Thoraco-lumbar fractures

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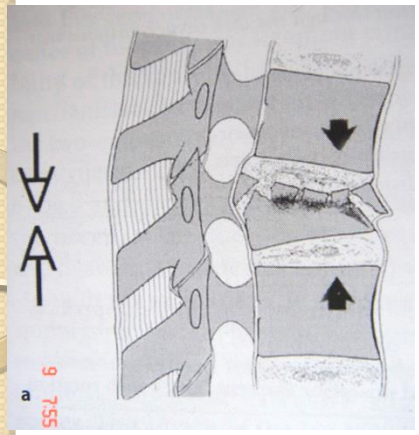
Nottingham University Hospitals

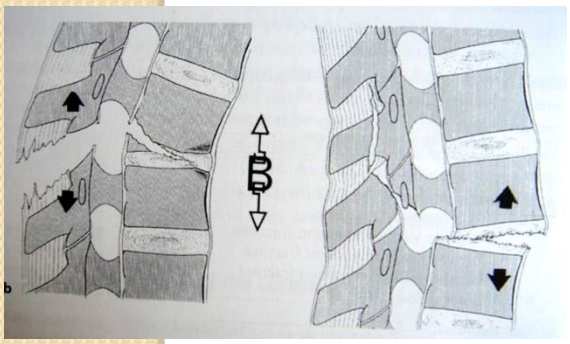
Outline for the talk

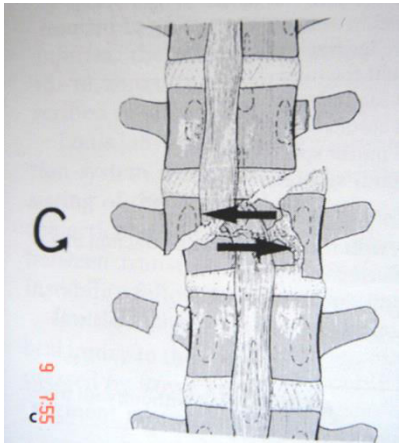
- AO classification
- Non-operative approach
- Surgical treatment indications
- Short segment approach:
  - Load sharing concept
  - Anterior v posterior

AO classification

- A.....A.1.1, A1.2, A1.3
  A.2.1, A2.2, A2.3
  A.3.1, A.3.2, A3.3
- B.....B.1, B.2, B.3
- C.....C.1, C.2, C.3







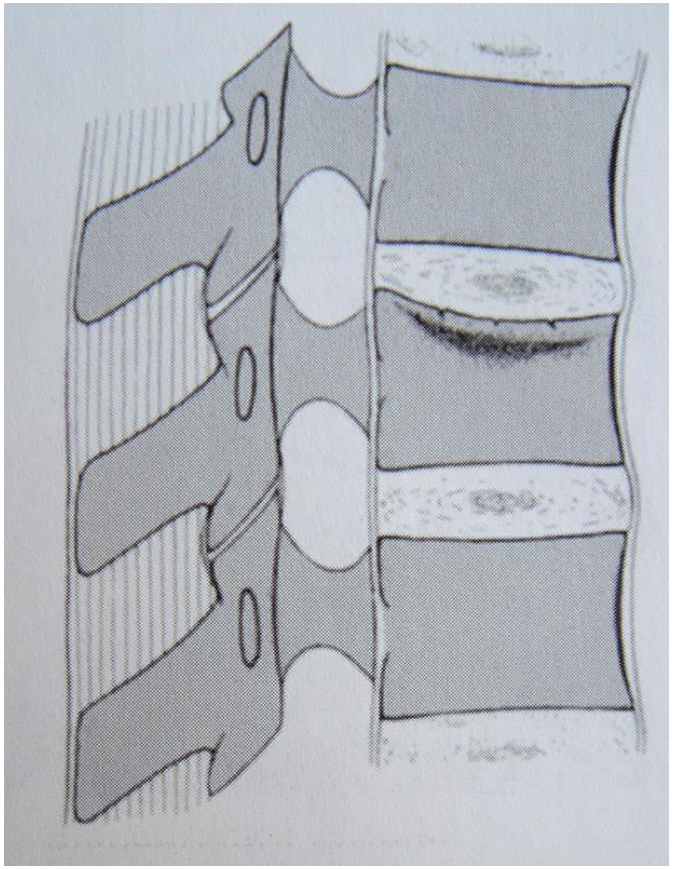
Basic types

- **A**: compression of the anterior column
- **B**: 2 column injury with posterior, anterior and transverse disruption
- **C**: 2 column injury with rotation

AI.1

End plate impaction

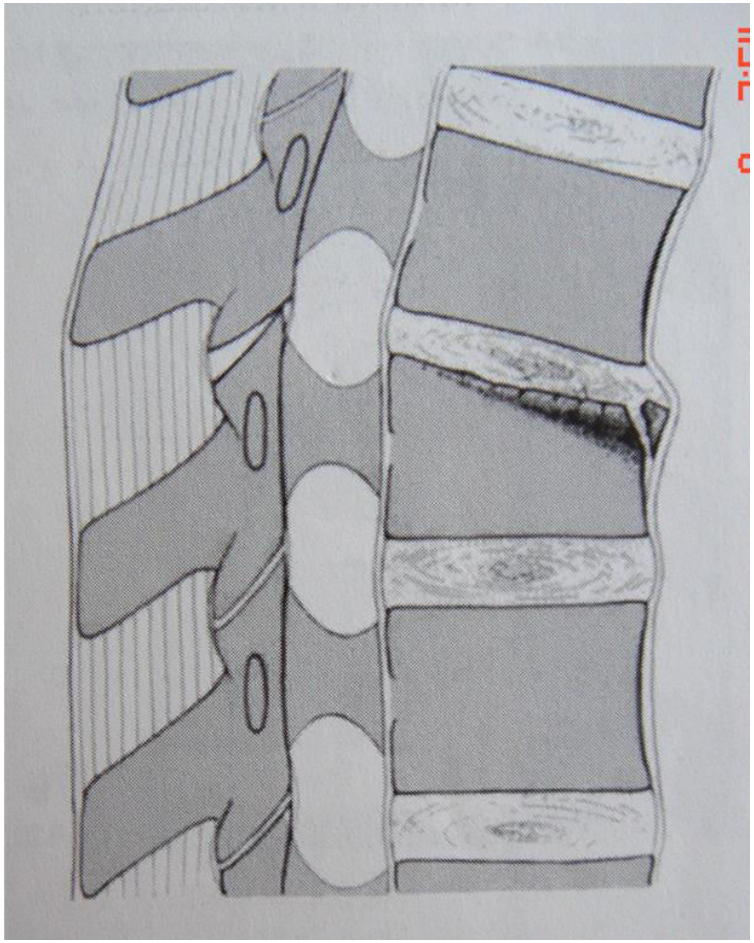
- End plate 'hour glass'
- Minor wedging upto 5°
- Posterior wall intact
- Often in juvenile and osteoporotic spines



AI.2

Wedge impaction fracture

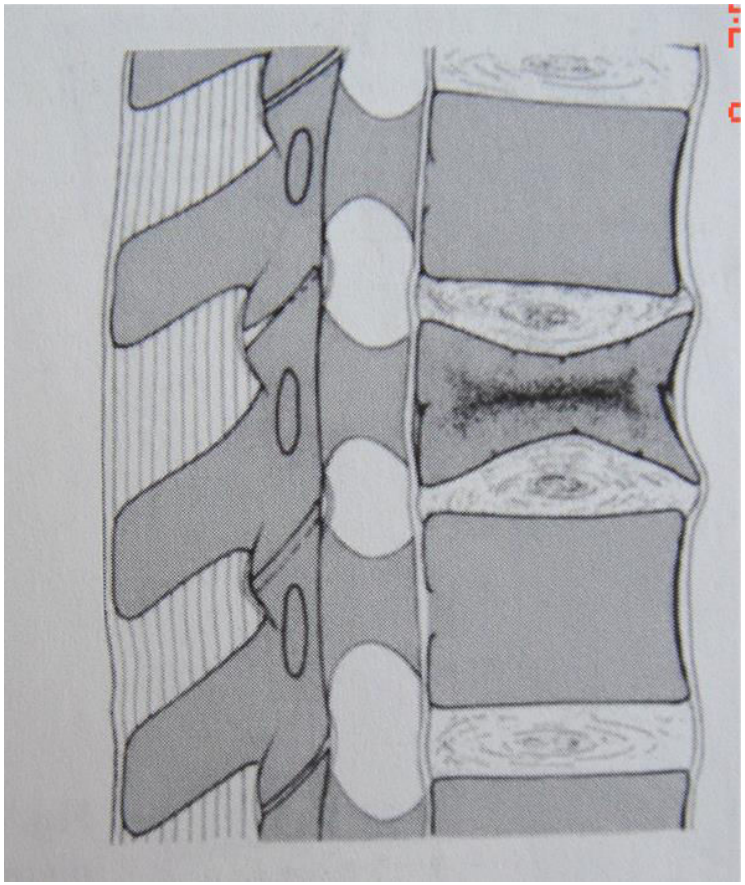
- Loss of anterior height
- Angulation over 5°
- Posterior wall intact



AI.3

Vertebral body collapse

- Osteoporotic spines
- Symmetrical loss of height
- Canal not violated
- ‘Fish vertebra’



A 2.1

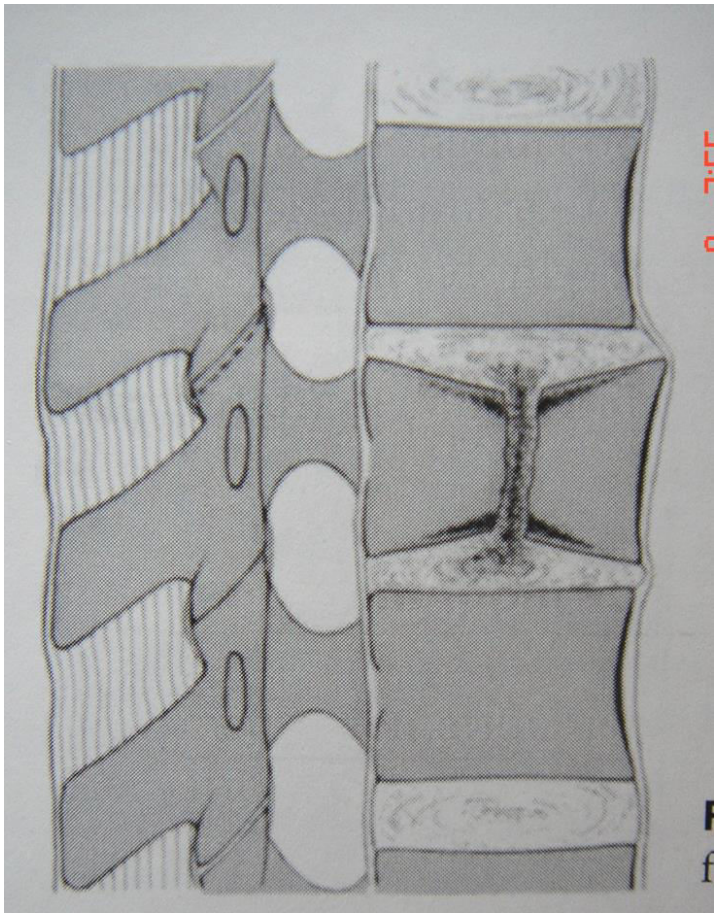
Sagittal split fracture

- Extremely rare
- Accompanying lesion of type C

A 2.2

Coronal split fracture

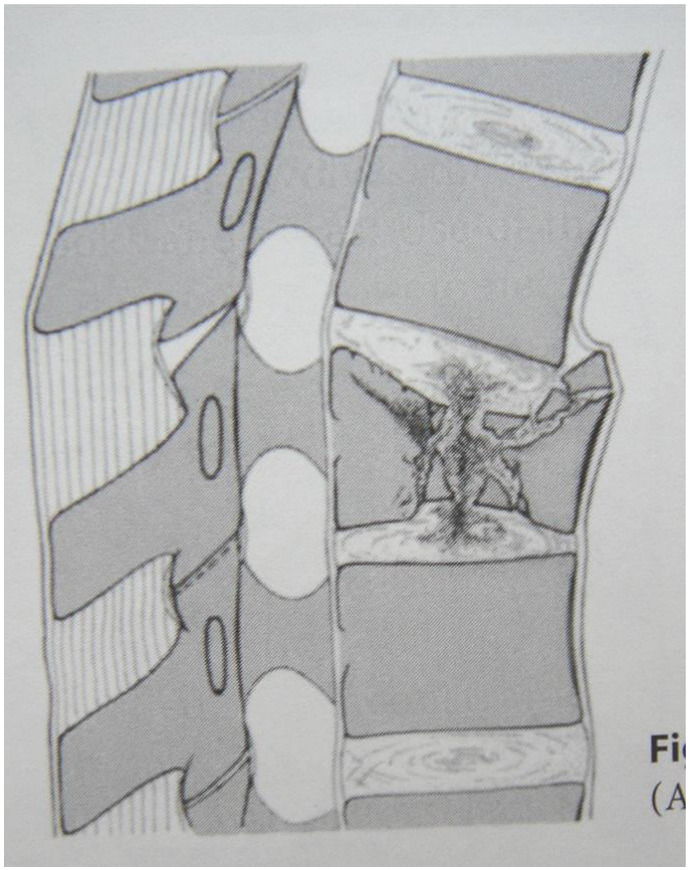
- Smooth coronal fracture gap is narrow
- Posterior wall is intact
- Stable



A 2.3

Pincer fracture

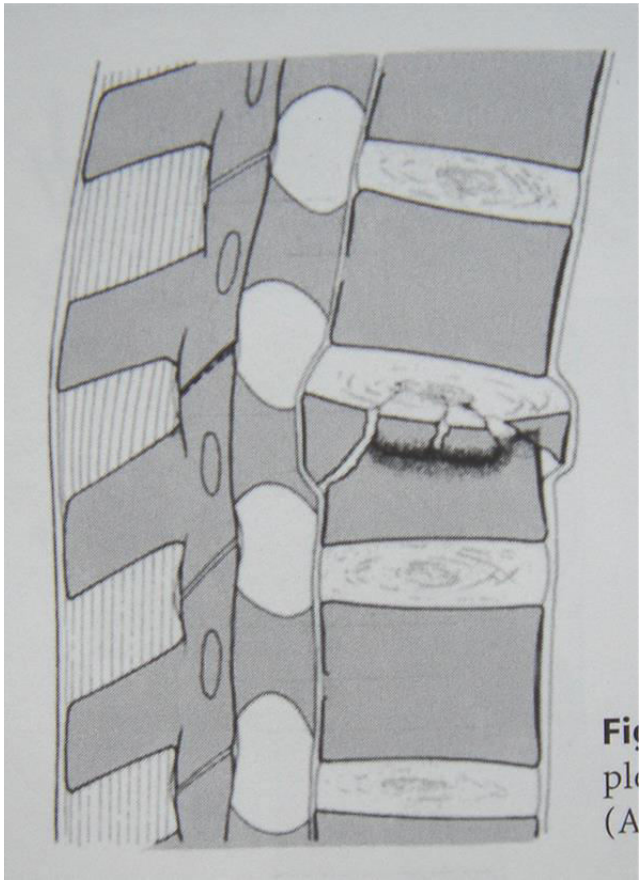
- Central part crushed and filled with disc
- Anterior fragment markedly displaced anteriorly
- Pseudarthrosis likely



A 3.1

Incomplete burst

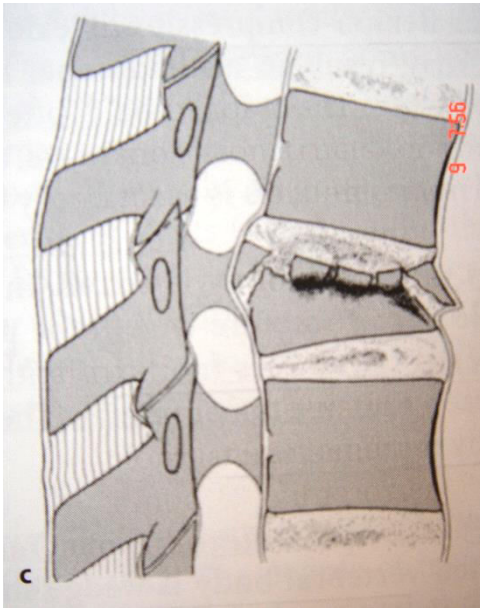
- Upper or lower half burst
- Other half intact
- Posterior wall partly disrupted

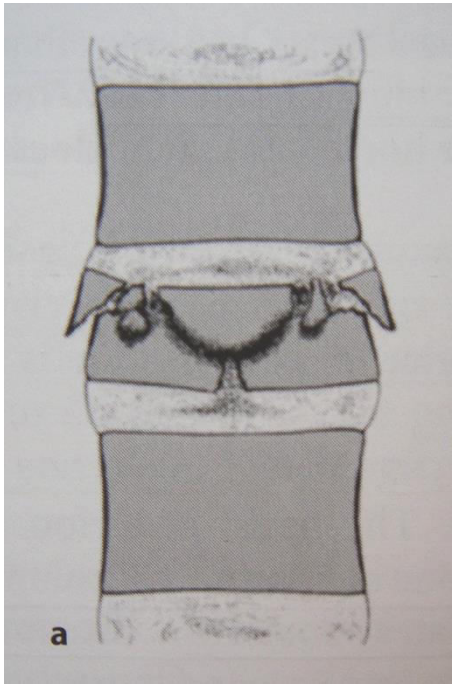


A 3.2

Burst-Split fracture

- One half (usually upper) burst
- Other half sagittal split
- More unstable

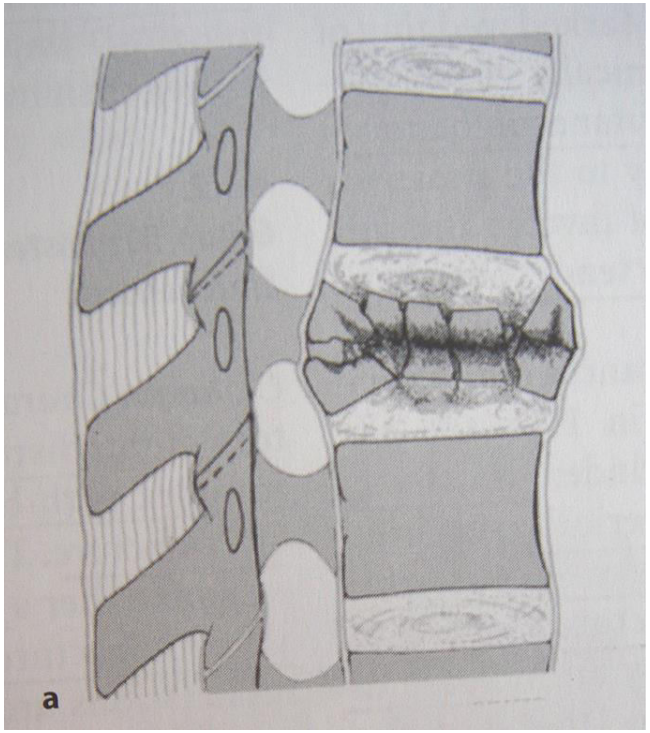


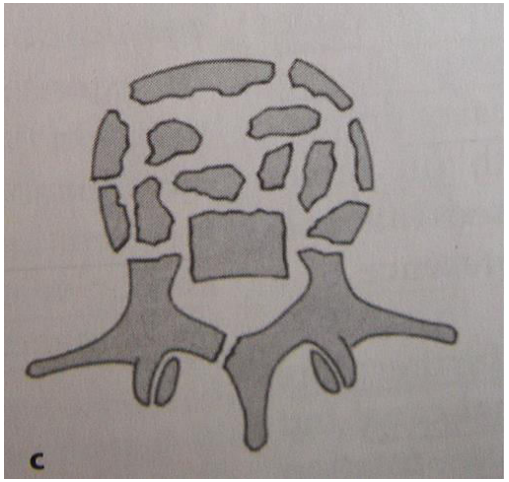


A 3.3

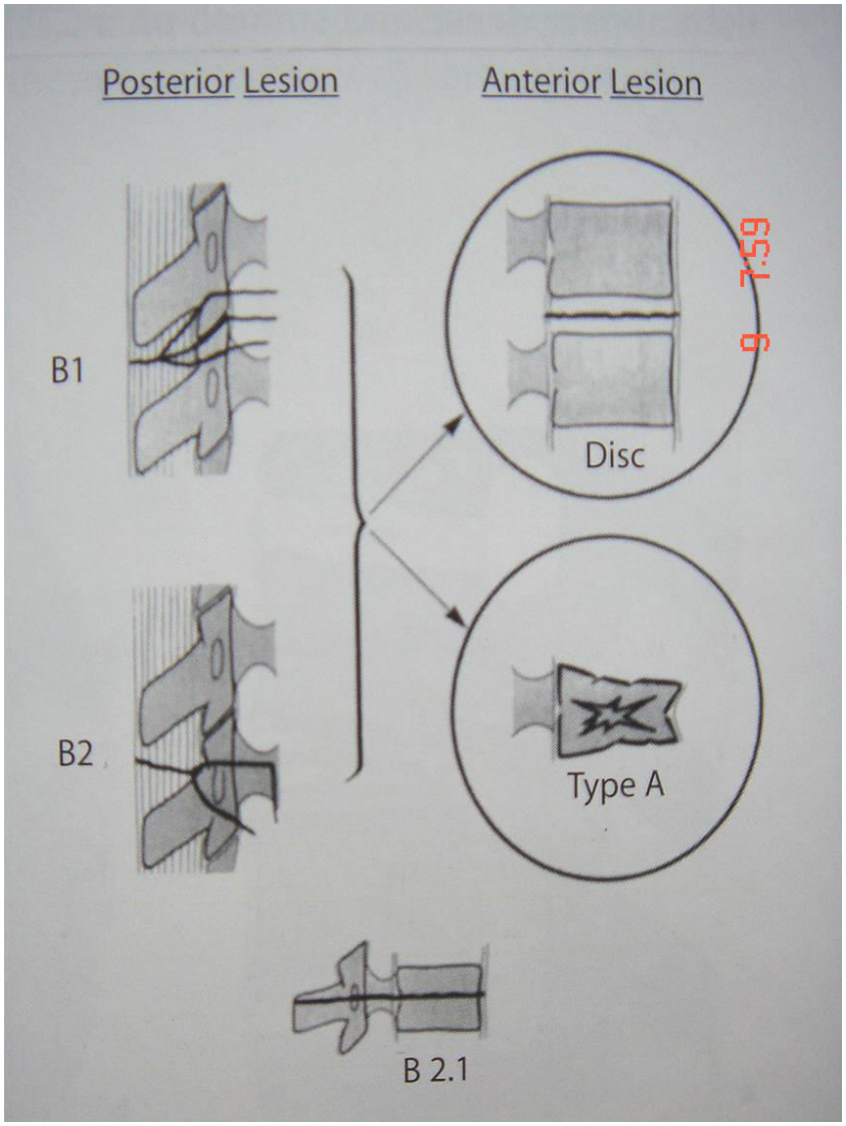
Complete burst

- Complete body has burst
- Unstable
- Canal involved
- Neurology frequent





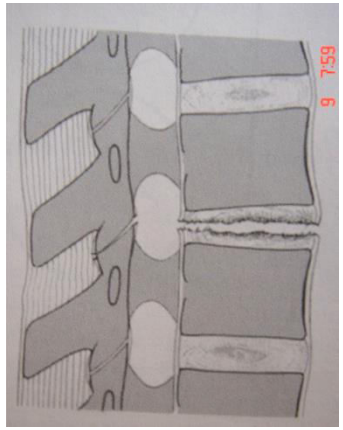
B1 or B2

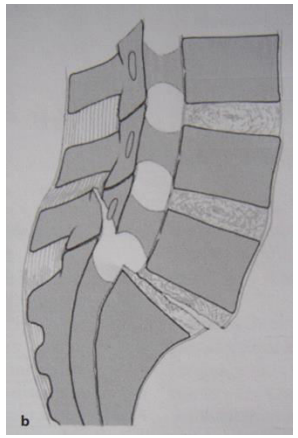


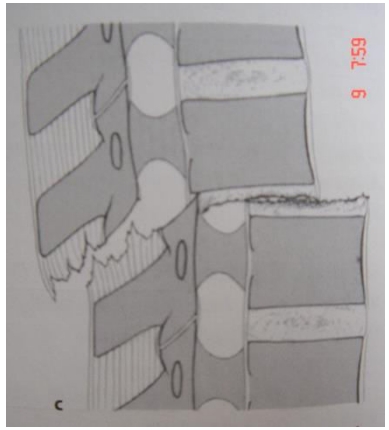
B3

Anterior disruption through the disc

- B3.1 Hyper-extension subluxation
- B3.2 Hyper-extension Spondylolysis
- B3.3 Posterior dislocation



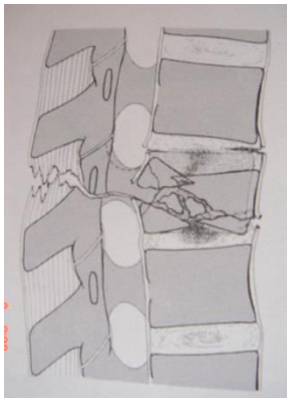


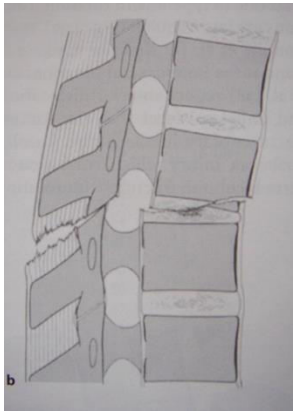


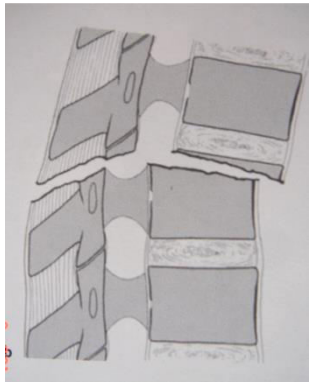
C

Anterior + posterior element injuries with rotation

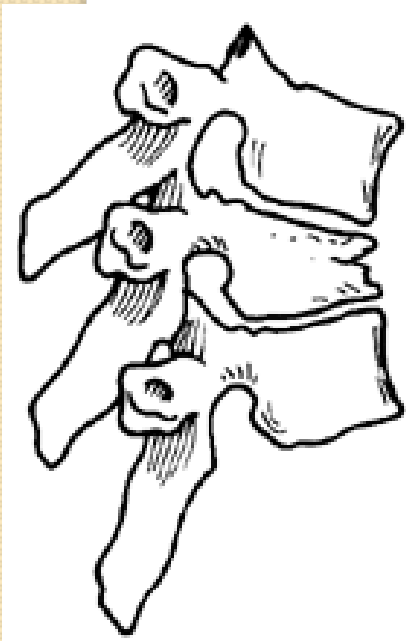
- C1 Type A + rotation
- C2 Type B + rotation
- C3 Rotational shear (Holdsworth slice fracture)







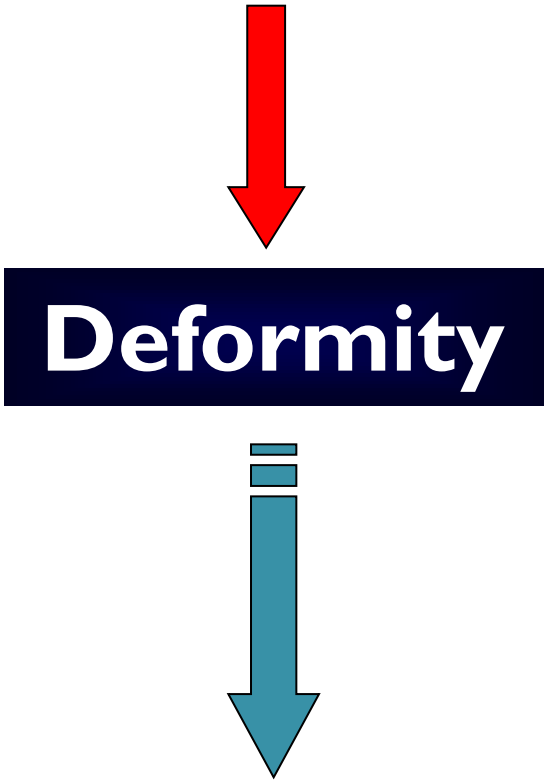
TL fractures with normal neurology: Deformity



- Sagittal alignment
- Axial pain
- Late deficits

- **Fractures Collapse to Heal**

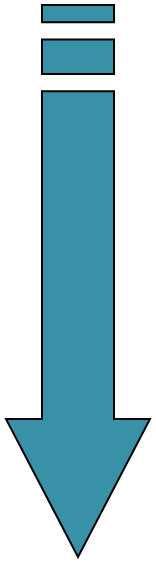
TL spinal fractures with normal neurology



…….at presentation

…….progression

Radiographic assessment of deformity



Supine imaging

Erect imaging

SPINE Volume 29, Number 5, pp 564–567
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Weight-Bearing Radiographs in Thoracolumbar Fractures

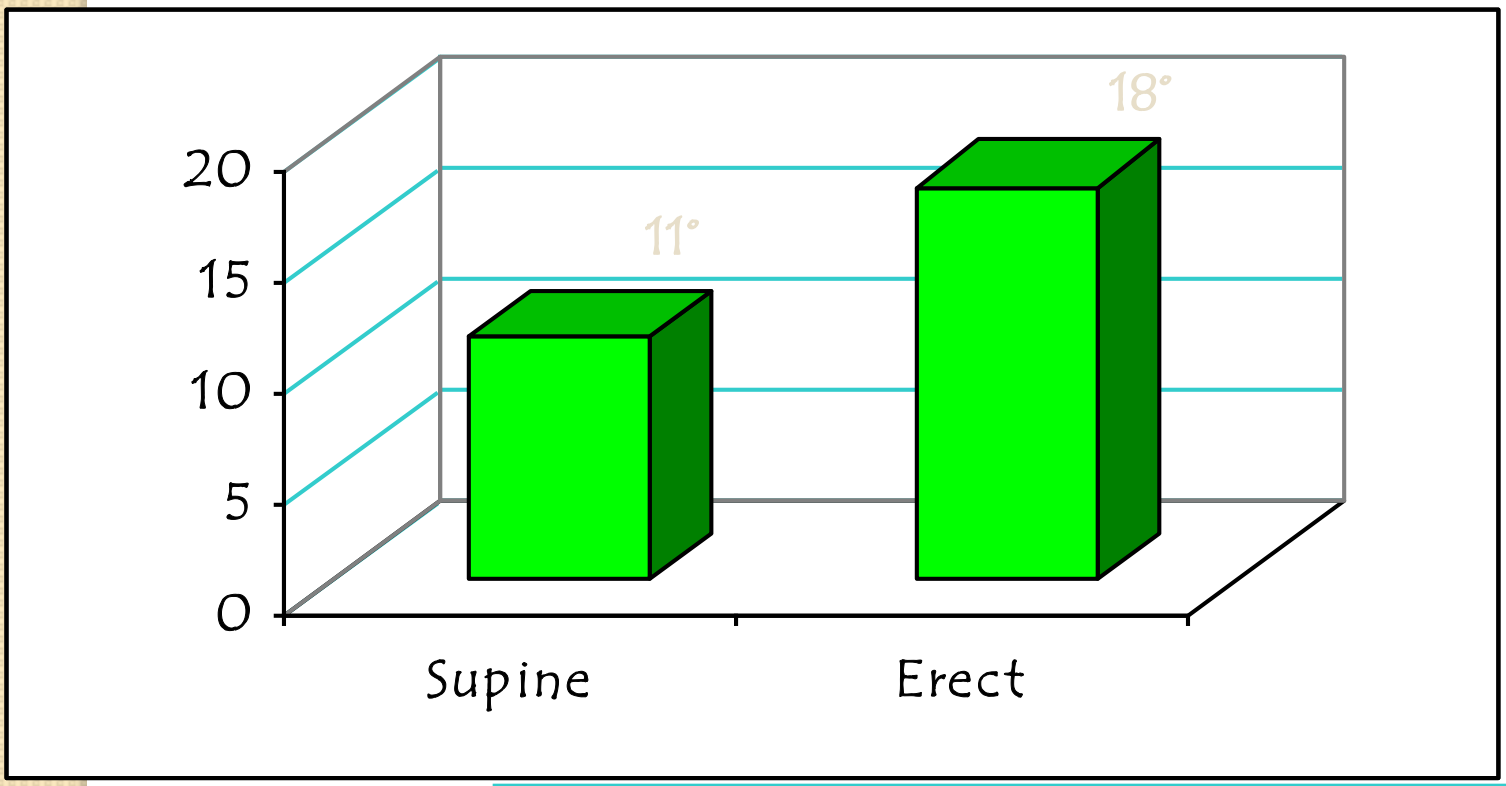
Do They Influence Management?

J. S. Mehta, MCh (Orth), M. R. Reed, FRCS, J. L. McVie, FRCS, and P. L. Sanderson, FRCS (Orth)

- Change in kyphosis (Cobb)
- Change in Vx height loss (compression)

Mehta JS, Sanderson PL Spine 29 (5) Mar 2004

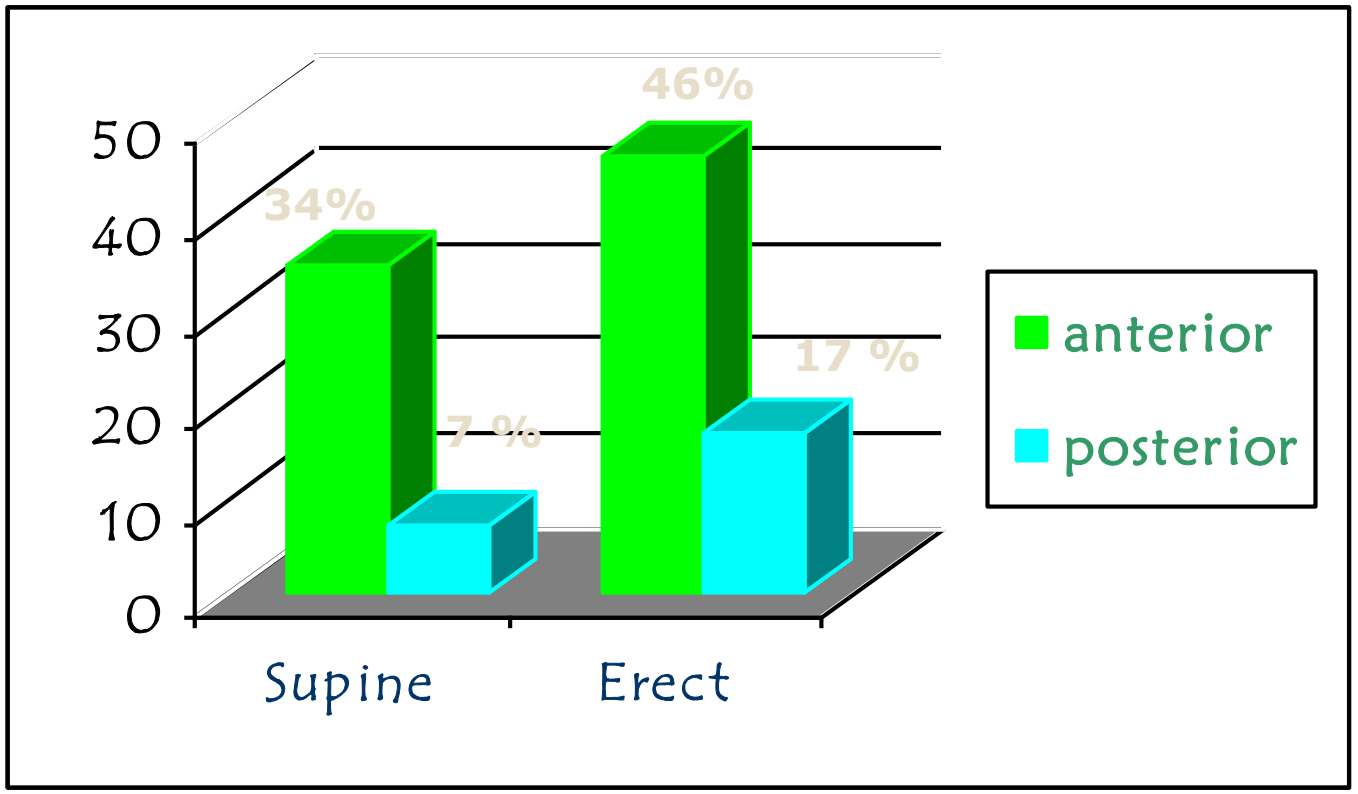
Cobb angle



Mean change: 7° (range 0° – 36°)

p = 0.0011 r = 0.756

Vertebral compression

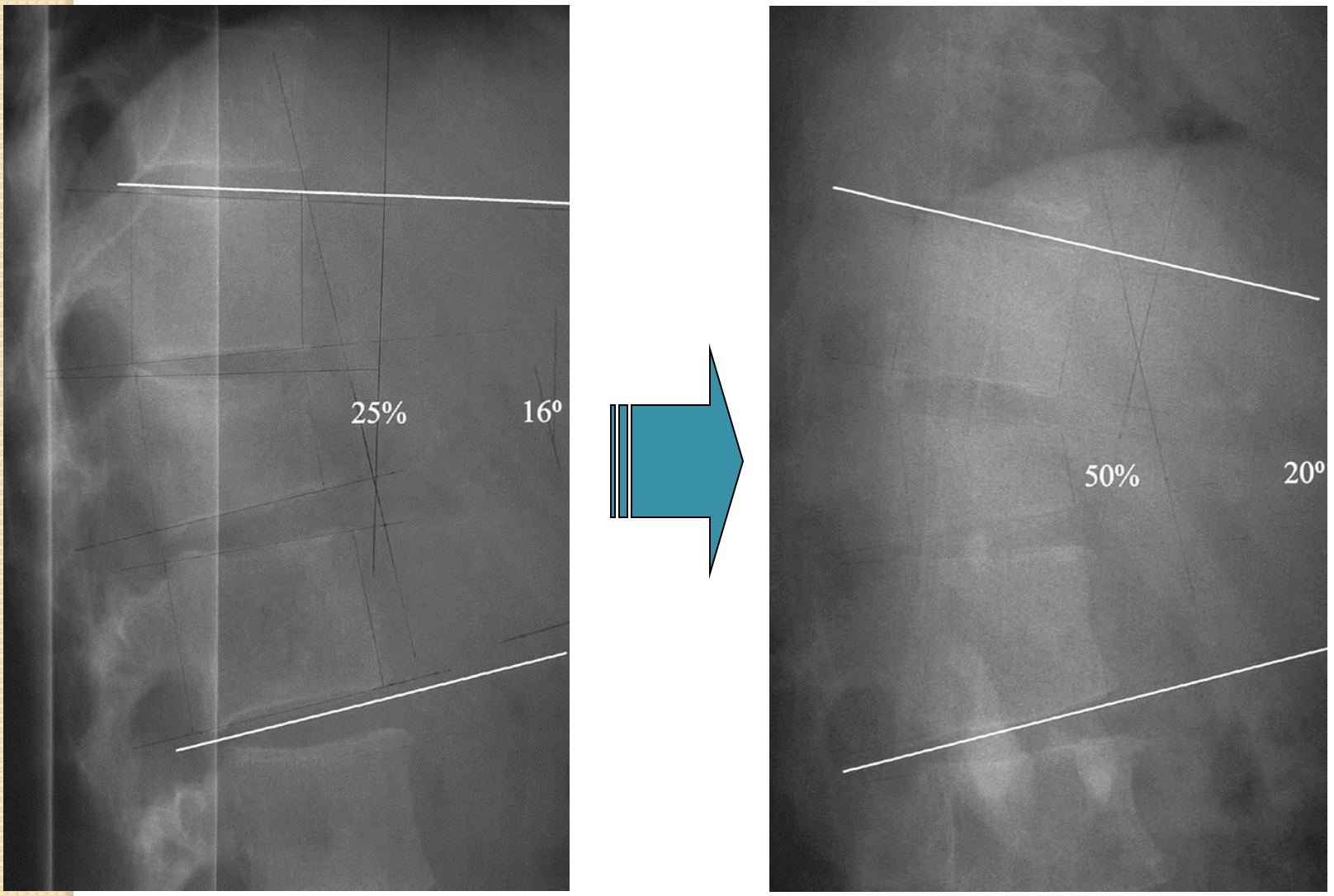


Anterior: p = 0.0002 r = 0.59

Posterior: p = 0.0001 r = 0.53

Supine

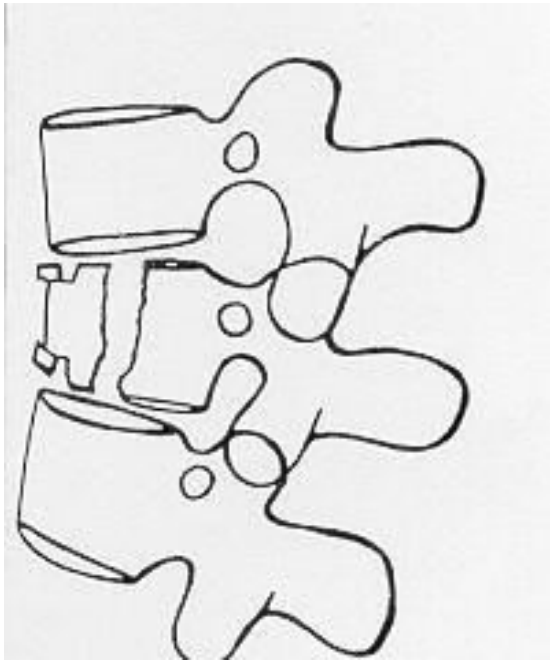
Erect



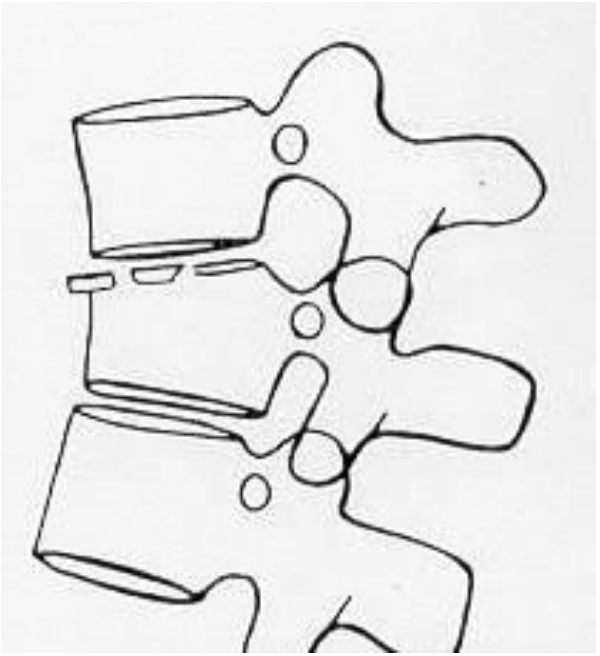
1 / 4th of the patients in our study

TL fractures with normal neurology: Deformity progression

Vertebral Body

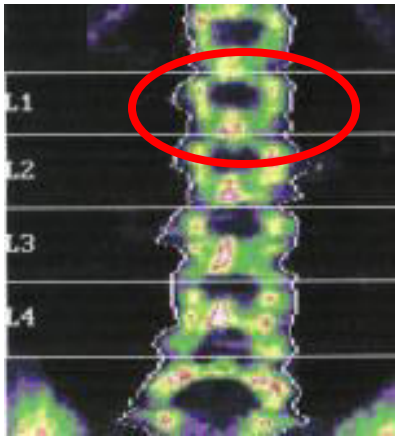


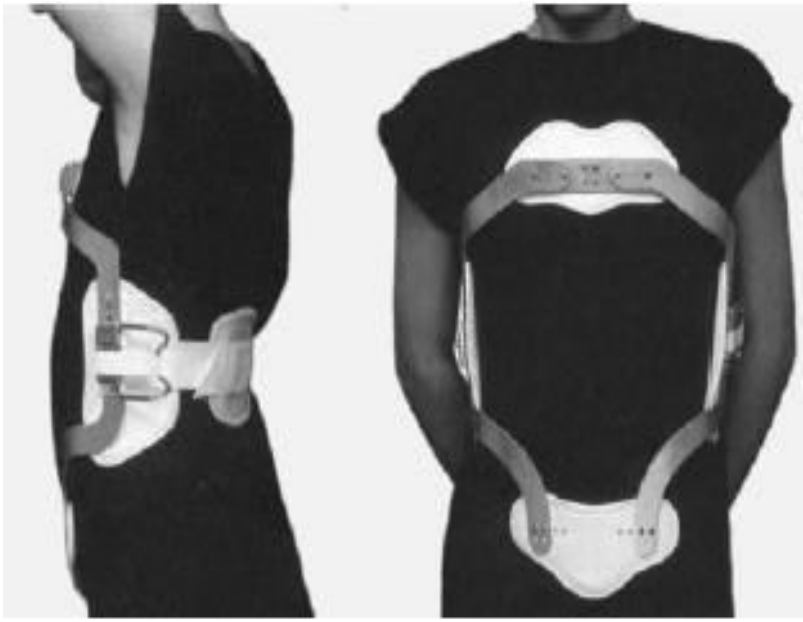
End plate



Oner Spine 2002

Bone mineral density





Strong linear correlation between the failure load and L1 bone mineral density

Shono , McAfee and Cunningham: Spine 1994 19:1711-1722

Are stable thoracic and lumbar fractures really benign?

A pilot study using a motion analysis software

J. S. Mehta*, J. Hipp#, I. B. Paul*, V. Shanbhag*, S. Ahuja*

Cardiff Spinal Unit * & Spinal Biomechanics Lab, Baylor College of Medicine#

Poster at Britspine 2010

Presented BTS; CAOS

Subjects:

- 105 patients
- Neurologically intact & stable
- Mean age 46.9 yrs
- Serial erect radiographs 2 – 9 / pat
- Final Xray 5.6 mo after injury

Radiographic assessment

- Supine radiographs
- Erect radiographs to review collapse
- Follow-up with erect radiographs


Day 0


Day 3

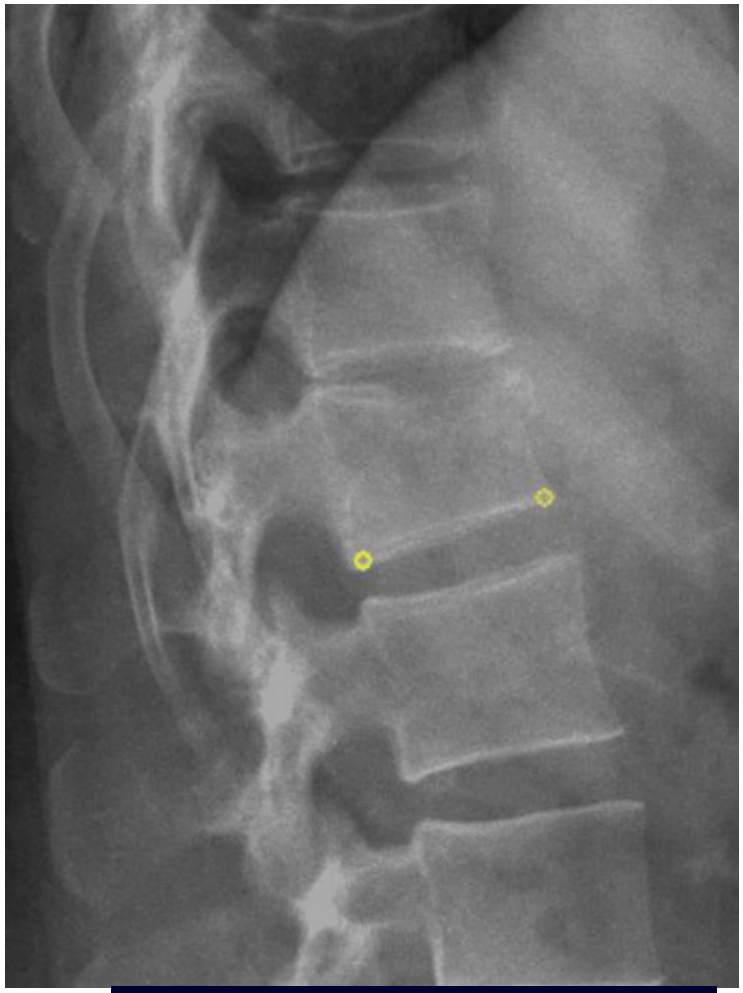

Day 49


Day 91


Day 175

QMA software

- Landmarks on the first radiograph
- Digital re-sizing for magnification
- Contrast enhancement filters
- Radiographs superimposed



0, 33, 89, 159 days

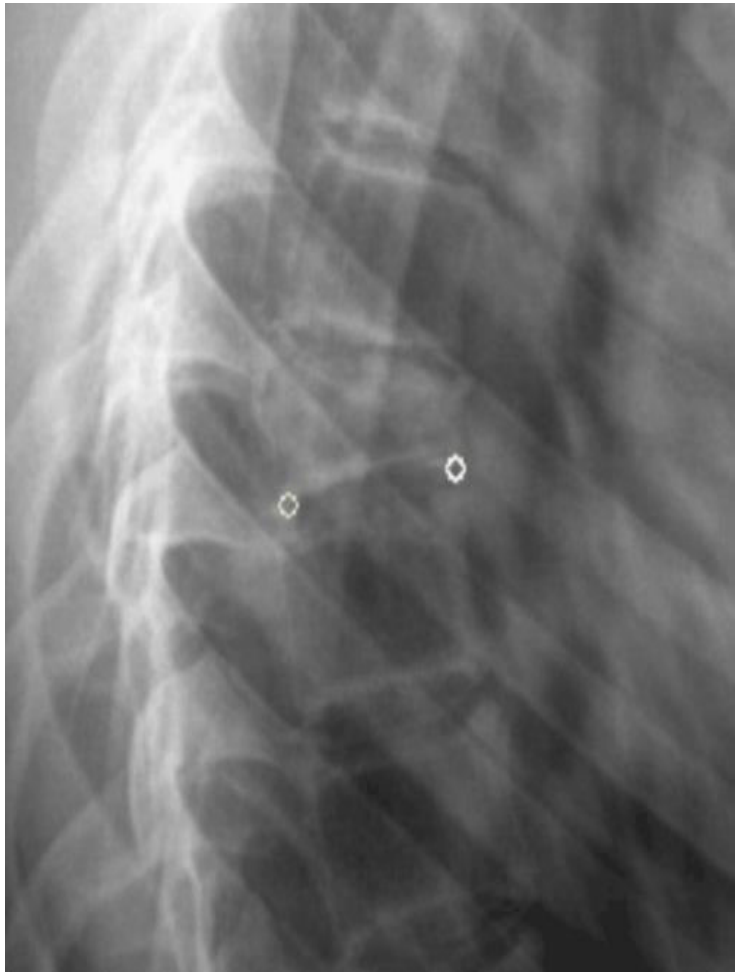
Day



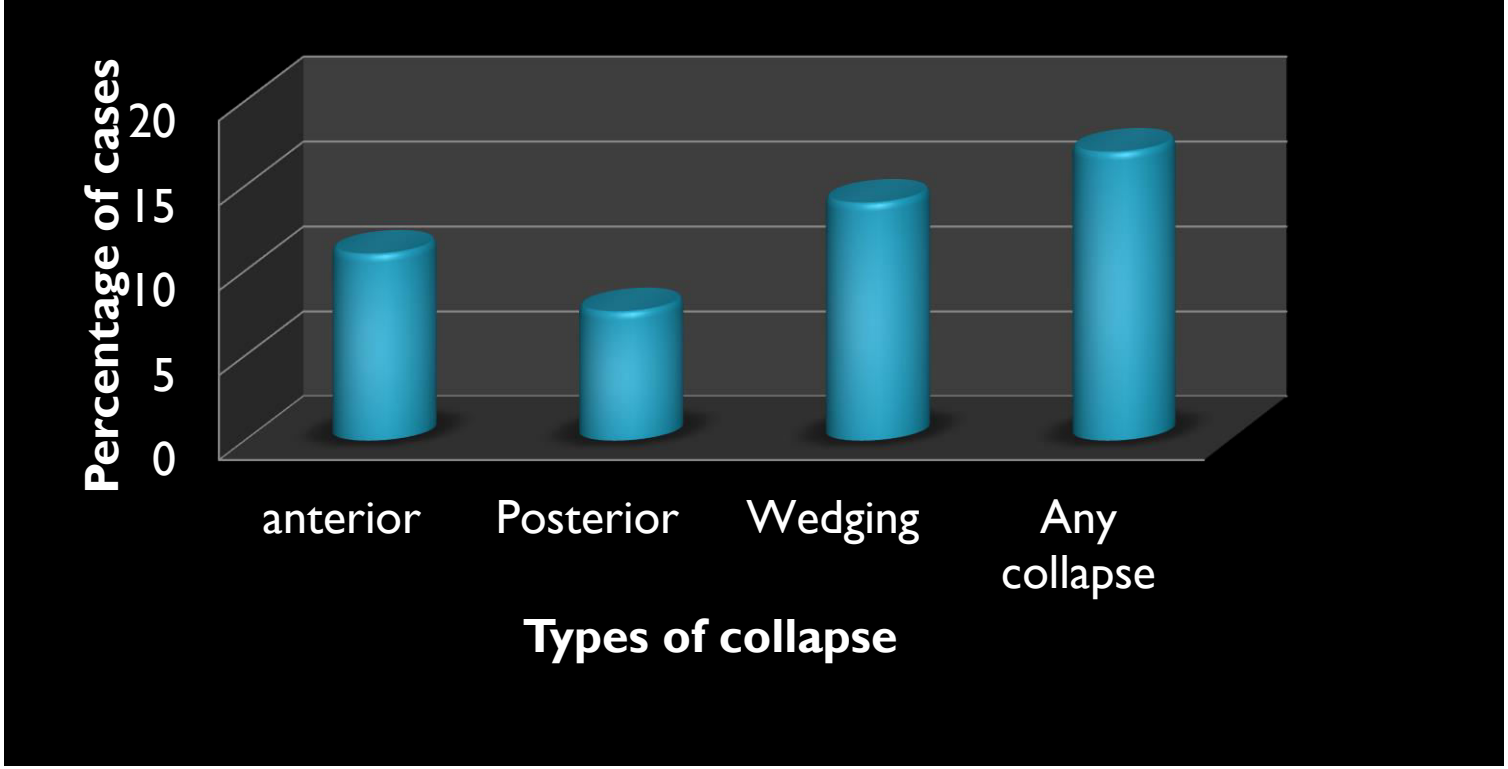


QMA: analysis

- Transformation matrices
- Tracking motion of end plates
- Vertebral heights & end plate angulation



0, 33, 59 days



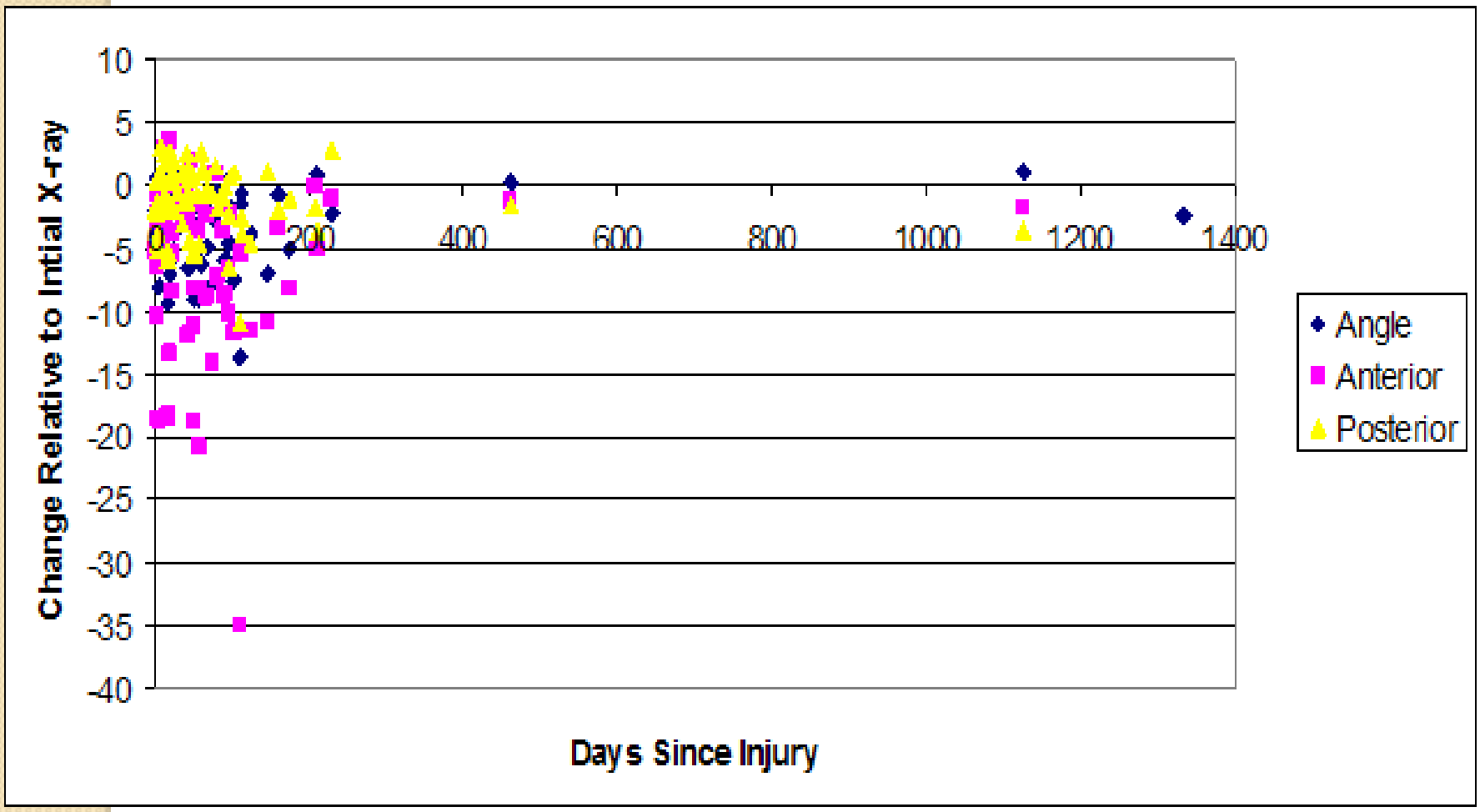
Collapse definition: > 15% height loss; >5°

17% had some form of collapse

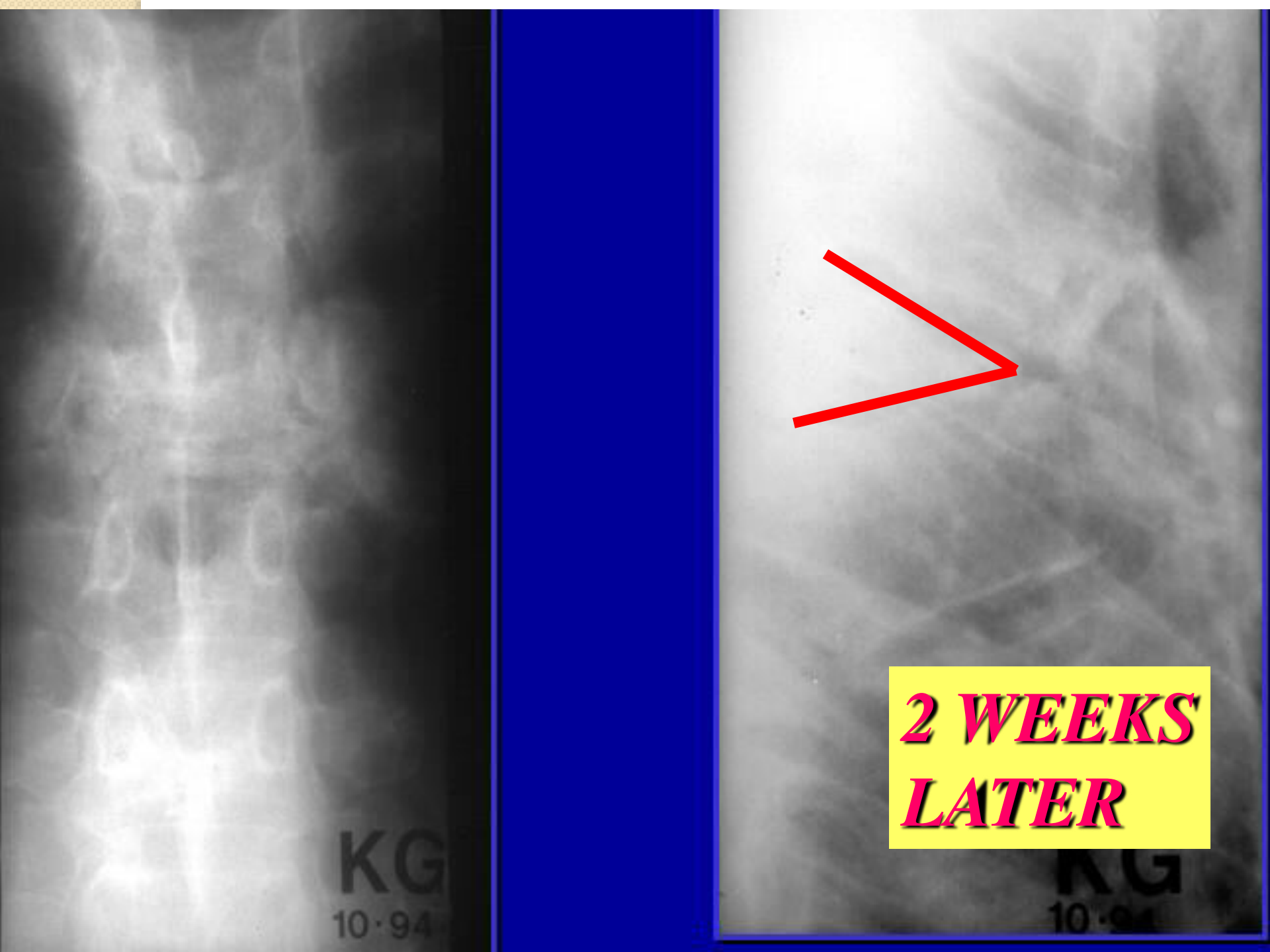
ODI worse for posterior collapse

Modest intial collapse likely to progress OR1.09; p = 0.03

Collapse most dramatic in the first year



INNOCENT XRAY !!NO PROBLEM!!


2 WEEKS
LATER

3 Column

- Too many subclasses
- Too much emphasis on *MIDDLE* column
- No quantification of *COMMINUTION*

3 Column

- *MANY* burst fx's can be treated nonoperatively
- *DAMAGE* to **BODY** (ant + mid) *and* ligament injury determine prognosis and treatment - not just middle column injury

SPINE Volume 19, Number 15, pp 1741–1744

The Load Sharing Classification of Spine Fractures

Thomas McCormack, MD, Eldin Karaikovic, MD, and Robert W. Gaines, MD

Load-Sharing Classification

Components

- Amount of body involved
- Appostion of fragments
- Correction of kyphosis

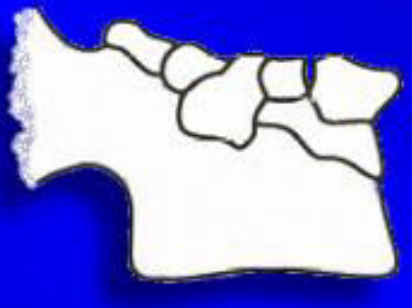
Grading

- Each component
- Mild, moderate, severe
- 1,2,3 points

Components of LS Classification

- Amount of Involvement 1-3
- Spread of Fragments 1-3
- Correction of Kyphosis 1-3

Comminution/Involvement



<1/3

Little
1

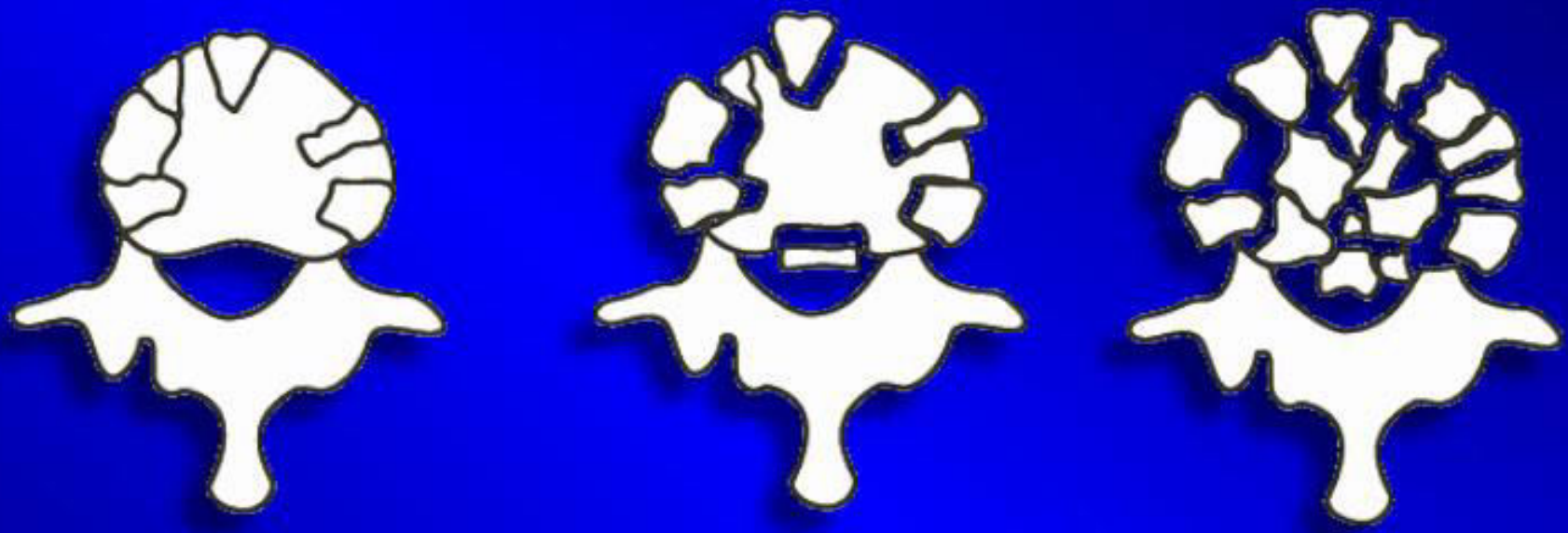
1/3-2/3

More
2

Gross
3

>2/3

Apposition of Fragments



Minimal
1

0-1 MM

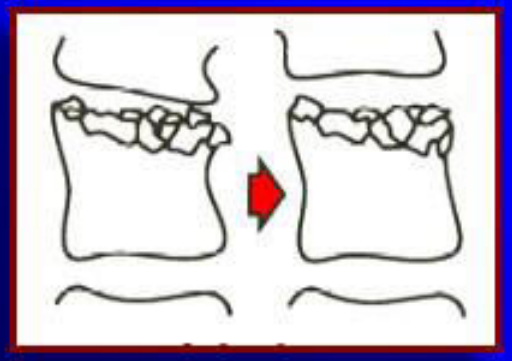
Spread
2

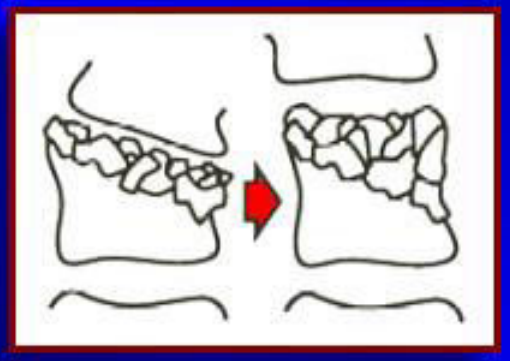
<2MM
<50%

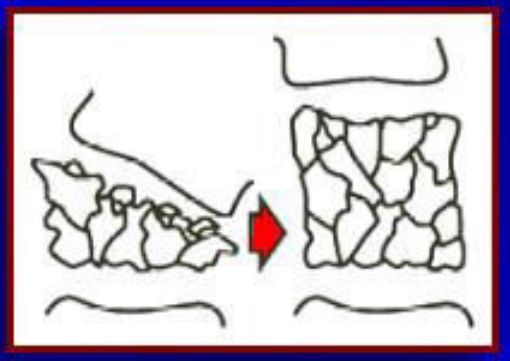
Wide
3

>2MM
>50%

Deformity Correction







Little
1

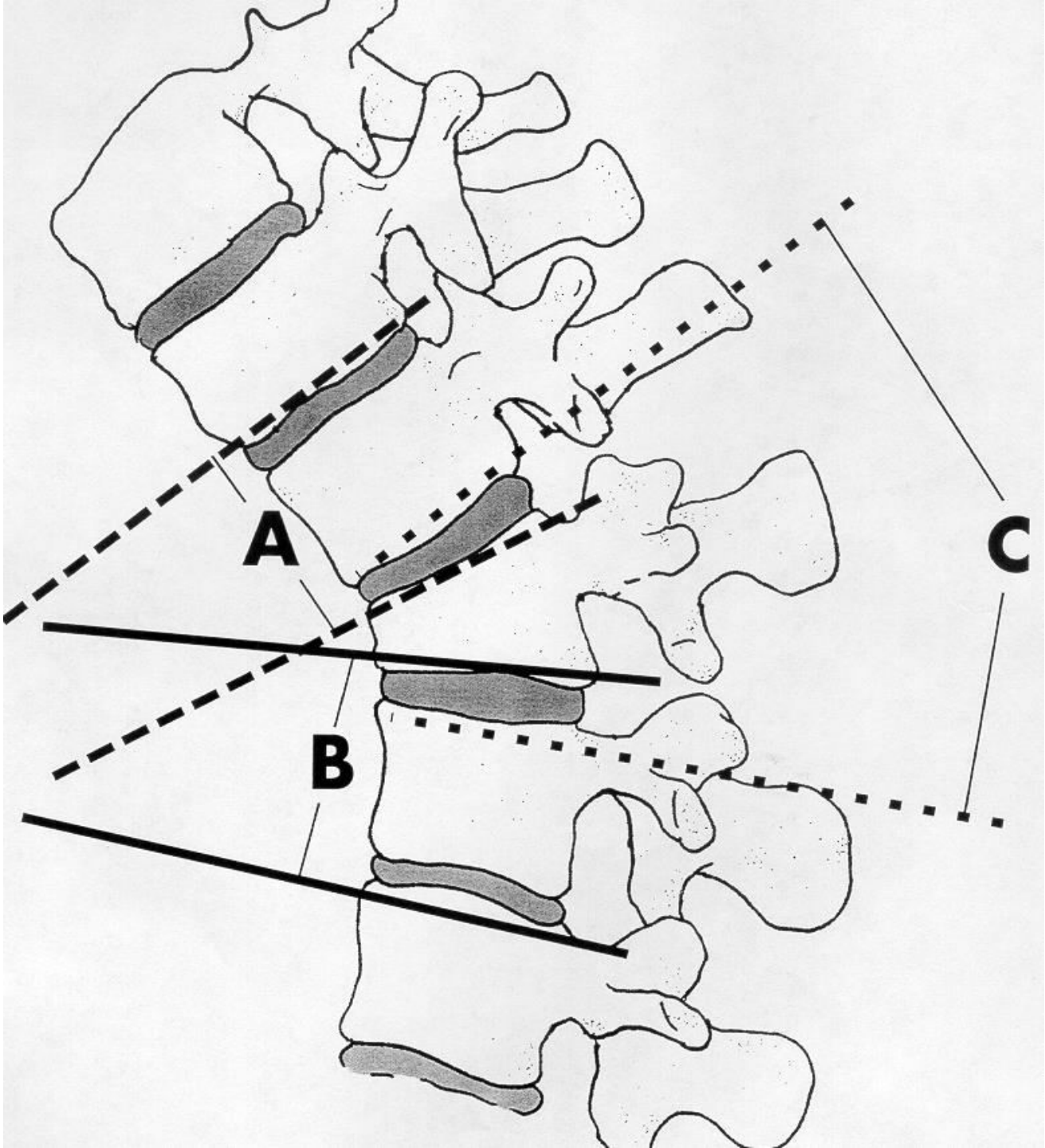
0-3 DEG

More
2

4-9 DEG

Most
3

10 DEG OR MORE


A
B
C

Load-Sharing Classification

- Describes (quantitates) bony injury
- Do
- Not concerned with mechanism of injury

BONE DAMAGE CLASSIFICATION

Must Also Use Patient Variables and Ligament Assessment to Determine Treatment -
Not Just the Classification

Damage done by the accident is *MUCH MORE IMPORTANT* in determining outcome and treatment

Load sharing classification

- Describe Fracture
- Predict Outcome
- Help with Treatment
  - Op
  - Non-op

- Simple to Apply
- Easy to Remember

Load-Sharing Classification

Point Total

ANY fracture
3 - 9 points

Defines the Approach

Long Segment Instrumentation

Short Segment Instrumentation

Short Segment Instrumentation - One Level Above to One Level Below

Short-Segment Instrumentation

Superb for majority of isolated fractures in young patients

Long-Segment Instrumentation

Reserved for **unpredictable** patients

(due to pre-existing disease or trauma)

Short Segment

- Point Total

3, 4, 5, 6

POSTERIOR

- Short Segment Instrumentation

Short Segment

- Point Total

7, 8, 9

ANTERIOR

- Short Segment Instrumentation

2-COMM.

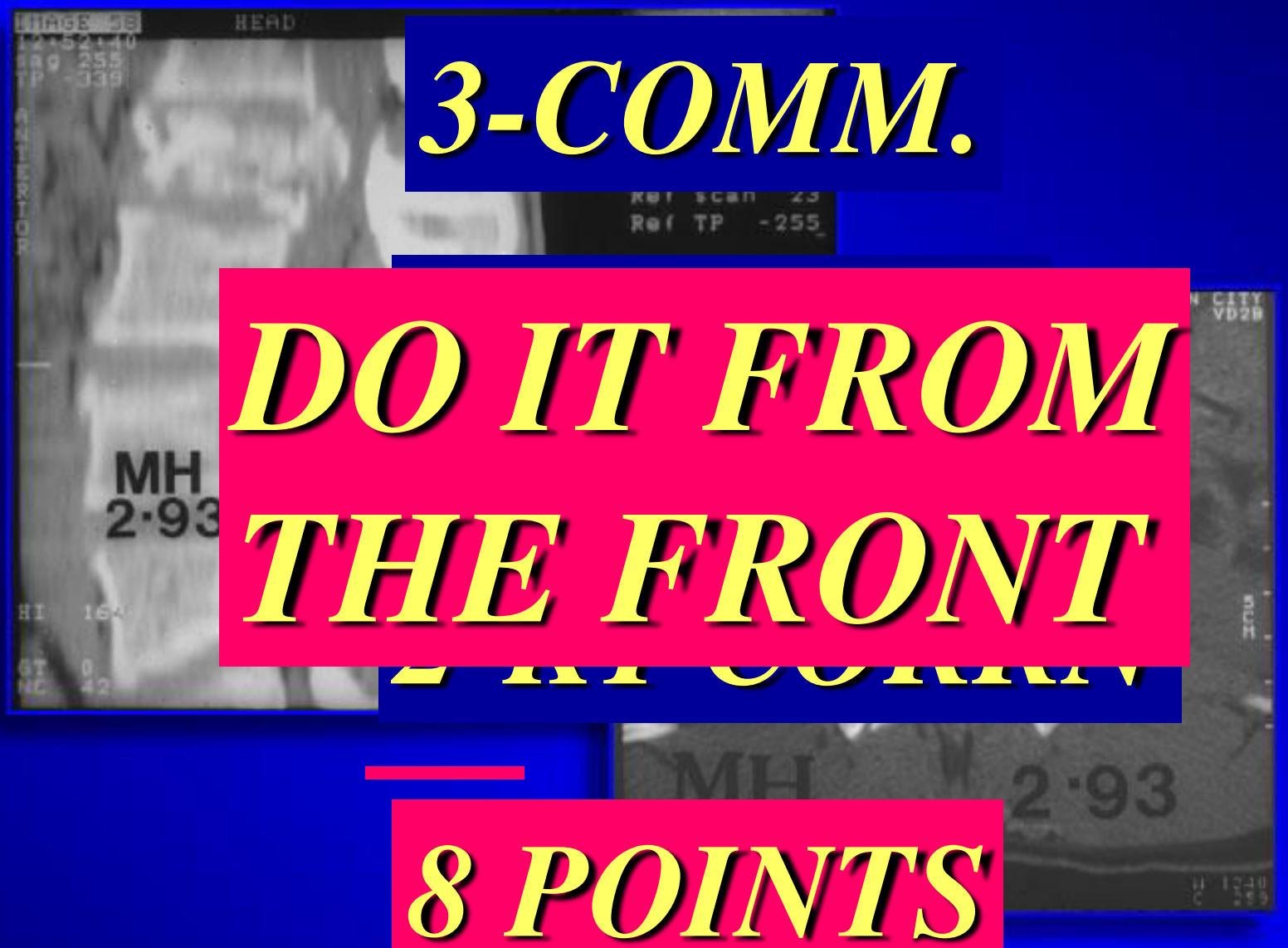
DO IT FROM THE BACK

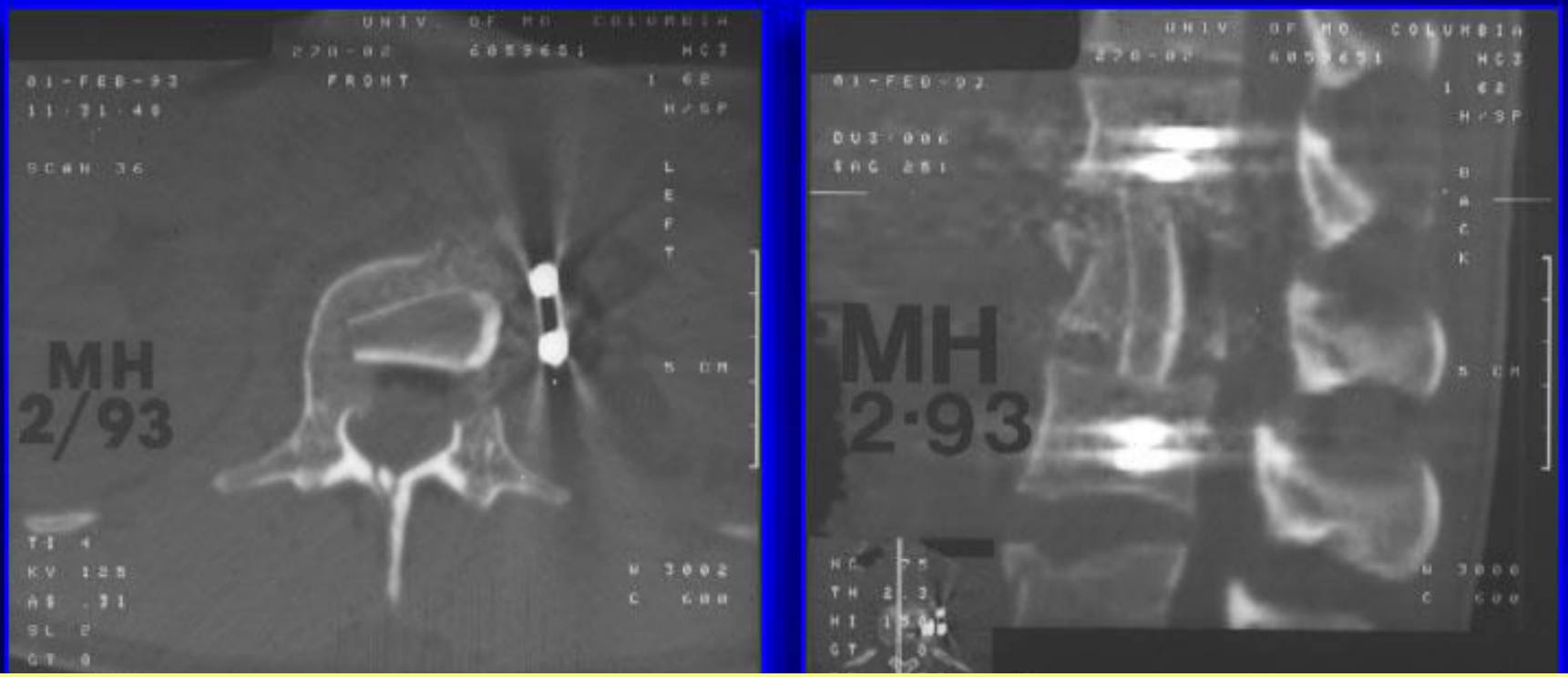
+1-FRAG SPRD

+3-KY CORRN

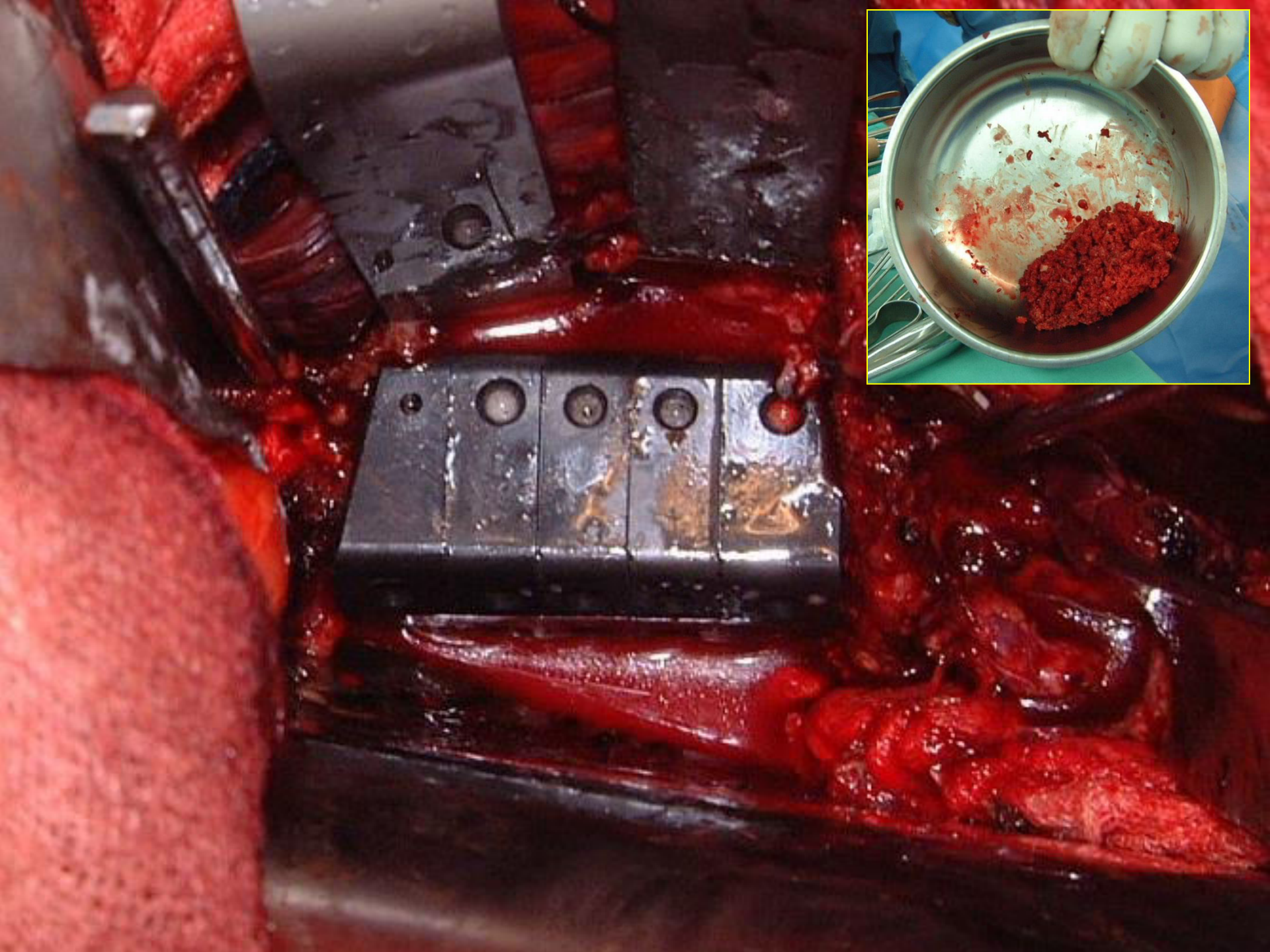
= 6

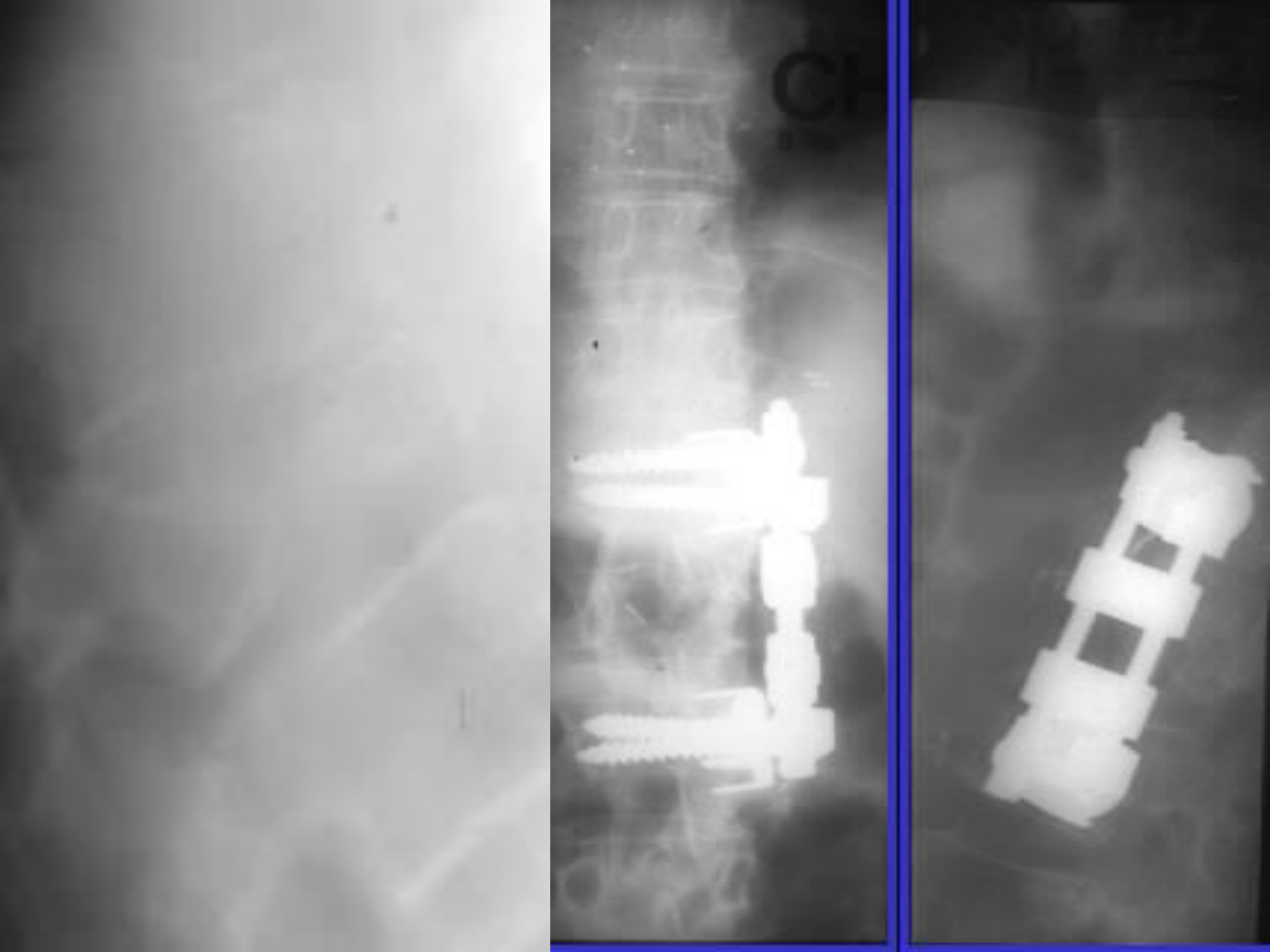

2 PTS -COMM
+2 PTS - FRAGS
DO IT FROM
NOT MUCH
COMMTN
6 POINT TOTAL
L1 BURST FX


3-COMM.
DO IT FROM
THE FRONT
8 POINTS



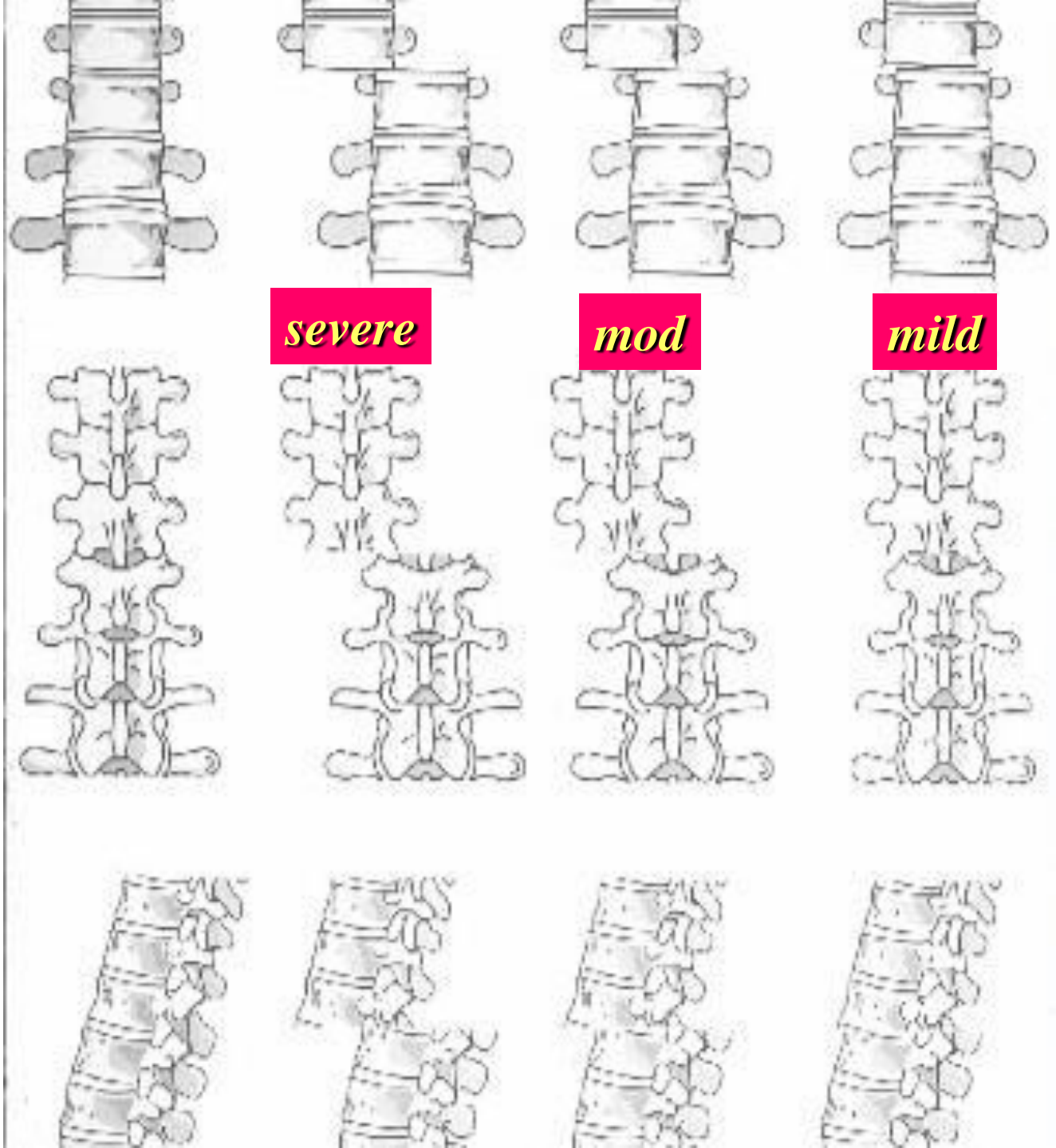
STRUT GRAFT TRANSFERS BODY WEIGHT W IMPLANTS





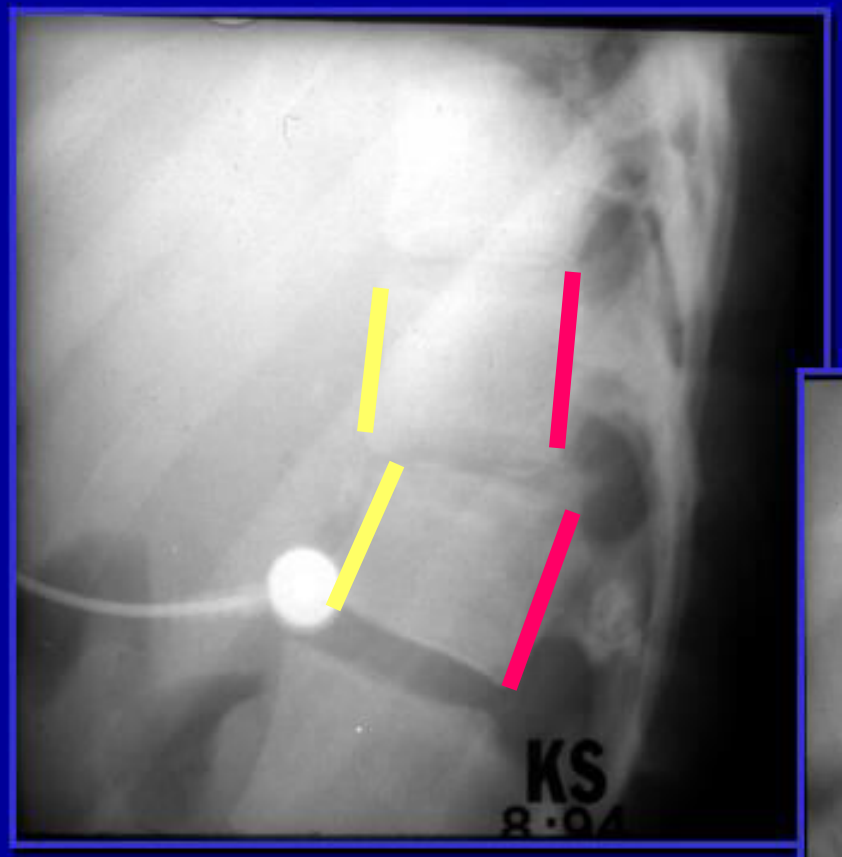
Translational Displacement

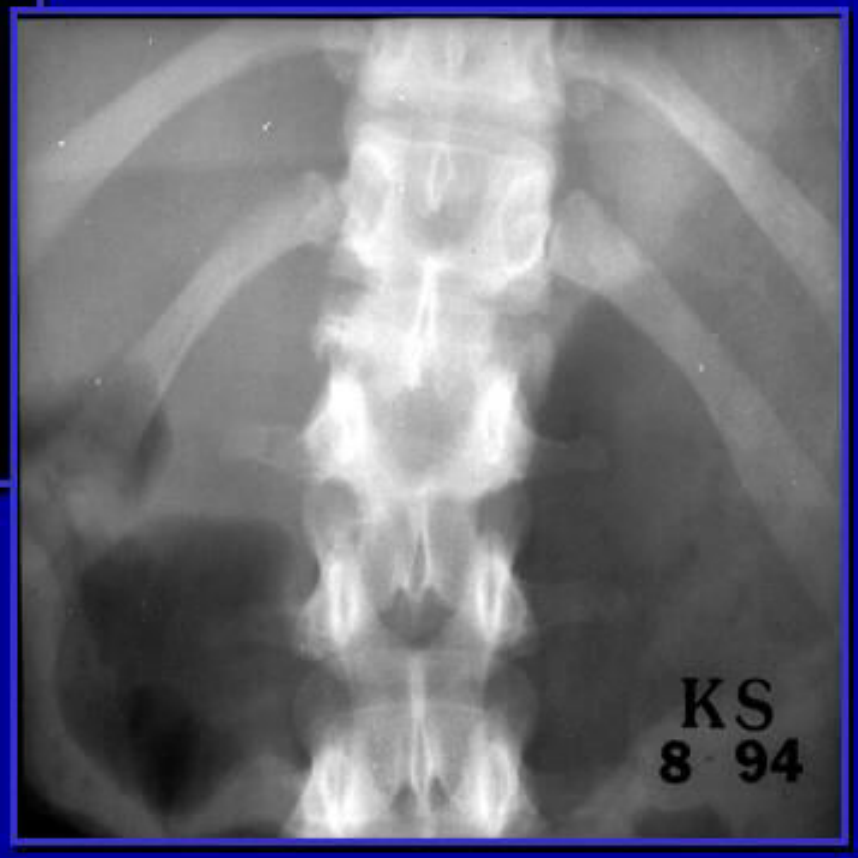
(Fracture-Dislocation)

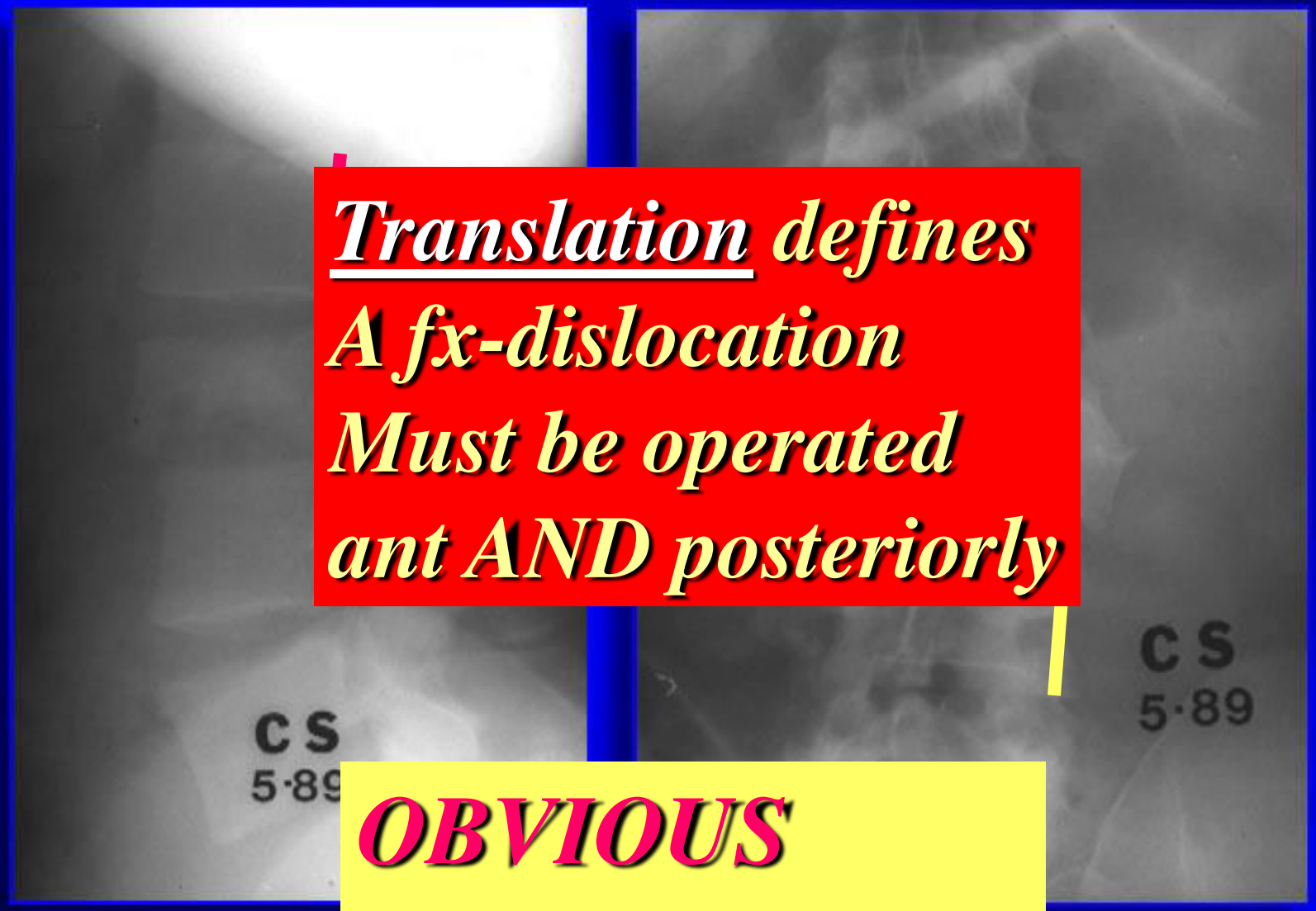

severe
mod
mild

TRANSLATION: ***All ligaments torn***

ALL LIGTS TORN

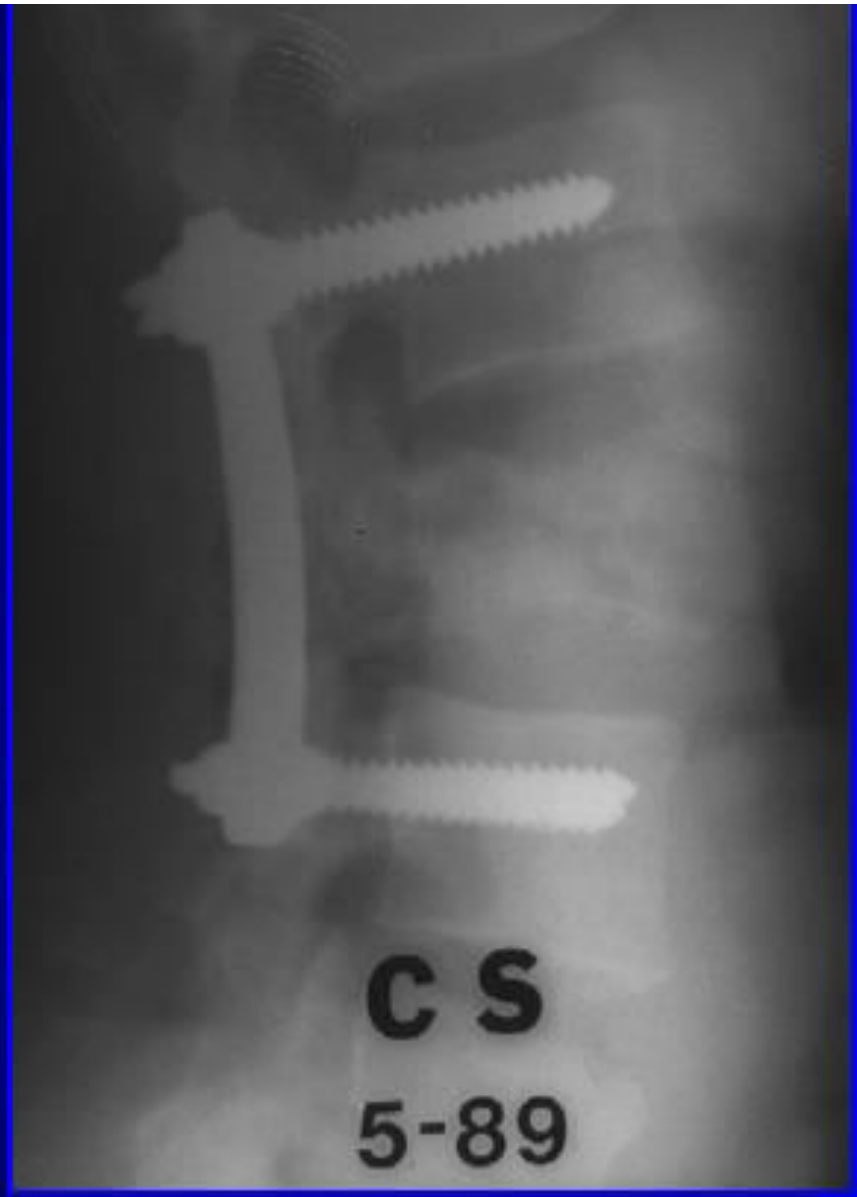






Translation defines
A fx-dislocation
Must be operated
ant AND posteriorly

OBVIOUS
TRANSLATION



3-COMM
3-SPREAD
3-KY CORRN
<u>SEVERE</u> COMMINUTION
--WORST POSSIBLE--

Goals of surgery

Neurology

- Canal clearance
- Improve deficit

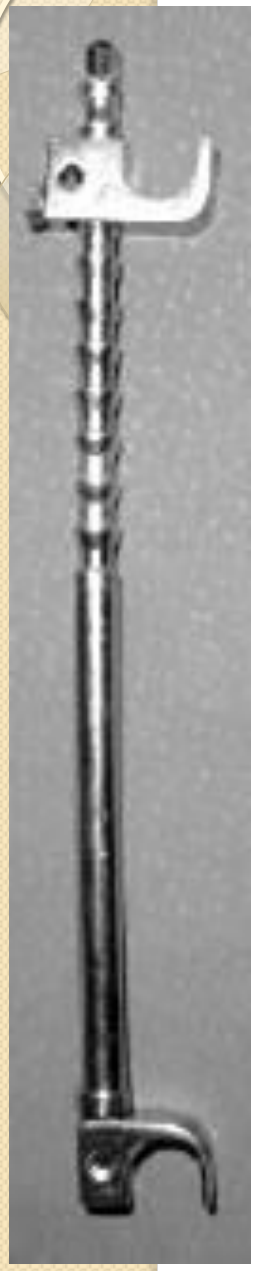
Biomechanics

- Correct kyphotic deformity
- stabilize anterior column

Principles, techniques & rationale of surgical options

Spinal Fixation Modes

- Distraction
- Compression
- Neutralisation



Spinal fixation modes

Distraction

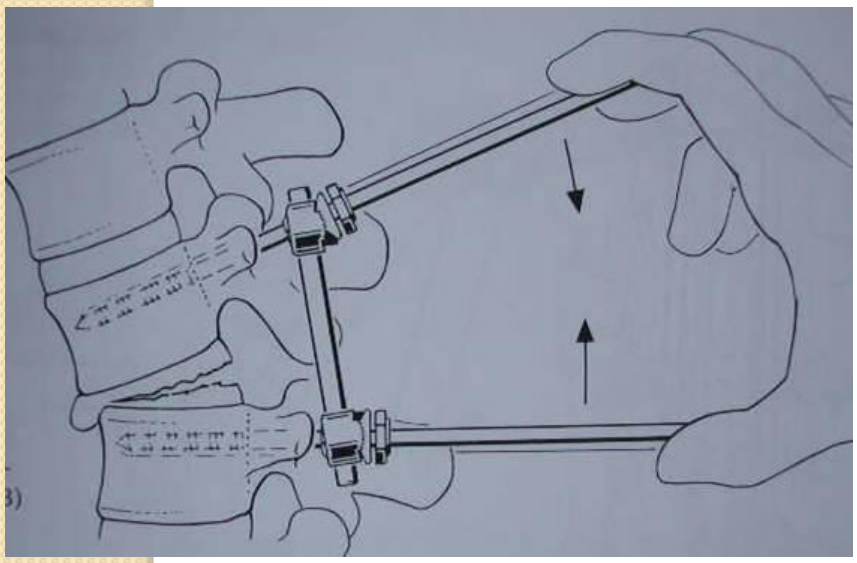
Harrington rod

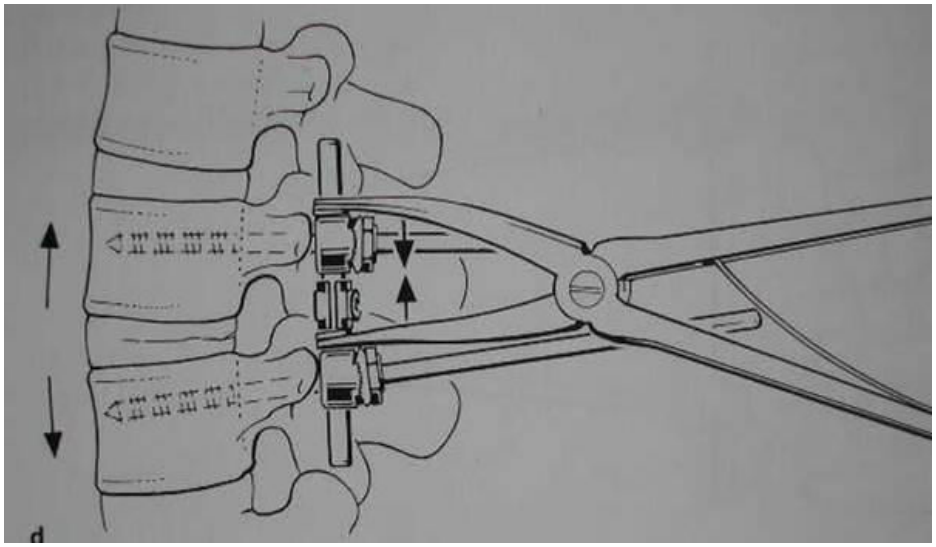
Complications

- Hook detachment
- Rod breakage
- Sagittal profile
- No. of levels

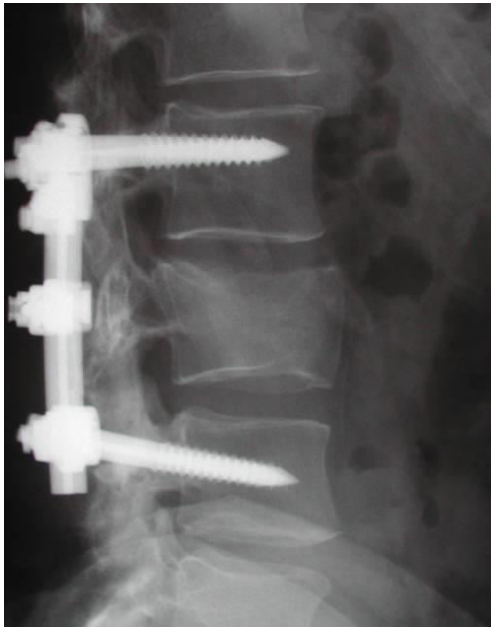
Spinal fixation modes
Compression

B





Spinal fixation modes:
Neutralization

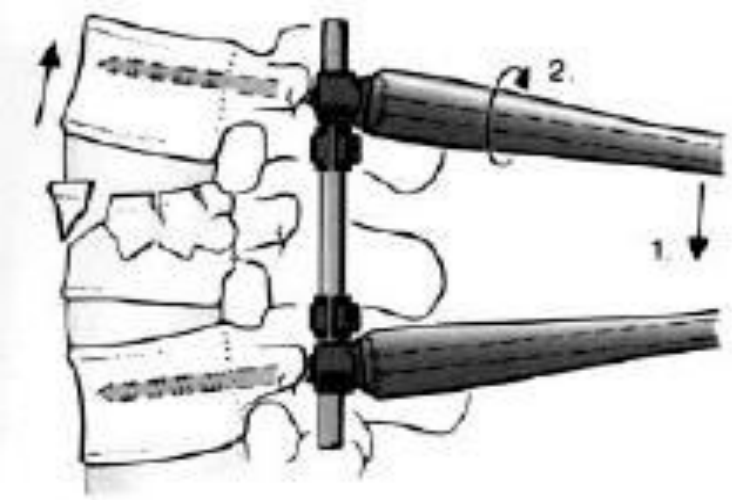


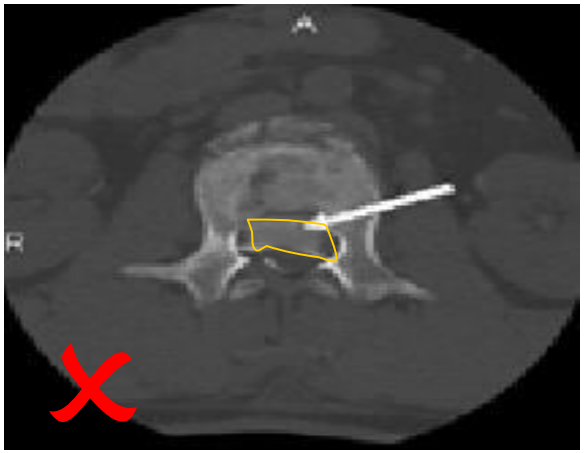
Pedicle screw fixation:

- Multidirectional stability
- Short segment

‘Short segment posterior’

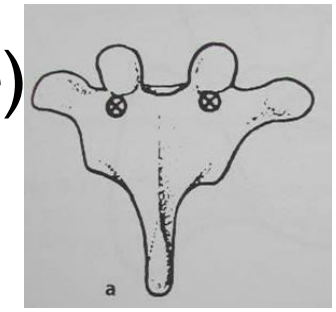
- Indirect reduction manouver
- Rapid stabilization
- Minimal no of segments
- ± fusion

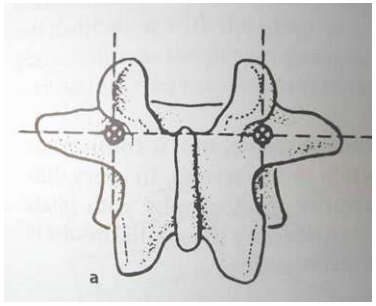


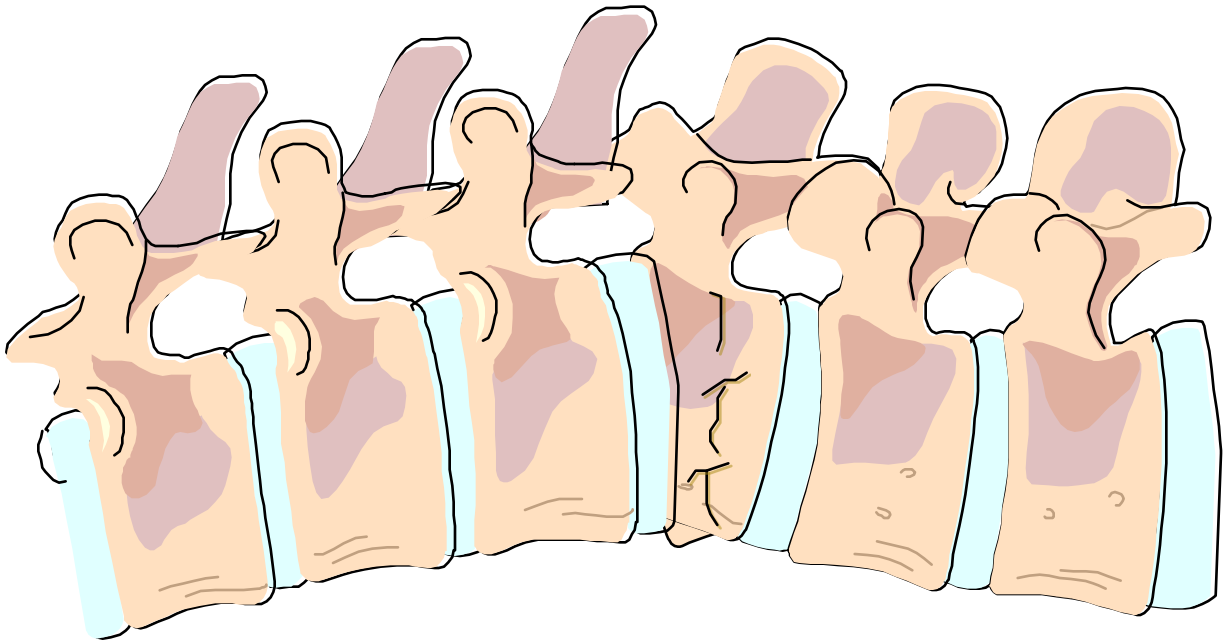


Posterior indirect reduction; stabilization

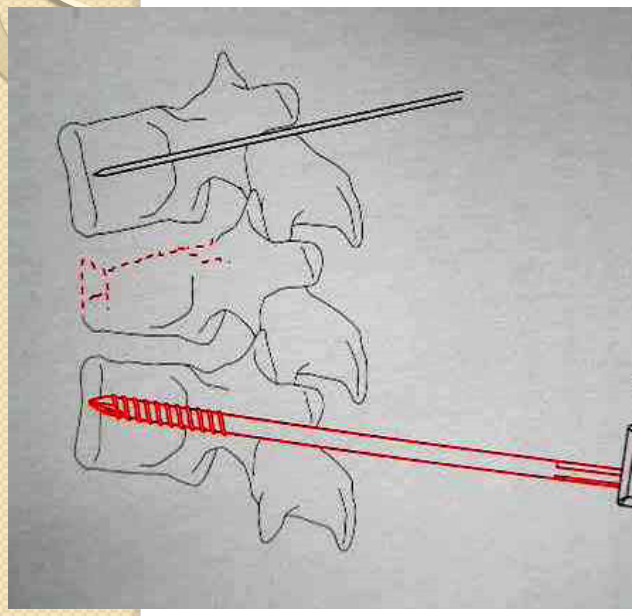
- Positional reduction (prone)
- ‘Careful’ posterior strip
- Identify pedicle entry sites

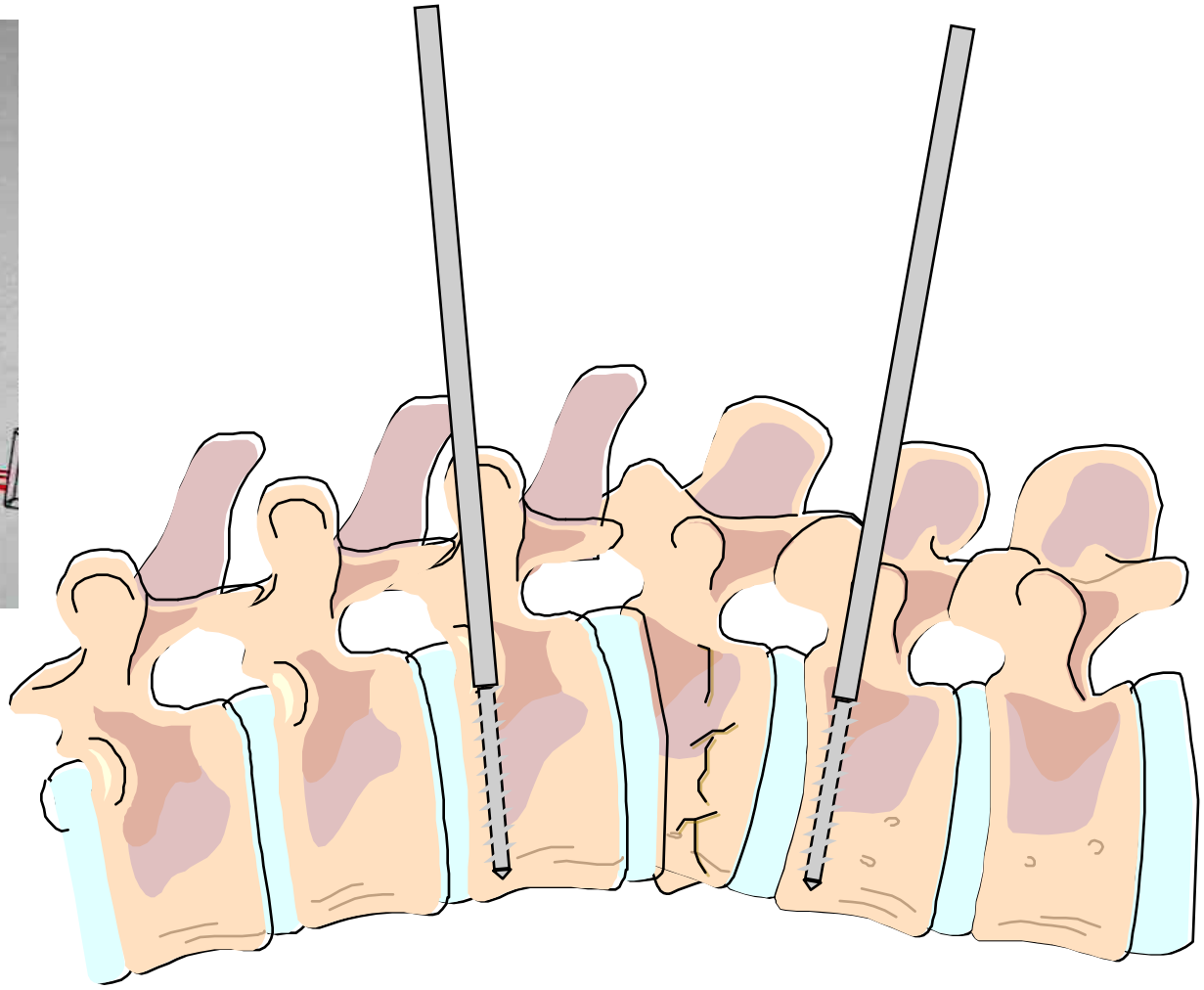




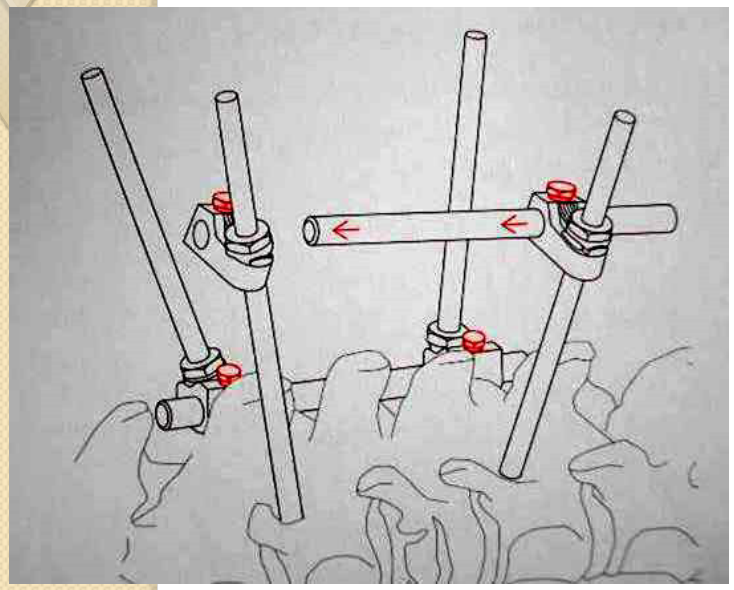


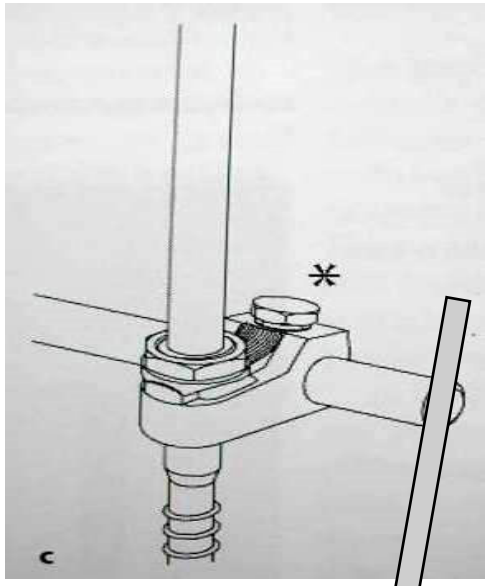
‘Short segment posterior’





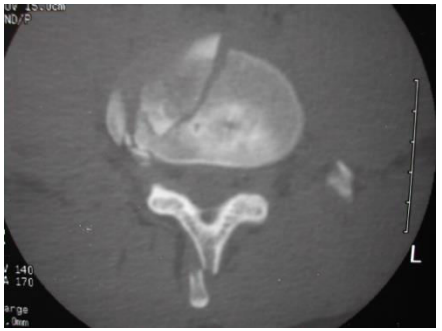
‘Short segment posterior’

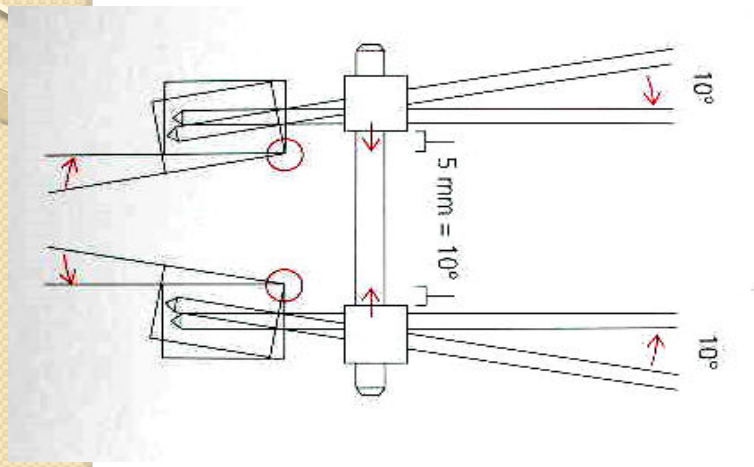


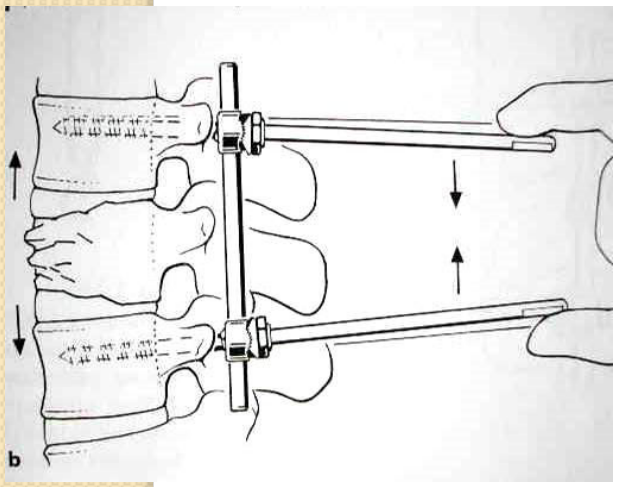


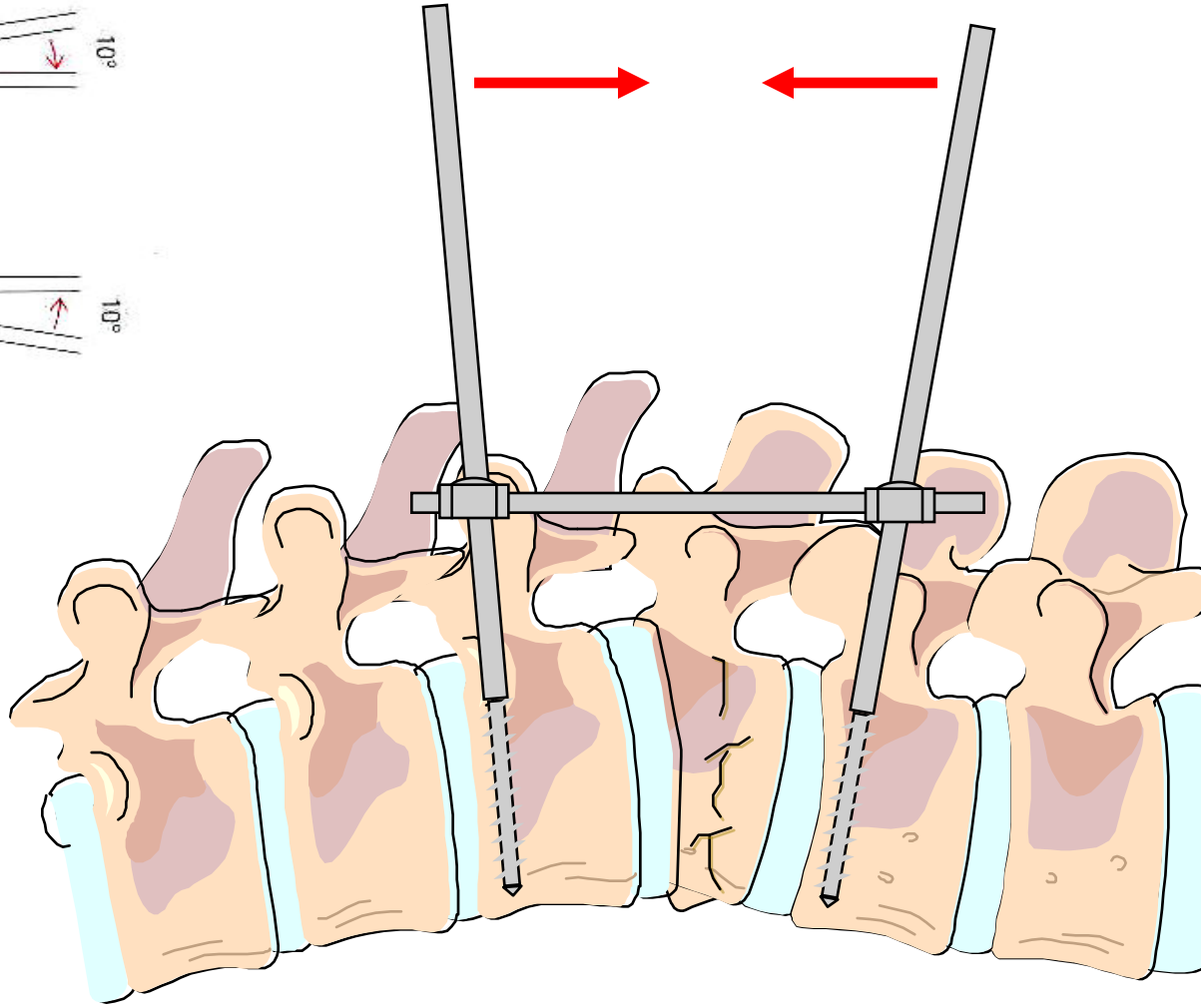
Reduction scenario I:

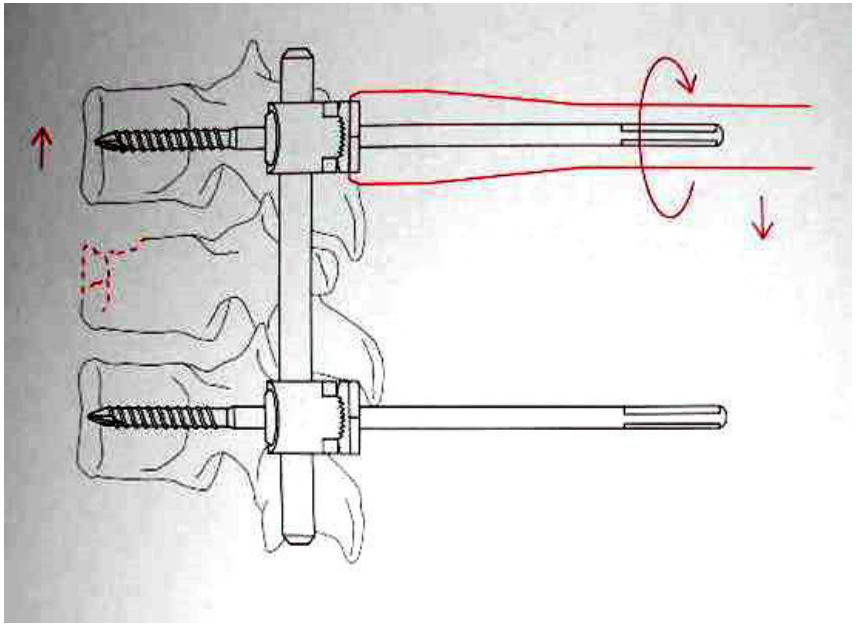
Intact posterior wall

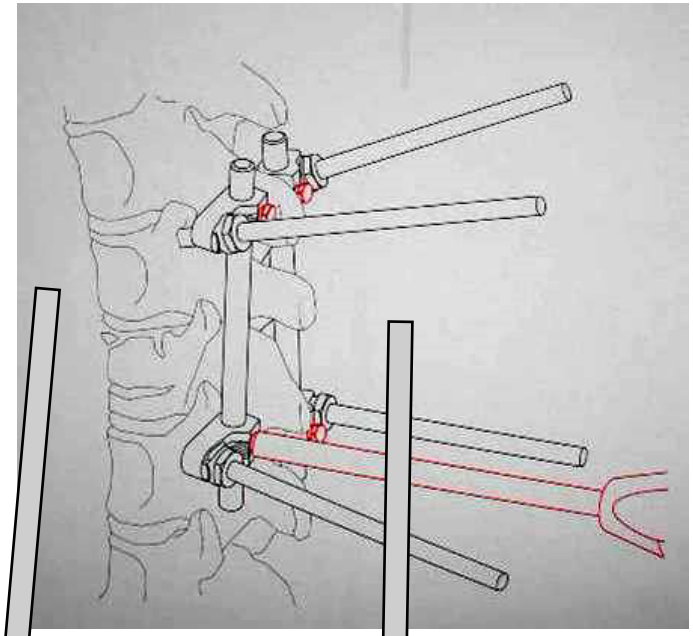


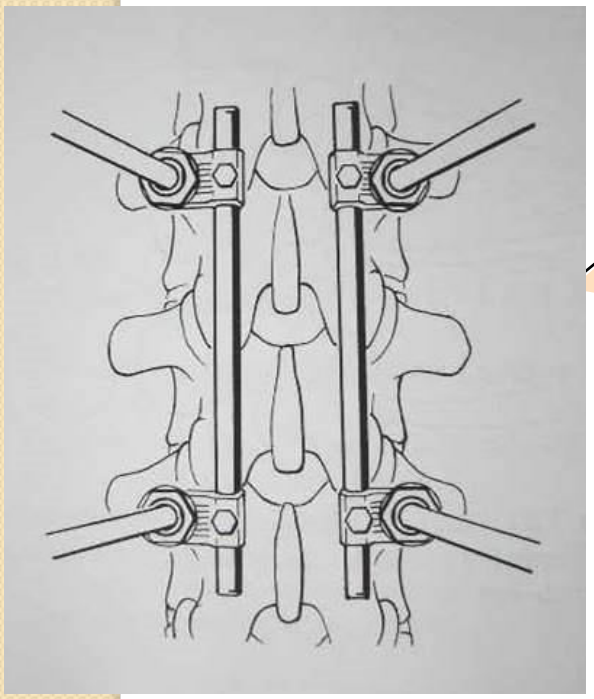






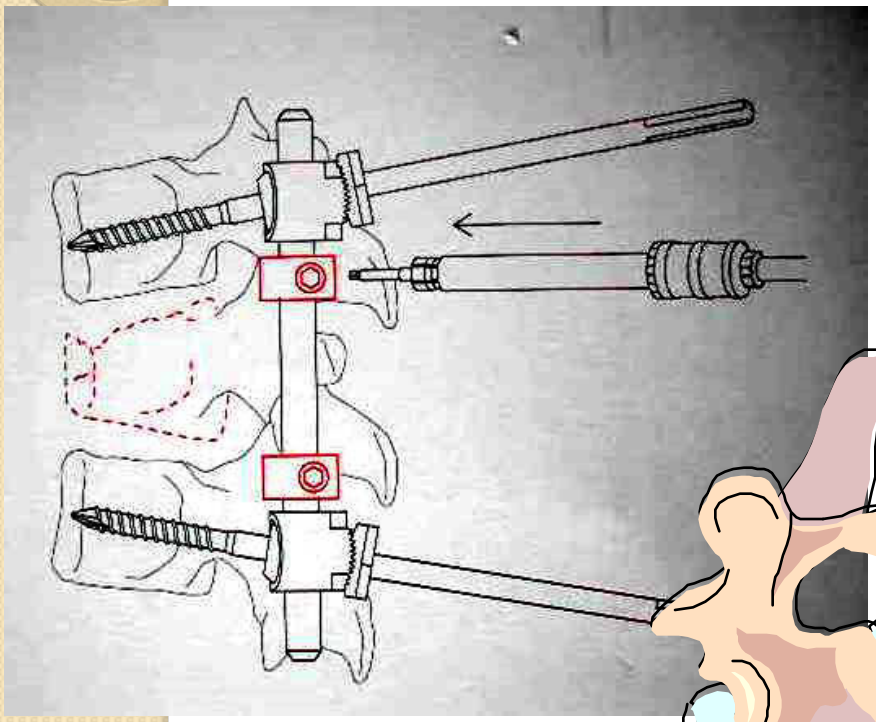


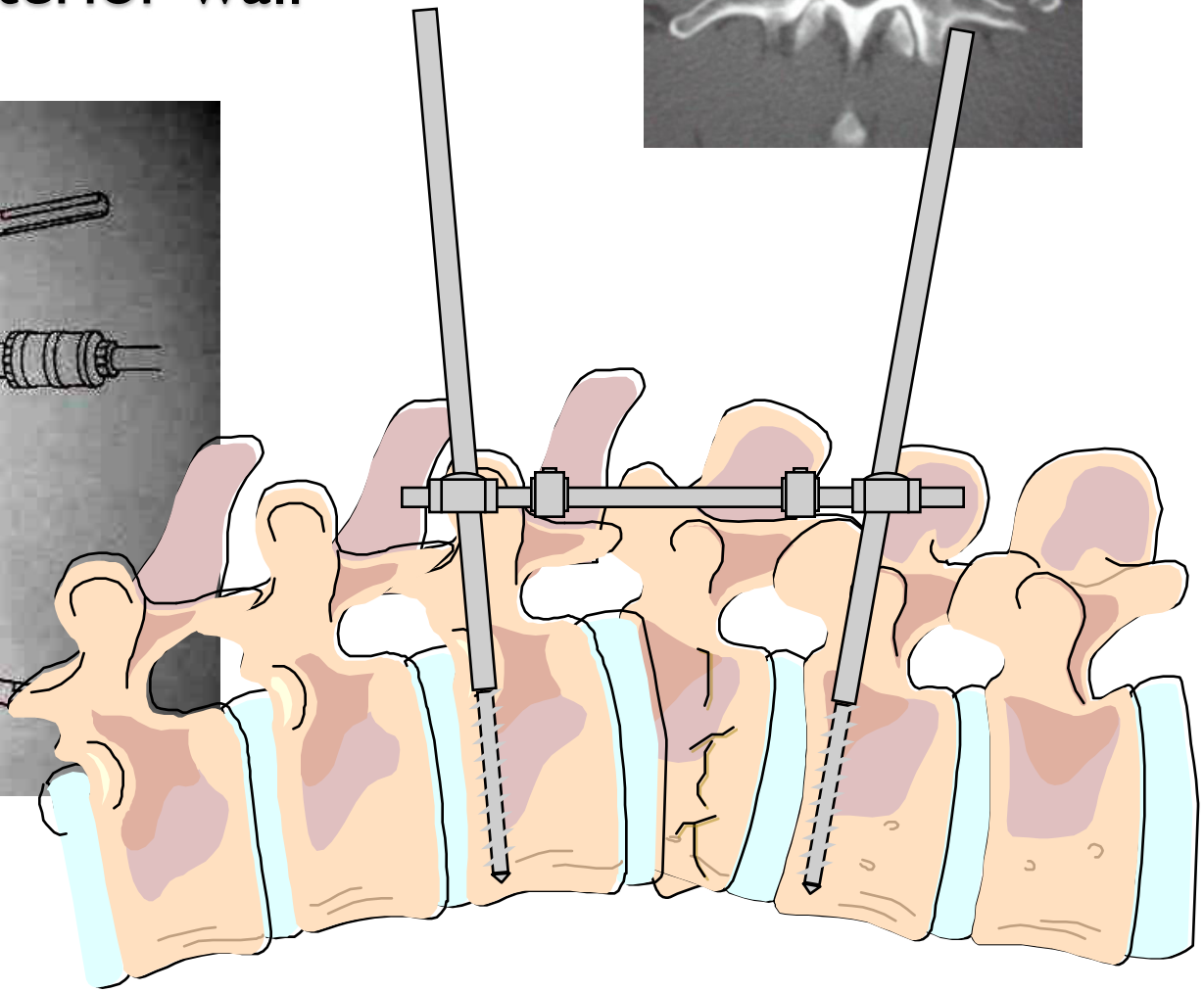




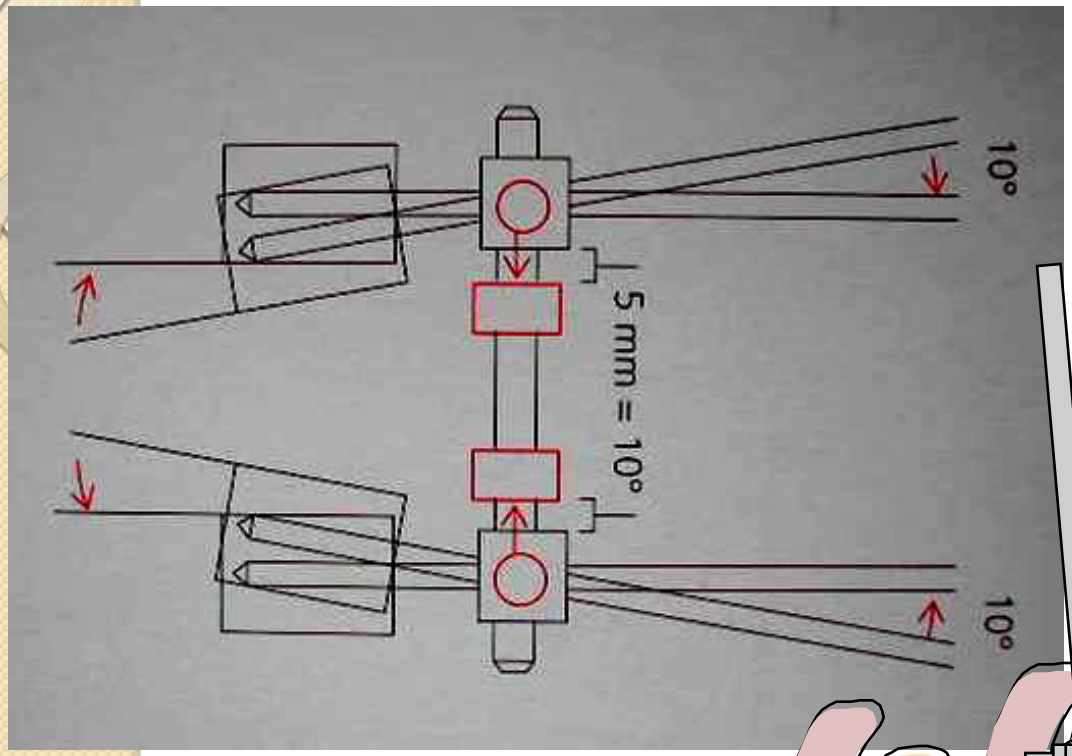
Reduction scenario II:

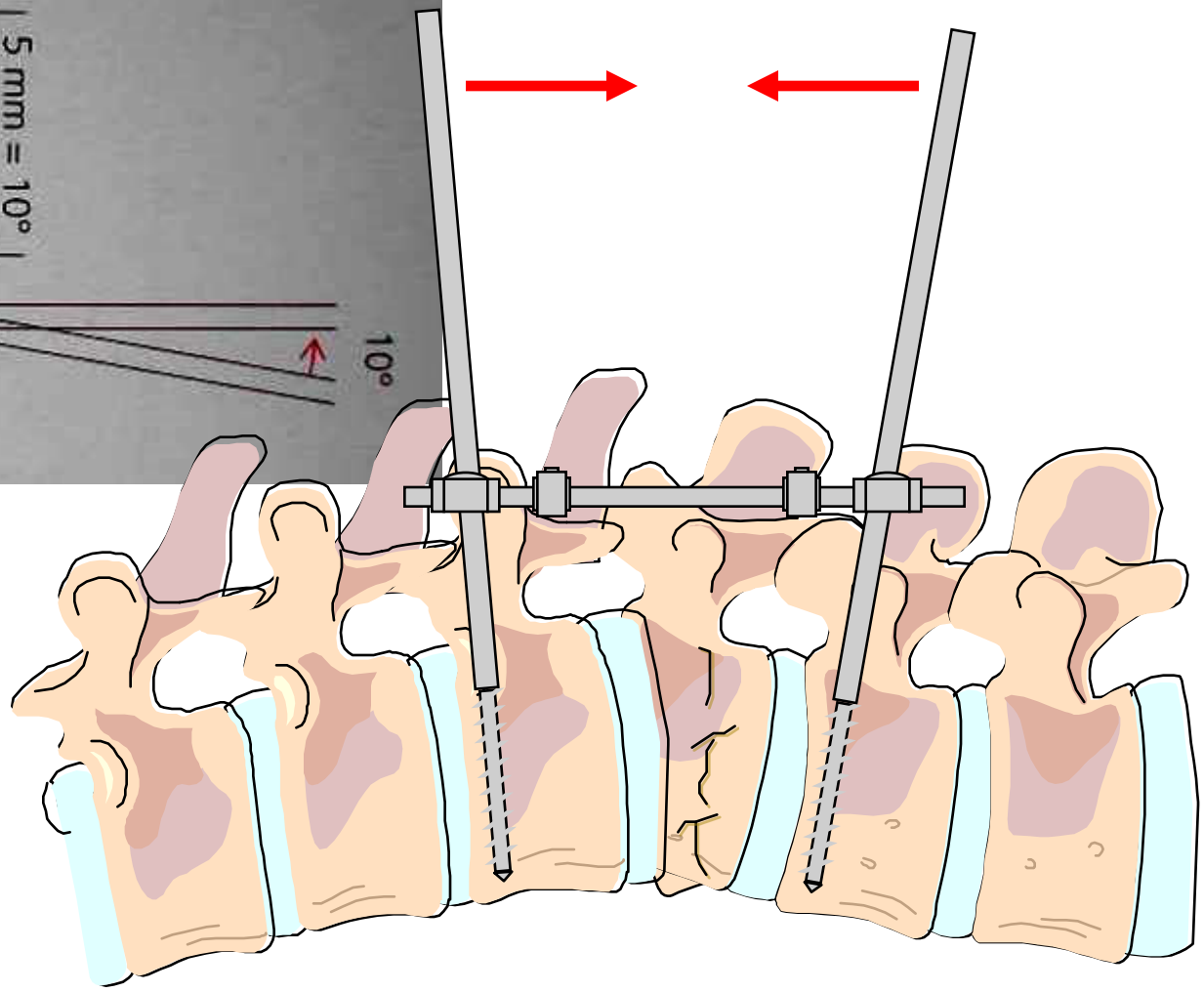
Fractured posterior wall



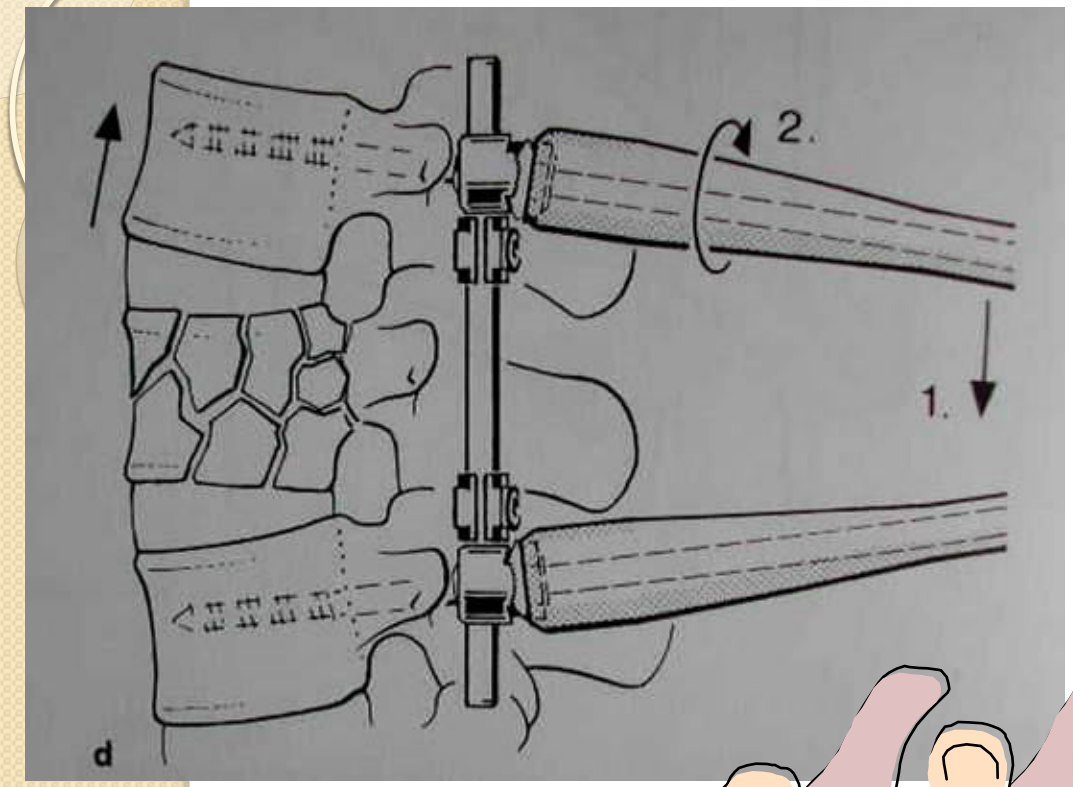


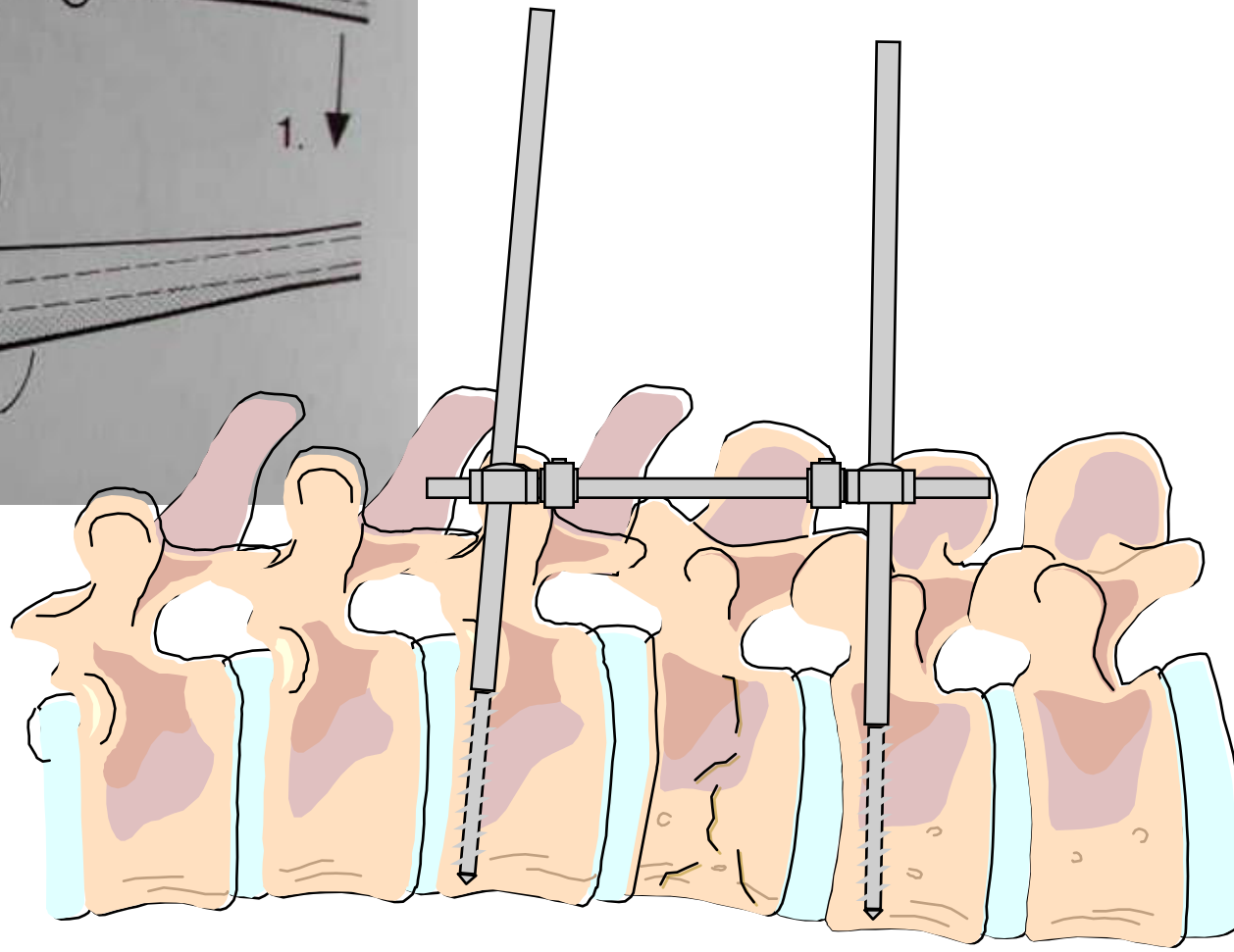
Controlled reduction



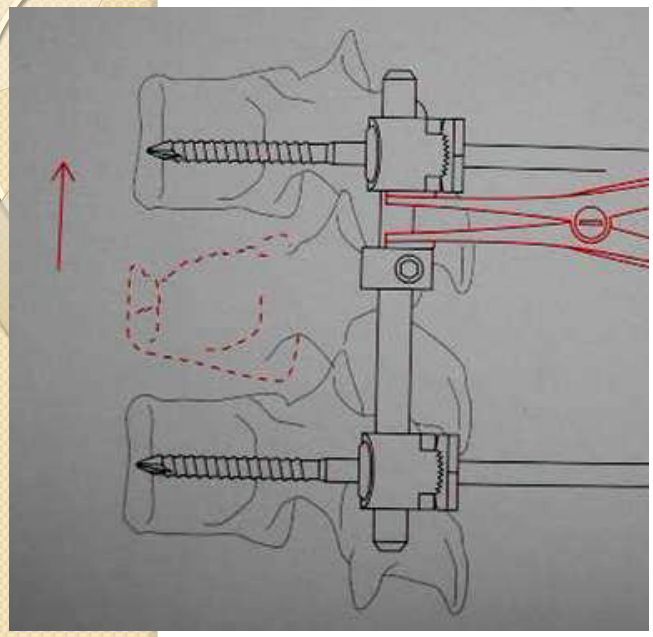


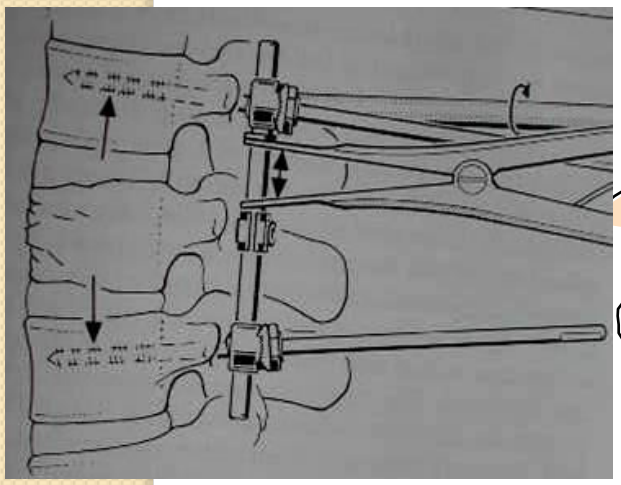
Correcting kyphosis

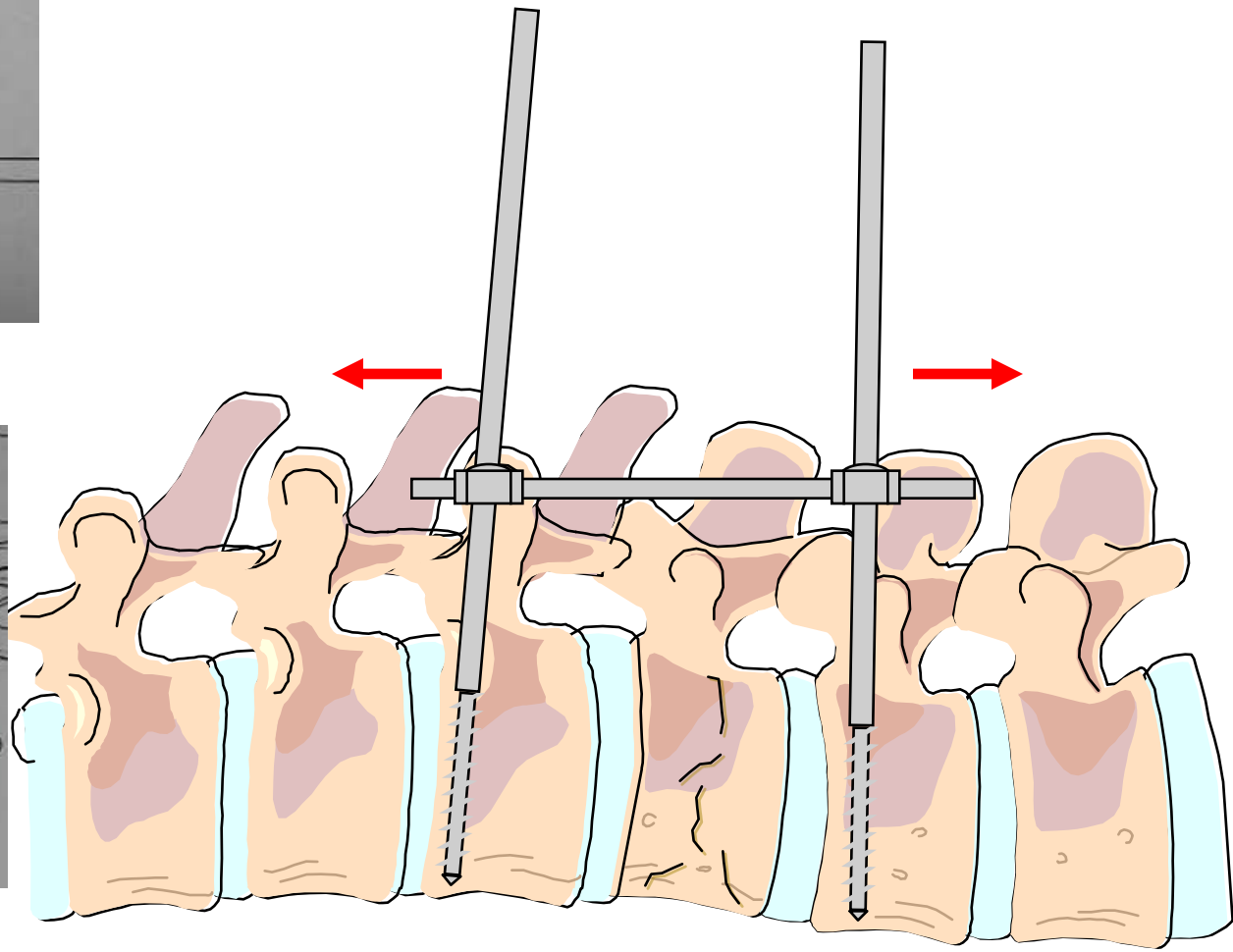


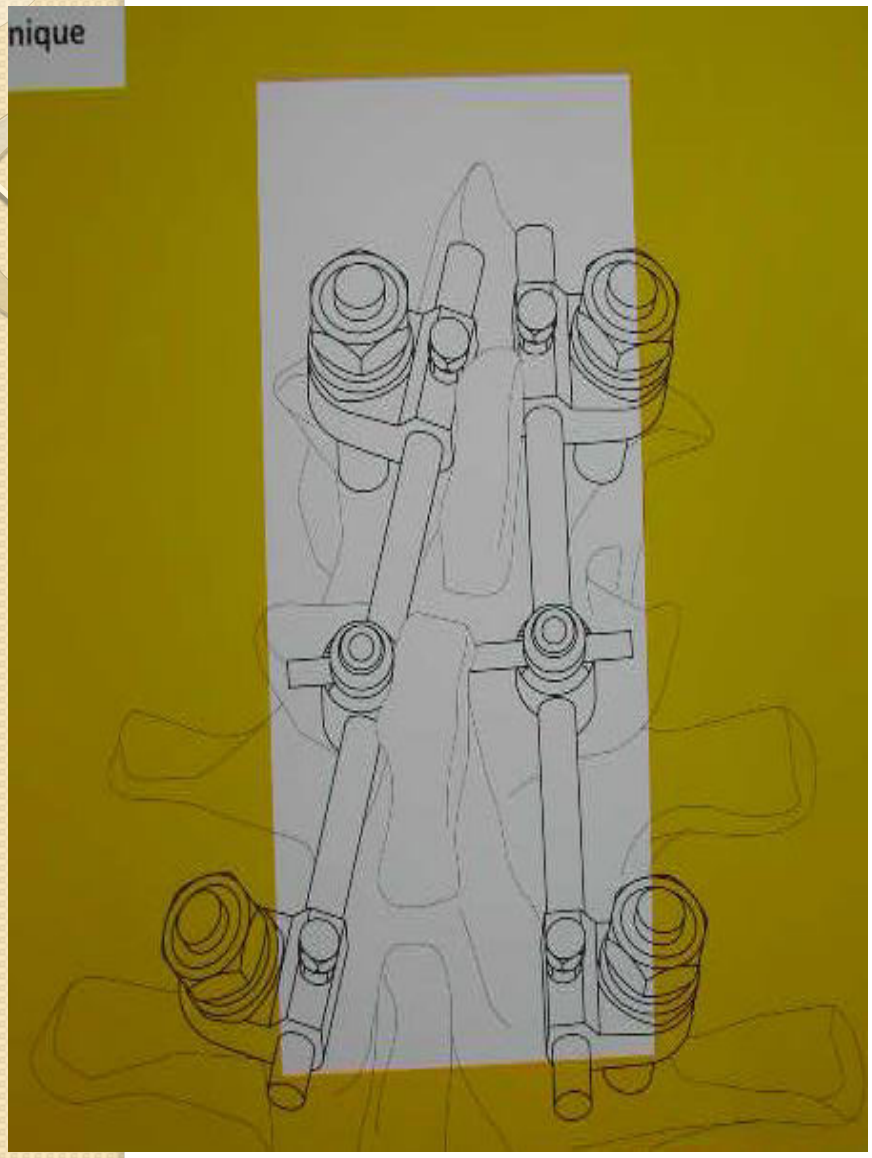


Restoring vertebral height





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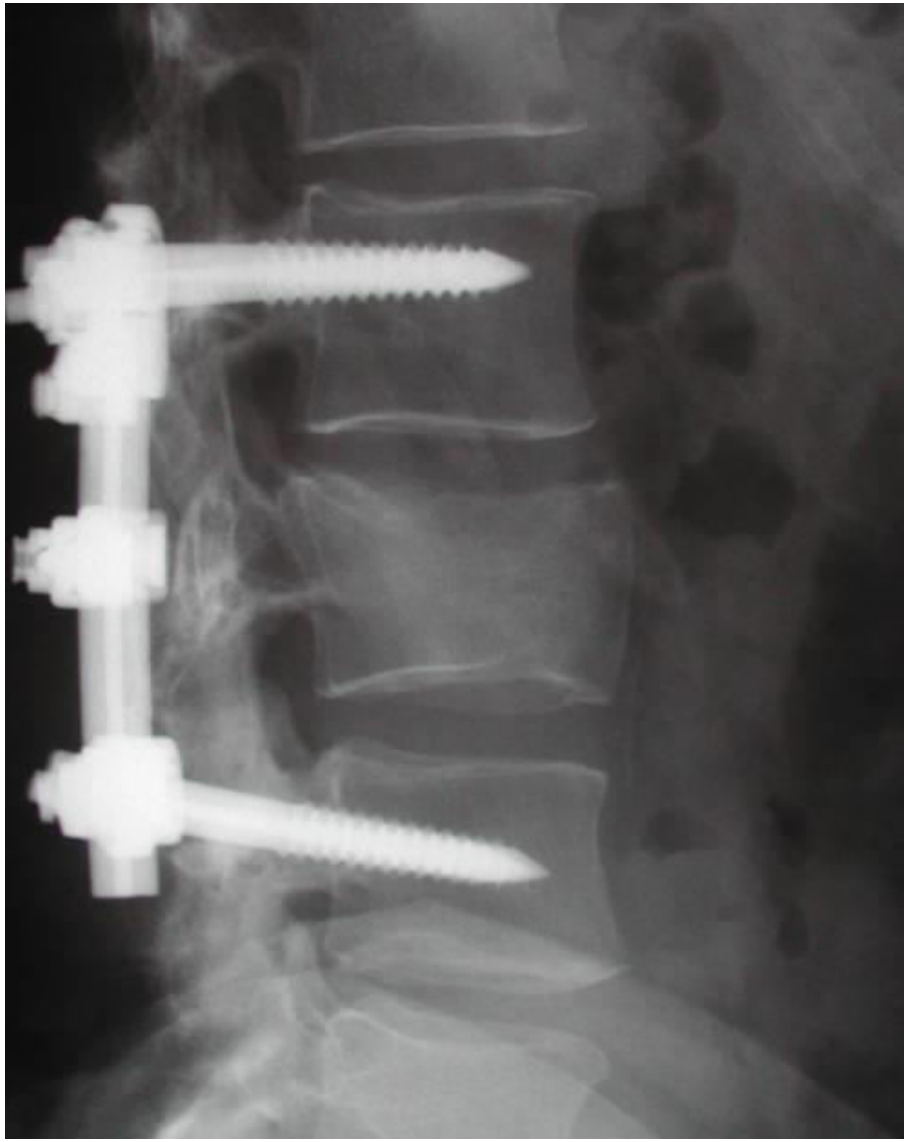
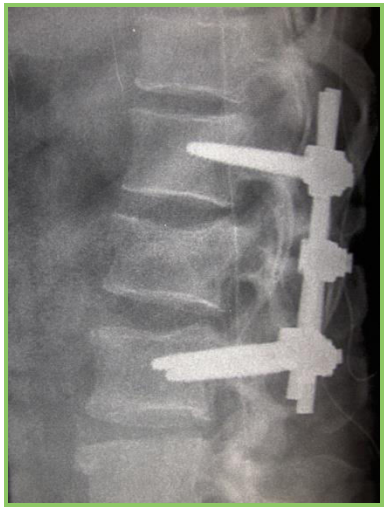




Clinical & functional outcome of posterior stabilization

P Lakshmanan, A Jones, J Mehta, S Ahuja, PR Davies, J Howes

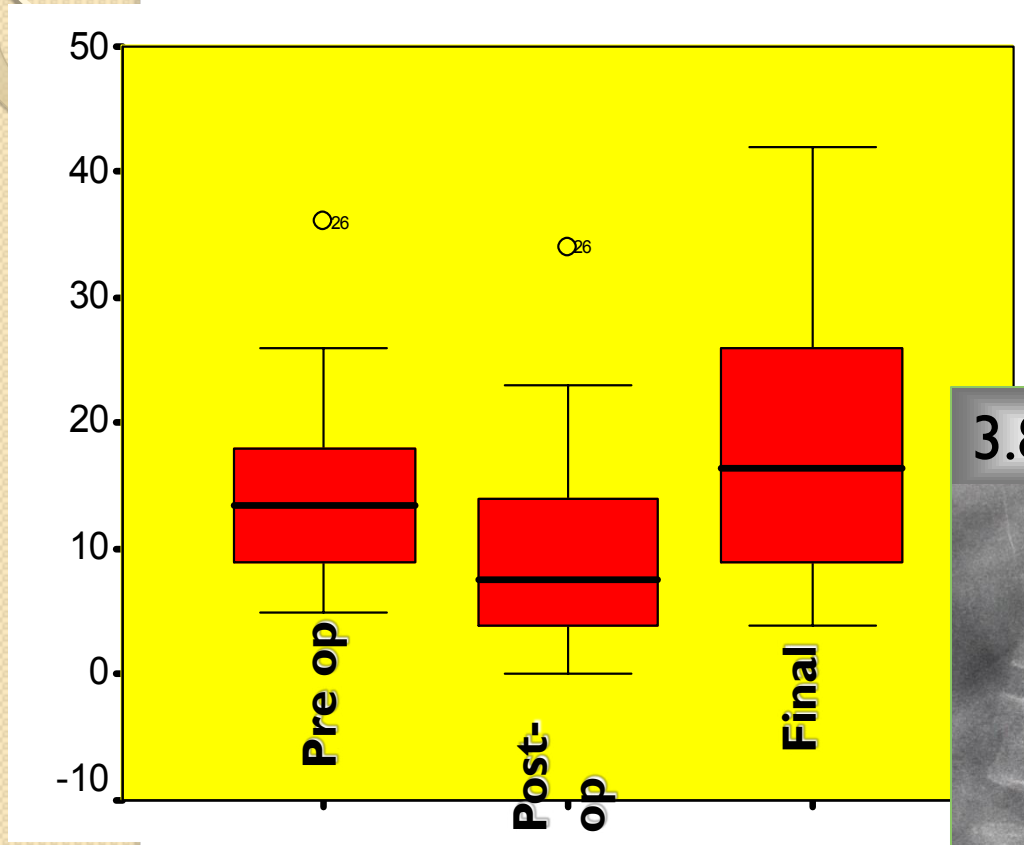
Cardiff Spinal Unit

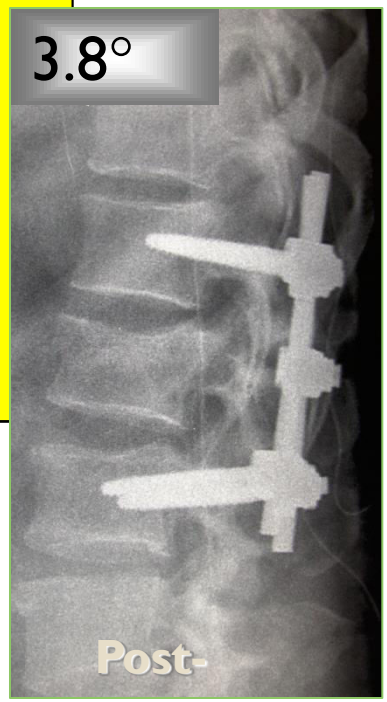
Clinical + functional outcome

- Jan 1998 – March 2003
- 34 patients
- Mean age 39.7 y
- Mean follow up 23.6 mo
- Short segment posterior (no fusion)

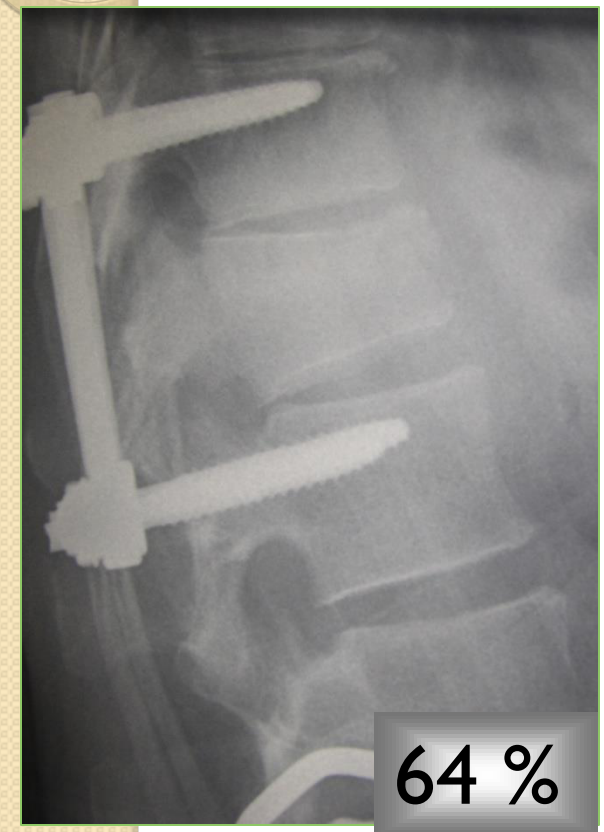
A3	26
B	5
C1	3

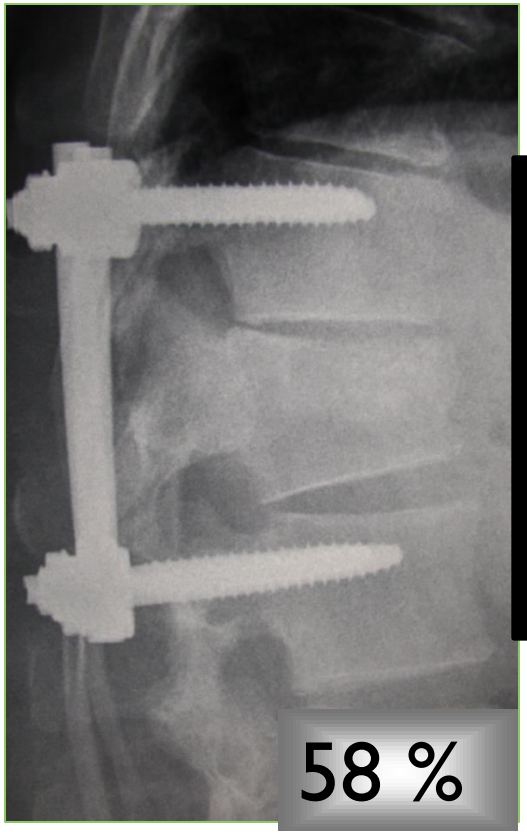
Decrease in kyphosis





Progressive deformity & loss of correction……..function good





Function Score (56.3%)

r = 0.12

Pain Score (49.7%)

r = 0.14

Goals of surgery

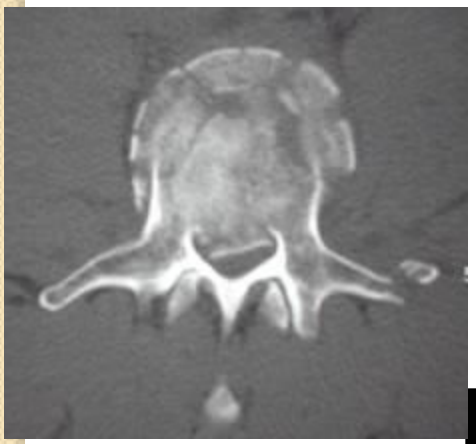
Neurology

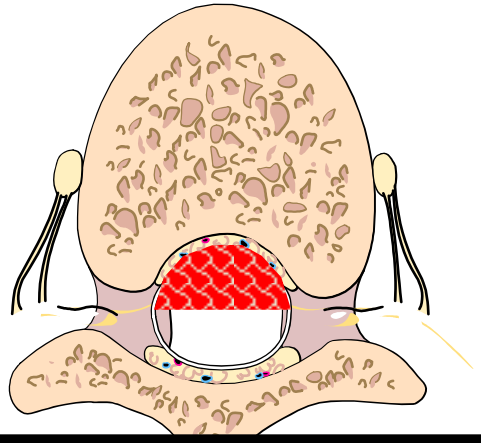
- Canal clearance
- Improve deficit

Biomechanics

- Correct kyphotic deformity
- stabilize anterior column

Canal encroachment





Surgical clearance or Remodelling

Remodelling of canal geometry

Fidler JBJS, 1988
Johnsson Acta Orth Scand, 1991
Mumford Spine, 1993
Yazici J Spinal Dis 1996
Dai Clin Orth, 2001
Weesberg ESJ, 2001

>65%
Possible neurology

Canal clearance

Posterior reduction

22 TL #

CT assessment of canal geometry

initial encroachment	38%
postoperatively	18%
at 1 year	2%

Sjostrom et al
(Eur Spine J 1988)

Neurological Deficit

Relationship to canal compromise

Level	Percentage canal compromise *
T11 / T12	> 35%
L1	> 45%
L2 – L5	> 55%

* associated with significant neurological deficit

Hashimoto et al (Spine 1988)

Anterior decompression + fusion

- 150 burst TL #
- 8 yr follow up
- Fusion 93 %
- Canal clearance: 47 % → 2 %

Neurology:

95 % improved by 1+ grade

72 % recovered completely

Kaneda et al JBJS Jan 1997

Neurological Deficit

Anterior vs Posterior surgery

Gertzbein, et al
(Spine 1988)

Esses, et al
(Spine 1990)

No difference in neurological outcome between anterior and posterior surgery

Korovessis, et al
(Eur Spine J 1994)

Hu, et al
(CORR 1993)

Surgery for deficits:
criteria

- Document the cord damage
- Incomplete lesions only
- Decompress early (6 – 8 hrs)
- Do not handle neural elements

Neurological Deficit

Does canal clearance help?

- Neural trauma occurs with the initial impact
- Imaging shows the 'resting' position of the fragments

- **Surgery for neurological deficit not justified**
- **Surgery should be for structural reasons only**
- **This information should not be withheld from patients**

Boerger, Dickson JBJS July 2000