Reverse Shoulder Prosthesis For Acute Fracture

Mark Mighell, MD

Proximal Humerus Fractures

• Incidence
  – 2nd most common UE fx.
  – 10% of all fx’s in patients > 65y.o.
  – 2-10% 4-part proximal humerus fx.
  – Increases with age.
  – 85% non-displaced.

Trends in Fracture Management

• Medicare Data
  – 2009-2012
    • Incidence of proximal humerus fractures unchanged
    • Hemi utilization drop
      • 52% to 39%
    • RSP increased utilization
      • 11% to 28
Indications

• 3- & 4-Part proximal humerus fractures not amenable to fixation
• Fracture with previous rotator cuff tear
• Fracture in setting of severe arthritis in elderly

Tuberosity Healing is Important

• Improved Outcomes with Tuberosity Healing
  – 41 RSA for Acute Fracture
  • 27 (66%) cases where tuberosity could be repaired
  • Anatomic tuberosity healing in 67%
    - Better overall ROM vs unrepaired
    - ER improved by nearly 40 degrees more when tuberosity healing was anatomic

Tuberosity Healing with RSA

<table>
<thead>
<tr>
<th>Study</th>
<th>healed</th>
<th>total</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bradford et al (2014)</td>
<td>21/25</td>
<td>84%</td>
<td></td>
</tr>
<tr>
<td>Bulfin et al (2007)</td>
<td>17/36</td>
<td>47%</td>
<td></td>
</tr>
<tr>
<td>Cuff et al (2013)</td>
<td>20/24</td>
<td>83%</td>
<td></td>
</tr>
<tr>
<td>Gallie et al (2009)</td>
<td>25/27</td>
<td>93%</td>
<td></td>
</tr>
<tr>
<td>Gutierrez et al (2012)</td>
<td>11/11</td>
<td>100%</td>
<td></td>
</tr>
<tr>
<td>Lury et al (2011)</td>
<td>6/7</td>
<td>80%</td>
<td></td>
</tr>
<tr>
<td>Maibl et al (2013)</td>
<td>19/23</td>
<td>83%</td>
<td></td>
</tr>
<tr>
<td>Sebastiani-Franchi et al (2014)</td>
<td>20/31</td>
<td>65%</td>
<td></td>
</tr>
<tr>
<td>OVERALL</td>
<td>139/194</td>
<td>72%</td>
<td></td>
</tr>
</tbody>
</table>

RSA: reverse shoulder arthroplasty
Common Feature of Fracture Management

Tuberosity healing is key

Hemi For Fracture Indications

- Fracture dislocations.
- Anatomic neck fractures.
- Head split > 40%.
- Locked posterior dislocation with > 40% head impaction.
- 4-part fractures not amenable to open reduction and internal fixation.

Hemi For Fracture

- Recipe for success...
  - Restore proper height.
  - Replicate anatomic version.
  - Secure, anatomic tuberosity fixation.
  - Early rehab.
  - Young age.
Hemi For Fracture

- Recipe for disaster...
  - Improper height and/or version.
  - Tuberosity fixation failure.
  - Nonunion
  - Malunion – over/under reduction.
  - Late presentation.
  - Old age.
  - Osteoporosis.

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Hemi For Fracture

- Complex procedure.
- Mixed short-term results seen in the literature.
- Longer the f/u....greater number of unsatisfactory results.

Hemi For Fracture Results

<table>
<thead>
<tr>
<th>Study</th>
<th>n</th>
<th>Follow Up</th>
<th>Satisfaction Rate</th>
<th>Complication Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Goldman et al.</td>
<td>28</td>
<td>30 months</td>
<td>73%</td>
<td></td>
</tr>
<tr>
<td>Mighell et al.</td>
<td>71</td>
<td>36 months</td>
<td>93%</td>
<td></td>
</tr>
<tr>
<td>Smith et al.</td>
<td>82</td>
<td>2.1 years</td>
<td>50%</td>
<td>50%</td>
</tr>
<tr>
<td>Antuna et al.</td>
<td>57</td>
<td>10.3 years</td>
<td>47%</td>
<td></td>
</tr>
<tr>
<td>Boileau et al.</td>
<td>66</td>
<td>27 months</td>
<td>58%</td>
<td>50%</td>
</tr>
</tbody>
</table>
Consequence of Malunion

- Boileau et al. JSES 2002
  - Concluded tuberosity malposition and failure correlated with poor results.
  - “Factors associated with failure of tuberosity osteosynthesis were poor initial position of the prosthesis, poor position of the greater tuberosity, and women over age 75 years (likely with osteopenic bone).”

Hemi For Fx Failure

- Current salvage technique is conversion to reverse total shoulder arthroplasty.

RSA For Fracture Results

<table>
<thead>
<tr>
<th>Study</th>
<th>n</th>
<th>Follow Up</th>
<th>Satisfaction Rate</th>
<th>PostOp Forward Flexion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frankle et al.</td>
<td>60</td>
<td>33 months</td>
<td>95%</td>
<td>105°</td>
</tr>
<tr>
<td>Boileau et al.</td>
<td>45</td>
<td>40 months</td>
<td></td>
<td>123°</td>
</tr>
</tbody>
</table>
RSA For Fracture Results

<table>
<thead>
<tr>
<th>Study</th>
<th>Patient #</th>
<th>Age</th>
<th>Ave FF</th>
<th>Constant Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cazeneuve, Cristofari</td>
<td>16</td>
<td>75</td>
<td>120°</td>
<td>60</td>
</tr>
<tr>
<td>Sirveaux et al.</td>
<td>15</td>
<td>78</td>
<td>107°</td>
<td>55</td>
</tr>
<tr>
<td>Bufquin et al.</td>
<td>43</td>
<td>78</td>
<td>97°</td>
<td>44</td>
</tr>
</tbody>
</table>

RSA For Fracture Summary

- Indications
  - Elderly (physiologic)
  - Osteoporosis
  - Extensive comminution/displacement
  - Late presentation

Outcomes
- 41 patients
- Average age 74.
- 3 or 4 part fx's.
  - 21 hemi for fx, ave f/u 16.5 months.
  - 19 RTSA (Depuy) for fx, ave f/u 12.4 months.
Outcomes

- 6 tuberosity failures in hemi.
- 15 cases of notching.
- ABD, FF, pain scores, Constant scores significantly better in RTSA
- Rotation superior in hemi.
- Concluded RTSA superior short-term results in elderly patients.

Survey Says....

- Hemi for fx results mixed.
- Tuberosity failure = poor outcome.
  - Mal/union
  - Osteoporosis
- Primary RSA shows good results.
  - Equal to or superior vs Hemi for fx.
- Salvage to RSA results inferior to primary.

RSA For Fracture

- Why not do the right operation first?
Fins can facilitate the reconstruction of the tuberosity fragments.

Use of a cerclage can minimize the interfragmentary motion and strain.

Suture Techniques

• 4 Suture Configurations
  – Horizontal – tuberosity to tuberosity (green)
  – Vertical – tuberosity to shaft (purple)
  – Cerclage – around tuberosities (blue)
  – Stem – tuberosity to stem

Operative Technique
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• Deltopectoral Approach

Operative Technique

• Access Joint

Operative Technique

• Mobilize Tuberosities
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Operative Technique

• Remove Head Segment

Operative Technique

• Adequate exposure of glenoid is obtained.
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• Tap is inserted.
• Cannulated reamer.
Operative Technique
• Baseplate is inserted.
• 5.0mm locking screws are inserted.
• Appropriate glenosphere is selected.
Operative Technique

- Baseplate is inserted.
- 5.0mm locking screws are inserted.
- Appropriate glenosphere is selected.
- Glenosphere is inserted with retaining screw.

Primary Operative Technique

- Humeral metaphysis is reamed.
- Excess bone is removed from medial margin.
Primary Operative Technique

• Prosthesis placed in ~20° retroversion.

• Tuberosity attachment to metaphysis.
  – Transosseous suture fixation.
Case Example #1
- 61 y.o female.
- Hx of fall.
- Asthma – on chronic steroid therapy.

Post-op

Case Example #2
- 81 y.o. female.
- 2 months s/p ORIF.
- Repeat fall.
Post-op

Conclusion
• Hemiarthroplasty for fracture shows best results in younger patients.

• Tuberosity placement and healing is key to outcome.
  – RSA has superior outcome in setting of tuberosity failure.

Conclusion
• RTSA traditionally a salvage operation but should now be considered the procedure of choice in many cases.
• Doing the right operation first leads to superior outcomes.
• More research and longer follow-up is needed to establish the best treatment.