Thoracolumbar Trauma: Minimally Invasive Techniques

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Disclosures

• Research Support:
  – Biomet, NuVasive, Stryker

Advantages of MISS

• Smaller incisions/minimal soft tissue disruption
  – Improved healing and decreased infection risk

• Less blood loss
Advantages of MISS

- Ability to perform surgery in “Silver day”
- Patient upright within 24 hrs from injury (decreased risk of ARDS, head injury)
  - mobilize the patient

Disadvantages of MISS

- Learning Curve
- Accuracy
- Long term outcomes (pain, etc)
  - Need for hardware removal ???
- T-L reductions difficult

Thoracolumbar Trauma: Minimally Invasive Techniques

Posterior Techniques

- Percutaneous posterior segmental fixation
  - Temporizing Measure
  - Definitive Care

- Anterior
  - Balloon-assisted reduction
  - Endoscopic assisted approaches
  - Mini Open Anterior Approach
New Strategy for T-L Trauma

Temporizing Measure

- Polytrauma patient with spine fracture
  - Too sick ….

Damage Control

- “maintaining a ship’s functions while it has taken on damage”
- Trauma/General surgery
  - to quickly stop bleeding and surgically resuscitate a patient

Damage Control Spine Surgery

- Trauma patients are often too sick for the “BIG” spine procedure
- Percutaneous posterior spinal fixation

Damage Control Spine Surgery

- Retrospective review of 10 patients with > 24 month f/u
- MISS within 48 hrs
- No revision surgery except planned hardware removal
- Blood loss avg 177 ml
- Surgery time 95 min

Poelstra et al, 2009 AAOS Annual Meeting, Las Vegas, NV
OTA 2010

- Minimally Invasive Surgery (MIS) Reduction and Stabilization with Percutaneous Pedicle Screw and Rod Fixation without Arthrodesis for Unstable Spinal Fractures: Early Experience and Results
  Sean Owen, MD; Dirk Alander, MD; St. Louis University Hospital, St. Louis, Missouri, USA

- Percutaneous Posterior Instrumentation after Unstable Thoracolumbar Fractures: Prospective Analysis of Two Systems
  Oliver Gonschorek, MD; Stefan Hauck, MD; Thomas Weilk, MD; Volker Bühren, MD; Department of Spine Surgery, BGU Murnau, Murnau, Germany

- Spine Damage Control: A Safe and Effective Treatment Modality for Unstable Spine Fractures in Multiply Injured Patients
  Philip F. Stahel, MD; Michael A. Flierl, MD; Ernest E. Moore, MD; Kathryn M. Beauchamp, MD; Denver Health Medical Center, Denver, Colorado, USA

SFGH Data

- Oct 2008 -
  - 24 patients (age, 17-80)
  - Average level of instrumentation
    - 3.8 (2-10)
  - Mean OR Time: 173 min (66-360)
  - Mean EBL: 180cc (50-500)
  - Complication:
    - Superficial infection (1), DVT (1), PE (1)

Case Example

X-ray
Indirect Reduction

28 y/o male s/p 3 story fall
New Strategy for T-L Trauma

Definitive Fixation

- Isolated unstable spine fracture
  - Is there a less invasive technique ....

52 y/o female s/p 2 story fall sustaining an unstable T10 fracture, rib fractures and SAH
Screw and Rod Placement

Percutaneous Pedicle Screw Instrumentation for Temporary Internal Bracing of Nondisplaced Bony Chance Fractures

- 2 cases
- L2 and L4 (neuro intact)
- Short-segment pedicle screw construct for Chance fractures

*J Spinal Disorders and Techniques, May 2007*
Technique

Accuracy & Reduction

SFGH Data

- Patients who had percutaneous instrumentation and postoperative CT scan

- Accuracy evaluated by a neuro-radiologist, ortho spine and neuro spine surgeon
Accuracy with C-Arm

Criteria developed by Gertzbein et al.

- A: lateral pedicle wall penetration
- B: superior or inferior pedicle wall penetration
- C: medially pedicle wall penetration
- D: anterolateral vertebral body penetration

Quantitative grade:

1: >0 and _2 mm
2: >2 and _4 mm
3: >4 mm
4: >4 mm without pedicle or vertebral body contact

- Sixteen patients
- 102 screws

Accuracy with C-Arm

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<th>Ortho-Spine</th>
<th>Neuro-Spine</th>
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<tr>
<td>Lateral Breach</td>
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<td>Sup-Inf Breach</td>
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<tr>
<td>Medial Breach</td>
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<tr>
<td>Anterior Breach</td>
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<td>4.9</td>
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</table>

Anterior Approach

- Sixty-two patients
  - General satisfaction (82%)
  - Postoperative pain (32.3%),
  - Bulging (43.5%),
  - Functional disturbance (24.2%)
Anterior Techniques

- Balloon assisted reduction
- Endoscopic assisted approaches
- Mini Open Anterior Approach

Balloon Assisted Reduction and Augmentation with Calcium Phosphate Cement

- Preservation of motion segments (short segment posterior fusion)
- Avoids morbidity of anterior approach
- Less blood loss
- Lower infection rate
- Less pain / improved recovery time

Balloon Assisted Reduction and Augmentation with Calcium Phosphate Cement

Technique: Open or Percutaneous +/- Posterior Fixation

- 28 patients
- A3 burst injury / 13 with incomplete deficit
- Balloon assisted reduction with Norian Ca Phosphate cement
- 22 (79 %) laminectomy
- Operative time 116 min (80-165)
- Blood loss 316 (50-1200)

Short segment fixation with cement augmentation of burst fractures

Thoracolumbar Burst Fractures Treated with Posterior Decompression and Pedicle Screw Instrumentation Supplemented with Balloon-Assisted Vertebroplasty and Calcium Phosphate Reconstruction

JBJS 2009
• 80yo F s/p syncopal fall with back pain December 28, 2009
• PMH: HTN, hyperlipidemia, asthma
• Physical Exam:
  5/5 strength in BUE, BLE, intact rectal tone
1 year Follow up

Thoracoscopic-assisted treatment of thoracic and lumbar fractures
- 373 pts (T3-L3)
- Supplemental posterior instrumentation – 65%
- Complication rate – 1.3%
- Steep learning curve

Thoracoscopic transdiaphragmatic approach to thoracolumbar junction fractures
- 212 patients
- Supplemental posterior fixation – 64.6%
- Complication rate – 11.7%
- Conversion to open – 1.4%


MISS Techniques for Anterior Column Reconstruction

Mini Open Technique (XLIF)
Advantages of MOA

- Reduced pain
- Better cosmesis
- Excellent direct visualization
- No approach surgeon

46 y/o F with L1 burst

Positioning
SFGH Data

- May 2009 –
- 10 patients, mean age: 42 (24 – 68)
- Fracture mechanism:
  - High energy, 8
  - Pathologic, 2
- Level:
  - L1

SFGH Data

- Incision: 6.6 cm (5-8cm)
- OR Time: 265 minutes (205-451)
- EBL: 1447cc (300-3000)

SFGH Data

- Hospital stay: 7.5 days (2-12 days)
- Chest tube: 4 patients
- Complications:
  - Cage subsidence: 1
  - PE: 1
  - Superficial wound dehiscence: 1
56 y/o female, fall from 3rd floor

Methods

Intact Endplate  Defective Endplate

Novel Cage Design
A new distractable implant for vertebral body replacement: biomechanical testing of four implants for the thoracolumbar spine

<table>
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<th>X-Tenz</th>
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<th>Synex-I</th>
<th>Synex-II</th>
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<tr>
<td>Ultimate load to failure (N)</td>
<td>1470 ±</td>
<td>1310 ±</td>
<td>1650 ±</td>
<td>1790 ±</td>
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<table>
<thead>
<tr>
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<th>X-Core Circular</th>
<th>X-Core + defect</th>
<th>X-Core no defect</th>
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<tbody>
<tr>
<td>Ultimate load to failure (N)</td>
<td>1260 ± 446</td>
<td>1690 ± 471</td>
<td>2620 ±</td>
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26 y/o male who sustained an L2 burst fracture following an MVA
Which fractures?

- Unstable burst fracture
- Multi-level injuries
- Bony chance
- Fracture-Dislocation