Indications for Rib Fracture Fixation

Historical Perspective

Disclosures

- Physicians have published on rib fracture fixation for over 100 years

- Over the last few years, the benefits of surgical stabilization have been reported in several small case series

  (Althausen, Paris, Ahmed, Tanaka, Lardinois, Reber, Mouton)

- These reports suggest that ORIF shortens the duration of intubation, improves pulmonary function testing, restores chest wall continuity and allows patients to return to work.

  (Tanaka, Lardinois, Mouton)

The following relationship(s) exist:
6) Stock or stock options in a company

- Peter L. Althausen, MD, MBA

- 6: The Orthopedic Implant Company (OIC)
Historical Perspective

- The indications have never been very clear cut
- Over past 3 years, several authors have attempted to define this more scientifically
- Indications range from absolute to relative
- Certainly easy to see why some might think it a “lunatic fringe”
- However, for those who perform this more regularly, indications seem to be expanding

Our Indications

- Non-intubated patients with respiratory failure despite continuous epidural anesthesia
- Intubated patients with flail chest who failed to wean from the ventilator
- Patients with extensive antero-lateral flail chest and progressive displacement of fractured ribs
- Patients who required a thoracotomy due to associated intra-thoracic injury
- Revision of mal-positioned hardware
- Painful Nonunion

True Flail Chest

- The definition of flail chest varies from study to study
- We define flail chest as fractures of 4 or more ribs fractured at more than 2 sites.
- Paradoxical motion of chest wall observed
Our Results

<table>
<thead>
<tr>
<th></th>
<th>Operative Patients (Mean)</th>
<th>Non-Operative Patients (Mean)</th>
<th>P-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>ICU LOS</td>
<td>7.6(7.43)</td>
<td>9.7(9.38)</td>
<td>0.018</td>
</tr>
<tr>
<td>Hospital LOS</td>
<td>11.9(7.79)</td>
<td>19.0(12.64)</td>
<td>0.006</td>
</tr>
<tr>
<td>Days on Vent</td>
<td>4.4(6.66)</td>
<td>7.6(9.38)</td>
<td>0.007</td>
</tr>
<tr>
<td>Tracheostomy</td>
<td>3.6%(3/22)</td>
<td>9.3%(11/128)</td>
<td>0.042</td>
</tr>
<tr>
<td>Pneumonia</td>
<td>4.6%(1/22)</td>
<td>25%(7/28)</td>
<td>0.047</td>
</tr>
<tr>
<td>Re-intubation</td>
<td>4.6%(1/22)</td>
<td>7.6%(5/28)</td>
<td>0.034</td>
</tr>
<tr>
<td>Home O2</td>
<td>4.6%(1/22)</td>
<td>7.9%(5/28)</td>
<td>0.034</td>
</tr>
</tbody>
</table>

Patients treated with ORIF had better outcomes across all variables.

Effect of Early Operative Intervention

<table>
<thead>
<tr>
<th></th>
<th>Pearson Coefficient</th>
<th>P-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>ICU LOS</td>
<td>0.485</td>
<td>0.029</td>
</tr>
<tr>
<td>Days on Vent</td>
<td>0.477</td>
<td>0.033</td>
</tr>
<tr>
<td>Hospital LOS</td>
<td>0.485</td>
<td>0.031</td>
</tr>
</tbody>
</table>

- Regression analysis in our series did show a positive correlation between time to operation and Hospital LOS, days on ventilator, and ICU LOS
- These were all statistically significant findings, suggesting that patients should receive operative intervention as soon as they can be cleared for surgery.

Reduction of Pain and Disability

- Multiple painful rib fractures
- Failure of narcotics or injections
- Fracture movement causing significant discomfort
Severe Displacement

- Ribs impeding lung expansion
- Marked loss of thoracic volume

Intra-thoracic Injury

- Cases where thoracotomy performed to address injury
- Rib perforation of vital structures

Lung Herniation

- 27 year old female
- Assaulted with chair
- 8th and 9th rib fractures
- Extruded Lung
- Treated with ORIF
- Home POD 2
Nonunion

- Multiple studies exist showing benefit for painful rib nonunion (Anavian, JOT 2009, Cho, JOT 2009, Gardenbroek, JBJS 2009)
- Diagnose with CT scan
- Correlates with pain on physical exam
- Can use rib block to confirm diagnosis
- Treat with standard compression technique.
- No bone grafting or BMPs required

Case Study

32 y/o with painful rib nonunion for 2 years
Confirmed by CT
Treated with ORIF
Immediate relief with surgery
Pain free at 6 weeks

Revision Surgery

- Never be surprised by fixation methods you will see
- If standard orthopaedic principles were ignored, revision is often indicated
- Bone will not heal if incorrect fixation is utilized
Conclusions

- Absolute indications for rib fixation are still unclear
- The role for ORIF does appear to be expanding
- Preliminary studies have shown that when compared to non-operative cohorts, patients with flail chest treated with ORIF had
  - Shorter ICU stays
  - Decreased ventilator requirements
  - Shorter hospital LOS
  - Fewer tracheostomies
  - Less pneumonia
  - Less need for re-intubation
  - Decreased home oxygen requirements
  - Decreased overall cost
- Appears to be an advantage to early fixation
- Prospective randomized controlled studies are needed