Thoraco-lumbar fractures

Jwalant S. Mehta
FRCS (Orth), MCh (Orth), MS (Orth), D (Orth)
Consultant Spine Surgeon
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.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
End plate impaction

- End plate ‘hour glass’
- Minor wedging up to 5°
- Posterior wall intact
- Often in juvenile and osteoporotic spines
Wedge impaction fracture

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

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

- Extremely rare
- Accompanying lesion of type C
Coronal split fracture

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

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

- Complete body has burst
- Unstable
- Canal involved
- Neurology frequent
B1 or B2
**Anterior disruption through the disc**

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

Deformity

..........at presentation

..........progression
Radiographic assessment of deformity

Supine imaging

Erect imaging
Change in kyphosis (Cobb)

Change in Vx height loss (compression)

Mehta JS, Sanderson PL Spine 29 (5) Mar 2004
Mean change: 7° (range 0° - 36°)

\[ p = 0.0011 \]
\[ r = 0.756 \]
Vertebral compression

Anterior: \( p = 0.0002 \quad r = 0.59 \)

Posterior: \( p = 0.0001 \quad r = 0.53 \)
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
QMA software

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

0, 33, 89, 159 days
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 initial 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
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
- Apposition 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

- Little (<1/3)
- Gross (1/3-2/3)
- More (1/3-2/3)

- Little 1
- More 2
- Gross 3
Apposition of Fragments

Minimal 1
Spread 2
Wide 3

0-1 MM
<2MM <50%
>2MM >50%
Deformity Correction

**Little 1**
0-3 DEG

**More 2**
4-9 DEG

**Most 3**
10 DEG OR MORE
Load-Sharing Classification

- Describes (quantitates) bony injury
- Does not concern 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
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. +1-FRAG SPRD +3-KY CORRN = 6
DO IT FROM THE BACK
+1-FRAG SPRD
+3-KY CORRN
= 6
2 PTS - COMM
+2 PTS - FRAGS
+2 PTS - KY COR
6 POINT TOTAL

DO IT FROM THE BACK
NOT MUCH COMMNTN

6 POINT TOTAL

L1 BURST FX

CL 9/87
3-COMM.

DO IT FROM THE FRONT 8 POINTS
STRUT GRAFT TRANSFERS
BODY WEIGHT W IMPLANTS
TRANSLATION: All ligaments torn
ALL LIGHTS TORN
Translation defines a fx-dislocation. Must be operated ant AND posteriorly.
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
Spinal fixation modes:
Neutralization

Pedicle screw fixation:
- Multidirectional stability
- Short segment
‘Short segment posterior’

- Indirect reduction maneuver
- 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
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)

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<thead>
<tr>
<th></th>
<th>A3</th>
<th>B</th>
<th>C1</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>26</td>
<td>5</td>
<td>3</td>
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## Decrease in kyphosis

<table>
<thead>
<tr>
<th></th>
<th>Pre op</th>
<th>Post-op</th>
<th>Final</th>
</tr>
</thead>
<tbody>
<tr>
<td>Decrease in kyphosis</td>
<td>10.6°</td>
<td>3.8°</td>
<td>13.6°</td>
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</tbody>
</table>

- **Pre op**: Image showing kyphosis measurement before operation.
- **Post-op**: Image showing kyphosis measurement after operation.
- **Final**: Image showing kyphosis measurement at final follow-up.
Progressive deformity & loss of correction............function good

Function Score (56.3%)
  \[ r = 0.12 \]

Pain Score (49.7%)
  \[ r = 0.14 \]

64 % 58 %
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

<table>
<thead>
<tr>
<th>Level</th>
<th>Percentage canal compromise *</th>
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<tr>
<td>T11 / T12</td>
<td>&gt; 35%</td>
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<tr>
<td>L1</td>
<td>&gt; 45%</td>
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<tr>
<td>L2 – L5</td>
<td>&gt; 55%</td>
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* 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)


Hu, et al (CORR 1993)

No difference in neurological outcome between anterior and posterior surgery
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