A Comparison of Open Reduction and Internal Fixation and Primary Total Elbow Arthroplasty in the Treatment of Intraarticular Distal Humerus Fractures in Women Older Than Age 65

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Objective: To compare open reduction and internal fixation (ORIF) with total elbow arthroplasty (TEA) for intraarticular distal humerus fractures in women older than 65 years of age.

Design: Retrospective review.

Setting: Information was obtained from a Level 1 trauma center with fellowship-trained traumatologists and a tertiary care center with fellowship-trained shoulder and elbow surgeons.

Patients: Patients were 24 women older than age 65 who sustained distal humerus fractures that required surgical treatment with clinical follow-up at a minimum of 2 years. All fractures were OTA classification 13.C2 or 13.C3. No patients were lost to follow-up.

Intervention: ORIF or TEA was the treatment method.

Main Outcome Measurements: The Mayo Elbow Performance score and the need for revision surgery were established as the means of patient evaluation.

Results and Conclusions: Using the Mayo Elbow Performance score, the outcomes of the 12 patients treated with ORIF were as follows: 4 excellent, 4 good, 1 fair, and 3 poor (cases that required conversion to TEA). Outcomes of the 12 patients treated with TEA were as follows: 11 excellent and 1 good. There were no fair or poor outcomes in the TEA group. No patients treated with TEA required revision surgery. We believe TEA to be a viable treatment option for distal intraarticular humerus fractures in women older than age 65. This is particularly true for women with associated comorbidities, such as rheumatoid arthritis, osteoporosis, and conditions requiring the use of systemic steroids.

Key Words: elbow, fracture, comorbidities, arthroplasty, open reduction and internal fixation

Intraarticular distal humeral fractures in older women remain a problem with no predictable surgical solution.1–6 Fracture comminution, coupled with osteopenic bone and poor compliance with postoperative physical therapy programs, has contributed to suboptimal results. Controversy exists regarding the ability of internal fixation to achieve excellent outcomes predictably in these patients. Total elbow arthroplasty (TEA) has been shown to offer a solution for posttraumatic deformities of the elbow, particularly for selected patients older than age 60 years.7 To evaluate better the role of TEA as a definitive treatment solution for intraarticular distal humeral fractures in older women, we compared TEA with the present standard of care, open reduction and internal fixation (ORIF). We report our findings in this article.

MATERIAL AND METHODS

To locate subjects, we used the orthopaedic trauma registry and the total joint registry at our institution (a Level 1 trauma center and an academic tertiary care referral center). Twenty-four women older than age 65 met inclusion criteria for this study. There were 12 patients in each group. No fractures were open, and there were no neurovascular injuries. All fractures were treated operatively, either with osteosynthesis or with arthroplasty. A fellowship-trained senior traumatologist performed each osteosynthesis, and each arthroplasty was performed by a fellowship-trained senior shoulder and elbow surgeon. Within our practice, acute fractures generally were referred to the traumatologists, whereas patients with superimposed rheumatoid arthritis preferentially were referred to the shoulder and elbow arthroplasty surgeon. Although treatment was left to the discretion of the operating surgeon, expertise in a specific operative procedure played a role in the decision-making process.

Notwithstanding the fact that this was a retrospective study, all data points were recorded prospectively, either
in the orthopaedic trauma registry or in the total joint registry at our institution. Data included all patient demographics, operative and hospital information, and complications that occurred in the immediate or later postoperative period. A minimum of 24 months for patients not requiring revision was required for follow-up. Follow-up for patients requiring arthroplasty revision of their previous internal fixation was halted before their conversion to TEA. These patients were not considered in the arthroplasty group.

Internal Fixation Group

There were four AO/OTA 13.C2 fractures and eight AO/OTA 13.C3 fractures (Table 1). The average age was 73.6 years (range 65–86 years). Eight of the 12 fractures occurred in the nondominant extremity, and 4 occurred in the dominant extremity. The usual mechanism of injury was a motor vehicle accident or a minor fall. Five comorbid conditions were identified in five patients, including three patients with steroid-dependent chronic obstructive pulmonary disease (COPD); one of these patients had an additional comorbidity of alcoholism. One patient had gout, and one patient had advanced dementia. In addition, all of the patients with steroid-dependent COPD had proven osteoporosis (radiographic osteopenia with a documented history of multiple insufficiency fractures). The time between injury and index procedure averaged 2.08 days (range 1–5 days). ORIF was performed using techniques according to AO/ASIF principles. In 12 of 10 cases, access to the distal articular surface of the humerus was obtained with an olecranon osteotomy; in the remaining 2 cases, the articular surface was approached using a triceps-sparing approach.

Arthroplasty Group

There were four definable AO/OTA 13.C3 fractures (Table 2). The remaining eight fractures were diagnosed as AO/OTA 13.C fractures, but rheumatoid destruction of the joint was so advanced that further subclassification (AO/OTA 13.C2 or 13.C3) was not possible. The average patient age was 72.3 years (range 65–88 years). The dominant extremity was affected in 8 of 12 patients. All injuries were the result of a minor fall. All patients in the arthroplasty group had comorbidities. All patients were diagnosed with osteoporosis; eight had DEXA scan–proven osteoporosis, and four had radiographic osteopenia in conjunction with multiple insufficiency fractures. Eight of 12 patients had rheumatoid arthritis. One patient had steroid-dependent COPD, and one had alcoholism. The interval between injury and the index procedure averaged 7.75 days (range 2–30 days). All arthroplasties were performed using the same semiconstrained, cemented total elbow implant (Conrad-Morrey; Zimmer, Warsaw, IN). All were small in size. Seven of the 12 had a 6-inch stem; 5 had a 4-inch stem. The operative technique was performed according to the technique of Morrey et al, as described elsewhere. Rehabilitation in both groups included antiedema measures, which included early motion and were supervised by a physical therapist or were done at home. Neither group used measures other than the aforementioned to prevent heterotopic ossification.

Follow-up consisted of clinical and radiographic examination for a minimum of 2 years in patients not requiring a revision from ORIF to TEA. The clinical examination was performed independently by a nurse practitioner to avoid the inherent biases of the treating surgeon. Range of motion, including arc of flexion-extension and pronation-supination, was measured with a handheld goniometer. Stability of the elbow was evaluated based on a history and physical examination. Subjective evaluation included the patient’s level of satisfaction; the amount of pain (none, mild, moderate, or severe); and the ability to perform self-care activities, such as grooming, dressing, feeding, and personal hygiene.

### TABLE 1. Distal humerus fractures in women older that age 65 treated by open reduction and internal fixation

<table>
<thead>
<tr>
<th>Case no.</th>
<th>Age</th>
<th>Affected side (dominant ext)</th>
<th>Comorbidities*</th>
<th>Time to surgery</th>
<th>Complication</th>
<th>Duration of follow-up</th>
<th>Duration of hospitalization</th>
<th>Tourniquet time</th>
<th>Arc of flex/ext</th>
<th>Arc of pro/sup</th>
<th>Patient satisfied</th>
<th>Pain</th>
<th>Mayo elbow performance (rating)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>68</td>
<td>L (R)</td>
<td>A/C</td>
<td>2 days</td>
<td>Fixation</td>
<td>8 wk</td>
<td>2 days</td>
<td>150 min</td>
<td>0</td>
<td>0</td>
<td>No</td>
<td>Severe</td>
<td>50 (P)</td>
</tr>
<tr>
<td>2</td>
<td>79</td>
<td>L (R)</td>
<td>A/B/C</td>
<td>2 days</td>
<td>Fixation</td>
<td>12 wk</td>
<td>2 days</td>
<td>150 min</td>
<td>0</td>
<td>0</td>
<td>No</td>
<td>Severe</td>
<td>50 (P)</td>
</tr>
<tr>
<td>3</td>
<td>80</td>
<td>R (R)</td>
<td></td>
<td>1 day</td>
<td>6.5 yr</td>
<td>3 days</td>
<td>150 min</td>
<td>95</td>
<td>80/80</td>
<td>Yes</td>
<td>None</td>
<td>85 (G)</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>68</td>
<td>L (R)</td>
<td></td>
<td>1 day</td>
<td>6 yr</td>
<td>3 days</td>
<td>150 min</td>
<td>110</td>
<td>80/80</td>
<td>Yes</td>
<td>None</td>
<td>85 (G)</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>73</td>
<td>L (R)</td>
<td>E</td>
<td>2.5 yr</td>
<td>1 day</td>
<td>2 days</td>
<td>140 min</td>
<td>90</td>
<td>80/80</td>
<td>Yes</td>
<td>Mild</td>
<td>95 (E)</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>86</td>
<td>R (R)</td>
<td></td>
<td>1 day</td>
<td>6.5 yr</td>
<td>4 days</td>
<td>155 min</td>
<td>110</td>
<td>80/80</td>
<td>Yes</td>
<td>None</td>
<td>100 (E)</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>73</td>
<td>R (L)</td>
<td></td>
<td>2 days</td>
<td>6.5 yr</td>
<td>4 days</td>
<td>135 min</td>
<td>110</td>
<td>80/80</td>
<td>Yes</td>
<td>None</td>
<td>85 (G)</td>
<td></td>
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<tr>
<td>8</td>
<td>65</td>
<td>L (R)</td>
<td></td>
<td>2 days</td>
<td>5 yr</td>
<td>3 days</td>
<td>155 min</td>
<td>90</td>
<td>80/80</td>
<td>Yes</td>
<td>Mild</td>
<td>90 (E)</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>66</td>
<td>L (R)</td>
<td>D</td>
<td>5 days</td>
<td>Infection</td>
<td>5 yr</td>
<td>5 days</td>
<td>145 min</td>
<td>95</td>
<td>80/80</td>
<td>Yes</td>
<td>Mild</td>
<td>70 (F)</td>
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<tr>
<td>10</td>
<td>83</td>
<td>R (R)</td>
<td>A/C</td>
<td>5 days</td>
<td>Fixation</td>
<td>n/a</td>
<td>4 days</td>
<td>155 min</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a (P)†</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>65</td>
<td>L (L)</td>
<td></td>
<td>3 days</td>
<td>2.5 yr</td>
<td>2 days</td>
<td>150 min</td>
<td>120</td>
<td>80/80</td>
<td>Yes</td>
<td>None</td>
<td>80 (G)</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>77</td>
<td>L (L)</td>
<td></td>
<td>2 days</td>
<td>2.5 yr</td>
<td>2 days</td>
<td>120 min</td>
<td>100</td>
<td>80/80</td>
<td>Yes</td>
<td>None</td>
<td>100 (E)</td>
<td></td>
</tr>
</tbody>
</table>

| Mean     | 74   | 2 days                       | 57 months†     | 3 days        | 146 min         | 100‡                   | 81                          |

*A, steroid-dependent chronic obstructive pulmonary disease; B, alcoholism; C, Osteoporosis; D, dementia; E, gout.

†Score of poor because of intraoperative revision to TEA.

§Mean does not include cases 1, 2, and 10 because of revision to TEA. Case 1: Intraarticular distal humerus fracture, ORIF, TEA (8 weeks), TEA revised (ulnar loosening—8 months), excellent outcome. Case 2: Intraarticular distal humerus fracture, ORIF, TEA (12 weeks), excellent outcome. Case 10: Intraarticular distal humerus fracture, ORIF, TEA (intraoperative revision), TEA revised (ulnar loosening—12 months), excellent outcome.

TABLE 2. Distal humerus fractures in women older than age 65 treated by primary total elbow arthroplasty

<table>
<thead>
<tr>
<th>Case no.</th>
<th>Age</th>
<th>Affected side (dominant ext)</th>
<th>Comorbidities*</th>
<th>Time to surgery</th>
<th>Complication</th>
<th>Duration of follow-up</th>
<th>Duration of hospitalization</th>
<th>Tourniquet time</th>
<th>Arc of flex/ext</th>
<th>Arc of pro/sup</th>
<th>Patient satisfied</th>
<th>Pain</th>
<th>Mayo elbow performance (rating)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>66</td>
<td>L (R)</td>
<td>A/C</td>
<td>10 days</td>
<td>Uncoupling prosthesis/radiolucency-ulnar component</td>
<td>5 yr</td>
<td>3 days</td>
<td>90 min</td>
<td>100</td>
<td>Yes</td>
<td>None</td>
<td>100</td>
<td>(E)</td>
</tr>
<tr>
<td>2</td>
<td>72</td>
<td>R (R)</td>
<td>C/F</td>
<td>4 days</td>
<td></td>
<td>6 yr</td>
<td>3 days</td>
<td>60 min</td>
<td>120</td>
<td>Yes</td>
<td>None</td>
<td>100</td>
<td>(E)</td>
</tr>
<tr>
<td>3</td>
<td>74</td>
<td>R (R)</td>
<td>C/F</td>
<td>7 days</td>
<td></td>
<td>4 yr</td>
<td>2 days</td>
<td>90 min</td>
<td>105</td>
<td>Yes</td>
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<td>95</td>
<td>(E)</td>
</tr>
<tr>
<td>4</td>
<td>74</td>
<td>R (R)</td>
<td>C/F</td>
<td>5 days</td>
<td></td>
<td>4 yr</td>
<td>2 days</td>
<td>100 min</td>
<td>110</td>
<td>Yes</td>
<td>None</td>
<td>95</td>
<td>(E)</td>
</tr>
<tr>
<td>5</td>
<td>88</td>
<td>R (R)</td>
<td>C</td>
<td>2 days</td>
<td></td>
<td>3 yr</td>
<td>2 days</td>
<td>55 min</td>
<td>130</td>
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<td>None</td>
<td>100</td>
<td>(E)</td>
</tr>
<tr>
<td>6</td>
<td>65</td>
<td>R (R)</td>
<td>C/F</td>
<td>6 days</td>
<td></td>
<td>3 yr</td>
<td>2 days</td>
<td>80 min</td>
<td>130</td>
<td>Yes</td>
<td>None</td>
<td>100</td>
<td>(E)</td>
</tr>
<tr>
<td>7</td>
<td>65</td>
<td>R (R)</td>
<td>C</td>
<td>30 days</td>
<td></td>
<td>3 yr</td>
<td>2 days</td>
<td>80 min</td>
<td>110</td>
<td>Yes</td>
<td>None</td>
<td>95</td>
<td>(E)</td>
</tr>
<tr>
<td>8</td>
<td>79</td>
<td>L (R)</td>
<td>B/C</td>
<td>4 days</td>
<td></td>
<td>4 yr</td>
<td>2 days</td>
<td>80 min</td>
<td>120</td>
<td>Yes</td>
<td>None</td>
<td>95</td>
<td>(E)</td>
</tr>
<tr>
<td>9</td>
<td>71</td>
<td>R (R)</td>
<td>C/F</td>
<td>3 days</td>
<td>Hematoma</td>
<td>3 yr</td>
<td>2 days</td>
<td>100 min</td>
<td>100</td>
<td>Yes</td>
<td>Mild</td>
<td>90</td>
<td>(E)</td>
</tr>
<tr>
<td>10</td>
<td>67</td>
<td>L (R)</td>
<td>C</td>
<td>5 days</td>
<td></td>
<td>2 yr</td>
<td>2 days</td>
<td>70 min</td>
<td>110</td>
<td>Yes</td>
<td>None</td>
<td>95</td>
<td>(E)</td>
</tr>
<tr>
<td>11</td>
<td>76</td>
<td>L (R)</td>
<td>C/F</td>
<td>15 days</td>
<td></td>
<td>2.5 yr</td>
<td>2 days</td>
<td>70 min</td>
<td>115</td>
<td>Yes</td>
<td>None</td>
<td>95</td>
<td>(E)</td>
</tr>
<tr>
<td>12</td>
<td>71</td>
<td>R (R)</td>
<td>C/F</td>
<td>2 days</td>
<td>Infection</td>
<td>5 yr</td>
<td>2 days</td>
<td>60 min</td>
<td>110</td>
<td>Yes</td>
<td>None</td>
<td>95</td>
<td>(E)</td>
</tr>
<tr>
<td>Mean</td>
<td></td>
<td></td>
<td></td>
<td>8 days</td>
<td></td>
<td>45 mo</td>
<td>2 days</td>
<td>78 min</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>95</td>
</tr>
</tbody>
</table>

*A, steroid-dependent chronic obstructive pulmonary disease; B, alcoholism; C, Osteoporosis; D, n/a; E, n/a, F, rheumatoid arthritis.

The Mayo Elbow Performance score was used to grade the overall effectiveness of both treatment methods. This score is based on a 100-point scale, with maximum scores of 45 points for pain relief, 25 points for function (5 points each given for grooming, feeding, personal hygiene, putting on a shirt, and putting on shoes), 20 points for motion, and 10 points for stability. Results were considered excellent if the score was 90 points or greater, good if the score was 75 to 89 points, fair if the score was 60 to 74 points, and poor if the score was less than 60 points. Revision surgery automatically placed the patient in the poor category. Standard, plain, anteroposterior, and lateral radiographs were made for all patients. In the ORIF group, radiographs were used to determine the quality of fixation and the rate of union. In the TEA group, radiographs were used to determine the presence or absence of radiolucent lines. If radiolucent lines were identified, sequential radiographs were taken to determine the presence or absence of progression.

RESULTS

Follow-up was possible in patients not requiring revision at an average of 57 months (range 24–78 months). Follow-up for all patients, including patients halted due to revision, was at an average of 46 months (range 2–78 months)—does not include patient who underwent intraoperative revision).

Internal Fixation Group

Operative time averaged 2.5 hours (Table 1), with tourniquet time averaging 146.3 minutes (range 120–155 minutes). The length of hospitalization averaged 2.92 days (range 2–4 days), whereas physical therapy visits averaged 30 visits over a 3-month period. Using the Mayo Elbow Performance score, there were four excellent, four good, one fair, and three poor results. The fair result was secondary to a postoperative infection that required formal debridement and intravenous antibiotic therapy in a patient who had comorbid dementia. Although the infection resolved, this patient ultimately developed elbow stiffness and pain secondary to heterotopic ossification (Brooker type III), but the patient declined further surgery. The three poor results all were from fixation failure after ORIF and required revision to TEA. Two cases required revision postoperatively, one at 8 weeks (case 1 in Table 1 [Fig. 1]) and one at 12 weeks (case 2 in Table 1). The patients presented clinically with elbow pain and instability in addition to radiographically evident loss of fixation. The third poor result (case 10 in Table 1) required immediate intraoperative revision after ORIF was complete. The elbow was examined, and gross interfragmentary motion was observed. This observation was made by two trauma fellowship surgeons who agreed, despite all attempts, that it would not be technically possible to obtain solid fixation (owing to small fragments of soft bone). An intraoperative consultation with the fellowship-trained shoulder and elbow surgeon was followed by a conversion to TEA. Two of these three revised patients, who underwent fixation, required an additional revision. One patient was revised postoperatively at 8 months (case 1 in Table 1) and the other at 12 months (case 10 in Table 1). Both patients were revised due to ulnar component loosening. At the most recent follow-up, all three patients have maintained excellent outcomes 2, 3, and 5 years after previous TEA. The patients revised to TEA were removed from follow-up because they could not be considered in the primary arthroplasty group. These three revised patients had comorbidities of osteoporosis and systematic steroid use for COPD, whereas one patient had a superimposed morbidity of chronic ethanol abuse.

With respect to motion, average extension was 30° (range 10–50°), average flexion was 110° (range 80–120°), and average arc of flexion-extension motion was 100° (range 90–120°), with all patients exhibiting full supination and pronation. The Mayo Elbow Performance
score was calculated for the nine patients whose fractures healed without the need for revision; an overall average score of 87.7 points was obtained. Average individual scores included 40 of 45 points for pain, 18 of 20 points for arc of motion, 10 of 10 points for elbow stability, and 17 of 25 points for activities of daily living. Using the Mayo Elbow Performance score, the nine patients were rated as excellent (four), good (four), and fair (one). The three revised patients were rated as poor. Radiographs taken for the fractures that healed without revision (nine patients) showed that all had an anatomic reduction with stable fixation. One patient had radiographic signs of stage II posttraumatic arthritis; in one patient, Brooker type III heterotopic ossification in the brachialis musculature was identified.

**Arthroplasty Group**

The operative time for elbow replacement averaged 90 minutes (Table 2), with an average tourniquet time of 77.9 minutes (range 55–100 minutes). There were 11 excellent, 1 good, no fair, and no poor results. Length of

**FIGURE 1.** A, Anteroposterior preoperative radiograph of patient in case 1 (Table 1). The patient sustained a low distal humerus fracture OTA 13.C2. This case demonstrates comminution and current comorbidity of osteoporosis. The patient also had steroid-dependent chronic obstructive pulmonary disease. B, Lateral preoperative radiograph of patient in case 1 (Table 1). Comminution of distal humerus articulation. C, Anteroposterior post-ORIF radiograph of patient in case 1 (Table 1). Status immediately after ORIF. D, Lateral post-ORIF radiograph of patient in case 1 (Table 1). Failure at 8 weeks of internal fixation. E, Anteroposterior post-TEA radiograph of patient in case 1 (Table 1). Follow-up 3 months after arthroplasty.
hospitalization averaged 2.16 days (range 2–3 days); physical therapy averaged less than two visits over a 3-month period. One patient required 18 visits to physical therapy, secondary to stiffness. Two patients complained of dysesthesia along the ulnar nerve distribution, which subsequently resolved. No patient required revision implant surgery. Three patients required subsequent operations, however—one to reconnect an uncoupled prosthesis, one to drain a postoperative hematoma, and one to debride a superficial infection. All of these complications resolved without subsequent sequelae. With respect to motion, average extension was 15° (range 0–30°), average flexion was 125° (range 110–130°), and average arc of motion of flexion-extension was 113° (range 100–130°), with all patients exhibiting full supination and pronation. The Mayo Elbow Performance score averaged 95.0 points overall. Average scores for individual categories were 43 of 45 points for pain, 19 of 20 points for functional arc of motion, 10 of 10 points for stability, and 25 of 25 points for activities of daily living. Eleven of the 12 patients were rated excellent using this score, and one patient was rated good. Radiographic evaluation in the TEA group indicated that in one patient, the implant was associated with a progressive radiolucency of the ulnar component. This patient was downgraded to a good result secondary to mild aching in her elbow, even though she was able to perform all activities of daily living. The patient died 5 years postoperatively without requiring revision surgery.

**DISCUSSION**

Fractures of the distal humerus account for 2% of adult fractures. Nonoperative treatment (immobilization in a cast, traction, or “bag of bones”) often results either in a united fracture with joint stiffness and poor function or in nonunion of the fracture with a painful pseudarthrosis.3,6 Although the recommended treatment of comminuted, displaced, intraarticular fractures of the distal humerus is osteosynthesis, this method can be technically difficult, especially in older patients.3,14 Previous data on internal fixation of distal humerus fractures indicate that complications such as failure of fixation, persistent pain and/or stiffness, heterotopic ossification, ulnar nerve entrapment, nonunion, malunion, and posttraumatic arthritis are common in any age group.

John et al.17 reported on the results of fractures of the distal humerus treated with ORIF in 49 patients with an average age of 80. Follow-up was possible in 39 patients. Although the authors stated that age was not a contraindication to ORIF, 10 of these patients (26%) had a poor result. Helfet and Schmeling2 reviewed the results of nine different series using osteosynthesis for the treatment of displaced intraarticular distal humerus fractures with patients in all age groups and found that 25% of the patients had less than a good result. Jupiter et al.5 described their results of treatment with ORIF for these fractures in 34 patients between the ages of 17 and 78. Fifteen fractures were in patients age 65 and older; nine were women. Of these, seven had excellent results (78%), and two had good results (22%). Two patients, both with excellent results, had ulnar nerve palsy, however.

Our series, using ORIF, had an overall excellent-to-good result in 75% of the cases, but ORIF failed completely in 25%. Of the three patients who required conversion to TEA, two subsequently developed ulnar component loosening that required revision arthroplasty at 8 and 12 months. The results of our data agree with those of the previous authors and show that although ORIF can give good results, failure of the fixation is the most frequent complication in this group. TEA has been carefully used as a definitive treatment of posttraumatic deformities of the distal humerus in selected older patients.11,12,15 More recently, a study by Cobb and Morrey7 showed good-to-excellent results using this method of treatment of acute distal humerus fractures in the elderly. In our study, initial enthusiasm for primary TEA evolved out of an inability to treat fractures in patients with severe rheumatoid arthritis whose bone loss rendered osteosynthesis technically impossible. TEA provided early restoration of function in these patients (Fig. 2). Additionally, the inability to achieve stable internal fixation in three patients without rheumatoid arthritis prompted us to reexamine osteosynthesis as a primary treatment in older women who may have bone loss related to osteoporosis.

We believe that the inability to achieve stable internal fixation in large part was related to the comorbidities associated with these fractures. These comorbidities may affect surgical outcomes.16–19 Rozencwaig et al.18 reported that total shoulder arthroplasty in patients with preexisting comorbidities had less than optimal shoulder arthroplasty results. In our series, comorbidities definitely affected outcome. When analyzing our database retrospectively, the rate of comminuted and displaced intraarticular fractures in patients older than age 65 was 12 times more prevalent in women than it was in men (92%). John et al.3 documented a 5:1 ratio of women to men, whereas Jupiter et al.14 had an older population that was composed of 60% women. Our large female population may be due in part to the large population of widowed retirees found in Florida and the relatively short study period. Palvanen et al.14 reported an age-adjusted increase in incidence of such fractures resulting from moderate trauma from 12 in 100,000 in 1970 to 28 in 100,000 in 1995. They concluded that if this trend continued, a threefold increase in the number of distal humerus fractures would occur by 2030.

Radiographic and clinically proven osteoporosis was present in 100% of the TEA group patients and in 62.5% of the patients overall. We believe that the demineralization of bone found in these older women plays an important role, not only in fracture etiology, but also in the selection of a treatment method. ORIF was unable to offer successful fracture stabilization in one quarter of the patients treated by surgeons well versed in these techniques. Similarly, patients experiencing an intraarticular
fracture of the distal humerus with the superimposed comorbidity of rheumatoid arthritis (coupled with rheumatoid destruction of the articular surface) were not candidates for internal fixation, precisely because osteosynthesis was not technically possible in this patient population. Although neither John et al \(^3\) nor Jupiter et al \(^4\) identified patients with rheumatoid arthritis, Cobb and Morrey \(^5\) had an experience similar to ours regarding these patients. In 2000, Ray et al \(^6\) reported their 2- to 4-year follow-up of seven patients with distal humerus fractures treated with primary TEA. The selected patients were as follows: Three patients had destruction of the articular surface secondary to rheumatoid arthritis, three had AO fracture classification type C3, and one had a type C2. All had significant osteopenia and were older (age range 74–88 years). Contraindications to TEA were active infection, contaminated open fracture, or a neurologic injury that impaired functional use of the limb. Five elbows were rated excellent, and two elbows were rated good using the Mayo Elbow Performance score. The mean arc of flexion-extension was 130° to 20°. Six patients had no pain, and one had only mild pain complaints.

In 2001, Gambirasio et al \(^7\) evaluated the functional outcome of 10 older patients treated with primary TEA for comminuted, intraarticular distal humerus fractures. Follow-up was a minimum of 1 year. All patients were women who had suffered a simple fall but had significant comminution and osteopenia. No patients had rheumatoid arthritis. All except for one were older than age 81, with a mean age of 85. Eight patients had an excellent result, and two had a good result using the Mayo Elbow Performance score. The mean arc of flexion-extension was 125.5° to 23.5°. There were no fair or poor results.

In 2002, Garcia et al \(^8\) reported a mean time to follow-up of 3 years in 16 patients treated with primary TEA. None of the patients had previous inflammatory arthropathies; their ages ranged from 61 to 95 years. Eleven patients had AO fracture classification type C3, two had type B3, and two had type A3. One fracture was unclassified. Fifteen patients were satisfied with their outcome, and the mean Mayo Elbow Performance score was 93. The mean flexion arc was 24° to 125°.

In our study, despite the superimposed comorbidities, patients treated with TEA scored higher (as determined by the Mayo Elbow Performance score) than the 75% of patients successfully treated with osteosynthesis. The risks of fixation failure secondary to loosening in the perioperative period, especially during the required period of physical therapy for elbow mobilization, make revision surgery (with either osteosynthesis or arthroplasty) a possibility in patients treated with ORIF. We had one TEA patient with a progressive radiolucent line evident on radiograph, which was clinically symptomatic (pain). This patient died 5 years after the index procedure, however, before revision arthroplasty was required. This patient also had a revision surgery for an uncoupled prosthesis.

Follow-up in the TEA group averaged only 45 months. Further long-term monitoring is required before we can assess long-term effectiveness. Based on published reports, however, it seems that a well-implanted prosthesis of this design does have significant longevity. In these older women, the real question may be whether the implant reliably can outlive the patient or vice versa.

A critical analysis of our data reveals a large percentage of patients (67%) in the TEA group with associated rheumatoid arthritis. This inherent bias limits the conclusions of our study. Similarly, the small number of patients in our study weakens our conclusions, as statistically significant statements are not possible. We view this as a preliminary study, with a longer term of follow-up and a larger study group to be obtained in the future. The outcomes of distal humerus fractures in patients treated by ORIF and TEA demonstrate that either operative treatment can restore function and provide pain

FIGURE 2. A, Anteroposterior and lateral preoperative radiograph of patient in case 6 (Table 2). The patient had a distal humerus fracture OTA 13.C2 not amenable to ORIF due to significant destruction of joint articulation from rheumatoid arthritis. B, Lateral post-TEA radiograph of patient in case 6 (Table 2). The patient had an excellent result with no loss of function. Radiograph was taken 3 months after arthroplasty.
relief. Patients undergoing ORIF have the advantage of maintaining bone stock, and when bony healing is complete, long-lasting function without the need for any further major reconstructive surgery is the rule. Our findings reveal 25% of our patients had early fixation failure, however, that necessitated conversion to TEA, and additional reconstructive procedures were necessary in two of these three revised patients to obtain good pain relief and elbow function. Initial TEA provided more predictable outcomes over the short-term. The disadvantages of this procedure that must be considered include excessive loss of bone stock, the stringent weight restrictions TEA patients should follow, and the devastating problem of mechanical failure or infections. Despite the disadvantages, results of this study lead us to treat preferentially comminuted and displaced intraarticular fractures of the distal humerus in older women with associated comorbidities with a primary TEA. In an older woman with adequate bone stock and without associated comorbidities, such as osteoporosis, rheumatoid arthritis, or conditions requiring the use of systemic steroids, ORIF performed by experienced surgeons is still our preferred method of treatment (Fig. 3).

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REFERENCES


