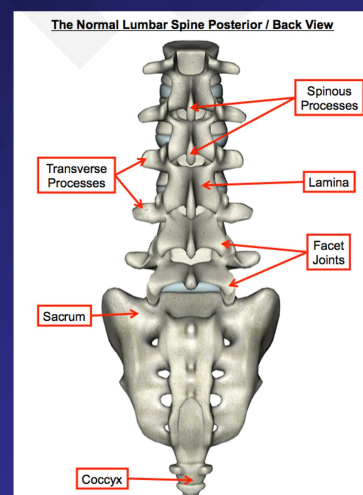
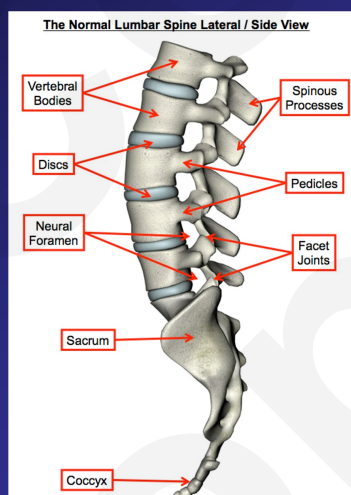
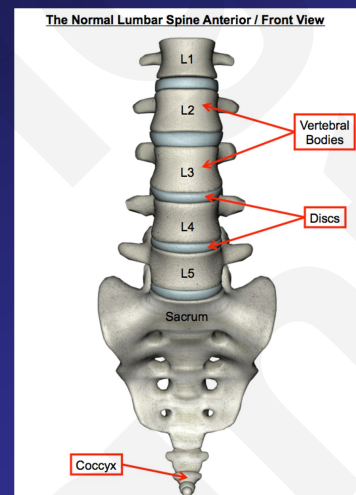
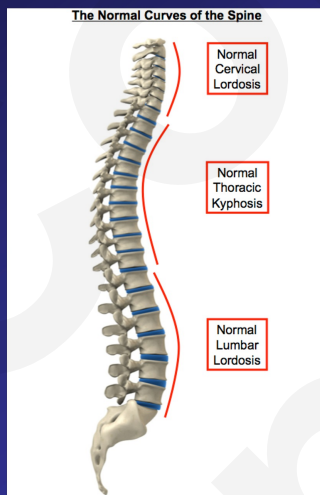


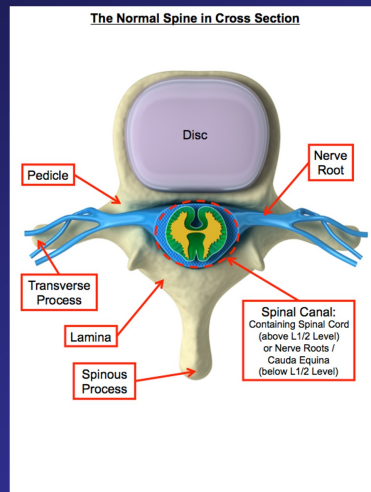
Surgical Treatment of Thoracolumbar Fractures



Aims / Objectives

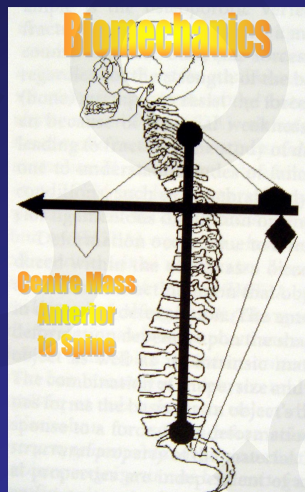
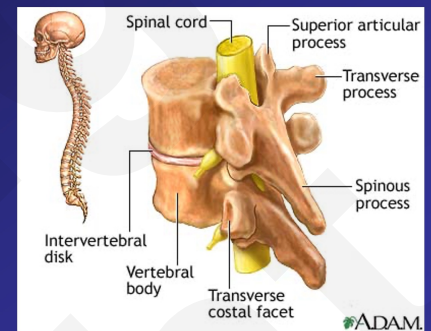
- Anatomy and Biomechanics
- Describe the aims of surgical fixation in the spine
- Fixation
 - Front, Back, Both
- Explain the rationale and mechanics of different approaches
- Summarise evidence of outcome (not covering osteoporotic fractures)





Function

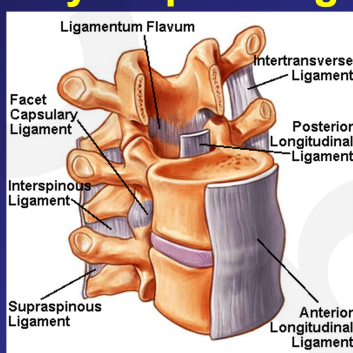
- Support
- Protects cord
- Movement



Spinal Biomechanics Bones

- Provide the load-bearing function of the spine
 - Vertebral size increases down the spinal column
- Subjected mainly to compressive loads
- Trabecular core carries ~55% of total loading
 - This decreases with age (& osteoporosis) to ~35%
- Trabeculae orientation vertical and transverse
 - Most effective orientation to resist compressive loading
- Facet joints 0-33% of total loading
- Facet joint orientation limits movement of adjacent vertebrae

Anatomy – Spinal Ligaments



Spinal Biomechanics Ligaments

- Permit smooth movement with a minimum of applied force within physiological range
- Offer protection for loading outside physiological range
 - Stiffness increases by up to 75 times
- Fibre orientation
 - Toe-in region of stress-strain curve
- Viscoelastic properties
 - Stiffness proportional to $d\epsilon/dt$

Spinal Kinematics

- Motion segments
- Flexibility
 - Large overall flexibility is achieved by small displacements at each motion segment
 - Limits both disc compression and ligament stretch
- Control of motion
 - By muscular action
 - By facet joint orientation

Facet (zygapophyseal) Joint

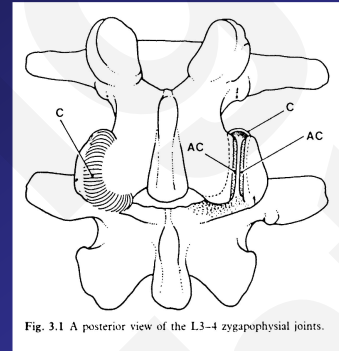
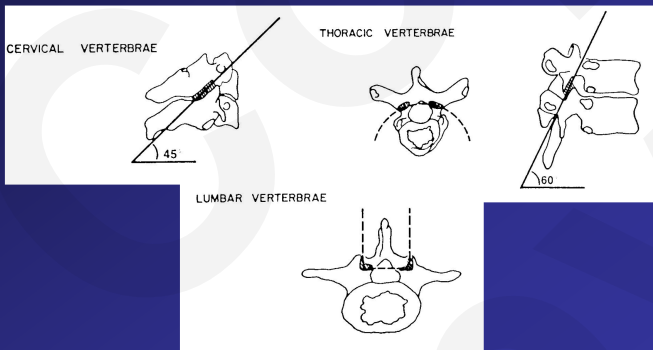


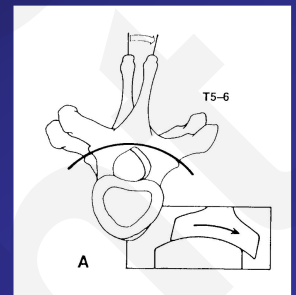
Fig. 3.1 A posterior view of the L3-4 zygapophysial joints.

Facet Joint Orientation



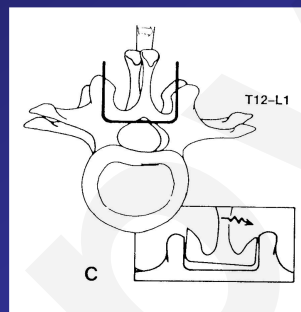
Thoracic Vertebrae

- In the thoracic vertebrae, the facet joints are orientated to allow rotation between adjacent vertebrae, but resist bending (flexion-extension)



Lumbar Vertebrae

- In the lumbar vertebrae, the facet joints are orientated to allow bending (flexion-extension) between adjacent vertebrae, but resist rotation

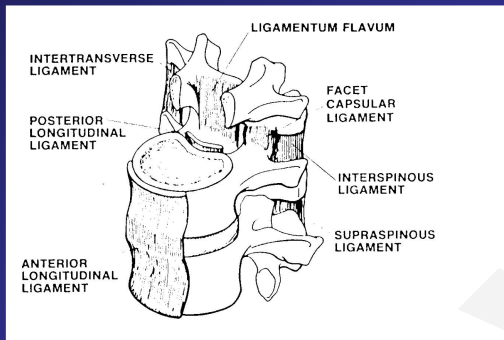


Spinal Kinematics

	Flexion-extension	Lateral bending	Axial rotation
Cervical	√√√√	√√	√√√
Thoracic	√√	√	√√
Lumbar	√√√√	√√	√

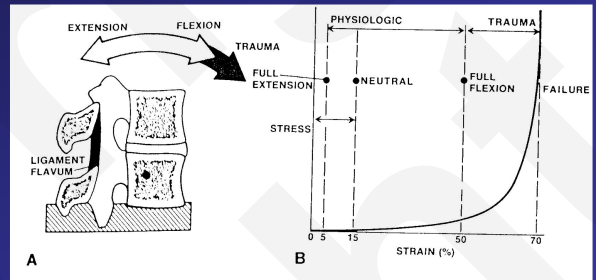
- √ = ~ 5° of movement

Spinal Biomechanics Ligaments



Spinal Biomechanics Ligaments

- Ligaments offer little resistance to movement within the physiological range but considerable resistance outside this range – protective function



Clinical Instability

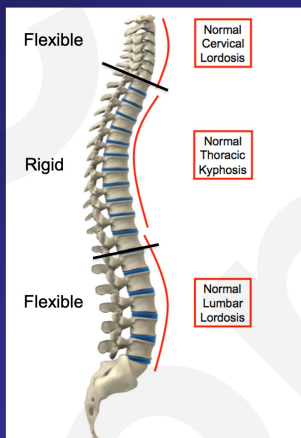
The loss of the ability of the spine under physiological loads to maintain its pattern of displacement so that there is no initial or additional neurological deficit, no major deformity and no incapacitating pain



Instability

- Kinematic - Quantity of motion
 - too much or too little
- Kinematic - Quality of motion
 - paradoxical motion
 - alteration of centres of rotation
- Component instability
 - considers loss of various anatomical structures in instability
- Combined instability

Thoracolumbar Fractures

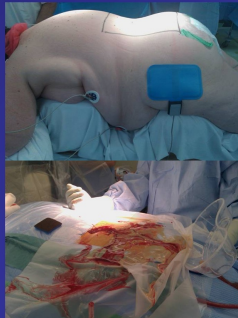


AO Principles

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

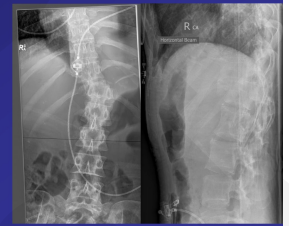
The Personalities

- 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 CLASSIFICATION OF THORACOLUMBAR FRACTURES

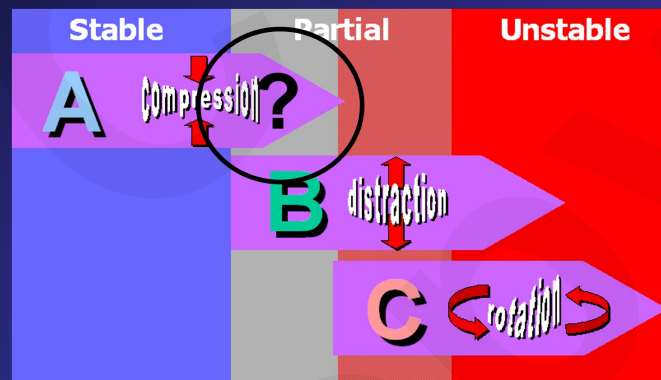
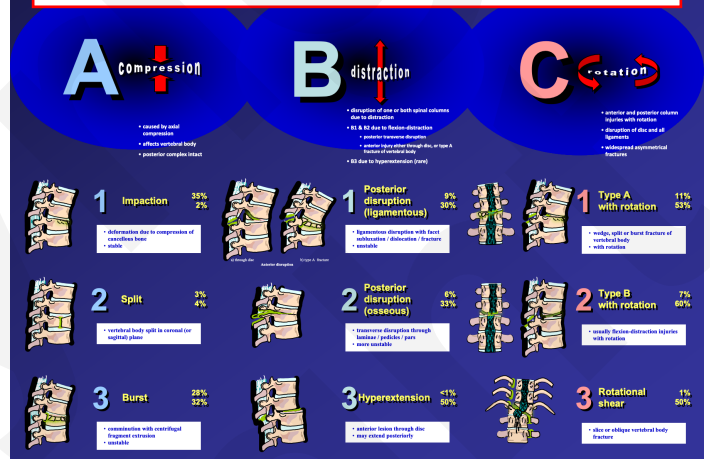


Table 2

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

≤ 3 = non op
4 = grey
≥ 5 = op

Load-sharing classification McCormack, Gaines et al spine 1994 **28 pts**

COMMINUTION	APPOSITION	KYPHOSIS
 1. Little < 30% comminution	 1. Minimal minimal spread	 1. Little < 4° correction
 2. More 30-60% comminution	 2. Spread < 2mm of < 50%	 2. More 4-9° correction
 3. Gross > 60% comminution on sagittal CT	 3. Wide > 2mm of > 50% on axial CT	 3. Most > 9° correction on lateral x-ray - POST OP

score from 3 to 9

≤ 6 = posterior surgery

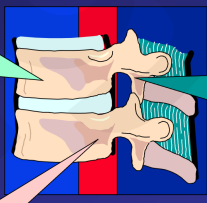
> 6 = anterior surgery

Old Instrumentation Not Externally Validated

lying vs standing
Prediction of correction

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

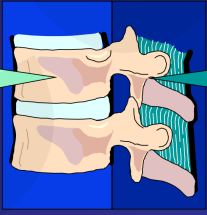
MIDDLE COLUMN

- 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



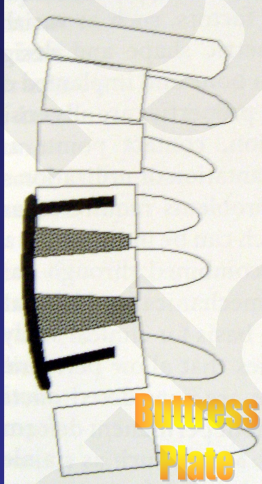
ANTERIOR COLUMN

- solid column of vertebral bodies
- compression-resistant

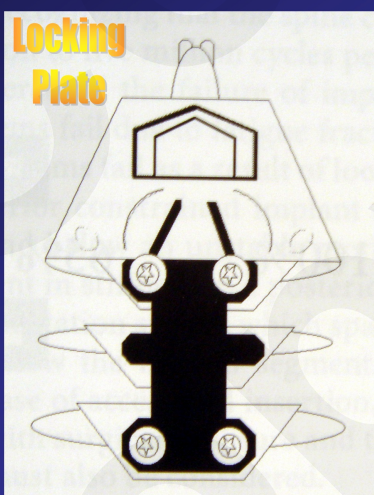
POSTERIOR COLUMN

- hollow column of neural canal
- tension-resistant

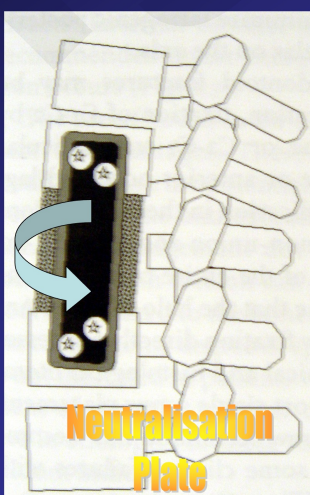
- AO Magerl 1993
- anatomically based concept



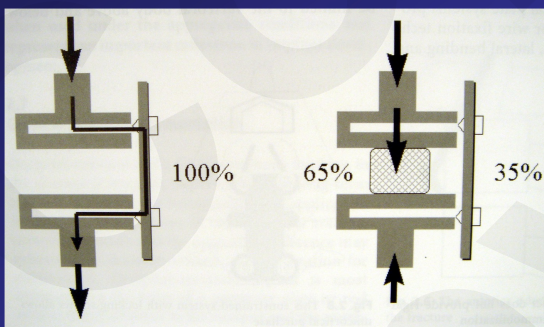
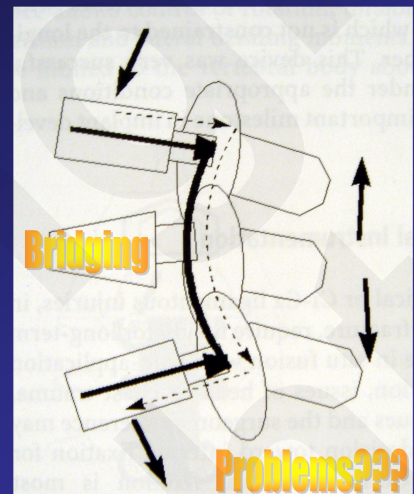
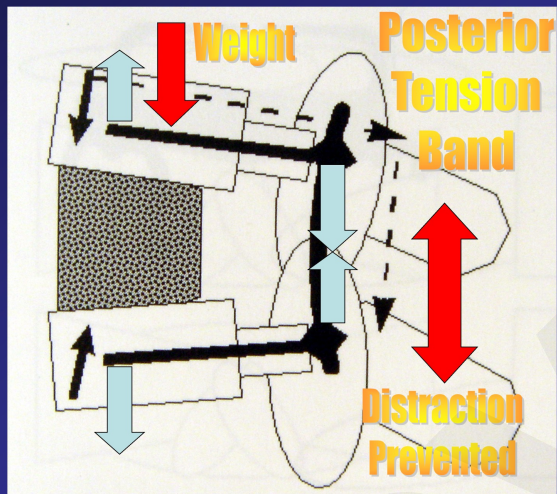
Butress Plate



Locking Plate

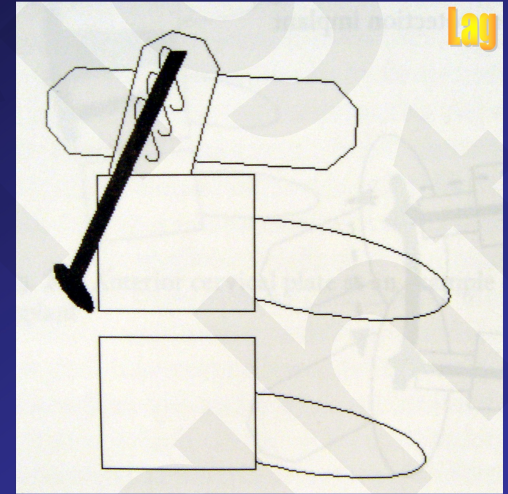


Neutralisation Plate



Failure

Success



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 degrees
 - Canal stenosis >50%
 - Disruption of posterior ligamentous complex

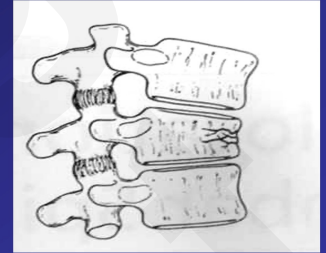
"Accepted" Indications for Surgery Thoracolumbar Burst Fractures

- 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.

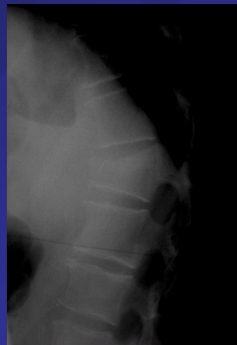
Compression / A1 Impaction

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



Treatment

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

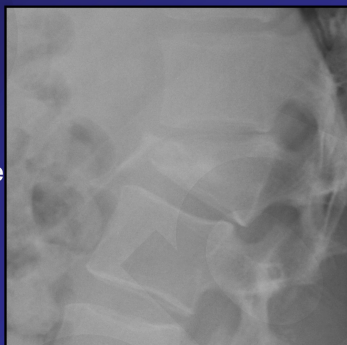


Outcome

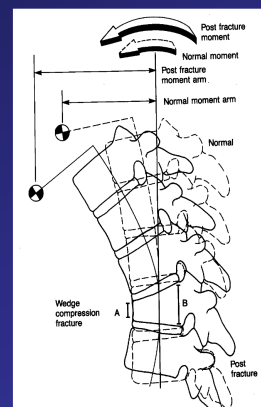
- Majority heal
- Low incidence of back pain
- Lumbar # more likely to be painful

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

Prevention 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

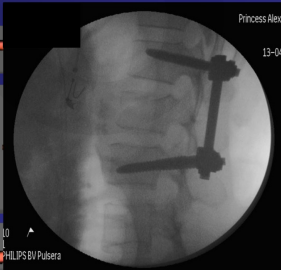
Anterior or posterior surgery

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

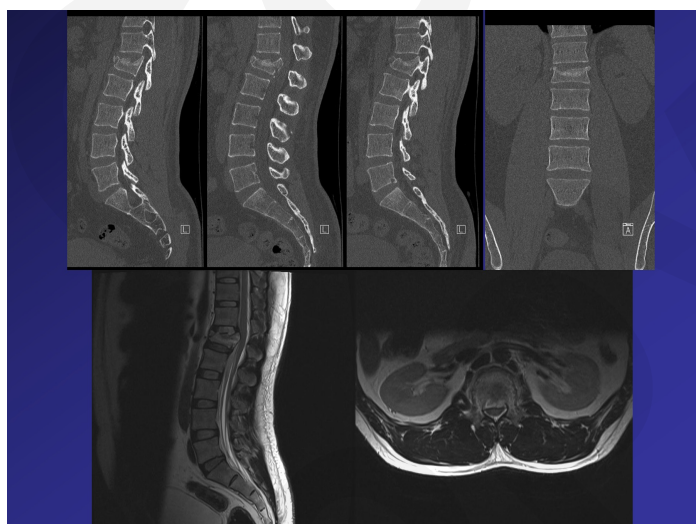
EP Cammisa, FJ Eismont and BA Green
J Bone Joint Surg Am. 1989;71:1044-1052.

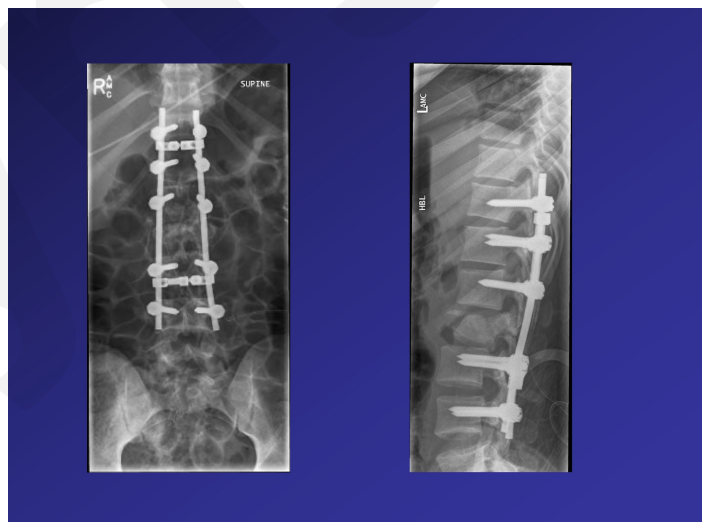
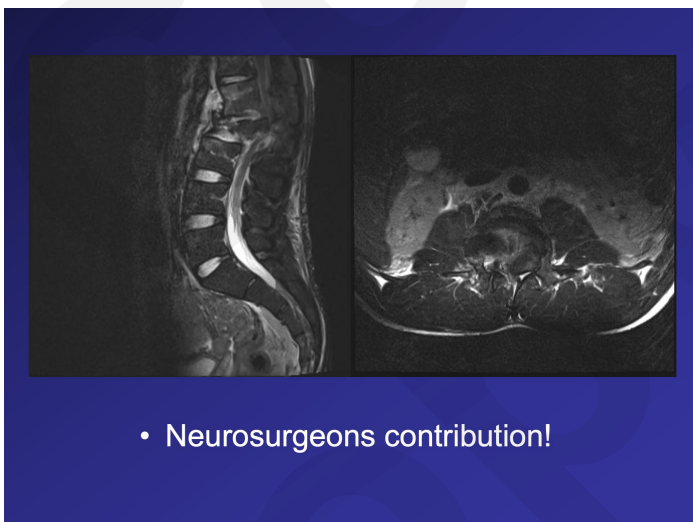
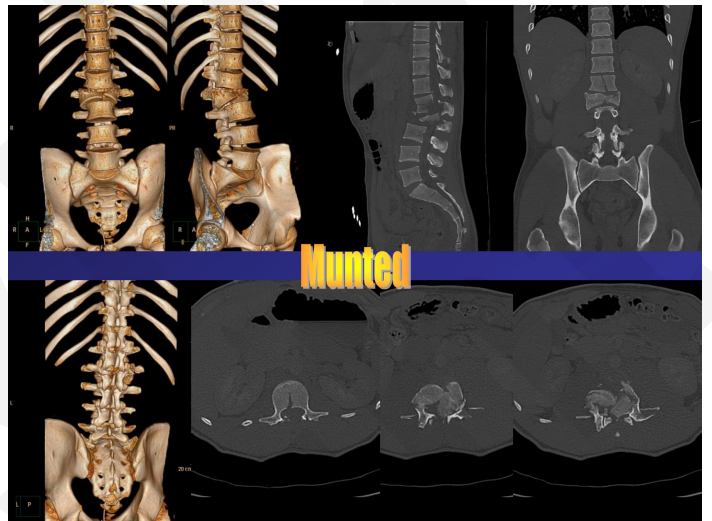
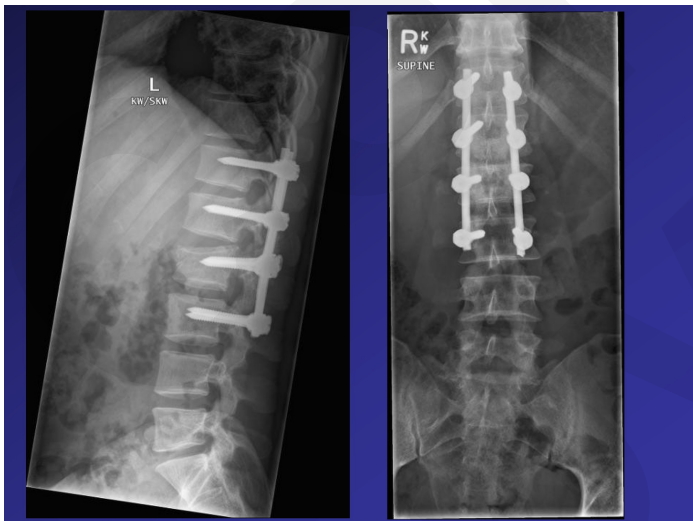
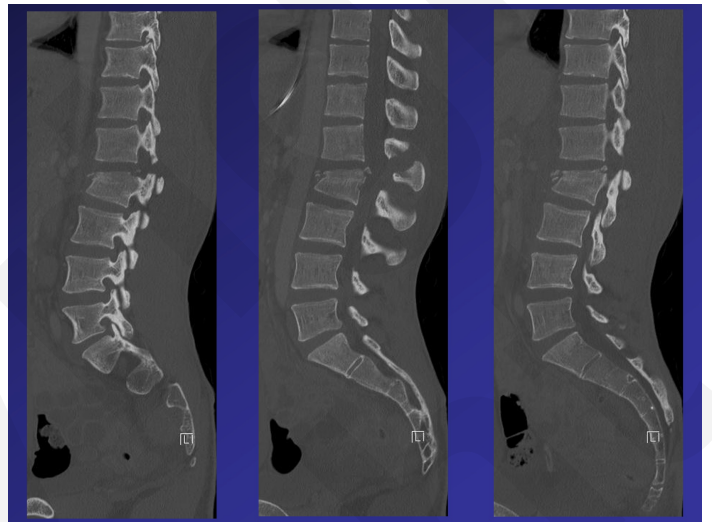
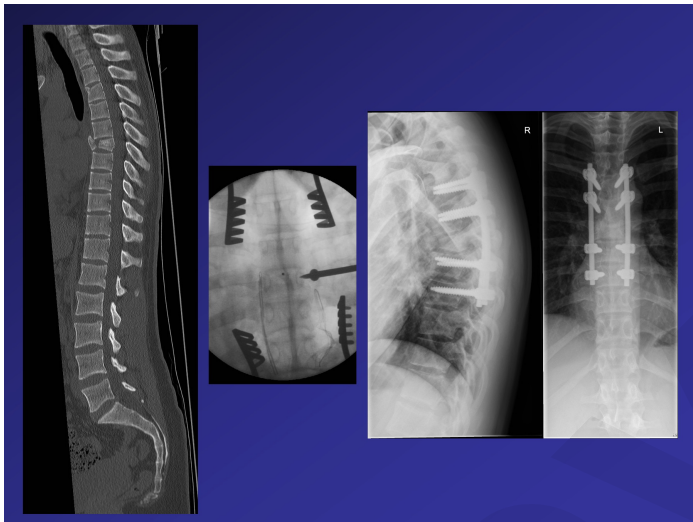
11/30 Dural Lacs

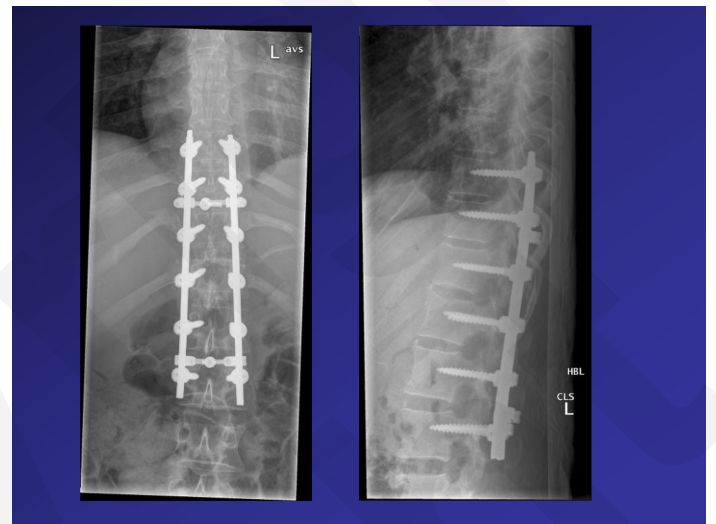
• Exception – facet fracture dislocations – i.e. remove posterior compressive fragments from the back

+ Posterior Fix + Decompression =

and destabilised!





Anterior or posterior surgery

posterior fixation cannot provide anterior column support

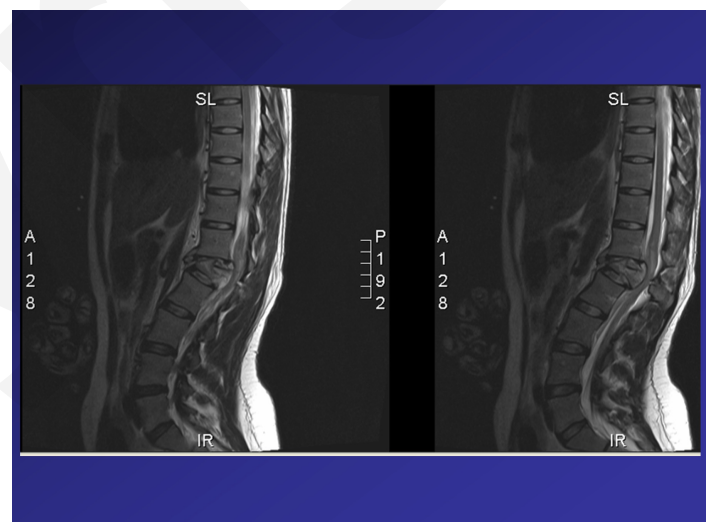
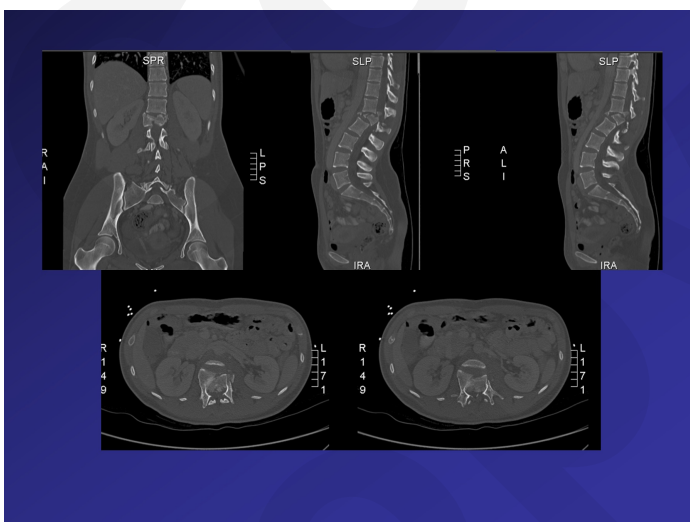
Corpectomy direct cord decompression vs. posterior indirect

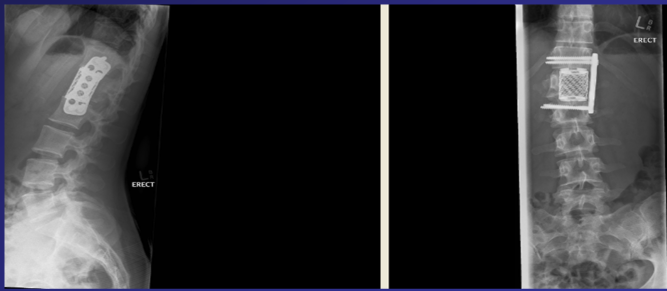
Cons:
Infrequent Specialist Training

Anterior surgery for significant anterior comminution

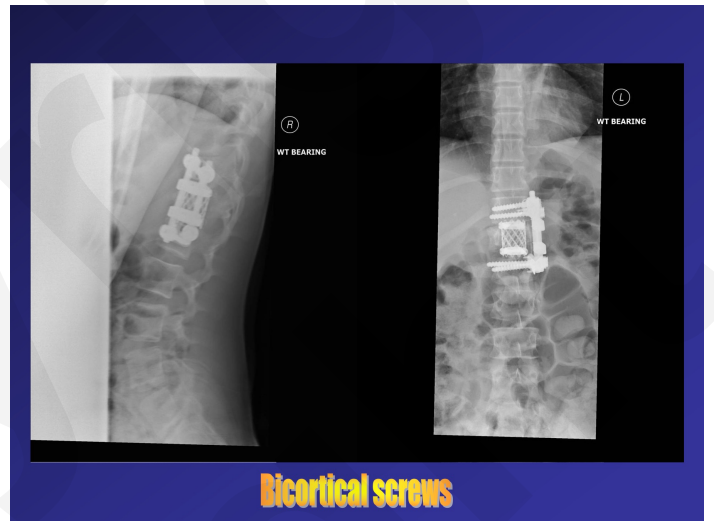
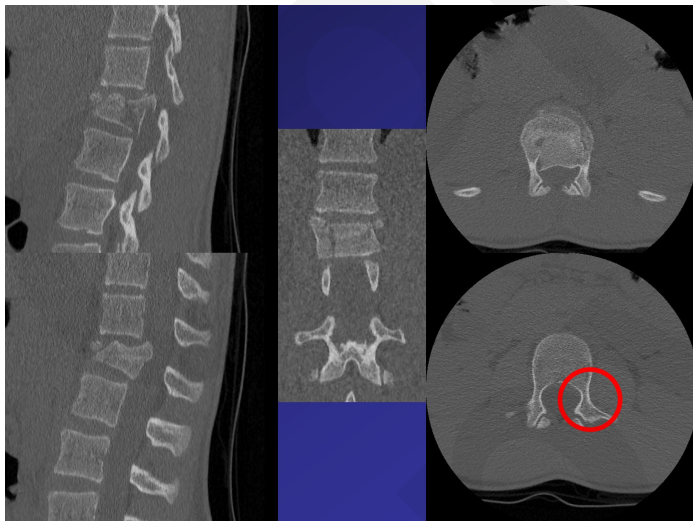
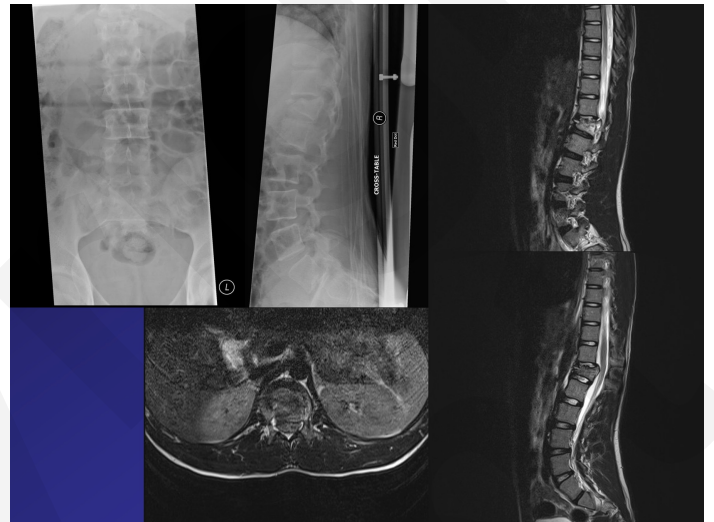
correction of deformity

stabilization of instability

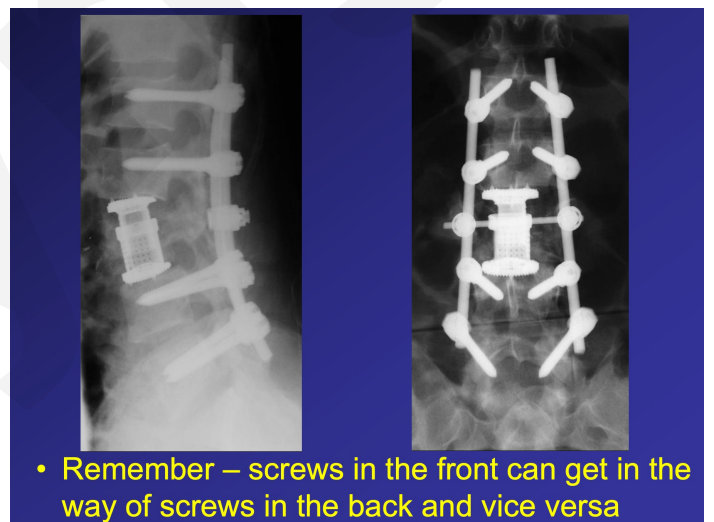
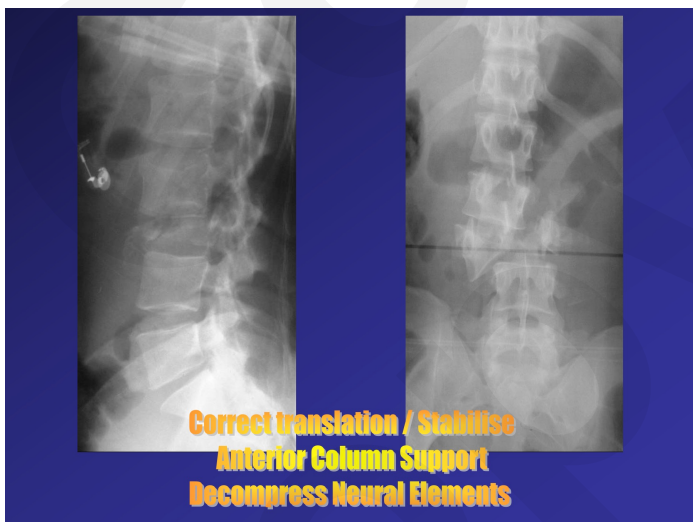




Bicortical screws



Bicortical screws



- Remember – screws in the front can get in the way of screws in the back and vice versa

- 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 and Outcomes

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

Aims / Objectives

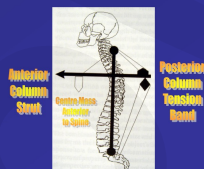
- Fixation
 - Front, Back, Both
 - Does it matter?
- Describe the aims of surgical fixation in the spine
- Explain the rationale and mechanics of different approaches
- Summarise evidence of outcome

Depends on #

**Realign
Stabilize
Decompress
Prevent Late Pain / Deformity**

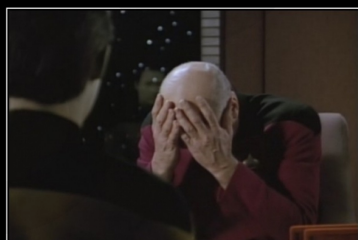
Realign, stabilise, decompress

**Pick your paper
AO A3 #3 P...**



Conclusion

- Fix Early (if you are going to fix!)
- Realign Posteriorly
 - Make sure the pedicles are big enough to screw
 - Indirect Decompression
- Do Anterior Surgery Electively



FACEPALM

When words fail to describe the dismay, there is always Facepalm.



Recent Literature

Does Early Fracture Fixation of Thoracolumbar Spine Fractures Decrease Morbidity or Mortality?

Carlo Bellabarba, MD,* Charles Fisher, MD, MPH,† Jens R. Chapman, MD,* Joseph R. Dettori, MPH, PhD,‡ and Daniel C. Norvell, PhD‡

Aim < 72hrs

Spine

SPINE Volume 36, Number 11, pp E727–E733
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LITERATURE REVIEW

Early Versus Late Stabilization of Spine Injuries

A Systematic Review

Leah Y. Carreon, MD, MSc* and John R. Dimar, MD†*

ORIGINAL ARTICLE

Effectiveness of pedicle screw-based ligamentotaxis in reducing preoperative kyphosis in thoracolumbar spinal fractures: a retrospective analytical study based on injury surgery interval

Hitesh N. Modi · Kook Jin Chung · Hol Soo Yoon · Ji Hyo Hwang · Hong Kyun Kim · Kyu Cheol Noh · Yong Wook Park · Jung Han Yoo

Conclusion Posterior-only pedicle screw fixation in unstable thoracolumbar fractures would correct and maintain the postoperative correction in kyphosis, at least at 3-year follow-up, without increasing implant failure if ISI is less than 2 weeks. While patients operated after 2 weeks of injury would require additional anterior procedure.

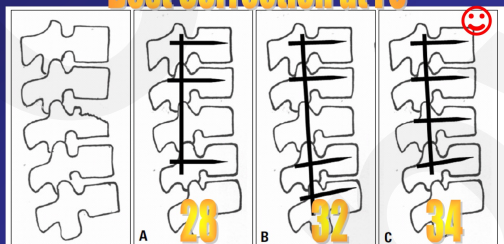
YMJ

Comparison of Surgical Outcomes in Thoracolumbar Fractures Operated with Posterior Constructs Having Varying Fixation Length with Selective Anterior Fusion

Hak Sun Kim, Seung Yup Lee, Ankur Nanda, Ju Young Kim, Jin Oh Park, Seong Hwan Moon, Hwan Mo Lee, Ho Joong Kim, Huan Wei, and Eun Su Moon

Department of Orthopaedic Surgery, Yonsei University College of Medicine, Seoul, Korea

Best Correction at FU



- Fixation randomly decided by surgeon...
- Why 2 above...?

Successful Treatment of Thoracolumbar Fractures With Short-segment Pedicle Instrumentation

Daniel Gelb, MD, Steven Ludwig, MD, Jacqueline E. Karp, BA, Edward H. Chung, MD, Clément Werner, MD, Terrence Kim, MD, and Kornelis Poelstra, MD

Methods: We conducted a retrospective radiographic review of 46 thoracolumbar fractures treated with short-segment posterior instrumentation to determine the rate of correction loss and instrumentation failure in relation to the Load Sharing Classification of Spine Fracture system and the AO Classification of Fractures system. No postoperative bracing was used. Patients with multisystem organ trauma and those with isolated injuries were included.

Results: An average loss of correction of 7.5 degree was observed. Pedicle screw placement into the fractured vertebra seemed to protect against correction loss: 4 of the 7 patients (57%) in the no intermediate fixation group had > 10 degree loss of correction. No relationship was shown between loss of correction and Load Sharing Classification (<6 or >7 points), loss of correction and AO Classification, or loss of correction and level of injury (thoracolumbar junction vs. lower lumbar).

Conclusions: With modern instrumentation and techniques, short-segment thoracolumbar fracture fixation could be used successfully, despite highly comminuted injuries, without anterior column support or supplemental bracing.



J Spinal Disord Tech • Volume 23, Number 5, July 2010

Open Access

Treatment of Unstable Thoracolumbar Burst Fractures by Indirect Reduction and Posterior Stabilization: Short-Segment Versus Long-Segment Stabilization

George Sapkas¹, Konstantinos Kateros², Stamatios A. Papadakis^{*,3}, Emmanouel Brilakis², George Macheras³ and Pavlos Katonis⁴

Abstract: In order to compare short-segment stabilization with long-segment stabilization for treating unstable thoracolumbar fractures, we studied fifty patients suffered from unstable thoracolumbar burst fractures. Thirty of them were managed with long-segment posterior transpedicular instrumentation and twenty patients with short-segment stabilization. The mean follow up period was 5.2 years. Pre-operative and post-operative radiological parameters, like the Cobb angle, the kyphotic deformation and the Beck index were evaluated. A statistically significant difference between the two under study groups was noted for the Cobb angle and the kyphotic deformation, while, as far as the Beck index is concerned, no significant difference was noted. In conclusion, either the long-segment or the short-segment stabilization is able for reducing the segmental kyphosis and the vertebral body deformation postoperatively. However, as time goes by, the long-segment stabilization is associated with better results as far as the radiological parameters, the indexes and the patient's satisfaction are concerned.

Biomechanical Evaluation of Short-Segment Posterior Instrumentation With and Without Crosslinks in a Human Cadaveric Unstable Thoracolumbar Burst Fracture Model

George M. Wahba, MD,* Nitin Bhatia, MD,* Christopher N. H. Bui, BS,† Kenneth H. Lee, BS,† and Thay Q. Lee, PhD†*

- Crosslinks, when added to short-segment posterior fixation, improve stiffness in axial rotation, but do not restore baseline stability in this unstable burst fracture model.
- Short-segment posterior instrumentation alone can achieve baseline stability in lateral bending, and crosslinks provide even greater stiffness.
- Short-segment posterior fixation, even with crosslinks, is inadequate in restoring stability in flexion when used to treat a severe anterior and middle column injury. For these severe injuries, anterior reconstruction and/or extension of the posterior construct may be necessary.

- When do I use cross links:
 - Rotationally Unstable Injuries
 - ? Incl. # dislocations in paralysed pts
 - Poor Bone – “Locked plate concept”
 - When in doubt...

Anterior Decompression and Stabilization with the Kaneda Device for Thoracolumbar Burst Fractures Associated with Neurological Deficits^{††}

BY KIYOSHI KANEDA, M.D., HIROSHI TANEICHI, M.D., KUNYOSHI ABUMI, M.D., TOMOYUKI HASHIMOTO, M.D., SHIGENOBU SATOH, M.D., AND MASANORI FUJII, M.D., SAPPORO, JAPAN

- 150 patients incomplete injuries
- Strut graft plus Kaneda (2 rod construct)
- 142 (95%) improved by 1 grade
- 140 successfully fused
- 56/78 (72%) regained their bladder
- 125/130 returned to work
- Mean 47% to 2% canal compromise on CT

Anterior-Only Stabilization Using Plating With Bone Structural Autograft Versus Titanium Mesh Cages for Two- or Three-Column Thoracolumbar Burst Fractures A Prospective Randomized Study

Li-Yang Dai, MD, PhD, Lei-Sheng Jiang, MD, PhD, and Sheng-Dan Jiang, MD, PhD

Key Points

- Sixty-five patients underwent anterior plating for a thoracolumbar burst fracture with a load-sharing score of 7 or more.
- These patients were randomly assigned to fusion with iliac crest autograft or titanium mesh cages with similar distribution of 3-column injuries in each group.
- Solid fusion was documented in all patients in this study, with significant neurologic improvement and no significant correction loss.
- The results showed no significant difference between the 2 treatment groups, nor were significant impacts of 3-column injuries identified.
- The authors recommend the use of anterior-only instrumentation and reconstruction with structural autograft or titanium mesh cages for surgical treatment of thoracolumbar burst fractures with a load-sharing score of ≥ 7 .

- 32 v 33
- Same Instrumentation
- Load Share ≥ 7
- 8 v 9 three column #s
- Randomised
- Unable to blind
- Neuro improved

Open Access

Combined Anterior-Posterior Surgery Versus Posterior Surgery for Thoracolumbar Burst Fractures: A Systematic Review of the Literature

Pim P. Oprel^{*}, Wim E. Tuinbreijer, Peter Patka and Dennis den Hartog

- Only 5 observational comparative studies found
- Better Kyphosis and height correction in AP group – Probably not clinically important
- AP – higher blood loss, longer ops, longer hospital stay, higher costs and complications
- Bias – worse cases have AP surgery

Comparison of anterolateral and posterior approaches in the management of thoracolumbar burst fractures

PATRICK W. HITCHON, M.D., JAMES TURNER, Ph.D., KURT M. EICHHOLZ, M.D., AND STEPHANIE N. BEELER, B.A.

Departments of Neurosurgery and Preventative Medicine and Environmental Health, University of Iowa Carver College of Medicine, Iowa City, Iowa

- Retrospective 63 Burst #s
 - 25 post
 - 38 anterolateral
- Anterior – greater cost

various techniques

Conclusions: Rigid guidelines for the selection of anterior or posterior approaches are lacking. Evaluation of the authors' results and those of others shows that angular deformity is more successfully corrected and maintained when the anterior approach is used.

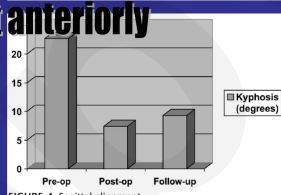
Anterior-Only Stabilization of Three-Column Thoracolumbar Injuries

Rick C. Sasso, MD, Natalie M. Best, BS, Thomas M. Reilly, MD, and Robert A. McGuire, Jr., MD

Methods: Between 1992 and 1998, 40 patients underwent anterior decompression and two-segment anteriorly instrumented reconstruction for three-column thoracolumbar fractures. Retrospective review of all available clinical and radiographic data was used to classify these unstable injuries according to the AO classification system, evaluating for neurologic changes, spinal canal compromise, preoperative and postoperative segmental kyphosis, and postoperative segmental kyphosis.

Results: According to the AO classification system, there were 24 (60%) type B1.2, 10 (25%) type C2.1, and 6 (15%) type C3.1 fractures. The mean preoperative kyphosis averaged 68.5° and vertebral height loss averaged 44.5%. There were no cases of neurologic deterioration, and 30 (91%) patients with incomplete neurologic deficits improved by at least one modified Frankel grade. Mean preoperative segmental kyphosis of 22.7° was improved to an early mean of 7.4° ($P < 0.0001$). At latest follow-up, angulation had increased by an average 2.1° but maintained significant improvement from preoperative measurements ($P < 0.0001$). There was one early construct failure due to technical error. Thirty-seven of the remaining patients (95%) went on to apparently stable arthrodesis.

Anterior Instrumentation	Reconstruction Method	
Z-plate	Structural allograft	2
	Titanium cage/autograft	19
		21
University plate	Structural autograft	10
	Structural allograft	6
		16
	Structural autograft	3
		40



Anterior Versus Posterior Treatment of Stable Thoracolumbar Burst Fractures Without Neurologic Deficit

A Prospective, Randomized Study

K. B. Wood, MD,* D. Bohn, MD,† and A. Mehbod, MD†

Results: Of 43 enrolled, 38 completed a minimum of 2-year follow-up (average: 43 months; range: 24–108 months). Eighteen received a posterior spine fusion and 20 an anterior approach. Hospital stay and operating time were similar. Blood loss was higher in the group treated anteriorly; however, the incidence of transfusion was the same. There were 17 “complications” including instrumentation removal for pain in 18 patients treated posteriorly, but only 3 minor complications in 3 patients treated anteriorly. Patient-related functional outcomes were similar for the two groups.

Conclusions: Although patient outcomes are similar, anterior fusion and instrumentation for thoracolumbar burst fractures may present fewer complications or additional surgeries.

- Posterior
 - 2 above 2
 - below with claw above and 3-4 level fusion



Not C3#s and not most C2#s

Low lumbar spinal fractures: management options

L3-5

Li-Yang Dai*

Department of Orthopaedic Surgery, Xinhua Hospital, Shanghai Second Medical University,
1665 Kongjiang Road, Shanghai 200092, PR China

significantly less pain compared to the patients treated non-operatively ($P < 0.01$). Because of the unique anatomy and biomechanics, fractures of the low lumbar spine are different from those in the remaining regions of spine. Most compression fractures are stable, and therefore conservative management is indicated. Surgery should be performed in those with burst fractures or flexion-distraction fractures, with severe spinal stenosis or kyphotic deformity, and fracture-dislocation.

Surgery for thoracolumbar fractures

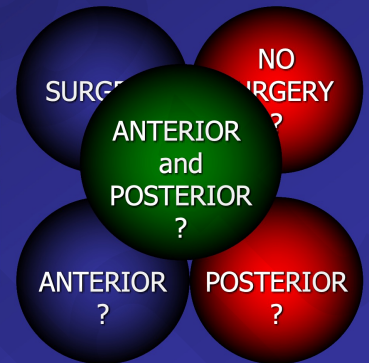
three questions

controversial topic

- varied opinions in literature

guidelines only

- depends on patient factors



Summary – A3 Burst # Mx

- McCormack 6 / TLICS 4 = GREY AREA!
- Few absolute indications for surgery - most T-L Burst fractures can be treated nonoperatively
- No significant correlation between residual kyphosis and pain or disability
- Neurological damage occurs at time of injury
- No evidence to support decompression for stable incomplete neurological deficits
- Significant amount of spontaneous canal remodelling has been demonstrated

Neurological Deficit

- no clear evidence that surgery improves neurological deficit
- trend that anterior surgery gives better results
- Kaneda (1997) JBJS
 - 150 patients incomplete injuries
 - 142 (95%) improved by 1 grade
 - 140 successfully fused
 - 56/78 (72%) regained their bladder
 - 125/130 returned to work

Canal clearance

- anterior decompression probably gives the most reliable canal clearance (>65% compromise)
- spontaneous resorption and indirect reduction (posterior) probably effective with less severe compromise

Goals for Surgery

Neurology

No Clear Evidence
any form of Surgery
Improves neurology

Biomechanics

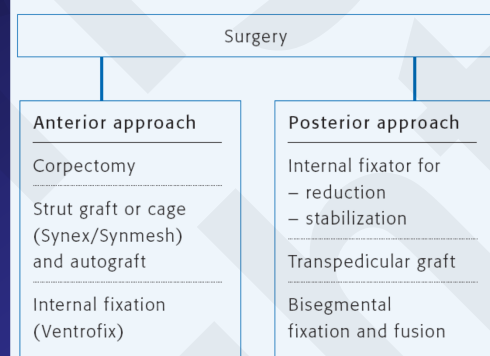
Greatest argument for anterior surgery is biomechanical where early screw breakage is expected ⇒ Anterior reconstruction ? Long Posterior...

Type A injuries with intact posterior elements are stable in the absence of osteoporosis. They can be treated conservatively in the absence of neurological deficit or if the deformity is moderate (kyphosis less than 25°), if canal encroachment is moderate (less than 50%), or if vertebral body wedging is less than 50%. Surgery for type A injuries can be performed posteriorly relying on ligamentotaxis, or anteriorly with corpectomy and anterior column reconstruction ([Table 1.3.2-1](#) and [Table 1.3.2-2](#)).

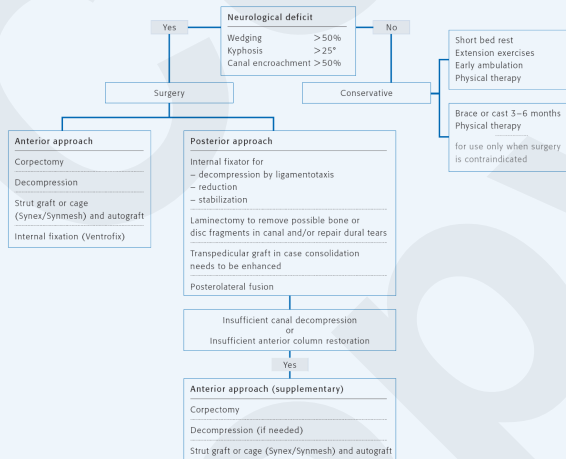
Type B injuries or flexion-distraction fractures will require posterior fixation because the posterior tension band system has been disrupted. If the type B injury has a burst component, additional anterior surgery may be warranted for further decompression and reconstruction ([Table 1.3.2-3](#)). Although type B2 injuries can be successfully managed without surgery, the author recommends treating them surgically if there is no medical contraindication in order to shorten recovery time ([Table 1.3.2-4](#)).

Type C injuries are best reduced with posterior surgery because anterior surgery will in most cases fail to achieve adequate reduction. Additional surgery may be necessary depending on the A or B component of the type C injury ([Table 1.3.2-5](#)).

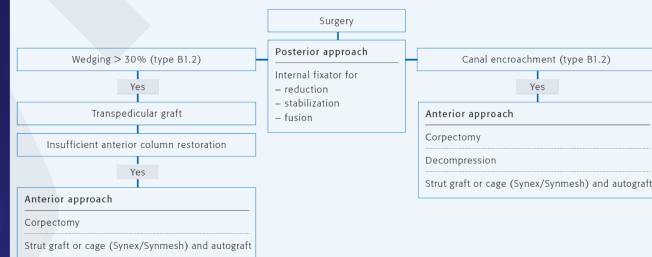
Type A2 treatment algorithm

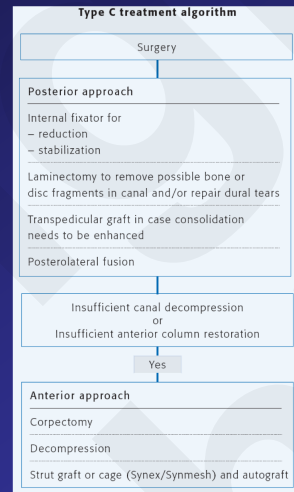
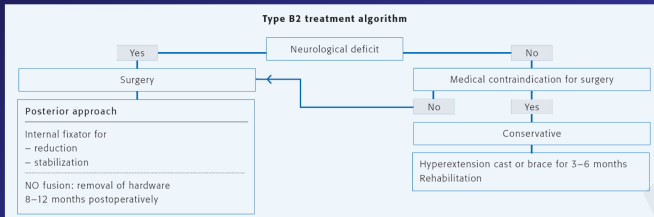


Type A3 treatment algorithm



Type B1 treatment algorithm





Non Operative Treatment

- Most compression fractures A1
- 2 column burst fractures without neurological deficit A3
- Most bony seatbelt (Chance) injuries (K<30 deg) B2

Operative Treatment

Absolute indication

- Progressive neurological lesion with fracture +/- dislocation

Relative indications

- Fracture dislocations +/- neurology All C group
- Burst fracture with stable neurology A3
- Soft tissue seatbelt (Chance) injury B1