

- Progressive neurologic deficit
- Progressive kyphosis ass. with neurologic deficit
- CT evidence of spinal canal compromise associated with an incomplete neurologic deficit
- Greater than 50% loss of vertebral body height
- Kyphosis greater than 30 degrees at level of #
- Spinal canal compromise greater than 50%

J Spinal Disord. 1990 Mar;3(1):39-46.

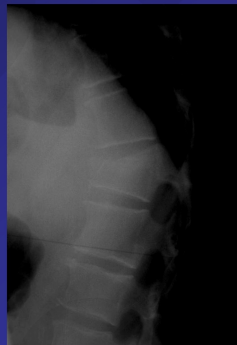
Compression / A1 Impaction

- Primarily involve anterior column in flexion
- Cause RTAs and Falls
- Most common thoracolumbar junction



Treatment

- Mobilise
- Pain Relief
- ? Brace
- ?????Operation

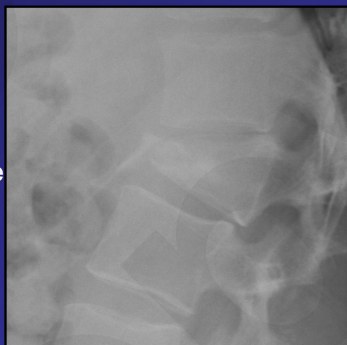


Outcome

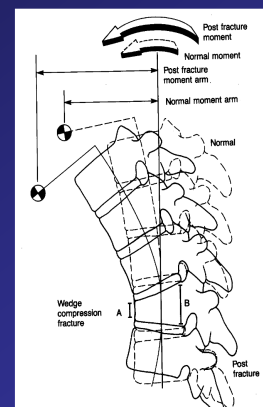
- Majority heal
- Low incidence of back pain
- Lumbar # more likely to be painful

Deformity – Standing Xrays

Gertsbein
>30 deg kyphosis
at union is associate
with increased pain



Post Traumatic Kyphosis



**Moment =
Force x
Distance**

Goals for Surgery

Neurology

Biomechanics

Realign
Stabilize
Decompress
Prevent Late Pain / Deformity

clearance of canal compromise

Maintain Function

restoration of neurological deficit



SPINE Volume 19, Number 15, pp 1711-1722
©1994, J. B. Lippincott Company

Experimental Study of Thoracolumbar Burst Fractures
A Radiographic and Biomechanical Analysis of Anterior and Posterior Instrumentation Systems

Yasuhiro Shono, MD,* Paul C. McAfee, MD,† and Bryan W. Cunningham, BS‡

Anterior > Posterior

SPINE Volume 19, Number 15, pp 1731-1740
©1994, J. B. Lippincott Company

Biomechanical Evaluation of the Stability of Thoracolumbar Burst Fractures

Kenneth S. James, Karl H. Wenger, John D. Schlegel, and Harold K. Dunn

Importance of Intact Posterior Column

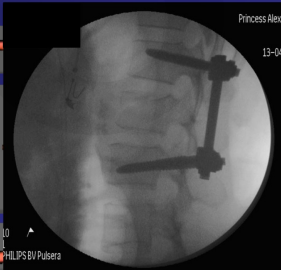
Anterior or posterior surgery

Posterior surgery is mainstay

posterior approach technically easy low morbidity

short segment pedicle fixation reduction of deformity & canal compromise

posterior approach Important for dislocation / realign



Dural laceration occurring with burst fractures and associated laminar fractures

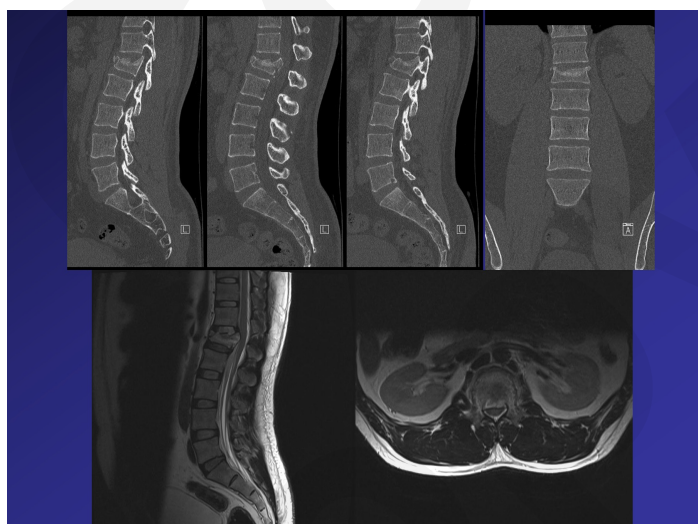
EP Cammissa, FJ Eismont and BA Green
J Bone Joint Surg Am. 1989;71:1044-1052.

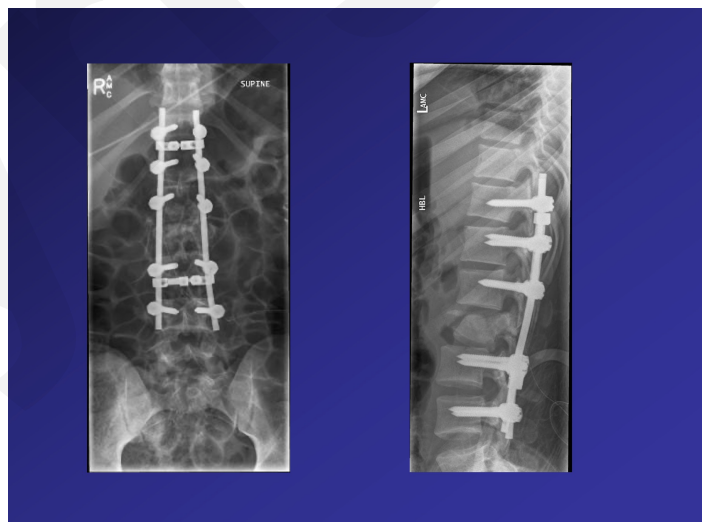
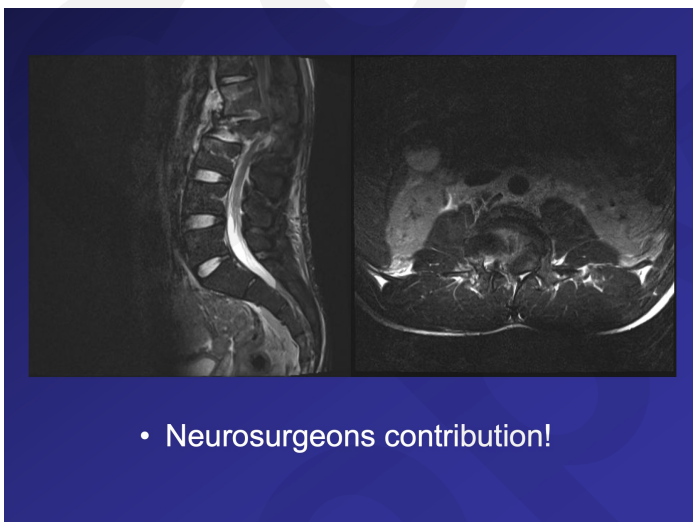
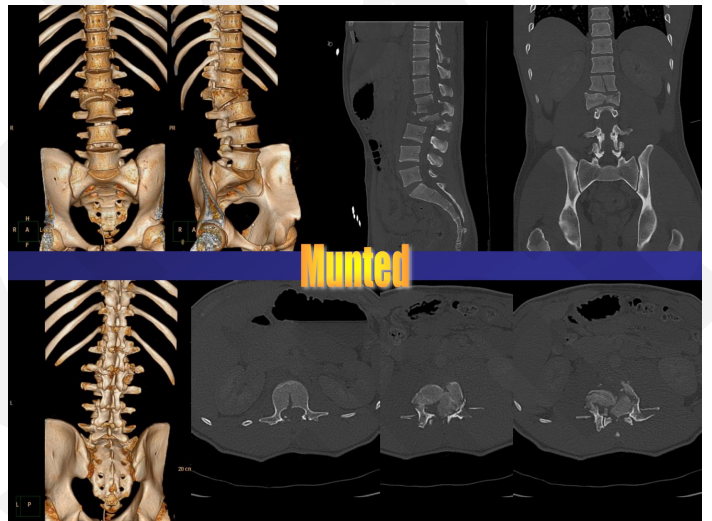
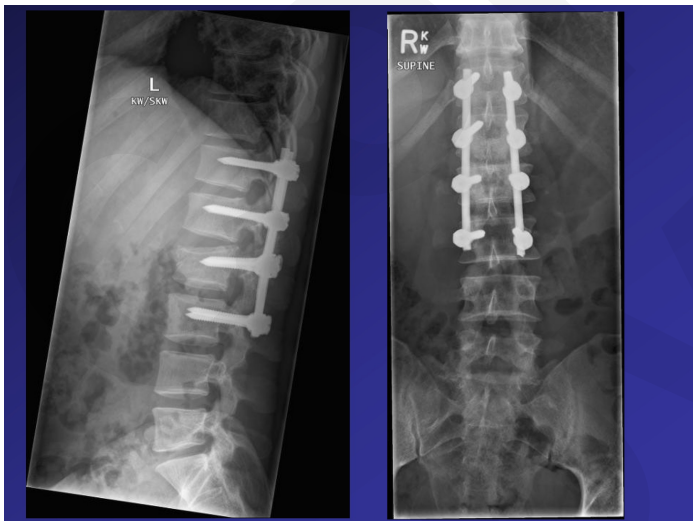
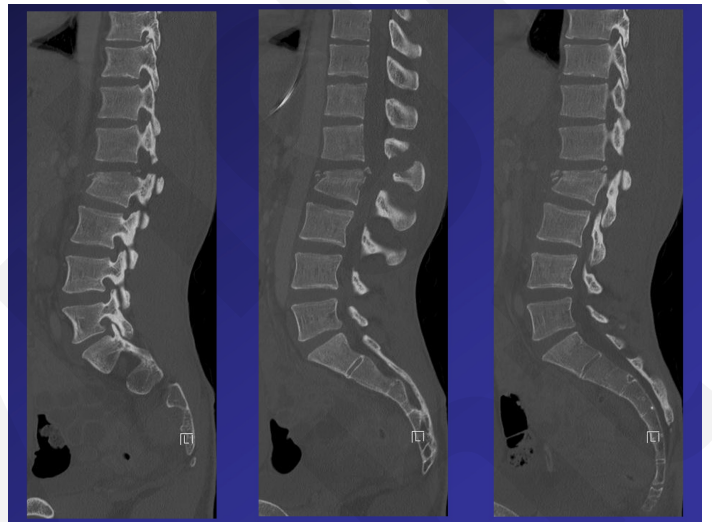
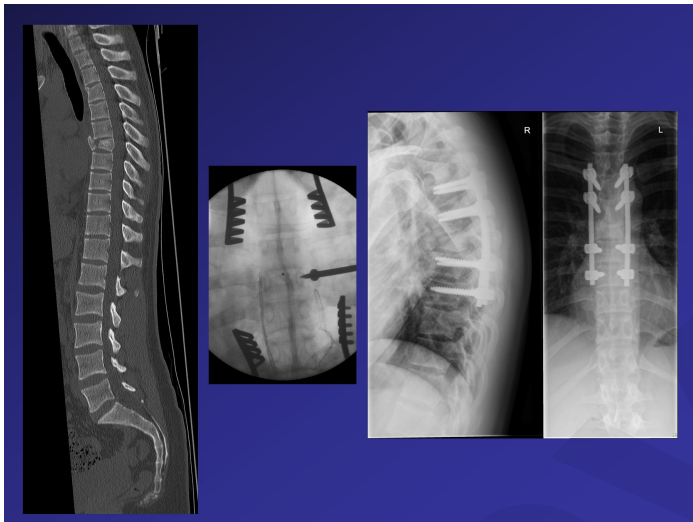
11/30 Dural Lacs

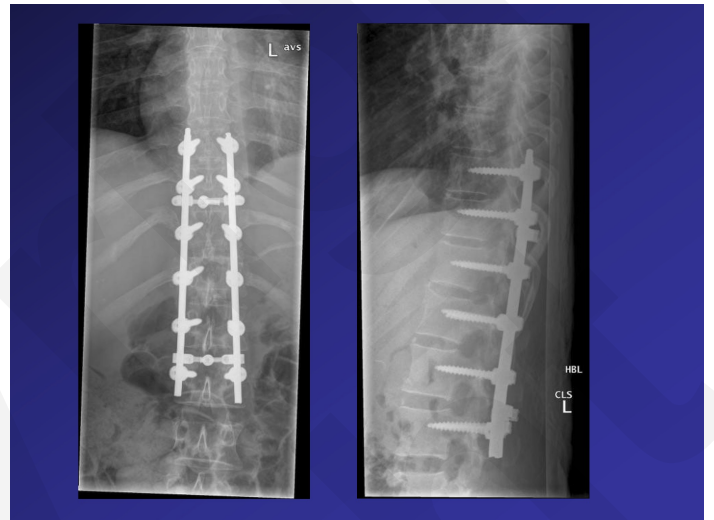
- Exception – facet fracture dislocations – i.e. remove posterior compressive fragments from the back

+ Posterior Fix + Decompression =

and destabilised!





Anterior or posterior surgery

posterior fixation cannot provide anterior column support

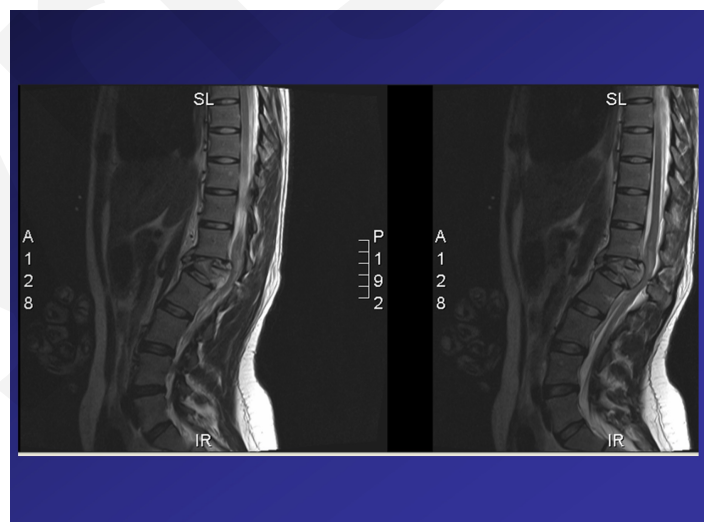
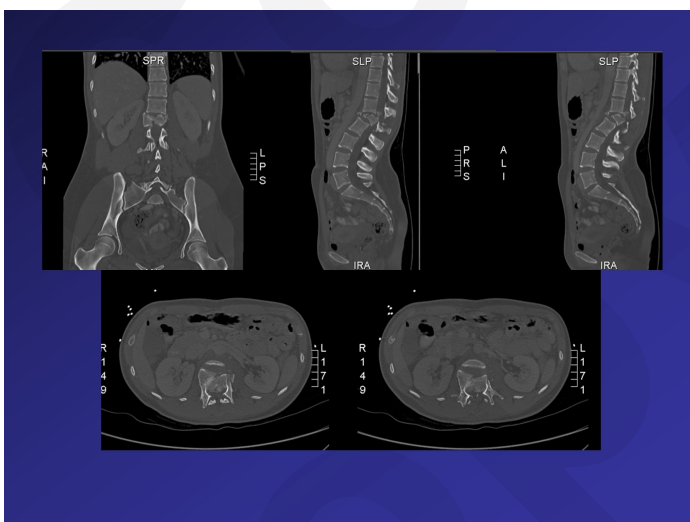
Corpectomy direct cord decompression vs. posterior indirect

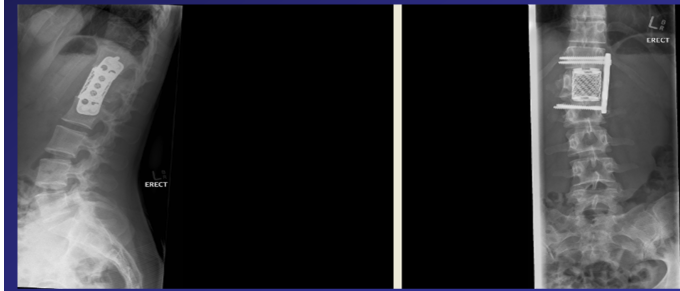
Cons:
Infrequent Specialist Training

Anterior surgery for significant anterior comminution

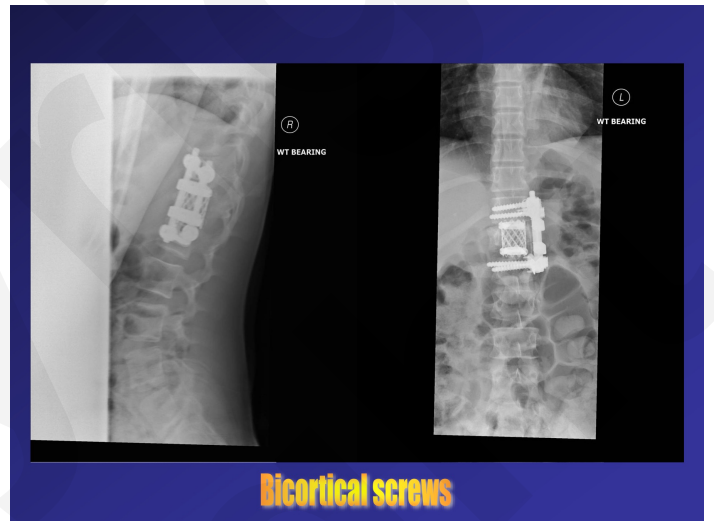
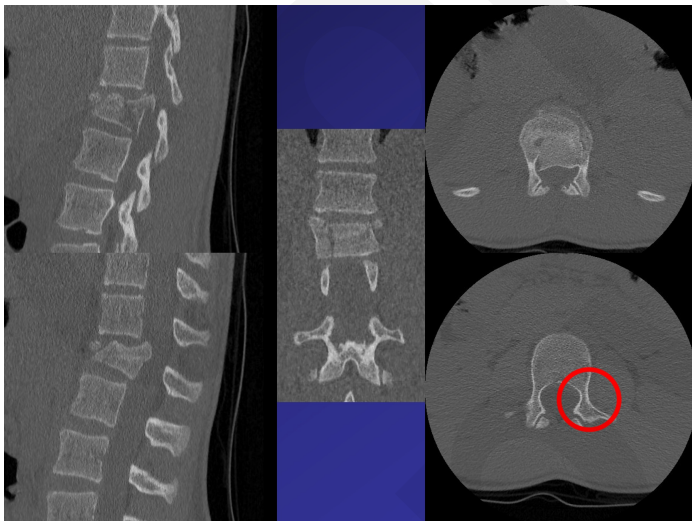
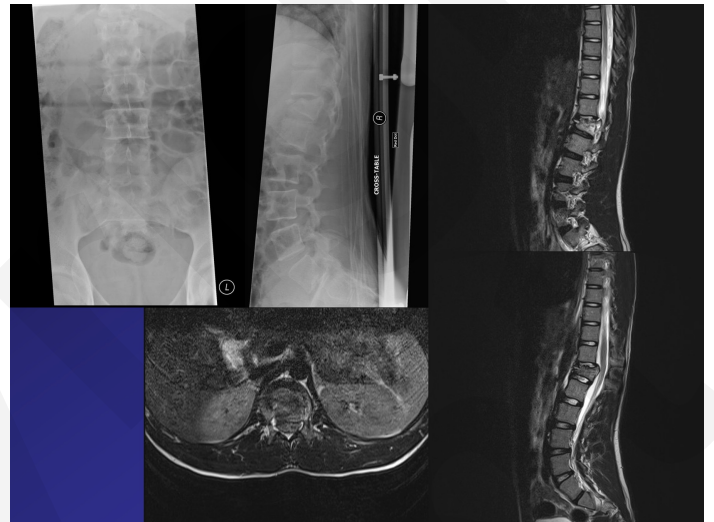
correction of deformity

stabilization of instability

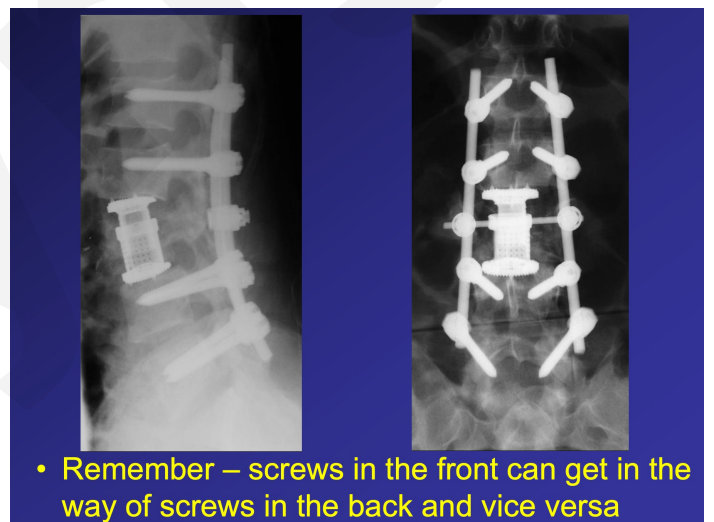
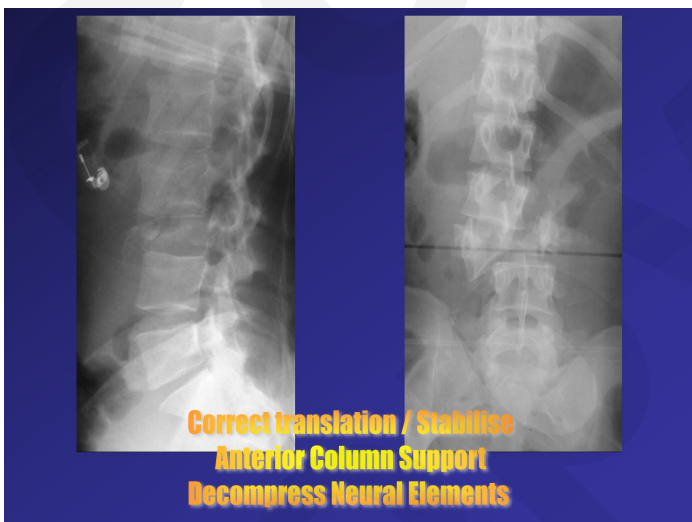




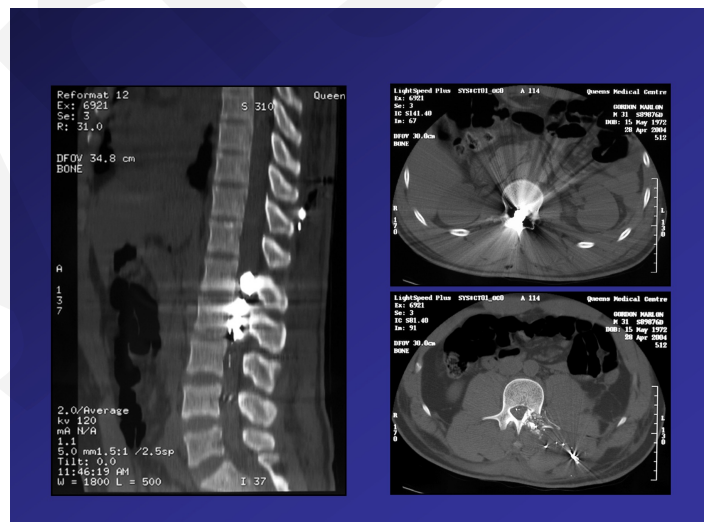
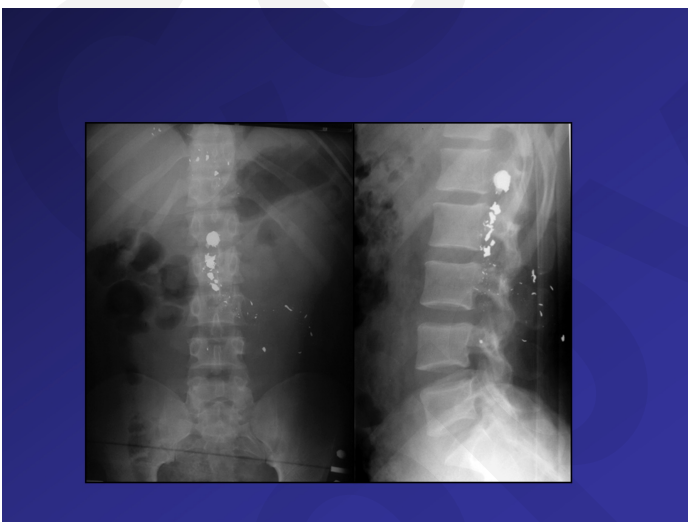
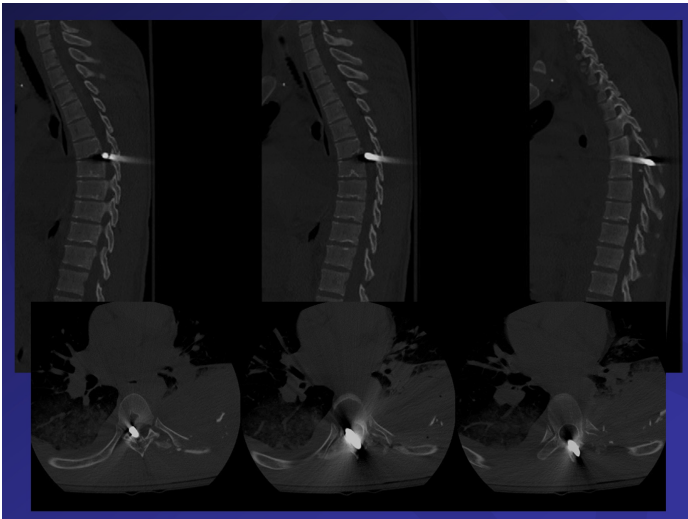
Bicortical screws

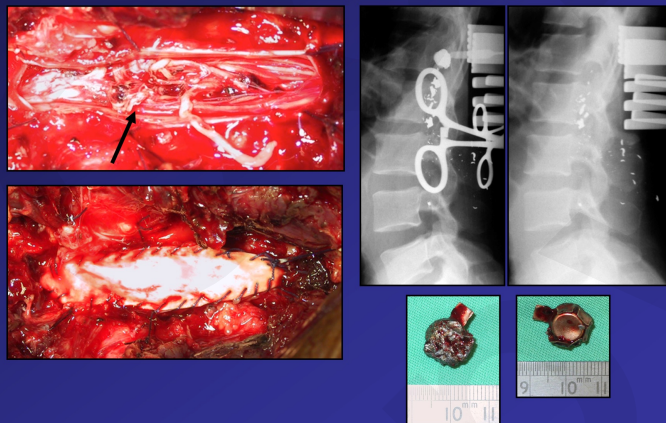
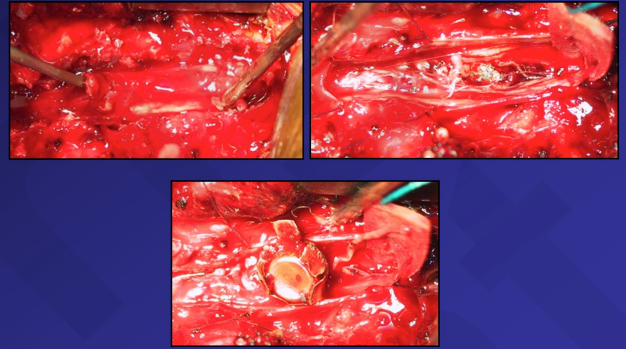
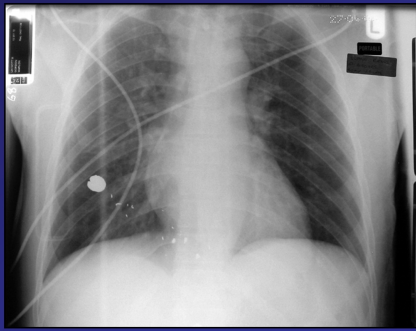


Bicortical screws



- Posterior
 - Realign
 - Restore Tension Band
 - Ligamentotaxis
 - Indirect Canal Decompression
- Anterior
 - Column support
 - Decompression
- Posterior Qs
 - Short or long
 - +/- Fracture screws
 - +/- Cross Links
 - Decompression
 - Fuse
- Anterior Qs
 - Structural Allograft
 - Cage Autograft
 - Expandable Cage
 - Rods or Plate





Complications / Outcomes TL

Stadhouder (Spine 2008)

- Thoracolumbar fractures
- Complications : 17% Nonop 21% Op (NS)
- Outcomes: VAS, ODI, GHQ similar at 2-6 years
- Employment: 88% Nonop, 83% op

Complications

- Pneumonia
- Postural Hypotension
- DVT / PE
- Autonomic Dysreflexia
- Renal Failure
- Pseudo-obstruction
- Sexual Dysfunction
- Pressure Sores
- Psychological Problems

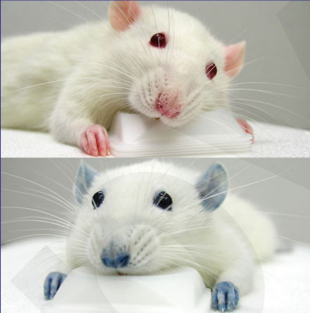
Outcomes Paralysis

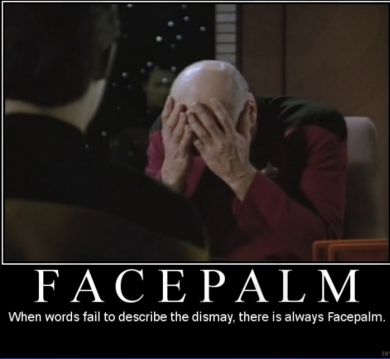
- 25yr tetraplegic >60% normal life expectancy (level below C5)
- 25yr paraplegic >80% normal life expectancy
- 25yr partial paraplegic with mobility >85% normal life expectancy
- 90% of patients with complete tetraplegia will recover some level of function in the muscles below the neurologic level of injury
- MRC 1-2/5 at 30 days have 97% chance progressing to 3/5 at 1 year
- MRC 0/5 at 30 days only 57% recover to 1/5 and 27% to 3/5 at 1 year
- 80% of patients with incomplete paraplegia recover to grade 3/5 in their hip flexors and knee extensors at 1 year (enough to stand with aids)



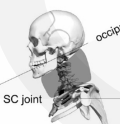
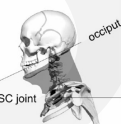
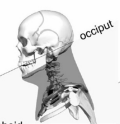
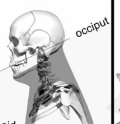
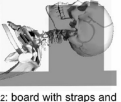
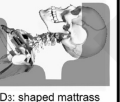
Summary

- Remember ABCDE / ATLS
 - Treat life threatening injuries first
- Protect then Detect
- Think second injury





type A: cervical devices		type B: cervico-thoracic devices		type C: cranial devices	
 A1: soft collar*	 A2: rigid collar**	 B1: high thoracic**	 B2: low thoracic***	 C1: cranial traction	
type D: cranio-thoracic devices for non-ambulatory patients			type E: cranio-thoracic devices for ambulatory patients		
 D1: board with sandbags and tape	 D2: board with straps and head blocks	 D3: shaped mattress	 E1: cast/vest without skull pins	 E2: vest connected with skull pins	