Hemiarthroplasty for comminuted proximal humeral fractures

Ashish Babhulkar,1 Ashok K Shyam,1,2 Parag K Sancheti,1 Koshish Shah,1 Steve Rocha1
1 Sancheti Institute of Orthopaedics and Rehabilitation, Pune, Maharashtra, India
2 Indian Orthopedic Research Group, Mumbai, Maharashtra, India

ABSTRACT

Purpose. To evaluate early functional outcomes of hemiarthroplasty for 3- or 4-part proximal humeral fractures.

Methods. 16 men and 11 women aged 27 to 83 (mean, 56) years underwent hemiarthroplasty for comminuted 3-part (n=13) or 4-part (n=14) proximal humeral fractures. All the patients reported normal shoulder function prior to injury. The range of shoulder motion and muscle power were evaluated, as were subjective pain and satisfaction (using the UCLA scoring system).

Results. At the final follow-up, the mean maximum abduction was 111º (SD, 47º; range, 30º–180º), and the mean maximum forward flexion was 143º (SD, 41º; range, 45º–180º). All patients had radiographic union of the tuberosities. The mean UCLA score was 28; 21 patients attained good-to-excellent scores (≥27), whereas 6 attained lower (fair-to-poor) scores. The mean UCLA score was higher in patients aged <60 (n=13) than those who were older (n=14) [30 vs. 26, p=0.008] and in patients operated after 7 days (n=6) than those operated before 7 days (n=21) [32 vs. 27, p=0.02], but did not differ significantly in terms of gender and fracture type and side. Patient age and gender, fracture type, and injury-to-surgery interval did not have a significant impact on maximum forward flexion and abduction.

Conclusion. Early functional outcomes of hemiarthroplasty for comminuted proximal humeral fractures is good in medically fit and cooperative patients.

Key words: pain measurement; range of motion, articular; shoulder fractures; treatment outcome

INTRODUCTION

The proximal humerus is involved in 4 to 5% of all fractures; 11% of these entail 3- or 4-part fragments.1 The interval from injury to surgery is important for treatment success,2 as is the decision to perform anatomic reconstruction with fixation or hemiarthroplasty.2 For comminuted fractures,
conservative treatment usually yields poor results, whereas osteosynthesis is often unfavourable in those who are osteoporotic. Hemiarthroplasty for 3- and 4-part proximal humeral fractures achieves varying results from excellent to suboptimal or poor. Improvement in surgical technique and the use of modular prostheses has enabled better functional outcomes. Restoration of humeral length and correct positioning of the tuberosities are the keys to success. Better results are usually achieved in primary than secondary hemiarthroplasty, which is the gold standard for nonviable or non-amenable fractures.

We evaluated early functional outcomes of hemiarthroplasty for 3- or 4-part proximal humeral fractures.

**MATERIALS AND METHODS**

Between January 2006 and December 2008, 16 men and 11 women aged 27 to 83 (mean, 56) years underwent hemiarthroplasty for comminuted 3-part (n=13) or 4-part (n=14) proximal humeral fractures that were non-amenable by internal fixation. 12 of the patients injured the right side. All patients reported normal shoulder function prior to injury. Patients with associated ipsilateral upper-limb fractures, neurovascular injury, compound fractures, or similar previous injury were excluded.

A modular prosthesis (Bigliani-Flatow, Zimmer) was used. Its stem was 130-mm long for all patients; 22 received size-10 or -11 stems, and the remaining 5 received size-9 and -8 stems. Its humeral head thickness was one size less or equal to the extracted humeral head and included 46x18 mm (n=13), 46x15 mm (n=5), 40x18 mm (n=6), and 40x15 mm (n=3).

Surgeries were performed by a single surgeon via a delto-pectoral approach. Detachment of the deltoid to improve exposure was not necessary. The fractured lesser tuberosity was retracted medially to expose the humeral head. When the lesser tuberosity was not fractured, either a lesser trochanteric osteotomy (preferred) or subscapular tenotomy was performed. The long head of the biceps tendon was tenotomised at its insertion at the superior glenoid tubercle and then tenodised into the groove for the tendon of the long head of the biceps. Thinning, attenuation, and minor tears of the rotator cuff were commonly encountered. After thorough medullary lavage, antibiotic impregnated cement was delivered by a cement gun in a retrograde fashion. The prosthesis was inserted, and the tuberosities were placed under tension and repaired with 2-0 Ethibond non-absorbable sutures. The gap in the rotator cuff between the anterior edge of the supraspinatus and the superior edge of the subscapularis was closed with multiple interrupted non-absorbable sutures (Fig. 1).

Postoperatively, a sling pouch was used. Gravity-assisted pendulum exercises and passive motion exercises were allowed on day 1. At week 3, assisted forward elevation and supine external rotation and full elbow range-of-motion exercises were allowed for the next 6 weeks or longer (until adequate tuberosity healing). At weeks 6 to 8, stretching and strengthening of the shoulder with the help of a theraband was allowed under supervision. Daily home exercises were then prescribed for 6 to 10 weeks, and activities of daily living (bathing, eating, and personal hygiene) were allowed. Daily home exercises were encouraged for at least 6 months, and preferably one year.

Patients were followed up at weeks 2 and 6, months 3 and 6, and then half yearly thereafter. The range of shoulder motion and muscle power were evaluated, as were subjective pain and satisfaction (using the UCLA scoring system).

The t-test was used to compare means of...
RESULTS

The mean injury-to-surgery interval was 6.7 (standard deviation [SD], 6; range, 2–21) days. The mean duration of hospital stay was 7 (SD, 2.5; range, 5–14) days. The mean time to radiographic union of the tuberosities was 7.3 (range, 6–15) weeks. The mean duration of follow-up was 21.4 (range, 13–54) months.

At the final follow-up, the mean maximum abduction was 111º (SD, 47º; range, 30º–180º), and the mean maximum forward flexion was 143º (SD, 41º; range, 45º–180º). All patients achieved radiographic union of the tuberosities, and 11 endured moderate pain.

The mean UCLA score was 28; 21 attained good-to-excellent scores (≥27), whereas 6 attained lower (fair-to-poor) scores. Among the latter, one had a good range of motion but was not satisfied with his result; 4 were aged >70 years and adhered poorly to the rehabilitation protocol; and one developed rheumatoid arthritis that was treated with corticosteroids. This patient had wasting of the rotator cuff muscles and underwent prolonged physiotherapy. He also endured severe superior migration of the humeral head attributable to the weak rotator cuff (Fig. 2).

The mean UCLA score was better in patients aged <60 (n=13) than those who were older (n=14) [30 vs. 26, p=0.008, non-parametric Mann-Whitney U test] and in patients operated after 7 days (n=6) than those operated before 7 days (n=21) [32 vs. 27, p=0.02, non-parametric Mann-Whitney U test], but did not differ significantly in terms of gender and fracture type and side (Table). Patient age and gender, fracture type, and injury-to-surgery interval did not have a significant impact on maximum forward flexion and abduction (Table).

One patient died from a colorectal carcinoma one year later, after undergoing 3 surgeries and 12 cycles of chemotherapy prior to shoulder hemiarthroplasty. Another patient developed a haematoma around the shoulder immediately after the operation owing to a malfunctioning drain. The haematoma resolved after conservative treatment. Functional recovery was not delayed; the UCLA score was 27 at the 6-month follow-up.

DISCUSSION

Hemiarthroplasty is the best treatment modality for comminuted proximal humeral fractures.4,5 It enables good pain relief, but functional limitation may persist.5,19 Patient age, gender, injury-to-surgery interval, rehabilitation time, and condition of the rotator cuff affect functional outcome,25,34,35 as does anatomic union of the tuberosities and rotator cuff.36–40 Better functional outcomes are
Table

<table>
<thead>
<tr>
<th>Variable</th>
<th>No. of patients</th>
<th>Mean±SD UCLA score</th>
<th>p Value (non-parametric Mann-Whitney U test)</th>
<th>% of patients UCLA score of &lt;27</th>
<th>p Value (Fisher’s exact test)</th>
<th>Mean±SD maximum forward flexion (degrees)</th>
<th>p Value (t test)</th>
<th>Mean±SD maximum abduction (degrees)</th>
<th>p Value (t test)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;60</td>
<td>13</td>
<td>30±2</td>
<td>0.008</td>
<td>0</td>
<td>100</td>
<td>0.016</td>
<td>13±35</td>
<td>122±39</td>
<td>0.168</td>
</tr>
<tr>
<td>≥60</td>
<td>14</td>
<td>26±6</td>
<td>0.016</td>
<td>43</td>
<td>57</td>
<td>0.168</td>
<td>113±44</td>
<td>101±52</td>
<td>0.708</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Females</td>
<td>12</td>
<td>28±5</td>
<td>0.54</td>
<td>25</td>
<td>75</td>
<td>0.49</td>
<td>116±38</td>
<td>107±42</td>
<td>-</td>
</tr>
<tr>
<td>Males</td>
<td>15</td>
<td>29±5</td>
<td>0.49</td>
<td>20</td>
<td>80</td>
<td>0.424</td>
<td>129±43</td>
<td>114±51</td>
<td>-</td>
</tr>
<tr>
<td>Side of injury</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Left</td>
<td>15</td>
<td>27±5</td>
<td>0.22</td>
<td>27</td>
<td>73</td>
<td>0.124</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Right</td>
<td>12</td>
<td>30±5</td>
<td>0.124</td>
<td>17</td>
<td>83</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Fracture type</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 part</td>
<td>13</td>
<td>29±4</td>
<td>0.88</td>
<td>23</td>
<td>77</td>
<td>0.86</td>
<td>126±38</td>
<td>117±46</td>
<td>0.503</td>
</tr>
<tr>
<td>4 part</td>
<td>14</td>
<td>28±6</td>
<td>0.86</td>
<td>21</td>
<td>79</td>
<td>-</td>
<td>120±44</td>
<td>105±48</td>
<td>-</td>
</tr>
<tr>
<td>Injury-to-surgery interval (days)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≤7</td>
<td>21</td>
<td>27±5</td>
<td>0.02</td>
<td>29</td>
<td>71</td>
<td>0.0001</td>
<td>116±40</td>
<td>102±46</td>
<td>0.105</td>
</tr>
<tr>
<td>&gt;7</td>
<td>6</td>
<td>32±2</td>
<td>0.0001</td>
<td>0</td>
<td>100</td>
<td>0.105</td>
<td>147±34</td>
<td>142±39</td>
<td>0.06</td>
</tr>
</tbody>
</table>

achieved following primary than secondary hemiarthroplasties.31–33 Tension in the glenohumeral muscles and ligaments is difficult to restore once soft tissues are scarred following previous surgery. Soft-tissue balance may be restored through permutations and combinations of various modular prostheses, which provide varying heights, widths, posterior offsets, and versions of the humeral stem.41,42

Younger patients are more likely to have an intact rotator cuff and/or good bone stock at the tuberosity, leading to healthier abductor function of the arm and better functional outcomes.14,16,22,26,28 In our study, elderly patients could also benefit from hemiarthroplasty, as their final range of shoulder motion (maximum forward flexion and abduction) did not differ significantly from younger patients. The severity of the fracture has little impact on outcomes.39 Patients who were operated after 7 days from injury had better functional score than those operated before 7 days. This may be due to fragile soft tissues in acute condition. However, the sample size in the delayed group was small (n=6), and further investigation is needed to make this conclusion. In our study, patient age and gender, fracture type, and injury-to-surgery interval did not have a significant impact on the range of shoulder motion. Early or late mobilisation regimen also has no significant effect.35,43,44

Complications after humeral head replacement include infections, wound problems, nerve injuries, intra-operative fractures, instability, non-union and migration of the tuberosities, rotator cuff tears, component malposition and loosening, heterotopic ossification, and stiffness.45

Limitations of our study included the lack of a control group, the small sample size, and wide age range of the patients. Radiological parameters (humeral head offsets and elevation of the humeral head) were not evaluated. Their role in functional outcome is poorly understood.46 Longer follow-up is needed to comment on implant loosening and wear.

REFERENCES

5. Gronhagen CM, Abbazadeghan H, Revay SA, Adolphson PY. Medium-term results after primary hemiarthroplasty for