THE COST-EFFECTIVENESS OF SURGICAL TREATMENT FOR COMPLEX PROXIMAL HUMERUS FRACTURES

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Disclosures
• None

Background
• Common Injury
  • 5% of all fractures (Baron et al., Bone, 1996)
  • Aging population = increasing incidence
• Many treatments, no consensus
  • Nonoperative
  • Fix (CRPP, ORIF)
  • Replace (Hemiarthroplasty, rTSA)
• 20-30 fold geographic variation in rate of surgery (Bell, JBJS 2011)
  • 30% increase in ORIF, 20% increase in hemiarthroplasty from 1998 to 2006

Purpose/Question
• What is the most cost-effective treatment for complex (3- and 4-part) proximal humerus fractures?
Study Design

- Markov model in Treeage 2012 (Williamstown, MA)
- Four interventions
  - Nonoperative treatment → 2 health states
  - ORIF with locking plate → 6 health states
  - Hemiarthroplasty
  - Reverse total shoulder arthroplasty → 4 health states
- One-year cycle length
- Cost and Quality-of-life accumulated over time
  - 3% discount rate
  - Lifetime time horizon

Key assumptions

- No reoperations for ORIF after the first year (Hirschmann, 2011)
- Constant annual failure rate for all arthroplasties (primary, revision)
- Rehabilitation costs, indirect costs (missed work of patient/family, travel time, etc.) are equivalent among groups (Fjalestad, Injury 2010)
- Cost and benefit of revision ORIF and revision arthroplasty assumed to be constant
- Nonoperatively treated patients do not later elect to undergo surgery (Fjalestad, Injury 2010)
- No impact on mortality

Model structures

Model Inputs

<table>
<thead>
<tr>
<th></th>
<th>Cost</th>
<th>Utility</th>
<th>Prob. Failure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nonoperative treatment</td>
<td>1000</td>
<td>0.62</td>
<td>-</td>
</tr>
<tr>
<td>ORIF</td>
<td>10000</td>
<td>0.70</td>
<td>13%</td>
</tr>
<tr>
<td>Hemiarthroplasty</td>
<td>11500</td>
<td>0.65</td>
<td>1% annual</td>
</tr>
<tr>
<td>Reverse TSA</td>
<td>22000</td>
<td>0.68</td>
<td>1% annual</td>
</tr>
</tbody>
</table>

- Costs obtained from HCUP.net, supplemented by literature (Coe et al. JSES 2012)
- Utilities derived from linear interpolation of Constant scores from multiple systematic reviews (Kantakis, Injury 2008; Sproul et al. Injury 2011) based on EQ-5D scores (Olerud, JSES 2011)
- Failure rates based on literature (Multiple studies)
Results

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Cost</th>
<th>QALYs</th>
<th>ICER ($/QALY)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nonoperative Treatment</td>
<td>$1,000</td>
<td>8.64</td>
<td></td>
</tr>
<tr>
<td>ORIF</td>
<td>$11,510</td>
<td>9.39</td>
<td>$37,038</td>
</tr>
<tr>
<td>Hemiarthroplasty</td>
<td>$15,761</td>
<td>9.04</td>
<td></td>
</tr>
<tr>
<td>Reverse TSA</td>
<td>$24,514</td>
<td>9.23</td>
<td>$39,652</td>
</tr>
</tbody>
</table>

Sensitivity Analysis: Reoperation after ORIF

- rTSA > ORIF if reoperation > 19%, hemi preferred > 26%
- Lifetime risk reoperation after hemi or rTSA = 18%

Sensitivity analysis: Age + Reoperation

WTP = $50,000/QALY

Sensitivity analysis: Age + Reoperation

WTP = $100,000/QALY
Limitations

- “Garbage in, garbage out”
- Few comparison studies, poor follow up, high heterogeneity
- Difficult to include all patient and fracture variables into a model
- Sensitivity analysis
- Identify meaningful clinical thresholds
- Cost data not true societal perspective (rehab, outpatient pain prescriptions, missed work for family)

Conclusions

- Poor functional outcome, long-term risk reoperation associated with shoulder replacement make ORIF preferred in most cases
- In high-risk cases (head-split, fracture-dislocation) or elderly, reverse TSA may be preferred over hemiarthroplasty
- Caution should be taken in interpreting short-term studies comparing ORIF with arthroplasty

Thank you

References