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ORIGINAL ARTICLE

Hemiarthroplasty for the treatment of distal humeral fractures: midterm clinical results

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Background: Total elbow arthroplasty is a treatment for unreconstructable distal humeral fractures; however, longevity of the implant remains a concern in younger, more active patients. Distal humeral hemiarthroplasty (DHH) offers an alternative with multiple advantages.

Methods: This is a retrospective study of 10 patients who underwent DHH for distal humeral fractures during a 4-year period (2008-2012) by a single surgeon. Patients underwent testing of range of motion, Mayo Elbow Performance Score, Disabilities of Arm, Shoulder and Hand, visual analog scale, Single Assessment Numeric Evaluation, and American Shoulder and Elbow Surgeons scores. Average patent age at surgery was 71.9 years (range, 56-81 years); average follow-up was 73.2 months (range, 36-96 months).

Results: Patients maintained improvements in Mayo Elbow Performance Scores (mean, 89.23; range, 75-100) and Disabilities of Arm, Shoulder and Hand scores (mean, 33.71; range 11.2-55.1), along with no significant decrease in range of motion compared with 1 year after surgery. Mean visual analog scale was 2.43 (range, 0-5), Single Assessment Numeric Evaluation was 74.14 (range, 50-100), and American Shoulder and Elbow Surgeons score was 72.14 (range, 48.33-100). Participants had an average flexion of 128.7° (range, 95°-142°), extension deficit of 27.1° (range, 0°-45°), supination of 79.1° (range, 45°-90°), and pronation of 73.3° (range, 50°-90°). No heterotopic ossification, elbow dislocations, or subluxations were observed. Complications included 1 fracture and 1 complaint of prominent hardware. Two patients died, and 1 patient was lost to follow-up.

Conclusion: This midterm review suggests that DHH may be an effective treatment for certain distal humeral fractures. The data suggest that elbow range of motion and functional use are maintained from comparison with short-term studies. Additional studies must be conducted to further define the role of DHH for complex fractures of the distal humerus.

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

Keywords: Total elbow arthroplasty; distal humeral hemiarthroplasty; elbow hemiarthroplasty; distal humeral fractures; elbow fracture; fracture care

Distal humeral fractures are often a challenging condition to treat. The preferred method of treatment for reconstructable fractures is open reduction and internal fixation, whereas in unreconstructable fractures where there is significant fracture comminution or joint instability, total elbow arthroplasty (TEA)

The Cedars-Sinai Medical Center Institutional Review Board approved this study (study number: Pro00040247).

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has been the gold standard.[6,15,18] Despite this, TEA has limited indications, and because of limited longevity of the implant from aseptic loosening and perioprosthetic fracture, TEA is only recommended in patients older than 70 years with sedentary lifestyles.[7,8,10,14] Patients undergoing a TEA have lifelong activity restrictions, with strict limitations on weight-bearing activities to decrease the risk of premature wear or fracture and subsequent revision.[2]

Distal humeral hemiarthroplasty (DHH) has existed since 1947, when Mellen and Phalen[16] used custom acrylic implants for active duty members of the US Army who sustained comminuted distal humeral fractures. Since that time, metallic implants were developed for use in hemiarthroplasty. Currently, only 1 implant, the Tornier (now Wright Medical, Memphis, TN, USA) Latitude system, has been used both internationally and in the USA. Its use in the USA is currently considered off-label by the US Food and Drug Administration (FDA).

DHH has multiple potential benefits over TEA, especially in younger and more active patients. Because there is no ulnar component or polyethylene, the risk of component loosening is decreased.[4,7,10] Concern for polyethylene wear is thereby eliminated, and patients have a more durable implant with less stringent restrictions on weight bearing.[2,11] Only addressing the humeral side of the elbow may decrease operative time and decrease periprosthetic fracture risk as well as provide an option for surgeons who fail at attempted fixation of the fracture; especially when using an olecranon osteotomy to visualize the distal humerus, DDH obviates the need to perform a TEA in a suboptimal setting (postosteotomy).[3] Decreased operative time and less component use is also implicated in the lower incidence of infections with the use of DHH compared with TEA, because infections are a common complication with TEA use.[12]

Despite the potential advantages of DHH over TEA, the indications for DHH are limited. Anatomic requirements for DHH include an intact and stable or reconstructable radial head and coronoid, intact or reconstructable columns, stable or reconstructable collateral ligaments, and the absence of ulnohumeral degenerative changes or trauma. A potential disadvantage of DHH is that the construction is considered unlinked, so placement of the implant must be at the correct level and orientation to restore stable joint kinematics.[12]

This study evaluated the midterm clinical outcomes of 10 patients who underwent DHH for comminuted intra-articular distal humeral fractures that were deemed unreconstructable. Our previous short-term study examined outcomes at 1 year from surgery and revealed improvements in range of motion, Mayo Elbow Performance Scores (MEPSs), and Disabilities of the Arm, Shoulder and Hand (DASH) scores.[2]

Materials and methods

This is a retrospective study of 10 patients who underwent DHH for distal humeral fractures over a 4-year period (2008-2012) by a single surgeon (J.M.I.) with fellowship training in shoulder and elbow surgery. Patients at the time of surgery underwent DHH as a US FDA off-label use.

Inclusion criteria for DHH included low distal humeral fractures with comminution and poor bone quality that were deemed unreconstructable by the senior surgeon. All fractures had been classified as AO C2 or C3, based on the Orthopaedic Trauma Association Classification system, at the time of surgery.

All fractures demonstrated an intact radial head and coronoid process, intact sigmoid notch cartilage, intact or reconstructable medial or lateral columns, or both, intact or repairable collateral ligaments, and an intact elbow extensor mechanism. All patients were skeletally mature and had no history of pathologic fracture or polytrauma at the time of surgery.

A standard posterior approach to the elbow was used in all patients. The ulnar nerve was identified and transposed anteriorly and subcutaneously. All patients underwent olecranon osteotomy, the senior author's preferred exposure for visualization of the fracture and for preservation of the collateral ligaments. Other exposure options include the triceps-spring Bryan-Morrey approach and the triceps-split, often used with the extended lateral-sided Köcher approach. The olecranon osteotomy is indicated in the case of a substantial bone defect or acute fracture, where distal fragments may necessitate resection. The Bryan-Morrey approach provides excellent joint exposure and protects the extensor mechanism, yet is associated with the risk of lateral subluxation and weakness of the triceps. The triceps-split approach provides similar exposure quality to the Bryan-Morrey approach but risks muscular weakness due to difficulty in repairing the medial half of the triceps.[19]

One patient required bicolumnar reconstruction, which was achieved using precontoured anatomic parallel locking plates (Acumed, LLC, Hillsboro, OR, USA). The medial and lateral epicondyles were preserved to protect the origin of the collateral ligaments. DHH was performed using the Tornier Latitude system (Tornier North America, Stafford, TX, USA), with implant placement focused on recreating the flexion-extension axis and radiocapitellar relationship. The insertion of the collateral ligaments and the condyles were used to determine adequate position.

The olecranon osteotomy was fixed using a 6.5-mm cannulated screw (Acumed, LLC; Fig. 1). The collateral ligaments were maintained in all patients but 1. One patient required repair of the lateral collateral ligament, which was achieved with transosseous sutures.

Patients were started on gentle range of motion exercises (active-assist) at 2 weeks postoperatively, with gentle strengthening at 6

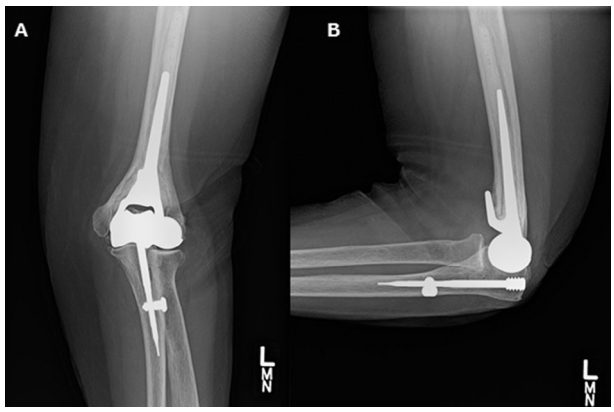

Figure 1 (**A**) Anteroposterior and (**B**) lateral views of the elbow demonstrate the distal humeral hemiarthroplasty prosthesis.