Odontoid Fractures and Other Cervical Trauma: Geriatric Considerations

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Cooper Bone and Joint Institute
Cooper University Health Care
• no disclosures
Outline

• The Aging Spine
  • Osteoporosis Evaluation and Treatment
• Geriatric Odontoid Fractures
• Central Cord Syndrome
Outline

• **The Aging Spine**
  • Osteoporosis Evaluation and Treatment
• Geriatric Odontoid Fractures
• Central Cord Syndrome
The Aging Spine

- Population > 65 years old was 43.1 million in 2012 → increase to 83.7 million by 2050
Fragility Fractures
Only 19% of patients received treatment for osteoporosis after hip fracture surgery.

Women were nearly 3 times more likely to receive treatment than men (23.2% vs 8%, p=0.004)
## Risk Factors for Osteoporosis

- Female gender
- Petite body frame
- White or Asian ancestry
- Sedentary lifestyle/immobilization
- Nulliparity
- Increasing age
- High caffeine intake
- Renal disease
- Lifelong low calcium intake
- Smoking
- Excessive alcohol use
- Long-term use of certain drugs
- Postmenopausal status
- Low body weight
- Impaired calcium absorption
Osteoporosis Evaluation

• The U.S. Preventive Services Task Force recommends using DEXA screening on:
  • ALL women > 65
    • Rescreening every 4 years if normal bone mineral density
  • younger women who have an increased fracture risk as determined by the World Health Organization's FRAX Fracture Risk Assessment Tool.
  • insufficient evidence to recommend screening for osteoporosis in men; other organizations recommend screening all men 70 years and older.

<table>
<thead>
<tr>
<th>Population</th>
<th>Recommendation</th>
<th>Grade (What's This?)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Women age 65 years and older</td>
<td>The USPSTF recommends screening for osteoporosis with bone measurement testing to prevent osteoporotic fractures in women age 65 years and older.</td>
<td>B</td>
</tr>
<tr>
<td>Postmenopausal women younger than age 65 years at increased risk of osteoporosis</td>
<td>The USPSTF recommends screening for osteoporosis with bone measurement testing in postmenopausal women younger than age 65 years who are at increased risk of osteoporosis, as determined by a formal clinical risk assessment tool.</td>
<td>B</td>
</tr>
<tr>
<td>Men</td>
<td>The USPSTF concludes that the current evidence is insufficient to assess the balance of benefits and harms of screening for osteoporosis to prevent osteoporotic fractures in men.</td>
<td>I</td>
</tr>
</tbody>
</table>
Quantitative CT to assess bone mineral density as a diagnostic tool for osteoporosis and related fractures

Normal BMD > 120 mg/cc
Osteopenia < 120 mg/cc
Osteoporosis < 80 mg/cc
Very high fracture risk < 50 mg/cc.
Normative Vertebral Hounsfield Unit Values and Correlation with Bone Mineral Density

Shaun P. Patel¹*, John J. Lee², Garin G. Hecht³, Sven A. Holcombe⁴, Stewart C. Wang⁴ and James A. Goulet⁵

<table>
<thead>
<tr>
<th>Classification</th>
<th>T-Score</th>
<th>Hounsfield Units</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>DXA Reports</td>
<td>Automated Reports</td>
<td>DXA Reports</td>
<td>Radiology</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mean ± SD</td>
<td>95% CI</td>
<td>Mean ± SD</td>
<td>95% CI</td>
</tr>
<tr>
<td>Normal</td>
<td>Greater than -1.0</td>
<td>195.7 ± 55.5</td>
<td>171.4 – 220.0</td>
<td>189.3 ± 58.9</td>
<td>159.5 – 219.1</td>
</tr>
<tr>
<td></td>
<td>Between -1.0 and -2.5</td>
<td>118.9 ± 29.1</td>
<td>98.7 – 139.0</td>
<td>139.4 ± 48.8</td>
<td>109.2 – 169.7</td>
</tr>
<tr>
<td></td>
<td>Less than -2.5</td>
<td>97.9 ± 58.8</td>
<td>54.4 – 141.5</td>
<td>107.2 ± 60.4</td>
<td>65.3 – 149.0</td>
</tr>
</tbody>
</table>

Notes: Values of P < 0.001 between automated groups and P < 0.01 between radiology groups. DXA, dual x-ray absorptiometry.
Nutrition

• Routinely recommending vitamin D supplementation for all spine fusion patients (especially those aged > 65 years) may be the most efficient way to ensure that a patient will have a sufficient level at the time of surgery.

<table>
<thead>
<tr>
<th>Age Group (yr)</th>
<th>Vitamin D</th>
<th>Calcium</th>
</tr>
</thead>
<tbody>
<tr>
<td>Men and women aged 19–70</td>
<td>600 IU</td>
<td>1,000 mg for men</td>
</tr>
<tr>
<td>Men and women aged &gt;70</td>
<td>800 IU</td>
<td>1,200 mg for women</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Vitamin D Status</th>
<th>Blood Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deficient</td>
<td>0–30 ng/ml</td>
</tr>
<tr>
<td>Insufficient</td>
<td>31–39 ng/ml</td>
</tr>
<tr>
<td>Sufficient</td>
<td>40–80 ng/ml</td>
</tr>
<tr>
<td>Toxic</td>
<td>&gt;150 ng/ml</td>
</tr>
</tbody>
</table>
Vitamin D Metabolism

1. Sun Ultraviolet B
2. 7-Dehydrocholesterol (provitamin D₃) to Previtamin D₃ in the skin
3. Vitamin D₃ is produced from dietary sources of vitamin D (Vitamin D₃, Vitamin D₂)
4. Liver converts Vitamin D₃ to 25-Hydroxyvitamin D (25-OH Vitamin D)
5. Kidney converts 25-OH Vitamin D to 1,25-Dihydroxyvitamin D (1,25(OH)₂ Vitamin D)
6. Activation of vitamin D receptor in target tissues
Laboratory Evaluation

- Complete Metabolic Panel (Cr, Ca)
- TSH and free T4
- PTH
- 25-OH-Vit D

### Evaluation of Secondary Osteoporosis

<table>
<thead>
<tr>
<th>ABNORMAL STUDY RESULT</th>
<th>SUGGESTED PATHOLOGY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increased creatinine level</td>
<td>Renal disease</td>
</tr>
<tr>
<td>Increased hepatic transaminase levels</td>
<td>Hepatic disease</td>
</tr>
<tr>
<td>Increased calcium level</td>
<td>Primary hyperparathyroidism or malignancy</td>
</tr>
<tr>
<td>Decreased calcium level</td>
<td>Malabsorption, vitamin D deficiency</td>
</tr>
<tr>
<td>Decreased phosphorus level</td>
<td>Osteomalacia</td>
</tr>
<tr>
<td>Increased alkaline phosphatase level</td>
<td>Liver disease, Paget's disease, fracture, other bone pathology</td>
</tr>
<tr>
<td>Decreased albumin level</td>
<td>Malnutrition</td>
</tr>
<tr>
<td>Decreased TSH level</td>
<td>Hyperthyroidism</td>
</tr>
<tr>
<td>Increased ESR</td>
<td>Myeloma</td>
</tr>
<tr>
<td>Anemia</td>
<td>Myeloma</td>
</tr>
<tr>
<td>Decreased 24-hour calcium excretion level</td>
<td>Malabsorption, vitamin D deficiency</td>
</tr>
</tbody>
</table>
Treatment - Non-Pharmacological

- Behavior Modification
  - Smoking Cessation
  - Reduce Caffeine intake
  - Reduce/Eliminate Alcohol Consumption

- Exercise
- Sunlight
Treatment - Pharmacological

- Ca/Vitamin D
- Calcitonin
- Bisphosphonates
- Raloxifene (Evista)
- Teriparatide (Forteo)
- Denosumab (Prolia)
Outline

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• Geriatric Odontoid Fractures
• Central Cord Syndrome
Geriatric Odontoid Fractures

67 year old healthy male
• Very active
• Avid tennis player, mountain biker
• Neck pain
• No deficits
• Isolated injury

85 year old female
• Sedentary
• Nursing home resident
• Mild dementia
• Household ambulator
• Minimal neck pain

Cooper Medical School of Rowan University
Geriatric Odontoid Fractures

• Odontoid fractures are the most common cervical spine fracture in adults aged > 70 years

• Usually result of low-energy, ground-level fall
  • Head trauma → extension injury
  • Blunt trauma patients > 65 are 2X more likely to have C-spine injuries than younger patients

• Increasingly prevalent with an aging population
Geriatric Odontoid Fractures

- Odontoid fractures are the most common cervical spine fracture in adults aged > 70 years.

**TYPE I**
Oblique fractures of the upper part of the odontoid process.

**TYPE II**
Fractures at the junctions of the odontoid process with the body of the axis.

**TYPE III**
Fracture through the body of the axis.
Geriatric Odontoid Fractures

- The management of type II odontoid fractures is CONTROVERSIAL with no consensus

- Watershed area with relatively poor blood supply for type II dens fractures
Non-operative Treatment

• An option in elderly with comorbidities
• 2 options:
  • Hard Cervical Collar
  • Halo-vest Orthosis
Non-operative Treatment - Halo

Halo-Vest Immobilization Increases Early Morbidity and Mortality in Elderly Odontoid Fractures

Robert Z. Tashjian, MD, Sarah Majercik, MD, Walter L. Biffl, MD, Mark A. Palumbo, MD, and William G. Cioffi, MD

66% Complication rate & 40% Mortality rate

Halo Vest Immobilization in the Elderly: A Death Sentence?

Sarah Majercik, MD, Robert Z. Tashjian, MD, Walter L. Biffl, MD, David T. Harrington, MD, and William G. Cioffi, MD

- Pin-site infections
- Pin loosening-ring slippage
- Pressure sores
- Nerve injury
- Headache
- Aspiration

- Re-dislocations/instability
- Pneumonia
- Dysphagia
- PE
- Dural perforation-CSF leak
- Intracranial abscess
- Seizure
- Respiratory decline
Non-operative Treatment - Hard Collar

Management of Type II Dens Fractures
A Case-Control Study

Peter J. Lennarson, MD,* Homan Mostafavi, BS,* Vincent C. Traynelis, MD,* and Beverly C. Walters, MD†

Table 2. Nonsignificant Variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>P Value*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex</td>
<td>0.27</td>
</tr>
<tr>
<td>Displacement &lt; 5 mm, ≥ 5 mm</td>
<td>0.14</td>
</tr>
<tr>
<td>Direction a = 1, n = 0, p = −1</td>
<td>0.81</td>
</tr>
</tbody>
</table>

* Fisher’s Exact test, two-tailed.

Table 4. Contingency Table for Age of Cases and Controls

<table>
<thead>
<tr>
<th>Age</th>
<th>Cases</th>
<th>Controls</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 50 years</td>
<td>1</td>
<td>15</td>
<td>17</td>
</tr>
<tr>
<td>≥ 50 years*</td>
<td>10</td>
<td>7</td>
<td>16</td>
</tr>
<tr>
<td>Total</td>
<td>11</td>
<td>22</td>
<td>33</td>
</tr>
</tbody>
</table>

P = 0.002 (Fisher’s Exact test, two-tailed).
Odds ratio = 21.4**. 21 times more likely to fail halo immobilization if age ≥ 50.*

* The risk factor in this analysis is age ≥ 50.
Non-operative Treatment - Hard Collar

• High non-union rates (17-63%)
  • 21X risk of non-union in older patient

• Risk Factors for Non-union
  • Displacement > 5mm
  • Angulation > 10 deg
  • Age > 50
  • Fracture comminution
  • Delayed Surgery (> 2mo)
  • Smoking
Non-operative Treatment - Hard Collar

Rigid cervical collar treatment for geriatric type II odontoid fractures

Robert W. Molinari · Oner A. Khera · William L. Gruhn · Ryan W. McAssey

- Retrospective review of 34 patients with < 50% displacement treated with hard collar for 12 wks
  - Avg age 84.9 yrs
- Results at 15 months:
  - 6% (2) had evidence of fracture healing
  - 12% (4) mortality rate
  - 70% (21) had mobile non-union (avg 2.5mm on flex-ex)
  - No difference in NDI between healed fx, mobile non-union or age-matched cohort groups
- Fracture healing and stability did not correlate with improved outcomes with respect to levels of pain, function, and satisfaction.
Non-operative Treatment

- Many small retrospective studies with support for non-operative treatment

...HOWEVER...

- Recent data shows increase survivorship
- View odontoid fracture as “sentinel event”
152 patients age 65+ with type II odontoid fractures
- 44 treated surgically (28%)
- 112 treated non-surgically (72%)

Overall 3-year mortality was 39%
Lower mortality in operatively treated group
- 11% vs 25% @ 3 months
- 21% vs 36% @ 1 year
Type II Odontoid Fractures of the Cervical Spine

Do Treatment Type and Medical Comorbidities Affect Mortality in Elderly Patients?

Andrew J. Schoenfeld, MD,* Christopher M. Bono, MD,† William M. Reichmann, MA,‡ Natalie Warholic, MA,§ Kirkham B. Wood, MD,¶ Elena Losina, PhD,‖ Jeffrey N. Katz, MD, MSc,** and Mitchel B. Harris, MD, FACS‡†

65-74

75-84

85+
A Retrospective Review of Mortality Outcomes for Operative Versus Nonoperative Treatment of 322 Patients With Long-Term Follow-up

Jens Chapman, MD,* Justin S. Smith, MD, PhD,† Branko Kopjar, MD, PhD,‡ Alexander R. Vaccaro, MD, PhD,§ Paul Arnold, MD,¶ Christopher I. Shaffrey, MD,¶ and Michael G. Fehlings, MD, PhD∥

- Retrospective study of patients > 65 w/type II odontoid fracture from 3 level I trauma centers from 2003-2009
  - Mean age 82
  - 165 operative (mean f/u 851 days)
  - 157 non-operative (mean f/u 648 days)
- Short-term and long-term mortality analysis
Short-term Analysis (30 day)

TABLE 3. 30-day Mortality Rates for 322 Geriatric Patients With Type II Odontoid Fracture, Stratified on the Basis of Sex and Operative Versus Nonoperative Treatment

<table>
<thead>
<tr>
<th>Variable</th>
<th>Died (N = 46)</th>
<th>Alive (N = 276)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>18 (13%)</td>
<td>116 (87%)</td>
</tr>
<tr>
<td>Female</td>
<td>28 (15%)</td>
<td>160 (85%)</td>
</tr>
<tr>
<td>Treatment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operative</td>
<td>11 (7%)</td>
<td>154 (93%)</td>
</tr>
<tr>
<td>Nonoperative</td>
<td>35 (22%)</td>
<td>122 (78%)</td>
</tr>
</tbody>
</table>

![Survivor functions graph](image)
TABLE 1. Patient Demographics for 322 Geriatric Patients With Type II Odontoid Fracture, Stratified on the Basis of Operative Versus Nonoperative Treatment

<table>
<thead>
<tr>
<th></th>
<th>All (N = 322)</th>
<th>Operative (N = 165)</th>
<th>Nonoperative (N = 157)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (yr)</td>
<td>81.8 ± 7.8</td>
<td>80.4 ± 7.7</td>
<td>83.2 ± 7.7</td>
<td>0.0014</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
<td></td>
<td>0.9395</td>
</tr>
<tr>
<td>Male</td>
<td>134 (42%)</td>
<td>69 (42%)</td>
<td>65 (41%)</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>188 (58%)</td>
<td>96 (58%)</td>
<td>92 (59%)</td>
<td></td>
</tr>
<tr>
<td>Living arrangements prior to injury</td>
<td></td>
<td></td>
<td></td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Independent</td>
<td>142 (44%)</td>
<td>56 (34%)</td>
<td>86 (55%)</td>
<td></td>
</tr>
<tr>
<td>Assisted living facility</td>
<td>44 (14%)</td>
<td>16 (10%)</td>
<td>28 (18%)</td>
<td></td>
</tr>
<tr>
<td>Unknown</td>
<td>136 (42%)</td>
<td>93 (56%)</td>
<td>43 (27%)</td>
<td></td>
</tr>
<tr>
<td>Mechanism of injury</td>
<td></td>
<td></td>
<td></td>
<td>0.0097</td>
</tr>
<tr>
<td>Fall</td>
<td>296 (92%)</td>
<td>158 (96%)</td>
<td>138 (88%)</td>
<td></td>
</tr>
<tr>
<td>Motor vehicle collision</td>
<td>26 (8%)</td>
<td>7 (4%)</td>
<td>19 (12%)</td>
<td></td>
</tr>
<tr>
<td>Hospital length of stay (d)</td>
<td>11.3 ± 15.0</td>
<td>15.0 ± 18.5</td>
<td>7.4 ± 8.7</td>
<td>&lt;0.0001*</td>
</tr>
<tr>
<td>ICU stay (d)</td>
<td>1.3 ± 4.1</td>
<td>1.5 ± 4.4</td>
<td>1.1 ± 3.8</td>
<td>0.0008*</td>
</tr>
<tr>
<td>Feeding tube placement</td>
<td>38 (12%)</td>
<td>30 (18%)</td>
<td>8 (5%)</td>
<td>0.0003</td>
</tr>
<tr>
<td>Discharge disposition</td>
<td></td>
<td></td>
<td></td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Skilled nursing facility</td>
<td>81 (25%)</td>
<td>32 (19%)</td>
<td>49 (31%)</td>
<td></td>
</tr>
<tr>
<td>Home</td>
<td>76 (24%)</td>
<td>29 (18%)</td>
<td>47 (30%)</td>
<td></td>
</tr>
<tr>
<td>Rehabilitation facility</td>
<td>29 (9%)</td>
<td>17 (10%)</td>
<td>12 (8%)</td>
<td></td>
</tr>
<tr>
<td>Homeless</td>
<td>1 (&lt;1%)</td>
<td>0 (0%)</td>
<td>1 (1%)</td>
<td></td>
</tr>
<tr>
<td>Died</td>
<td>30 (9%)</td>
<td>9 (5%)</td>
<td>21 (13%)</td>
<td></td>
</tr>
<tr>
<td>Unknown</td>
<td>105 (33%)</td>
<td>78 (47%)</td>
<td>27 (17%)</td>
<td></td>
</tr>
</tbody>
</table>

*Kruskal-Wallis test.

ICU indicates intensive care unit.
Collectively, these data, demonstrate that surgical treatment of type II odontoid fracture in this elderly population did not negatively impact survival, even after adjusting for patient age and comorbidities, and, that operative treatment may be associated with a significant 30-day survival advantage compared with nonoperatively treated patients. The observation that this survival advantage seems to diminish to the level of a nonsignificant trend during longer term follow-up may relate to a dilutional effect of deaths occurring due to unrelated comorbid conditions in both groups of this elderly population. It is also important to recognize that, although the
Subgroup analysis of a prospective multicenter study of elderly patients (≥65 yr) with type II odontoid fracture

- NDI & SF-36 collected at baseline, 6 & 12 months
- 58 patients treated non-op
  - 8 died within 90 days
  - 35 (70%) with bony/fibrous union
  - 15 (30%) developed primary or secondary non-union
    - 11 (22.0%) developed nonunion → 7 requiring surgery
    - 4/39 (10.3%) patients classified as having “successful union” required surgery due to late fracture displacement
• All outcome measures demonstrated a significant decline from preinjury baseline in BOTH union and non-union groups
  • no significant differences in outcomes in union and non-union groups
  • However, 12-month outcomes for the non-union patients reflect the status of the patient after delayed surgical treatment in the majority of these cases
Functional and Quality-of-Life Outcomes in Geriatric Patients with Type-II Dens Fracture

Alexander R. Vaccaro, MD, PhD, Christopher K. Kepler, MD, MBA, Branko Kopjar, MD, PhD, MS, Jens Chapman, MD, Christopher Shaffrey, MD, Paul Arnold, MD, Ziya Gokaslan, MD, Darrel Brodke, MD, John France, MD, Mark Dekutoski, MD, Rick Sasso, MD, S. Tim Yoon, MD, Christopher Bono, MD, James Harrop, MD, and Michael G. Fehlings, MD, PhD

- Mortality rate was 18% at 1 year
  - 26% in non-surgical and 14% in surgical groups (p=0.05)
- NDI had increased (worsened) by 14.7 points in the nonsurgical cohort (p < 0.0001)
  - Nonsignificant increase (worsening) of 5.7 points in the surgical group (p = 0.0555).
- Surgical group had significantly better outcomes based on NDI and SF-36 Bodily Pain dimension compared with the nonsurgical group
- No difference in the overall rate of complications,
- Lower non-union rate in surgical group (5% vs 21%, p=0.003)
Surgical Treatment Options

- Anterior (odontoid screw)

- Posterior (C1-2 posterior spinal fusion)
Odontoid Fx - Anterior Fixation

• **Benefits:**
  - Lower risk of vertebral artery injury
  - Preservation of C1-2 motion
  - Shorter surgical time
  - Avoids prone positioning

• **Risks**
  - Loss of Fixation
  - Hardware failure
  - Hardware malpositioning
  - Pseudoarthrosis
  - Dysphagia
  - Aspiration
Odontoid Fractures - Anterior Fixation

- Contraindications:
  - Disruption of transverse ligament
  - C2 body fracture
  - Osteoporosis
  - Pathologic fx
  - Comminution
  - Anterior-oblique fracture orientation
  - C1-2 Arthrosis
  - Chronic fracture
Odontoid Fractures - Anterior Fixation

Dens fractures in the elderly. Results of anterior screw fixation in 19 elderly patients.

Berlemann U, Schwarzenbach O.

- 19 patients > 65 years of age
- 84% (16/19) bony fusion rate
- 2/19 with pseudoarthrosis requiring no treatment

Anterior Screw Fixation of Odontoid Fractures Comparing Younger and Elderly Patients

Patrick Platzer, MD, Gerhild Thalhammer, MD, Roman Ostermann, MD, Thomas Wieland, MD, Vilmos Vécsei, MD, and Christian Gaebler, MD

- 96% union in patients < 65 yo
- 88% union in patients > 65 yo
Odontoid Fractures - Anterior Fixation

- Cement Augmentation

  - 96% stability using 2 screws
  - 56% stability using 1 screw

  - 35% had dysphagia
  - 25% of patients required a feeding tube
  - 19% had aspiration pneumonia requiring antibiotics

Anterior fixation of odontoid fractures in an elderly population

Andrew T. Dailey, M.D., David Hart, M.D., Michael A. Finn, M.D.,
Meic H. Schmidt, M.D., Ronald I. Apfelbaum, M.D.

J Neurosurg Spine 12:1–8, 2010
Odontoid Fx - Posterior Fixation

• **Benefits:**
  - Increased stability
  - Definitive treatment
  - Less dysphagia

• **Risks**
  - Pseudoarthrosis
  - Hardware malposition
  - Hardware failure
  - Vertebral artery injury
  - Harvest issues (for autograft)
Odontoid Fx - Posterior Fixation Techniques

- C1-2 transarticular screw

- Harms Technique (C1 Lateral mass + C2 pedicle/pars screws)
Retrospective review of 43 patients from 2006-2016
Mean fracture displacement was $5.1 \pm 3.6$ mm and mean absolute value of angulation was $19.93 \pm 12.93^\circ$.
Complications:
- altered mental status (41.9%, n = 18)
- dysphagia (27.9%, n = 12) --> 50% (6) required feeding tube
- Respiratory failure/Reintubation (9.3%, n = 4).
- 25 of 43 patients expired (58.1%)
  - median survival of 1.76 years from the date of surgery.
Mortality: 2.3% @ 30 days; 18.6% at 1 year.
Patients who developed dysphagia were 14.5 times more likely to have expired at 1 year
Summary - Geriatric Odontoid Fractures

- Treatment of type II odontoid fractures in geriatric patients remains highly controversial
- Paucity of high-level evidence
- Treatment should be individualized based on fracture type/pattern, level of function and comorbidities
- Non-operative management has high rates of pseudoarthrosis
  - continued instability, persisting pain, or the development of neurological sequelae are indications for delayed C1-2 PSF
- Protective effect of surgical intervention
  - Most favor posterior approach
Outline

• The Aging Spine
  • Osteoporosis Evaluation and Treatment

• Geriatric Odontoid Fractures

• Central Cord Syndrome
Case Example

- 67 yo F s/p fall at home
  - Tripped over a rug while walking at home
  - Fell and landed on her face
  - Noticed immediate bilateral hand/arm burning pain and weakness

- Exam:
  - AOx3
  - Bilateral UE – 5/5 except 3/5 hand intrinsics
  - +rectal tone and sensation
  - Decreased pinprick C7 and T1
  - B/L UE hyperreflexia
  - +Hoffman’s bilaterally
Imaging
Treatment options?

1. Allow patient to plateau recovery, then operate
2. Place in cervical collar and operate at 6 weeks
3. Treat medically only
4. Operate within 24 hours if cleared/stable
5. Operate within 2 week hospitalization
The Geriatric Spine

- Increase prevalence of cervical spinal stenosis
  - Osteophytes
  - Thickening of Ligamentum Flavum
  - 26% incidence of cervical stenosis in patients > 65 yo
Central Cord Syndrome

- The most common type of incomplete spinal cord injury
- 15% to 25% of all cases
- Classically presents in elderly (aged >60 years) with pre-existing cervical spondylosis
Mechanism of Injury

• Hyperextension Injury
  • Cord is contused/compressed between ligamentum flavum and arthritic spurs/discs
Mechanism of Injury

• Hyperextension Injury
  • Cord is contused/compressed between ligamentum flavum and arthritic spurs/discs

• Primary injury → Lateral corticospinal tracts
Presentation

• **CCS presents on a spectrum**
  • weakness limited solely to the hands and forearms with sensory preservation
  • complete quadriparesis with sacral sparing as the only evidence of incomplete SCI
Conservative Treatment

The long-term outcome after central cord syndrome: a study of the natural history.

Newey ML, Sen PK, Fraser RD.

- Younger patients (< 50, group 1) improved more
- >70 years of age had poorer outcome
  - 40% ambulatory, 20% bowel/bladder control at late follow-up
Conservative Treatment

Prospectively followed 22 patients
Favorable neurological recovery at 6 weeks
Poorer recovery correlated with older age & more severe initial neurological injury

Predictors of neurologic recovery in acute central cervical cord injury with only upper extremity impairment.

Ishida Y, Tominaga T.
Conservative Treatment

Predictors of neurologic recovery in acute central cervical cord injury with only upper extremity impairment.

Ishida Y¹, Tominaga T.

- Absence abnormal signal intensity on MRI associated with better neurological recovery

<table>
<thead>
<tr>
<th>Table 3. Predictors of Complete Motor Recovery</th>
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<tbody>
<tr>
<td><strong>Odds Ratio</strong></td>
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<tr>
<td>MRI</td>
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<tr>
<td>6W PDI</td>
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<tr>
<td>ASIA score at injury</td>
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<tr>
<td>3W PDI</td>
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<tr>
<td>1W PDI</td>
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<tr>
<td>Age</td>
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<tr>
<td>Canal stenosis</td>
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<td>Spondylosis</td>
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<td>OPLL</td>
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Surgical Treatment

Retrospective review of 28 patients
• 14 treated medically (mannitol, dexamethasone, sodium bicarbonate)
• 14 treated surgically

Surgical group had:
• failure to improve progressively after an initial period of improvement
• persistent compression of neural tissue visualized on myelography
• instability of the spinal bony elements

Operative group had significantly better recovery than conservative group
Surgical Timing

Management of patients with an incomplete cervical spinal cord injury

T Asazuma, K Satomi, N Suzuki, Y Fujimura and K Hirabayashi

Department of Orthopaedic Surgery, Keio University, School of Medicine, 35 Shinanomachi, Shinjuku-ku, Tokyo 160, Japan

- 35 patients with Traumatic CCS
- All patients undergoing surgery within 4 weeks improved at least 1 Frankel grade
  - 84.6% improved 2 or more Frankel grades
- 10 patients (55.6%) who underwent late surgery (> 4 weeks) failed to improve
- Recommend surgery within the first few weeks in the absence of neurological recovery
Observational analysis of Spine Trauma Study Group

Early surgical group (< 24hr) had improved total motor score & Functional independence Measure (FIM) score

It is safe to consider early surgical decompression in patients with profound neurodeficit (ASIA □ C) and persistent spinal cord compression due to developmental cervical spinal canal stenosis without fracture or instability
Retrospective review of 50 patients with CCS
Shorter ICU and LOS in early surgery (24hr) than late surgery (>24hr)
Greater motor improvement in early surgery (p=0.04) with ongoing cord compression than late surgery
- Disc herniation
- Fracture-dislocation
Similar motor outcome in patients with CCS secondary to stenosis/spondylosis who underwent early or late surgery (p=0.51)
The majority of spine surgeons prefer to decompress the acutely injured spinal cord within 24 hours.

Spine surgeons preferred to decompress an incomplete SCI earlier than a complete injury.
Surgical Timing - Summary

• Early surgery is safe and more cost effective than late surgery for the treatment of traumatic CCS
  • Shorter hospital LOS
  • Shorter ICU stay

• Early surgery can improve motor recovery in the setting of ongoing spinal cord compression

• In the setting of spinal stenosis or spondylosis, early surgery is safe
  • Reasonable to monitor ASIA D or high-C who has rapid recovery until plateau in neurological status
Thank you!