Minor Trauma, New MRI Changes and Serious Low Back Illness?

Eugene J. Carragee, MD
Professor, Department of Orthopaedic Surgery
Stanford University School of Medicine
What Causes Serious Low Back Pain Illness and Disability?

500 BC
Rheumatic Back Pain

1900's
Traumatic Back Pain
Definite Causes of LBP: Serious Disease (Fracture, Tumor, Infection, etc)
Possible Causes:

- Specific structural lesion
  - Disc, anulus
  - Facet
  - Endplate
- Social context (compensation, etc)
- Neurophysiologic Abn (Central pain/sensitivitivy)
- Psychological / Emotional Reserves
- Minor Trauma
- Combinations
Most frequently implicated:

Minor trauma and pre-existing DDD
Minor Trauma and DDD

• Questions???
  – Does minor trauma cause specific injury to degenerated discs (anular tear?)
  – Do persons with DDD + minor trauma have a greater risk of serious LBP illness than without minor trauma? (Is a LBP event going to happen anyway…regardless of trauma)

• No study has prospectively looked at minor trauma events in subjects with documented MRI DDD without serious LBP.
Stanford LBP Cohort Study

**Objective**
- To assess whether the occurrence of common minor trauma events affects the risk of developing serious LBP and LBP disability
- in subjects with and without degenerative changes to the lumbar spine.

**Primary Hypothesis**
- Minor trauma is an independent risk factor of subsequent disabling LBP episodes among persons without LBP histories but with known risk factors for degenerative disc disease.

**Secondary Hypothesis**
- In the presence of minor trauma, the effects of psychological and structural factors are not independent risk factors of subsequent disabling LBP.
Study Design and Population

• **Study Design**
  – Five-year prospective cohort study with assessments by blinded research assistant every six months.

• **Study Population**
  – *Working* subjects with known risk factors for degenerative lumbar disc disease but without histories of clinically important LBP episodes.

• **Sampling**
  – Stratification ratio of 1:1 with and without chronic non-lumbar pain on a consecutive case basis.
Eligibility Criteria

• **Inclusion Criteria**
  – History of cervical disc disease
  – No history of LBP resulting in functional loss, work-loss days, or medical treatment
  – <2/10 on Numeric Rating Scale for LBP (x 2 over 6 mo.)
  – <16 on Modified Oswestry Low Back Disability Index

• **Exclusion Criteria**
  – Serious structural spinal abnormalities (spondy, fx, tumor)
  – Inability to undergo MRI scanning
  – Working less than 20 hours per week
Measurement Tools

- Modified Oswestry Low Back Disability Index
- 0 to 10 Numeric Rating Scale for LBP
- Structured history and physical examination
- Plain radiographs*
- Lumbar spine MRI*
- Modified Zung Depression Scale*
- Modified Somatic Pain Questionnaire*
- Distress and Risk Assessment Method

*Graded by examiners blinded to history and examination findings.
Follow-up Assessments

• Scripted telephone interview every 6 months conducted by research assistant blinded to patient baseline data:
  – **Question:** “Have you had any sort of injury to your low back in the last six months including episodes such as ‘injuries’ occurring during sports, lifting, bending, twisting, or slipping or minor falls?”
  – Algorithm of further questions
  – Standardized questionnaires (ODI, VAS, work hx, etc)
Scripted follow-on questions Q 6 months

If positive for minor LBP trauma:

– Fall
  • Standing to ground
  • <1 meter -> ground
  • <2 meter -> ground
  • >2 meter

– MVA
  • < 10 mph
  • 10-20 mph
  • etc

– Sports Injury / Collision

– Lifting/twisting injury (weight involved)

– Other
Definitions of Trauma

• Back Pain after Major Trauma
  – LBP episodes associated with high-energy trauma resulting in serious visceral injury, proximal long bone, pelvic or spinal fracture or dislocation.

• Back Pain after Minor Trauma
  – Perceived injury to the low-back area with a pain intensity >2/10 for at least 48 hours but not meeting the major trauma definition.
  – Includes injuries occurring during lifting, sports, road traffic accidents, or slipping or minor falls.

• Back Pain with No Trauma
  – Activities of daily living, or insidious or spontaneous LBP
Outcomes Measures

• **Primary outcomes**
  – “Serious back pain episodes” with a 0-10 NRS pain intensity >5 for at least one week
  – Disability from usual occupation due to LBP troubles

• **Secondary outcomes**
  – Disability duration of 1 month or less
  – Disability duration greater than 1 month
  – Medical visits primarily for LBP evaluation and treatment, and surgical intervention
  – MRI changes in subjects with serious LBP events or disability when required in the course of medical assessment
**Statistical Methods**

- **Descriptive statistics**
- **Incidence of LBP events according to trauma status:**
  - No trauma
  - Minor trauma
  - Major trauma
- **Logistic regression used to estimate effects of:**
  - Minor trauma vs. no minor trauma on adverse LBP events
  - Possible clinical/structural predictors of adverse LBP events
- **Variables in initial prediction models:**
  - Trauma status, age, sex, chronic non-LB pain, previous compensation dispute, smoking status, psychological distress, disc degeneration grade, and presence of anular disruption, canal stenosis and end-plate changes
  - Selected variables combined to estimate joint effects
Results
## Baseline Characteristics

<table>
<thead>
<tr>
<th></th>
<th>All subjects</th>
<th>Chronic Non-lumbar Pain</th>
<th>No Pain</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number</td>
<td>200</td>
<td>100</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>39.4</td>
<td>38.2</td>
<td>40.8</td>
<td>0.34</td>
</tr>
<tr>
<td>Sex (% male)</td>
<td>59.5%</td>
<td>62</td>
<td>57</td>
<td>0.45</td>
</tr>
<tr>
<td>Baseline ODI</td>
<td>5.5</td>
<td>5.9</td>
<td>5.0</td>
<td>0.10</td>
</tr>
<tr>
<td>Normal DRAM</td>
<td>100</td>
<td>29</td>
<td>71</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Previous Disputed</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Compensation Claim</td>
<td>23</td>
<td>21</td>
<td>2</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Smoking</td>
<td>27.5%</td>
<td>44</td>
<td>11</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Heavy Work</td>
<td>28.0%</td>
<td>25</td>
<td>31</td>
<td>0.34</td>
</tr>
<tr>
<td>DDD Gr 3-5</td>
<td>76.5%</td>
<td>72</td>
<td>81</td>
<td>0.13</td>
</tr>
<tr>
<td>Anular Fissure (HIZ)</td>
<td>14.5%</td>
<td>19</td>
<td>20</td>
<td>0.86</td>
</tr>
<tr>
<td>Endplate Changes</td>
<td>21.5%</td>
<td>18</td>
<td>25</td>
<td>0.23</td>
</tr>
<tr>
<td>(mod-severe)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spinal Stenosis</td>
<td>13%</td>
<td>11</td>
<td>15</td>
<td>0.40</td>
</tr>
<tr>
<td>(mod-sev)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Incidence of Serious LBP Events

• Frequency of serious LBP events with preceding minor trauma
  – Total = 118

• Frequencies of serious LBP events without any trauma
  – Total = 228
  – Not associated with anything: 126
  – Associated with routine ADLs: 102
6 month-Incidence/Risk of Serious LBP Events

- Serious LBP event
  - Minor Trauma
  - No trauma

- Disability Risk/LBP event
  - Minor Trauma
  - No trauma
Minor Trauma Events with some LBP: 652 events per 1000 person-years

Number of “minor trauma” events with LBP/ persons during 5 year study
Does # of Minor Trauma events increase LBP events (dose-response effect)

![Chart showing the relationship between number of minor trauma events and LBP events.

Legend:
- **Serious LBP event**
- **Medical care for LBP**
- **Disability**

Number of “minor trauma” events with LBP/ persons during 5 year study

- **0**
- **1**
- **2**
- **3**
- **4**
- **>4**
Types of Trauma Associated with LBP
Lifting “Injuries” and LBP Episodes

Table 4: Frequency distribution of lifting events associated with LBP episodes.

<table>
<thead>
<tr>
<th>Weight involved (pounds)</th>
<th>Any LBP episode* after lifting</th>
<th>Serious LBP episode** after lifting</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total (%)</td>
<td>Occupation/PI</td>
</tr>
<tr>
<td>&lt; 30</td>
<td>33 (16.8)</td>
<td>20</td>
</tr>
<tr>
<td>30- &lt;60</td>
<td>28 (14.3)</td>
<td>10</td>
</tr>
<tr>
<td>60- &lt;90</td>
<td>76 (38.8)</td>
<td>7</td>
</tr>
<tr>
<td>≥ 90</td>
<td>59 (30.1)</td>
<td>2</td>
</tr>
</tbody>
</table>

* LBP > 2/10 intensity x 48° after the event.

** LBP > 6/10 intensity x 1 week after event.
Effects of Baseline MRI on Subsequent LBP

- DDD (3-5)
- HIZ/Anular fissue
- Disc Protrusion
- Modic Endplate (mod/sev)
- Canal Stenosis (mod/sev)

Legend:
- Minor Trauma
- No Trauma
Prediction Model: Full Cohort

Serious LBP event outcome*

• Joint effect of smoking and psychological distress:
  – Odds Ratio = 3.97, 95% CI = 2.19 – 7.22 (\( p < 0.004 \))
  – Correctly identified 72/118 (61%) serious LBP events

• Joint effect of smoking, psychological distress, and history of disputed compensation claim:
  – Odds Ratio = 10.6, 95% CI = 6.6 – 12.8 (\( p < 0.0001 \))
  – Correctly identified 94/118 (80%) serious LBP events

Disability outcome*

• Joint effect of psychological distress and history of disputed compensation claim:
  – Odds Ratio = 8.34, 95% CI = 4.31 – 16.16 (\( p < 0.0001 \))
  – Correctly identified 41/44 (93%) disability events

*All estimates adjusted for age, sex, and chronic non-lumbar pain status; minor trauma did not contribute to the models.
**Prediction Model: Wellness Effect**

**Serious LBP event after minor trauma***
- Joint effect of no psychological distress and no history of disputed compensation claim:
  - Odds Ratio = 0.26, 95% CI = 0.06 – 0.49 ($p = 0.02$)

**Serious LBP event without any trauma***
- Joint effect of no psychological distress and no history of disputed compensation claim:
  - Odds Ratio = 0.30, 95% CI = 0.10 – 0.90 ($p = 0.04$)

**Disability after minor trauma***
- Joint effect of no psychological distress and no history of disputed compensation claim:
  - Odds Ratio = 0.014, 95% CI = 0.04 – 0.97 ($p = 0.05$)

*All estimates adjusted for age and sex.*
Prediction Model: Spinal Arthritis Effect
No Baseline Comorbid Pain, No Psychological Distress, No Disputed Compensation Claim

Serious LBP event*

- Joint effect of moderate to severe end-plate changes and canal stenosis:
  - Odds Ratio = 2.88, 95% CI = 1.06 – 5.67 ($p = 0.04$)

*Estimate adjusted for age and sex.
New MR Performed for LBP

• 51 subjects (67 scans) over 5 years
• New MR more common if baseline:
  – Abnormal psychometrics (DRAM)
    • OR 2.27, (95% CI 1.15 - 4.49)
  – Non-lumbar chronic pain
    • OR 3.19, (95% CI 1.61 - 6.32)
  – Hx disputed comp claim
    • OR 2.35 (95% CI 0.97 - 6.69)
• Multiple MR seen mainly with Compensation Cases
  – 15 of 16 subjects with 2 new MR’s
• Mean 2.2 years (+/- 0.82) after baseline
• Reason for exam
  – 3 primary leg pain; 21 mixed leg/back; 43 primary LBP
Results - Baseline vs New

Total--
2 new annular fissures
3 new disc protr/ext
2 new endplate changes
Were new findings more common after reported “injury” compared to spontaneous LBP episodes?
Clearly Significant Findings in Two Subjects

• BOTH presented with primary leg pain
  – 1 -- Large Disc Extrusion, with root compression, no trauma, no comp issues
  – 1 -- new Gr I spondy, increased stenosis and root compression, no trauma, no comp issues.

• Conversely:
  – Presence of a compensation claim correlated with an absence of new findings. (OR 0.6)
New MRI Finds

• Findings very similar to others (Borenstein, Boos and Jarvik) when MR done at fixed intervals.
  – Repeat MRI after LBP episode is similar to random MR testing.

• HOWEVER in clinical practice, many of the baseline findings would very likely be attributed to an acute event.

• In fact chance of any finding being new or progressive was very low.
  – Anular fissure (1:12)
  – Disc Protrusion / Extrusion (1:15)
  – DDD Grade 3-5 (1:9)
  – Endplate Signal Changes (1:12)
Discussion

- Minor trauma is very common
  - .7 minor trauma w/ LBP events per person per year
- Minor trauma has no independent association with progression to serious LBP or disability
- Baseline psychosocial variables are strongly predictive of subsequent serious LBP and disability
- Structural variables (MRI and discography) have:
  - weak association with subsequent back pain episodes
  - no association with disability or future medical care
Conclusion

• Among persons with known risk factors for degenerative lumbar disc disease but with no history of serious LBP, minor trauma does not appear to increase the risk of serious low-back pain episodes or disability.

• The vast majority of serious LBP events may be predicted small set of demographic and behavioral variables (abnormal baseline psychological screening, smoking, chronic pain, prior compensation claims).

• Data do not support the hypothesis that minor trauma, as commonly reported, is an important cause of serious LBP illness.
Conclusion

• Data do not support concept that acute, serious LBP events are associated with demonstrable new MR findings.

• Most new findings are primarily age-related (DDD, facet arthrosis)

• **FOR acute LBP**: MR findings within 12 weeks of events are highly unlikely to represent new structural changes to the spine…need to carefully consider treatment directed at these findings.

• **Primary radicular syndromes** are more likely to have new findings of root compression.
Thank You!