SCIENTIFIC ARTICLE

Functional and Radiographic Outcomes Following Distal Ulna Implant Arthroplasty

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Purpose To determine the outcome of ulnar head endoprostheses in the treatment of distal radioulnar joint instability, arthrosis, or both.

Methods We conducted a retrospective review of 47 patients to analyze the outcome of a single ulnar head replacement over a 10-year period. All patients reported pain or instability at the distal radioulnar joint. Standardized assessments included a patient-rated pain score, forearm range of motion, grip strength, and Mayo wrist score. We examined preoperative and postoperative radiographs for final implant position, loosening, and osteolysis.

Results We observed 47 patients for a median of 56 months (minimum, 16 mo). There was a statistically significant decrease in pain scores from 4.6 to 2.2 and improvement in the mean Mayo wrist score from 14 to 69 points after surgery. There was no significant improvement in forearm rotation and wrist function. Kaplan-Meier analysis demonstrated 83% survival at 6 years. A total of 14 patients (30%) required additional surgical procedures after primary arthroplasty. Risk factors for failure included history of previous surgery, use of an extended collar, lucency greater than 2 mm around the implant stem, and pedestal formation at the tip of the implant.

Conclusions Distal ulna implant arthroplasty reduces pain and improves function in patients with distal radioulnar joint instability, arthrosis, or both. *(J Hand Surg 2012;37A:1364–1371. Copyright © 2012 by the American Society for Surgery of the Hand. All rights reserved.)*

Type of study/level of evidence Therapeutic IV.

Key words Ulnar head arthroplasty, endoprosthesis.

The distal radioulnar joint (DRUJ) has a critical role in forearm stability and force transmission from the forearm to the wrist.[1,2] The radius rotates about the fixed ulna via the DRUJ.[3] The stabilizing constraints of the DRUJ include its bony geometry and surrounding soft tissue support.[4–6] The soft tissue support includes the extensor carpi ulnaris, pronator quadratus, DRUJ capsule, ulnotriquetral and ulnolunate ligaments, interosseous membrane, and triangular fibrocartilage complex. The primary stabilizers of the DRUJ are the palmar and dorsal radioulnar ligaments.[7,8]

Numerous surgical options exist for management of DRUJ arthritis, ranging from distal ulnar excision (ie, the Darrach procedure)[9–11] to arthrodesis of the DRUJ with a distal ulnar osteotomy (the Sauvé-Kapandji procedure).[12–15] However, these do not restore normal joint anatomy or kinematics and can lead to persistent pain and impaired function with radioulnar convergence and multidirectional distal ulnar stump instability.[16–22]

Ulnar head arthroplasty has been shown to restore the normal axis of forearm rotation while also resisting tensile and compressive forces across the wrist.[16,23–25]

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Despite early promising results, however, there is a paucity of data on the intermediate outcome of ulnar head endoprosthesis. The purpose of our study was to review the intermediate follow-up of a cohort of patients with DRUJ pain, arthritis, or instability, who were treated with the same ulnar head prosthesis at a single institution.

MATERIALS AND METHODS

We conducted an institutional review board–approved retrospective study analyzing the outcomes of patients who underwent ulnar head endoprosthetic replacement over a 10-year period (June 1998 to June 2008) with the Avanta (Small Bone Innovations, Morrisville, PA) implant, with a minimum 1-year radiological and clinical follow-up. Six consultant surgeons placed all implants. We reviewed patient medical and radiographic records and recorded information pertaining to their demographics, indication for surgery, and the number and type of previous surgeries. We evaluated pain using the visual analog pain scale (0–10). We calculated preoperative and postoperative Mayo wrist scores[26] (100–90 = excellent; 89–80 = good; 79–65 = fair; < 65 = poor). Orthopedic residents in the clinic measured grip strength using a dynamometer on setting 3 (Jamar, Cambridge, MA), key pinch, and range of motion (ROM) (wrist flexion, extension, radial and ulnar deviation, and forearm pronation and supination). At final follow-up, consultants and residents asked patients whether they were satisfied after ulnar head arthroplasty, and whether they were "much better," "better," "the same," or "worse."

Three authors independently reviewed the x-rays (S.K., P.S., K.I.P.), with high correlation between the raters (K = 0.8).[27] Specific radiographic variables noted included the anatomic shape of the sigmoid notch and ulnar variance using the method of perpendiculars.[28,29] Using the Tolat classification,[28] on coronal computed tomography (CT) sections, the articular surfaces at the sigmoid notch can be parallel to each other (type I), oblique (type II), or reverse oblique (type III). Upon axial CT views, the sigmoid notch can either be flat-faced, ski-sloped, or C- or S-shaped. We measured radiographic evidence of DRUJ subluxation from true lateral radiographs, where there was an overlap of the distal third of the scaphoid on the pisiform.[30,31] We drew longitudinal lines through the centers of the radius and ulnar head and measured the distance between the 2 lines at the distal-most aspect of the sigmoid notch. For purposes of comparison and statistical analysis within this study, a positive difference of greater than 5 mm was defined as a sign of dorsal implant instability and a negative measurement greater than 5 mm was defined as volar instability (Fig. 1). We chose a difference of 5 mm because we thought it was clinically relevant and a surgeon could readily measure it when looking at plain radiographic images. We examined immediate postoperative films and the most recent postoperative radiographs for any change in the instability value. We also examined radiographs for signs of loosening (which we noted when there was more than 2 mm lucency around the prosthesis stem), osteolysis under the ulnar head collar, pedestal formation at the tip of the stem, and changes in ulnar variance (Fig. 2).[29,32] We examined the sigmoid fossa for signs of reaction to the implant (Fig. 3).

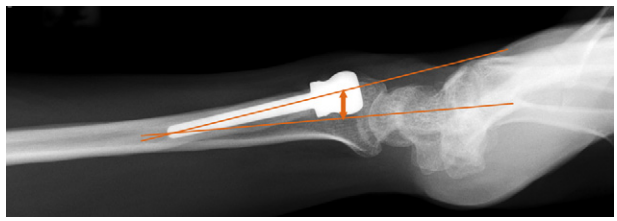

FIGURE 1: Measurement of dorsal to volar instability of the implant. We drew longitudinal lines through the centers of the radius and ulnar head at the level of the sigmoid notch and measured the distance between the 2 lines. A positive difference of greater than 5 mm was defined as dorsal instability, and a negative measurement greater than 5 mm was defined as volar instability.

We defined implant survival as the maintenance of the original arthroplasty. When an implant was replaced or cemented for fixation after original implantation, it was deemed a failure, as opposed to secondary procedures such as soft tissue stabilizations for instability, where the implant was deemed to have survived.

Statistical analysis

We compared differences in preoperative and postoperative ROM, grip strength, wrist score, pain, and radiographic evidence of dorsal instability using paired *t*-tests and the McNemar test. We constructed a Kaplan-Meier curve to visualize wrist failures over time. We used univariate Cox proportional hazards models to assess the association of demographics, implant characteristics, and immediate postoperative radiographic measures, when feasible, with the risk of implant failure. When possible, hazard ratios and *P* values were reported. When numbers were insufficient for formal hazard ratio calculations, we chose to describe the number (percentage) of the types of characteristics that failed. We investigated associations with postoperative wrist score using linear regression, adjusting for preop-