Arthroplasty for Proximal Humerus Fractures

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5/11/18
Disclosures

• none
Topics to Cover

• Indications for Arthroplasty for Fracture
• Hemiarthroplasty
  – Proper Positioning
  – Tuberosity Fixation
• Reverse Total Shoulder Arthroplasty
Deforming Forces
Indications for Arthroplasty

- 3 and 4-part fractures in osteoporotic patients
- Fracture-dislocations
- Displaced anatomic neck fractures
- Head-Split Fractures
Why Not ORIF?

- **Reoperation**
  - Much higher rate of reoperation with ORIF over HA and RTSA.
    - Gupta et. al. JOT 2015

- **Avascular Necrosis**
  - Approaches 100% with 4 part fractures
  - PHCA 65% of arterial blood supply
    - Hettrich JM et.al. JBJS. 2010
• Difficulty in decision making in the treatment of displaced proximal humerus fractures: the effect of uncertainty on surgical outcomes. LaMartina et. al. 2018.
  – 476 proximal humerus fractures treated with ORIF, HA or RTSA reviewed by 3 fellowship-trained shoulder surgeons
  – Unanimous agreement only 70% of cases
  – only 63.5% agreement among surgeons regarding treatment performed
Why all the Confusion?

• Poor Intra and Interobserver Reliability
  – Bruinsma. JBJS. 2013
  – Berkes. JBJS. 2014

• Evolving Technology

• Difficulty Measuring Outcomes.
Charles Neer, MD

• “results of hemiarthroplasty for acute proximal humerus fractures are good.” JBJS. 1955
Tips for a Successful Hemiarthroplasty

• 1. Use of Fracture Stem
• 2. Proper Positioning of Prosthesis
• 3. Reduction of Tuberosities
• 4. 3 Phase Rehab
• Shoulder Arthroplasty for Fracture: Does a Fracture-Specific Stem make a Difference? Krishnan et. al. 2011.
  – FF, ER and ASES Scores all better with fracture stem
  – Improved tuberosity healing with fracture stems (79% vs 66%)
Conversion of stemmed hemi- or total to reverse total shoulder arthroplasty: advantages of a modular stem design. Wieser K et.al. 2015
- less intraop blood loss, OR time, fewer complications and fewer revisions
Proper Positioning

  - Upper border of pectoralis major tendon to superior aspect of humeral head
Setting Stem Height during trialing
Proper Positioning

- Gothic Arch Technique

Reduction of Tuberosities

4 Horizontal Sutures and 2 Vertical Sutures to Reduce Tuberosities
Boileau. JSES. 2002.
Reduction of Tuberosities

Can pre-pass Sutures through Prosthesis
Then pass through Tuberosities with free Needle
“All or Nothing”

  - Final Tuberosity malposition in 50%
  - Correlated with unsatisfactory outcomes

No Average Results
Slow Rehab

- Overaggressive Rehab can lead to Greater Tuberosity Detachment
- Neutral Rotation Brace
- Pendulums Only for 1\textsuperscript{st} 4 weeks

- Standard Implant vs Fracture Implant
  - Worse GT positioning with Standard Implant
  - Worse GT healing with Standard Implant
  - Decreased Functional Outcome with Standard Implant

- Age and Gender Also Matter
  - Women and Patients over 75 have GT healing complications and worse outcomes
Reverse TSA for fracture

- Evidence is now strong to support the use of Reverse for 3 and 4 part fractures in patients over 70.
- Hemiarthroplasty requires an intact rotator cuff and anatomic tuberosity placement and healing for a good functional outcome.
- Reverse only requires greater tuberosity re-attachment with the infraspinatus and teres minor on it to regain ER. The Deltoid will get FF.
- Reverse overall is more predictable than hemiarthroplasty.
Biomechanics of Reverse TSA
Reverse Total Shoulder Arthroplasty Versus Hemiarthroplasty for Proximal Humeral Fractures: A Systematic Review

Jason R. Ferrel, MD, Thai Q. Trinh, MD, and Richard A. Fischer, MD

- 30 Studies identified for including that reported outcomes of Hemi for fracture, RSA for fracture, or compared.
  - 1346 patients
    - 322 RSA vs 1024 for Hemi
  - More predictable FF with RSA
    - 118 vs. 108
  - More Complications Overall with RTSA
    - But higher revision Arthroplasty rate with HA
Reverse Total Shoulder Arthroplasty Versus Hemiarthroplasty for Proximal Humeral Fractures: A Systematic Review

Jason R. Ferrel, MD, Thai Q. Trinh, MD, and Richard A. Fischer, MD

- Worse ER with RSA vs HA
  – 20 vs 30 degrees

Many of these studies done before surgeons realized importance of GT healing
Reverse total shoulder arthroplasty for acute head-splitting, 3- and 4-part fractures of the proximal humerus in the elderly

Florian Grubhofer, MD; Karl Wieser, MD; Dominik C. Meyer, MD; Sabrina Catanzaro, RN; Silvan Beeler, MD; Ulf Riede, MD; Christian Gerber, MD, FRCSEd(Hon)*

Background: Anatomic reduction and stable internal fixation of complex proximal humeral fractures in the elderly is challenging. Secondary displacement, screw perforation, and humeral head necrosis are common complications. The outcome of hemiarthroplasty is unpredictable and strongly dependent on the uncertain healing of the greater tuberosity. This multicenter study retrospectively analyzes the midterm results of primary reverse total shoulder arthroplasty for the treatment of acute, complex fractures of the humerus in an elderly population.

Methods: Fifty-two shoulders in 51 patients with a mean age of 77 years treated with reverse total shoulder arthroplasty for an acute, complex fracture of the proximal humerus were clinically and radiographically analyzed after a mean follow-up period of 35 months (range, 12-90 months).

Results: There were no intraoperative complications. Revision surgery was performed in 4 shoulders. At final follow-up, the absolute and relative Constant scores averaged 62 points (range, 21-83 points) and 86% (range, 30%-100%), respectively, with a mean Subjective Shoulder Value of 83% (range, 30%-100%). Of the patients, 92% rated the treatment outcome as excellent or good. Patients with a resected or secondarily displaced greater tuberosity had an inferior clinical outcome to those with a healed greater tuberosity.

Conclusion: The midterm clinical results are predictably good, with low complication rates and a rapid postoperative recovery of painfree everyday function. If secondary displacement of the greater tuberosity occurs, revision surgery may warrant consideration in view of potential improvement of ultimate outcome.

Level of evidence: Level IV; Case Series; Treatment Study

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Keywords: Complex proximal humeral fracture; reverse total shoulder arthroplasty; greater tuberosity healing; greater tuberosity displacement; elderly patients; greater tuberosity resection

Table II
Overall clinical results

<table>
<thead>
<tr>
<th>Data</th>
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<tbody>
<tr>
<td>CS, points</td>
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<tr>
<td>Relative CS, %</td>
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<tr>
<td>SSV, %</td>
</tr>
<tr>
<td>Flexion, °</td>
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<tr>
<td>Abduction, °</td>
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<tr>
<td>External rotation, °</td>
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<tr>
<td>Internal rotation, points (in CS)</td>
</tr>
<tr>
<td>ADLs, points (in CS)</td>
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<tr>
<td>VAS, points (in CS)</td>
</tr>
<tr>
<td>Satisfaction</td>
</tr>
<tr>
<td>Excellent</td>
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<tr>
<td>Good</td>
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<tr>
<td>Fair</td>
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<tr>
<td>Dissatisfied</td>
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<tr>
<td>Activities of daily living: CS</td>
</tr>
<tr>
<td>Constant score: RTSAs</td>
</tr>
<tr>
<td>Good</td>
</tr>
<tr>
<td>Fair</td>
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<tr>
<td>Dissatisfied</td>
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</tbody>
</table>

93% high satisfaction
35 RTSAs
13 RTSAs
4 RTSAs
0 RTSAs

ADLs, activities of daily living; CS, Constant score; RTSAs, reverse total shoulder arthroplasty; SSV, Subjective Shoulder Value; VAS, visual analog scale.

Data are presented as mean (range) unless otherwise noted.

Revision surgery, n

Periprosthetic humeral fracture (2 y after RTSA) 1
Postoperative hematoma 1
Infections—excluded from analysis because of RTSA explantation (ie, dropout) 2
Reverse total shoulder arthroplasty for acute head-splitting, 3- and 4-part fractures of the proximal humerus in the elderly

Florian Grubhofer, MD, Karl Wieser, MD, Dominik C. Meyer, MD, Sabrina Catanzaro, RN, Silvan Beeler, MD, Ulf Riede, MD, Christian Gerber, MD, FRCSEd(Hon)*/

Table III  Clinical results in patients with healed versus displaced or resected greater tuberosities

<table>
<thead>
<tr>
<th></th>
<th>Healed tuberosities (n = 44)</th>
<th>Displaced or resected tuberosities (n = 8)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>CS, points</td>
<td>65 (33 to 83)</td>
<td>50 (21 to 65)</td>
<td>.01</td>
</tr>
<tr>
<td>SSV, %</td>
<td>86 (30 to 100)</td>
<td>68 (45 to 100)</td>
<td>.03</td>
</tr>
<tr>
<td>VAS, points (in CS)</td>
<td>13.8 (8 to 15)</td>
<td>12.7 (5 to 15)</td>
<td>NS (.21)</td>
</tr>
<tr>
<td>ROM</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AAE, °</td>
<td>123 (45 to 165)</td>
<td>94 (40 to 130)</td>
<td>.01</td>
</tr>
<tr>
<td>AAB, °</td>
<td>115 (40 to 165)</td>
<td>92 (40 to 140)</td>
<td>NS (.11)</td>
</tr>
<tr>
<td>AER, °</td>
<td>21 (−10 to 60)</td>
<td>2 (0 to 10)</td>
<td>.01</td>
</tr>
<tr>
<td>AIR, points (in CS)</td>
<td>6 (0 to 10)</td>
<td>3 (0 to 8)</td>
<td>NS (.06)</td>
</tr>
<tr>
<td>ADLs, points (in CS)</td>
<td>7 (0 to 10)</td>
<td>9 (0 to 10)</td>
<td>.01</td>
</tr>
</tbody>
</table>

AAB, active abduction; AAE, active anterior elevation; ADLs, activities of daily living; AER, active external rotation; AIR, active internal rotation; CS, Constant score; NS, not statistically significant; ROM, range of motion; SSV, Subjective Shoulder Value; VAS, visual analog scale.

Data are presented as mean (range).

Improved FF and ER with healed tuberosities
Improved Patient Satisfaction with healed tuberosities
Reverse total shoulder arthroplasty for acute proximal humeral fracture: comparison to open reduction–internal fixation and hemiarthroplasty

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\textbf{Background:} Significant controversy surrounds optimal treatment of displaced 4-part proximal humeral fractures. Reverse total shoulder arthroplasty (RTSA) has recently been proposed as an alternative to hemiarthroplasty (HA) and open reduction–internal fixation (ORIF). Several authors have questioned the additional implant cost for RTSA. The purpose of this study was to compare outcomes and cost of RTSA, HA, and ORIF.

\textbf{Materials and methods:} We prospectively evaluated patients who underwent RTSA for displaced 3- and 4-part proximal humeral fractures and then retrospectively developed age- and sex-matched control groups with 3- and 4-part proximal humeral fractures who underwent HA and ORIF. Range of motion including active forward elevation and external rotation and time to achieve active forward elevation \(>90^\circ\) were recorded. American Shoulder and Elbow Surgeons (ASES), Short-Form 12-item (SF-12), and Simple Shoulder Test (SST) scores were recorded. In addition, treatment cost was assessed by Medicare data and implant list prices.

\textbf{Results:} This study enrolled 27 patients; 9 underwent RTSA, 9 HA, and 9 ORIF. Minimum follow-up was 1 year. No significant differences were seen in SST, ASES, or SF-12 scores. Significantly more patients achieved \(>90^\circ\) of active forward elevation after RTSA \((P = .012)\). RTSA provided significant cost savings to Medicare compared with HA and ORIF \((P = .002)\).

\textbf{Conclusion:} In this case-control study, RTSA appears to provide superior range of motion earlier and more predictably than HA and ORIF, with significant cost savings to Medicare.

\textbf{Level of evidence:} Level III, Retrospective Cohort Study, Treatment Study.

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\textbf{Keywords:} Shoulder arthroplasty; reverse shoulder arthroplasty; hemiarthroplasty; proximal humeral fracture; shoulder fracture; open reduction and internal fixation
Better ROM and more predictable results with Reverse TSA over HA

More cost-effective results with Reverse TSA over HA and ORIF

More savings to Medicare with Reverse TSA

Small numbers of patients in this case-control study
Cost Analysis

  - Lower Implant and OR costs with HA (approximately 9K less)
  - Total cost to patient 33K for HA and 57K for RTSA
Tips and tricks
RSA for fracture

1. Do it acutely if possible (within 2-3 weeks)
2. Deltopectoral approach
3. ID axillary nerve - may be not where you want it.
4. ID and get control of the tuberosities
   1. Use Biceps as a lighthouse
   2. Use preop CT
   3. Do LTO if needed
5. Tag with heavy suture (#2 or #5 Fiberwire)
6. Remove the head
Tips and Tricks
RSA for fracture

7. Once head out go to glenoid
   – Fukuda posteriorly and 2-pronged Bankart retractor anteriorly
   – Will get a great view!

8. Return to humerus
   – Ream the canal
   – Pick size and try to determine height
     • Place at 20 degrees retroversion
     • Pectoralis not very helpful in reverse
     • Get reduced- make sure you have “wiggle room” for when you cement
       – Can tie lap around the stem to help keep height if needed and loose
Tips and Tricks
RSA for fracture

• Prepare the stem on back table
  – Place 5-6 sutures through the stem where you want them
    • 1-2 Cerclage ”Around the world” sutures
    • 2 GT
    • 2 LT
    – Drill two holes in the bone adjacent to bicipital groove

• Place your cement restrictor

• Prepare your canal
  – Clean it out very well.
  – Pack with with E-tapes

• Cement into place
  – Maintain version and height
Conclusions

- Hemiarthroplasty
  - Use Fracture Stem (convertible!)
  - Proper Positioning
  - Meticulous Tuberosity Fixation
- Reverse TSA for Fracture
  - Women greater than 75
  - More predictable results
  - Better results if tuberosity healing occurs
  - More Costly
73 F

- Fall while bowling on outing with retirement community
- Bruising and ecchymosis of R arm/shoulder
- Neurovascularly intact
  - Including axillary nerve
6 months postop

- Minimal pain
- Forward elevation approximately 100 degrees
- External rotation 20 degrees
- Lives at Retirement community