Surgical Management of Acute Spine Injuries
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Epidemiology of Spine Trauma

• **Age Dependent**
  – 0-toddler
  – Toddler-8 years
  – 8 years to adult

• **Location dependent**
  – Cervical spine (Upper versus lower)
  – Thoracic spine
  – Lumbar spine

• **Mechanism dependent**
  – Abuse, MVC, sports
Epidemiology

• Younger children have a larger head to body ration predisposing to upper cervical injuries
• MVC most common mechanism
• Mortality up to 18%
• Adolescent and young adults sustain sports related injuries (27%)
• 20% with neurologic deficit
• Lumbar injuries almost exclusively adolescents
Operative Treatment

• Associated with higher Injury Severity Score
• Associated with injuries with concominant spinal cord injury
• Associated with other spine injuries
• Associated with higher energy mechanisms
Preoperative Imaging Studies

• Plain Films
  – Remain the initial imaging study of choice
  – Cervical spine films required in all trauma patients
  – Gain information about fracture, ligamentous integrity, and alignment
  – Normal variants in children which can be mistaken for injury
Computed Tomography (CT)

- Excellent bony detail
- Required in all operative cases
  - Instrumentation planning
- Radiation risk, Cost.
- Screening tool?
  - Awake and alert: not needed if pain free
- Obtunded:
  
  An analysis of cervical spine magnetic resonance imaging findings after normal computed tomographic imaging findings in pediatric trauma patients: ten-year experience of a level I pediatric trauma center. Gargas J J Trauma Acute Care Surg, 2013.
CT Scan

• Excellent bony anatomy and help define fracture anatomy, joint integrity

• CT Angiography in trauma
  – Blunt trauma: high risk fractures
    • Foraminal fractures
    • Upper cervical spine trauma


Magnetic Resonance Imaging

- Excellent anatomical detail of neural elements, discs, ligamentous structures
- Best in defining extent of injury
- Almost universal in operative patients
- Excellent screening tool in obtunded patients
  - Cost, convenience
  - Versus high resolution CT scans??
Reasons for Surgical Treatment

- Stability
- Reduction and maintenance of alignment
- Neurologic protection
- Neurologic decompression
Defining Stability

• No universal guidelines
• As a general rule ligamentous injuries and joint injuries don’t heal well
  – Determining the extent and degree of ligamentous injury
    • Acute setting: can be challenging
    • Chronic: Dynamic studies are useful

• The subaxial cervical spine injury classification system: a novel approach to recognize the importance of morphology, neurology, and integrity of the disco-ligamentous complex. Vaccaro A. SPINE, 2007.
Evolving Definitions

• Reliability in the past has been poor with defining injury severity and treatment

  Assessment of two thoracolumbar fracture classification systems as used by multiple surgeon. Wood K. JBJS, 2005
  – “…The tendency for well-trained spine surgeons to classify the same fracture differently on repeat testing is a matter of some concern.”

  – “…Should I operate?” and “Which surgical approach should I select?”…. The choice of a specific surgical technique and approach is currently not evidence based.”

• Improvement in Study groups have allowed for classification systems to become standardized
• Reliability with observations of injury patterns and treatment has improved
Alignment

• As a general rule—restoration of alignment is beneficial to global spine health
  – Critical at thoracolumbar junction
  – Critical at cervical spine

<table>
<thead>
<tr>
<th>Level of injury</th>
<th>AO/Magerl classification/fracture type</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td>T1–T10</td>
<td>36</td>
<td>57</td>
</tr>
<tr>
<td>T11–L2</td>
<td>322</td>
<td>106</td>
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<tr>
<td>L3–L5</td>
<td>66</td>
<td>15</td>
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<tr>
<td>Total</td>
<td>424</td>
<td>178</td>
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</table>
What Does Surgery Entail??

• **Neurologic Decompression**
  – Removal of bone and disc fragments which are impinging on spinal cord/nerves
Fusion and Instrumentation

- Application of plates/screws/combination in order to realign fracture and stabilize until the bones fuse.
- Structural support: removal of bone from the front of the spine (vertebral body) requires replacement for biomechanical stability.
Anterior Surgery

- Front of the spine
- Best when decompression/removal vertebral body needed---usually need to support bone which is removed
Posterior Surgery

• Excellent for alignment and stability
• More difficult to decompress if problem is in front of spine
Combined Surgery

- Highly unstable injuries
- Need decompression and stable fixation
Spinal Implants
Timing of Surgical Treatment

• **Role of emergent surgery**
  – Realignment of spine and decompression of cord

• **Stabilization of other injuries**
  – Operative cases tend to have significantly higher ISS

• **Mobilization of trauma patient**
  – Transport, ambulation, sitting up, pain requirements
Timing in SCI—EARLY!

  - 313 patients with SCI and cervical frx
  - 182 early (mean 14 hrs) versus 131 late (mean 48 hrs)
  - 20 percent vs 8 percent improvement in > 2 ASIA scale
  - Lower complication rate in early group
  - Odds 3X more likely for meaningful recovery.

  - Prospective cohort study

The results here add weight to the growing body of literature, which supports the principle of early intervention in the setting of spinal trauma and SCI.
Emergent Surgery

  - Incomplete Injury (STASCIS proved benefit of early surgery)
  - Steroids
  - Immediate resuscitation
  - Early decompression and circumferential fusion
  - Improvement in neurologic function

- Positives: Best case scenario, improvement, stimulates talk.
- Negatives: Press, incomplete story
Cervical Spine

• Unsupported region with significant motion
• Fulcrum of injury due to attachment of head
• Deceleration injuries (MVC) and axial loading injuries (sports)
• Cord injuries at these levels can be devastating
• Significant research performed for cervical SCI given morbidity to patient and cost
Cervical Spine Surgery

• Options include anterior, posterior, both

• Where is the compression?

• What is the injury?

• Anterior surgery:
  – Provides structural support
  – Limited for upper cervical spine due to exposure

• Posterior surgery:
  – Technically easy
  – Reliably fuses
Anterior Procedure

• 14 year old gymnast
• Sustained axial load injury during back handspring
• Neck pain
• Neuro intact
Treatment

- MRI shows anterior subluxation C6-C7
- Traumatic disc herniation
- Elected anterior procedure
  - DISC REMOVAL
  - BONE GRAFTING
  - PLATING
Realignment and Fusion

- Uneventfully fused
- Two level fusion
- Excellent motion
- Return to sports?
• **Expert opinion**

  • Return to Play After Cervical Spine Injury. Morganti C. *SPINE, 2001*
    - Expert opinions on questionnaire
    - Divided return to play based on contact and velocity
      - Type 1 full contact
      - Type 2 no contact
    - 49% respondents had some guidelines

  • Conclusions. There is no consensus on the postinjury management of many cervical spine-injured patients. Further research, education, and discussion on this topic are needed.
Operative Treatment

• High risk patient includes isolated cervical spine injury in adolescent athlete
  – Axial loading athletics (football, hockey, gymnastics)
  – Subaxial cervical spine
  – Frequently SCI present
Cervical Fracture with SCI
Cervical fracture

- 15 y.o. checked head first into boards
- Immediate neck pain and loss of function
- Transferred from OSH
- Complete quadriplegia
Cervical Surgery

- Highly unstable circumferential injury
- Spinal cord injury
- Mobilization needed
- Adolescent male
- Underwent decompression and stabilization
CHB Experience

- Retro review 329 patients with cervical spine injury
- 23 patients with injury at sports requiring surgery
- Mean age 14 yrs
- Sports: Hockey, wrestling, football, gymnastics
- 30% with SCI
Operative Thoracic Spine trauma

- Majority related to MVC
- Inherently a stable region
- Most operative injuries are associated with SCI
- Frequent other injuries given velocity
Thoracic Spine Trauma

- Neuroprotective
- Thoracic spine less important for mobility
- Goal is for mobilization and stability
Thoracolumbar spine Trauma

- As maturity approaches this is most common area
- Important as mobile section of spine
- Important for overall spine alignment
- Frequently associated with incomplete SCI
### Epidemiology

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| Total | 424 | 178 | 131 | 733 |

*Level of injury:*
- T1–T10: 36 A, 57 B, 52 C, Total 145
- T11–L2: 322 A, 106 B, 63 C, Total 491

*AO/Magerl classification/fraction type:*
- Total: 733

*Graph:*
- n=145; 19.8%
- n=491; 67.0%
- n=97; 13.2%
Surgery or not?

- Difficulty with classification and thus surgery

- Degree of deformity, canal compromise, ligamentous integrity

- Health of spinal cord

- Risk of global malalignment
Chance Fractures

- Commonly seen at TL junction or lumbar spine
- Mainly pediatric fracture
- Mostly preventable
- Significant association with small bowel injury
- Frequently (30%) associated with SCI
Chance fracture

- 3 year old retrained MVC
- Transferred two days later
- Small bowel injury
- Ligamentous-bony injury L2-3

Issues
  - Higher ISS and needs mobilization
  - Ligamentous injury requiring surgery
Instrumentation and fusion