Treatment decisions in thoracolumbar trauma: The Evolution of care for the Thoracolumbar Burst Fracture

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Stanford Univ.
Thoracolumbar Spine

- Compression fractures
- Stable burst fractures
- Unstable burst fractures
- Fx-dislocations
- Chance fractures
The Three Column Spine and Its Significance in the Classification of Acute Thoracolumbar Spinal Injuries

FRANCIS DENIS, MD, FRCS(C)

Spine, 1983

- Biomechanical in-vitro study
- L1 Burst Fractures
- Sequential sectioning of “columns”
- *Significant increase in motion across T12-L2 with ANTERIOR and POSTERIOR column compromise, but NOT when MIDDLE added*
Thoracolumbar Injury Classification System
A New Approach
Spine Trauma Study Group

Spine Trauma Study Group
Thoracolumbar Injury Severity Scale
Three Part Description

Injury Mechanism

Integrity of PLC

Neurologic Status
Point System

Injury Mechanism
Select one

Compression fx
- Axial, Flexion 1
- Lateral (scoliosis >15°) 1
- Burst - add 1

Distraction injury 4

Translation / Rotation 3

Translation / Rotation 3
Neurology-Point System

Cauda equina 3

Cord

Nerve root 1

Intact 0

And conus medullaris

Incomplete 3

Complete 2
Posterior Soft Tissue Point System

PLC (displaced in tension)

Evaluated by MRI, CT, Plain X-rays, Exam

Intact 0

Suspected/
Indeterminant 2

Injured 3
Next Step - Direct TX

Assign Points

Conservative  Surgery
Treatment

• Injuries with 3 points or less = non operative
• Injuries with 4 points = Nonop vs Op
• Injuries with 5 points or more = surgery
<table>
<thead>
<tr>
<th>Neuro Status</th>
<th>Posterior Lig.</th>
<th>Complex</th>
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<tbody>
<tr>
<td>Intact</td>
<td>Posterior**</td>
<td>Posterior</td>
</tr>
<tr>
<td>Root Injury</td>
<td>Posterior</td>
<td>Posterior</td>
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<tr>
<td>Incomplete SCI or CES</td>
<td>Anterior</td>
<td>Combined</td>
</tr>
<tr>
<td>Complete SCI Cauda</td>
<td>Posterior / *(Anterior)</td>
<td>Posterior / *(Combined)</td>
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* If felt necessary to optimize ANY potential, for neurologic recovery, restore CSF flow, allow short segment fixation  
** Anterior if preferred
<table>
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<tr>
<th>Morpholog</th>
<th>Neurology</th>
<th>PLC</th>
<th>Ant</th>
<th>Post</th>
<th>Combine</th>
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<tbody>
<tr>
<td>Intact</td>
<td>Intact</td>
<td>40%</td>
<td>60%</td>
<td></td>
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<td>Disrupt</td>
<td></td>
<td></td>
<td>92%</td>
<td></td>
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<tr>
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<td>Intact</td>
<td>92%</td>
<td>4%</td>
<td></td>
<td>4%</td>
</tr>
<tr>
<td>Incomplete</td>
<td>Disrupt</td>
<td>4%</td>
<td>14%</td>
<td></td>
<td>82%</td>
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<tr>
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<td>Intact</td>
<td>45%</td>
<td>55%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Complete</td>
<td>Disrupt</td>
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<tr>
<td>Distraction</td>
<td></td>
<td></td>
<td></td>
<td>100%</td>
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</table>
AOSpine Thoracolumbar Spine Injury Classification System

Fracture Description, Neurological Status, and Key Modifiers

Alexander R. Vaccaro, MD, PhD,* Cumhur Oner, MD, PhD,† Christopher K. Kepler, MD, MBA,* Marcel Dvorak, MD,‡ Klaus Schnake, MD,§ Carlo Bellabarba, MD,¶ Max Reinhold, MD,‖ Bizhan Aarabi, MD,** Frank Kandziora, MD, PhD,§ Jens Chapman, MD,†† Rajasekaran Shanmuganathan, MD, PhD,‡‡ Michael Fehlings, MD, PhD,§§ Luiz Vialle, MD, PhD,¶¶ and for the AOSpine Spinal Cord Injury & Trauma Knowledge Forum

Figure 1. The 3 basic types—Type A: Compression injuries. Failure of anterior structures under compression with intact tension band. Type B: Failure of the posterior or anterior tension band. Type C: Failure of all elements leading to dislocation or displacement.
AOSpine Thoracolumbar Spine Injury Classification Study

• Continued lack of a universally accepted classification system
• AO Magerl: Multitudes, poor reliability, absence of clinical decision making
• TLICS: Poorly reliable; creator bias
Figure 4. Subtype A1—Wedge Compression: Fracture of a single endplate without involvement of the posterior wall of the vertebral body. Vertebral canal is intact. Figure 4 demonstrates schematic drawing of this injury while Figure 4.2 available at Supplemental Digital Content http://links.lww.com/BRS/A814 shows a CT scan of a patient with this injury. CT indicates computed tomography.

- Subtype A1 injuries are wedge compression or impact fractures with fracture of a single endplate without involvement of the posterior wall of the vertebral body as demonstrated in Figure 4; Figure 4.2, Supplemental Digital Content available at http://links.lww.com/BRS/A814.
- Subtype A2 injuries are split- or pincher-type fractures of the lamina is usually present and does not indicate a tension band failure. Figure 7 demonstrates schematic drawing of this injury while Figure 7.2 available at Supplemental Digital Content http://links.lww.com/BRS/A817 shows a CT scan of a patient with this injury. CT indicates computed tomography.

Type B Injuries: Tension Band Injury
Type B injuries affect either anterior or posterior tension band. These injuries may be seen in combination with type A fractures of the vertebral body. They are further divided in 3 subgroups.

Figure 8. Subtype B1—Monosegmental bony posterior tension band injury: Transosseous failure of the posterior tension band. The classical

Figure 9. Subtype B2—Posterior tension band disruption: Bony and ligamentary failure of the posterior tension band together with a type A fracture. Type A fracture should be classified separately. This example should be classified as T12-L1 "type B2" with T12. "A4" according to
Operative v. Non-operative Treatment of Thoracolumbar Burst Fractures Without Neurologic Deficit: A Prospective, Randomized Study 16-22 year follow-up

JBJS-Am. 2015 Jan. (97-A); pg 3-8
Results
Pain

• Visual Analog Scale
  – Operative: Admiss. 6.3 (3-10)
    » 4 year Follow-up: 3.4 (0-7.5)
    » 15-20 year follow-up: 3.9
  – Non-Operative: Adm: 5.8 (0-10)
    » 4 year Follow-up: 2.3 (0-9)
    » 15-20 year follow-up: 1.7 (p=0.14)
## Results

### Rolland and Morris Back Disability

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<thead>
<tr>
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<th>Operative</th>
<th>Non-Operative</th>
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<tr>
<td>Adm</td>
<td>24.6</td>
<td>24</td>
</tr>
<tr>
<td>4 yr. F/U</td>
<td>16</td>
<td>20</td>
</tr>
<tr>
<td>17 yr. F/U</td>
<td>17 (6-25)</td>
<td>23.5 (16-25)</td>
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\[(p=0.003)\]
<table>
<thead>
<tr>
<th></th>
<th>Operative</th>
<th>Non-operative</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 yr. F/U</td>
<td>22.1</td>
<td>15.1</td>
</tr>
<tr>
<td>15-20 yr. F/U</td>
<td>17.2 (0-48)</td>
<td>4.9 (0-22) (p=0.032)</td>
</tr>
</tbody>
</table>

(0-20 = minimal disability
21-40 = moderate disability)
SF-36

- All indices favored the NON-operative group
- Social (p=0.02)
- Pain (p=0.01)
- General health (p=0.01)
Results

Return to work

- Operative:
  - 10/25 in < 6 mo (40%)
  - 2 in a6 – 12 mo
  - 40% (10) not working
  - 53% not working

- Non-operative
  - 16/23 in < 6 mo (70%)
  - 5/23 (22%) not working
  - 27% not working
Summary

• First study with 15-20 year follow-up
• No advantage to operative treatment of stable, neurologically intact thoraco-lumbar burst fractures
• Non-operative treatment may be significantly advantageous
Non-operative treatment

- Gummerson Surgery 2009
- Weinstein Spine 1988
- Aviles C, Medwave 2016
  - 14 systematic reviews and 25 RCTs
  - “Unclear if there are any differences”
  - Conservative treatment recommended
  - Less than 35° of kyphosis
Comparison of thoracolumbosacral orthosis and no orthosis for the treatment of thoracolumbar burst fractures: interim analysis of a multicenter randomized clinical equivalence trial

Clinical article

Christopher S. Bailey, M.D., M.Sc.(Surg), F.R.C.S.C.,¹
Marcel F. Dvorak, M.D., F.R.C.S.C.,² Kenneth C. Thomas, M.D., M.H.Sc., F.R.C.S.C.,³
Michael C. Boyd, M.D., F.R.C.S.C.,² Scott Paquette, M.D., F.R.C.S.C.,²
Brian K. Kwon, M.D., Ph.D., F.R.C.S.C.,² John France, M.D., F.R.C.S.C.,⁴
Kevin R. Gurr, M.D., F.R.C.S.C.,¹ Stewart I. Bailey, M.D., F.R.C.S.C.,¹
and Charles G. Fisher, M.D., M.H.Sc., F.R.C.S.C.²

- 69 patients randomized
- Non-brace wearers were encouraged to ambulate immediately maintaining “neutral” alignment for 2 mos.
- No difference at 1 year
- 4 failures requiring surgery: 3 from TLSO group
When IS surgery indicated for thoracolumbar burst fractures?

- Multi-trauma
- Obese?
- Senile?
- Injuries to the Posterior ligamentous complex
  - “Unstable Burst Fractures” MacAfee 1983
  - There remains NO level I or II data directly comparing operative v. non-operative
    - Sensitivity of MR
- Neurologic injuries
- The 10 – 25%??

- 10 pts. In three years with neurological compromise.
- Mean age 76.
- 90% present > 1 mo. after symptoms
- Symptoms themselves typically present LATE
The Load Sharing Classification of Spine Fractures

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

  - 34 pts. With AO Type A fractures
  - All functional outcomes better with operative treatment at 4.3 yr

  - 30 pts. Compared at 2 years for direct and indirect costs
  - Total cost TWICE as much per patient when treated non-operatively

- Shen *Orthop Surg.* 2011
68 neurologically intact burst fractures of T-L junction (T11-L2)
All with TLICs score of 2
18/68 (25%) failed mobilization and went on to surgery
More kyphotic (8° v. 1°)
More stenotic (48% v. 37%)
LSC score (McCormack Spine 1994) (7 v. 6)
Retrospective study of 129 Pts. With TL burst fractures (TLICS < 4) (Mean f/u 36 +/- 11 mo.)
80% successful NON-operative
20% NOT successful: Converted to surgery
RISK factors:
    VAS on admission: 6.5 v. 3.6
    Age and kyphosis NOT a predictor
Decision-Making Process in Patients with Thoracolumbar and Lumbar Burst Fractures with Thoracolumbar Injury Severity and Classification Score Less than Four

Shirzad Azhari, Parisa Azimi, Sohrab Shahzadi, Hassan Reza Mohammadi, Hamid Reza Khayat Kashani

Department of Neurosurgery, Shahid Beheshti University of Medical Sciences, Tehran, Iran

- PROSPECTIVE study
- Non-operative treatment with bed rest and bracing
- Surgery for “intractable pain”
- 90% successful (30% improvement in ODI)
- RISK predictors:
  - AGE (51 v. 33)
  - Canal involvement (51% v. 33%)
Conservative Treatment of Thoracolumbar Burst Fractures
A Long-term Follow-up Results With Special Reference to the Load Sharing Classification

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

- 137 thoracolumbar burst fractures
- 22 pts. with neurologic deficit
- Loss of kyphosis correction significantly correlated with load sharing score
- Loss of correction positively correlated with severity of pain ($p=0.04$, $r = 0.194$)
Clinical Study

Clinical and radiological results 6 years after treatment of traumatic thoracolumbar burst fractures with pedicle screw instrumentation and balloon assisted endplate reduction

Jorrit-Jan Verlaan, MD, PhD\textsuperscript{a,*}, Inne Somers, MD\textsuperscript{b}, Wouter J.A. Dhert, MD, PhD\textsuperscript{a}, F. Cumhur Oner, MD, PhD\textsuperscript{a}

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Less Invasive?

- 20 patients
  - Earlier it was *Vertebroplasty* but had five cement leakages!
- Remove pedicle screws after one year
- Average kyphosis 5.6°

Minimally invasive pedicle screw fixation combined with percutaneous vertebroplasty for the treatment of thoracolumbar burst fracture

Chunbo Li, M.D., Jianfeng Pan, M.D., Yutong Gu, M.D., Ph.D., Jian Dong, M.D., Ph.D.

37 pts.
Kyphosis corrected from 22 → 5 degrees
VAS 1 at final (2 year) follow-up
Future?

OP

Something in between?

Non-OP
Thank You