Spinal and Orthopaedic Surgery in the Elderly

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As the population ages, and patients remain active...

- More patients will complain and suffer spinal and orthopaedic disorders
- More patients can benefit from nonsurgical and surgical treatment
Spinal Disorders: A Primer

- Mechanical (Degenerative/Traumatic)*
- Rheumatologic
- Endocrinologic/Metabolic
- Neurologic
- Psychiatric
- Infectious
- Neoplastic/Infiltrative
- Hematologic
- Referred pain
Mechanical disorders of the lumbosacral spine

- Acute injury (Fracture), Back strain
- Lumbar disc herniation
- Lumbosacral spondylosis (Arthritis)
- Spinal deformity/scoliosis/kyphosis
- Spinal stenosis
- Spondylolisthesis
Spine surgery *highly* effective in geriatric patients for:

- Spinal Deformity
- Neurogenic claudication and myelopathy
  - Spinal stenosis
- Arm pain related to cervical radiculopathy
- Leg pain related to lumbar radiculopathy
- Trauma (kypho), Tumor in select patients
Spine Surgery NOT effective

- For:
  - Axial neck pain
  - Axial back pain
  - Those with very short life expectancy
A review of common diagnoses
Lumbar disc herniation

- The nucleus acts as a shock absorber.
- Nuclear material is normally contained within the annulus, but it bulges or herniate into the spinal canal/foramen.
Lumbar disc herniation

- Radicular pain, sensory deficit, asymmetry of reflexes, or motor weakness
- Most herniations occur at L4–L5 or L5–S1
- Better outcomes with surgery w/in 6 months
Lumbosacral spondylosis

- Osteoarthritis of the lumbosacral spine may cause localized low back pain.
- Facet joint narrowing, periarticular sclerosis and osteophytes.
Lumbar spinal stenosis

• Neurologic claudication
• It is classically described as bilateral leg pain initiated by walking, prolonged standing
• It is typically relieved by sitting or bending forward
• Surgery VERY effective
Scoliosis / Spinal Deformity

• Scoliosis is common in the elderly
• Leaning forward (positive sagittal balance) is VERY debilitation
• Increasing role for surgery in active patients
Cancer and Low Back Pain

• The spine is the most common site for bony metastases.
• Vertebral body metastases are found in more than one third of cancer patients.
• The most common cancers that involve the spine are
  – lung
  – breast
  – prostate
  – renal cell
Back Pain: Red Flags

**HISTORY**
- Thoracic back pain
- Pain > 6 weeks
- History of trauma
- Fever/chills/night sweats
- Unintentional weight loss
- Pain worse with recumbency
- Pain worse at night
- Unrelenting pain
- History of malignancy
- Immunosuppression
- Recent procedures

**PHYSICAL EXAM**
- Fever
- Hypotension
- Pale, ashen appearance
- Pulsatile abdominal mass
- Pulse amplitude differentials
- Spinous process tenderness
- Focal neurologic signs
- Acute urinary retention

*Winters et al, 2006*
Changing Gears.....
Geriatric spinal ‘trauma’

• You are not traumatologists…..
• However, spine fractures are endemic in your patients!
• Kyphoplasty is effective to relieve acute compression fracture pain
C2 Fractures

- C2: most commonly fractured cervical vertebra
- Most commonly odontoid/dens fracture
- Falls in patients >65
Study Objective

• To evaluate the *incidence* and *cost* of inpatient C2 fracture care in the U.S. from 2000 to 2010.

• Hypotheses:
  1) Incidence of C2 fractures is increasing, most rapidly in elderly patients
  2) The cost of treating C2 fracture patients is increasing faster than increasing incidence
Methods

• Dataset: Nationwide Inpatient Sample (NIS) from 2000 to 2010
• Cohort: Patients with closed fractures of C2 without neurologic injury (ICD-9 code 805.02)
• Variables: patient age, ICD-9 injury severity score (ICISS), hospital length of stay (LOS), halo placement, type of surgical intervention, and total inpatient hospitalization charge
Methods

• Surgical patients compared to non-operative patients for ICISS, LOS, hospital charge
• Hospital charges were adjusted for inflation – 2010 US$ values
• Trends in cost and treatment over time were analyzed
• Statistical cutoff p<0.05
Results: C2 fracture patients 2000 to 2010

- 31,129 patients with C2 fracture identified
  - Estimating 153,461 total patients
- Mean patient age increased from 59 to 67 years*
- Comorbidity rate increased from 26.3% to 38.2%*
- Mortality rate increased from 4.9% to 6.7%*

*p<0.05
An Aging Population

<table>
<thead>
<tr>
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<td>60</td>
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<td>63</td>
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<td>Age range, yr</td>
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<td>0–49</td>
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<td>50–64</td>
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<td>75–84</td>
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<td>24</td>
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<td>85+</td>
<td>16</td>
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<td>17</td>
<td>20</td>
<td>25</td>
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<td>21</td>
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</tbody>
</table>
Incidence of C2 fractures: 2000 to 2010

• C2 fracture incidence in all patients increased from 0.24 → 0.46 fractures/10,000/year (r=0.97, p<0.0001)

• C2 fracture incidence in 0-49 year olds increased from 0.14 → 0.23 (r=0.66, p<0.05)

• C2 fracture incidence >84 year olds increased from 3.18 → 9.77 (r=0.98, p<0.0001)
Interventions 2000 to 2010

• Rate of halo placement decreased from 25% to 10%*
• Rate of posterior C1-2 fusion increased from 4.4% to 6.2%*
• Rate of vertebral fracture repair increased from 6.6% to 12.4%*

*p<.0.01
Interventions

Procedures Performed 2000-2010

- Vertebral Fx Repair
- C1-C2 fusion
- Halo placement
Hospital Charges 2000 to 2010

• Mean inpatient charges for non-operative patients increased from $39,346 → $63,222
• Mean Inpatient charges for surgical patients increased from $70,784 → $133,064
• Total charges for annual inpatient care for C2 fracture patients increased 4.7-fold from $334,138,919 → $1,577,254,958
Mean Hospitalization Charge per Patient

Average Hospital Charge per Individual C2 Fracture Patient

- Surgically treated patients
- Non-operatively treated patients

Year

- 2001
- 2002
- 2003
- 2004
- 2005
- 2006
- 2007
- 2008
- 2009
- 2010
Reasons for increased incidence

• An increasingly active population
• Longevity
• Improved diagnostic capability
Cognitive impairment in geriatric orthopaedic patients
Preoperative Cognitive Impairment and Psychological Distress in Hospitalized Elderly Hip Fracture Patients

Alan H. Daniels, MD, Lori A. Daiello, PharmD, ScM, Craig R. Lareau, MD, Kathryn A. Robidoux, BS, Wylie Luo, BS, Brian Ott, MD, Roman A. Hayda, MD, and Christopher T. Born, MD
Prospective cohort study of hip fracture patients

Table 1. Preoperative Psychometric Tests Administered for CAFE (Cognitive Assessment After Hip Fracture in the Elderly) Study

- Confusion Assessment Method–Short Form (CAM-SF)
- Montreal Cognitive Assessment (MoCA)
- Zuckerman Activity Scale
- Short Form–12 Functional Status Assessment
- Wong-Baker Faces Pain Scale
- Visual analog scale (VAS) for anxiety
- Visual analog scale (VAS) for fear
- Impact of Event Scale
- Eight Question Screen Test
## Cohort

### Table II. Preoperative Characteristics of Hip Fracture Patients

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Cohort (N = 65)</th>
<th>NC (n = 23)</th>
<th>CI (n = 39)</th>
<th>( P^a )</th>
</tr>
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<tbody>
<tr>
<td><strong>Sociodemographics</strong></td>
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</tr>
<tr>
<td>Age, y</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean (SD)</td>
<td>82.5 (7.6)</td>
<td>81.2 (7.0)</td>
<td>82.8 (7.5)</td>
<td>.40</td>
</tr>
<tr>
<td>Range</td>
<td>66-97</td>
<td>66-93</td>
<td>67-97</td>
<td>.40</td>
</tr>
<tr>
<td>Sex, % female</td>
<td>71.0</td>
<td>73.9</td>
<td>69.2</td>
<td>.70</td>
</tr>
<tr>
<td>Mean (SD) no. of years of education</td>
<td>12.5 (1.7)</td>
<td>13.0 (1.8)</td>
<td>12.5 (1.6)</td>
<td>.20</td>
</tr>
<tr>
<td>Married, %</td>
<td>37.1</td>
<td>56.5</td>
<td>25.6</td>
<td>.02</td>
</tr>
<tr>
<td>Lives alone, %</td>
<td>41.5</td>
<td>43.5</td>
<td>46.2</td>
<td>.84</td>
</tr>
</tbody>
</table>
65 Patients: CI vs nonCI

![Bar graph showing documented cognitive impairment (CI) or dementia in medical records of study patients.](image-url)
More pain, anxiety, and fear in CI patients

<table>
<thead>
<tr>
<th>Rating Scale, mean (SD)</th>
<th>Quartile 1 (n = 15)</th>
<th>Quartile 2 (n = 19)</th>
<th>Quartile 3 (n = 12)</th>
<th>Quartile 4 (n = 15)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MoCA Total score, points</td>
<td>10.2 (3.5)</td>
<td>18.9 (2.3)</td>
<td>23.0 (0.85)</td>
<td>26.9 (1.5)</td>
</tr>
<tr>
<td>Wong-Baker Faces Pain Scale rating, points</td>
<td>5.2 (2.8)</td>
<td>5.6 (2.9)</td>
<td>3.5 (2.3)</td>
<td>2.6 (1.4)</td>
</tr>
<tr>
<td>VAS score for anxiety, mm</td>
<td>70.7 (30.2)</td>
<td>47.2 (37.4)</td>
<td>50.7 (32.9)</td>
<td>47.8 (40.9)</td>
</tr>
<tr>
<td>VAS score for fear, mm</td>
<td>64.8 (37.0)</td>
<td>24.7 (29.5)</td>
<td>47.3 (34.3)</td>
<td>32.6 (29.0)</td>
</tr>
</tbody>
</table>

aComputed from the distribution of MoCA scores at the beginning of the study.

bP-values, CI patients vs. healthy controls: p = 0.041.

cP-values, CI patients vs. healthy controls: p = 0.007.
More severe pain in CI patients

Figure 2. Sixty-one patients had evaluable preoperative pain ratings, presented here by MoCA quartiles: quartile 1, patients with most CI; quartile 4, patients with NC. Green circle indicates median score within quartile.
Major surgery in the elderly
Spinal Deformity Surgery is effective in elderly patients.
<table>
<thead>
<tr>
<th>≥75 years of age</th>
<th>All</th>
<th>Operative</th>
<th>Non-operative</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of patients</td>
<td>27</td>
<td>12</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>78.5 ± 2.5</td>
<td>78 ± 2.3</td>
<td>78.9 ± 2.6</td>
<td>0.3497</td>
</tr>
<tr>
<td>Female:male</td>
<td>22:5</td>
<td>7:5</td>
<td>15:0</td>
<td>0.0049</td>
</tr>
<tr>
<td>BMI</td>
<td>28.7 ± 5.5</td>
<td>29.8 ± 7</td>
<td>27.9 ± 4.3</td>
<td>0.4465</td>
</tr>
<tr>
<td>CCI</td>
<td>2 ± 1.2</td>
<td>1.7 ± 1.2</td>
<td>2.3 ± 1.2</td>
<td>0.2718</td>
</tr>
<tr>
<td>Baseline SRS-schwab coronal</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type N</td>
<td>16 (59.3 %)</td>
<td>6 (50 %)</td>
<td>10 (66.7 %)</td>
<td>0.3565</td>
</tr>
<tr>
<td>Type T</td>
<td>0 (0 %)</td>
<td>0 (0 %)</td>
<td>0 (0 %)</td>
<td></td>
</tr>
<tr>
<td>Type L</td>
<td>10 (37 %)</td>
<td>5 (41.7 %)</td>
<td>5 (33.3 %)</td>
<td></td>
</tr>
<tr>
<td>Type D</td>
<td>1 (3.7 %)</td>
<td>1 (8.3 %)</td>
<td>0 (0 %)</td>
<td></td>
</tr>
</tbody>
</table>
Table 7 The percentage of patients that reached minimum clinically important difference (MCID) from baseline to 2 years post-operative for Oswestry disability index (ODI), physical component score (PCS) from the SF36, and the Scoliosis Research Society (SRS) questionnaire.

<table>
<thead>
<tr>
<th>MCID</th>
<th>All</th>
<th>Operative</th>
<th>Non-operative</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of patients</td>
<td>27</td>
<td>12</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>ODI</td>
<td>25.9 %</td>
<td>41.7 %</td>
<td>13.3 %</td>
<td>0.0930</td>
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<tr>
<td>PCS</td>
<td>34.8 %</td>
<td>66.7 %</td>
<td>14.3 %</td>
<td>0.0092*</td>
</tr>
<tr>
<td>SRS Activity</td>
<td>50.0 %</td>
<td>81.8 %</td>
<td>26.7 %</td>
<td>0.0042*</td>
</tr>
<tr>
<td>SRS Pain</td>
<td>53.8 %</td>
<td>81.8 %</td>
<td>33.3 %</td>
<td>0.0117*</td>
</tr>
<tr>
<td>SRS Appearance</td>
<td>26.9 %</td>
<td>63.6 %</td>
<td>0.0 %</td>
<td>0.0001*</td>
</tr>
<tr>
<td>SRS Mental</td>
<td>23.1 %</td>
<td>27.3 %</td>
<td>20.0 %</td>
<td>0.6649</td>
</tr>
</tbody>
</table>

p values are for comparisons between operative and non-operative groups and those marked in bold with an (*) are significant (p < 0.05).
The economics of geriatric orthopaedic care

• Is it cost effective?
Redefining the Economics of Geriatric Orthopedics

Jeremy Truntzer, MD¹, Christopher Nacca, MD¹, David Paller, MS¹, and Alan H Daniels, MD¹
QALY

• Quality Adjusted Life Year

• QALY = Quality of Life X Quantity of Life

• May be problematic in geriatric population
<table>
<thead>
<tr>
<th>Procedure</th>
<th>Current cost, US$</th>
<th>Recent volume</th>
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<tbody>
<tr>
<td>Rotator cuff repair</td>
<td>19 366^4</td>
<td>250 000 (2012)^4</td>
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<tr>
<td>Total shoulder arthroplasty</td>
<td>11 675^5</td>
<td>29 359^a</td>
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<tr>
<td>Shoulder hemiarthroplasty</td>
<td>13 645^5</td>
<td>20 178 (2008)^6</td>
</tr>
<tr>
<td>Reverse total shoulder</td>
<td>21 536^7</td>
<td>21 692^a</td>
</tr>
<tr>
<td>Total knee arthroplasty</td>
<td>15 908^a</td>
<td>711 398^a</td>
</tr>
<tr>
<td>Total hip arthroplasty</td>
<td>17 155^a</td>
<td>464 452^a</td>
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<tr>
<td>Spinal fusion</td>
<td>13 611^8</td>
<td>464 975^a</td>
</tr>
<tr>
<td>Hip fracture</td>
<td>15 410^a</td>
<td>315 544^a</td>
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</table>

^a 2011 Agency for Healthcare Research and Quality (AHRQ) data."
Geriatric ortho/spine surgery *is* cost effective

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Study</th>
<th>Follow-up</th>
<th>Age (mean)</th>
<th>QALY</th>
<th>ICER/CE, US$</th>
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<td>TKA</td>
<td>Ruiz et al⁵⁰</td>
<td>Markov model</td>
<td>65-69</td>
<td>2.4⁵</td>
<td>8551</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>70-79</td>
<td>2.1⁵</td>
<td>10 091</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>&gt;80</td>
<td>1.8⁵</td>
<td>12 410</td>
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<tr>
<td>THA</td>
<td>Losina et al¹⁹</td>
<td>Markov model</td>
<td>&gt;65</td>
<td>1.1⁵</td>
<td>18 300</td>
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<tr>
<td></td>
<td>Chang et al²¹</td>
<td>Markov model</td>
<td>&gt;60</td>
<td>6.8⁵</td>
<td>(17 115)</td>
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<td></td>
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<td>&gt;85</td>
<td>2⁵</td>
<td>4527</td>
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<td>RCR</td>
<td>Mather et al⁸</td>
<td>Markov model</td>
<td>60-69</td>
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<td>12 024</td>
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<td>70-79</td>
<td>0.33⁵</td>
<td>36 576</td>
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<td>RSA</td>
<td>Renfree et al⁷</td>
<td>Markov model</td>
<td>2 years</td>
<td>7.58⁶</td>
<td>26 920</td>
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<td>Lumbar fusion</td>
<td>Rampersaud et al²²</td>
<td>5 years</td>
<td>(64.2)</td>
<td>1.39⁶</td>
<td>35 897</td>
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<tr>
<td>TSA/HA</td>
<td>Mather et al⁵</td>
<td>Markov model</td>
<td>(64)</td>
<td>TSA 12.19</td>
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<td>HA 11.43</td>
<td>1194</td>
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<td>Hip fracture</td>
<td>Parker et al²³</td>
<td>1 year</td>
<td>SC (80)</td>
<td>4.54⁵</td>
<td>993</td>
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<td>EC (78)</td>
<td>1.73⁵</td>
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<td>Avg. hip</td>
<td>3.32⁵</td>
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Thank you