

Ulnar Head or Total Distal Radioulnar Joint Replacement, Isolated and Combined with Total Wrist Arthroplasty: Midterm Results

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J Wrist Surg 2020;9:411–416.

Abstract

Purpose Various implants have been described for ulnar head replacement (UHR) or for total replacement of the distal radioulnar joint (DRUJ). Many series are small and few reports on mid- or long-term results. This study is primarily aimed to report on the midterm results after ulnar head only and total DRUJ replacement using the uHead in the treatment of painful disorders of the DRUJ. The secondary aim of the study was to eventually assess the combination of UHR and total wrist arthroplasty (TWA).

Materials and Methods We included 20 consecutive patients in whom an UHR with the uHead was performed at our institution between February 2005 and March 2017. There were 6 men and 14 women with mean age of 59 years (range: 36–80 years). The mean follow-up time was 5 years (range: 2–15 years). Data were recorded prospectively before operation and at follow-up examinations and entered in a registry. The patients were followed-up at 3 and 6 weeks and 3, 6, and 12 months postoperatively and thereafter annually. In five cases, the uHead was implanted simultaneously with a Remotion TWA. In four cases, a Remotion TWA had been implanted previously. Kaplan–Meier survival analysis was used to estimate the cumulative probability of remaining free of revision. A nonparametric Wilcoxon’s signed-rank test was used for comparing data not normally distributed (qDASH [quick disabilities of the hand, shoulder, and arm] scores), and the paired parametric Student’s *t*-test was used for normally distributed data (pain and visual analogue scale [VAS] scores, range of motion, and grip strength). Significance was set at a *p*-value of less than 0.05.

Results Pain, grip strength, and the function improved significantly. Pain after surgery decreased with 50 points on the VAS score scale of 100, from 66 (mean), preoperatively (range: 16–97) to 16 (mean; range: 0–51), postoperatively, while grip strength nearly doubled from 12 KgF (mean; range: 4–22), before to 21 KgF (mean; range: 6–36), after the surgery. Patients function measured with qDASH scores improved from 56 (mean; range: 36–75), preoperatively to 19 (mean; range: 4–47), postoperatively. Wrist extension, flexion, and ulnar and radial deviation did not change to a clinically or statistically significant extend, neither did supination nor pronation

Keywords

- ulnar head arthroplasty
- DRUJ prosthesis
- total wrist arthroplasty
- ulnar head prosthesis
- uHead prosthesis

received
March 27, 2020
accepted
April 28, 2020
published online
June 12, 2020

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Tel: +1(212) 760-0888.

DOI <https://doi.org/10.1055/s-0040-1712981>.
ISSN 2163-3916.

improved after surgery. While three UHRs were revised early because of pain problems and/or unsatisfactory forearm rotation in two cases and infection in one, 17 had an uncomplicated postoperative course and these patients were satisfied with the results of the surgery at all the follow-ups. Due to limited number of cases, the calculation of significance in comparing combined cases with UHR only cases was abandoned.

Conclusion Ulnar head arthroplasty (uHead) showed significant improvement in pain, grip strength, and the function of the patients with a painful disability of the DRUJ, without impairment on mobility on the midterm follow-up. The overall implant survival over the time and the complication rate was acceptable.

Various implants have been described for ulnar head replacement (UHR)^{1–5} or for total replacement of the distal radioulnar joint (DRUJ).^{6–9} Many series are small^{10–12} and few report on mid- or long-term results. Some of the reports include several different ulnar head implants.^{13,14}

Radiocarpal osteoarthritis and DRUJ osteoarthritis may coexist. In these patients, joint degeneration usually begins in the radiocarpal and intracarpal joints and after some time, degeneration of the DRUJ gradually follows. In rheumatoid arthritis, this pattern is usually reversed, the degeneration beginning in the DRUJ and later affecting the wrist joint. Also malunited intra-articular distal radial fractures may lead to osteoarthritis of both joints. In all these instances, a combination of a radiocarpal prosthesis and an ulnar head implant for the DRUJ is a possible option for patients who want a motion preserving solution. To our knowledge, no series have been published reporting on this combination.

This study primarily aimed to report on the midterm results after ulnar head only and total DRUJ replacement using the uHead (Stryker, Kalamazoo, MI) in the treatment of painful disorders of the DRUJ. The secondary aim of the study was to assess the combination of UHR and total wrist arthroplasty (TWA).

Materials and Methods

Patient Inclusion and Data Collection

We included 20 consecutive patients in whom an UHR with the uHead was performed at our institution between Febru-

ary 2005 and March 2017. All patients gave written informed consent for the use of their medical data in this study, according to the ethical and patient-safety standards in Denmark. Approval was obtained from Danish Patient Safety Authority under reference: 31-1521-198.

Data were recorded prospectively before operation and at follow-up examinations and entered in a registry. The patients were followed-up at 3 and 6 weeks and 3, 6, and 12 months postoperatively and thereafter annually. Clinical assessment included wrist range of motion (ROM) and forearm rotation measured with a goniometer, and grip strength measured with a Jamar hydraulic hand dynamometer (Performance Health, Warrenville IL). Patient-reported functional outcomes were assessed with the Danish version of the quick disability of arm, shoulder, and hand questionnaire (qDASH). The general pain level was recorded on a visual analogue scale (VAS) from 0 to 100, 0 indicating no pain and 100 maximal pain. Radiographic examination included plain posteroanterior and lateral views.

Implant Design

The uHead consists of a cobalt-chrome stem and semispherical head. The stem is titanium coated and can be press fitted or cemented in the medullary canal of the ulna. The prosthesis has two stem options: a standard collar or an extended collar for secondary procedures such as failed distal ulna resections. A polyethylene component on a metal tray called stability,¹² can be used as an option to replace the radial sigmoid notch (►Fig. 1).



Fig. 1 Septic arthritis of the distal radioulnar joint treated with total joint replacement (uHead plus stability). (A) Destroyed distal radioulnar joint, (B) 3-year after joint replacement.

Indications

Indication for uHead implantation was severely painful destruction of the DRUJ that did not respond adequately to nonoperative treatment. In three cases, the stability component was used, additionally. The indication for using stability was previous infection of the DRUJ in one case, failed Sauvé-Kapandji procedure in one case and DRUJ osteoarthritis with a step-like deformity of the sigmoid notch in one case.

Operative Procedure and Postoperative Regime

Three consultant surgeons performed the UHR. The operation was performed under lateral infraclavicular block and tourniquet control and according to the manufacturer's indications. In five cases, the uHead was implanted simultaneously with a Remotion TWA (Stryker, Kalamazoo, MI; ► Fig. 2). In four cases, a Remotion TWA had been implanted previously.

Twelve patients have been operated before UHR. The total number of previous wrist surgical procedures were 22 (range: 1–5), thus leaving eight patients in whom UHR implant was a primary wrist surgical procedure. Postoperatively, the extremity was immobilized during 2 to 6 weeks in a below-the-elbow cast or splint in 15 cases. In one case an above-the-elbow splint was used for 3 weeks. The remaining cases had soft dressing bandages only. After removal of the cast or splint, hand therapy was started.

Statistics

Kaplan–Meier survival analysis was used to estimate the cumulative probability of remaining free of revision (i.e., reoperation with total or partial removal of the implants). A nonparametric Wilcoxon's signed-rank test was used for

comparing data not normally distributed (qDASH scores), and the paired parametric Student's *t*-test was used for normally distributed data (pain and VAS scores, range of motion, and grip strength). Significance was set at a *p*-value of less than 0.05.

Results

Demographics

There were 6 men and 14 women with mean age of 59 years (range: 36–80 years). Among them, 14 were operated on the right and 6 on the left side, 13 being dominant hands. The underlying condition was idiopathic degenerative arthritis in nine cases, posttraumatic arthritis in seven, and inflammatory rheumatoid arthritis in four. Of the posttraumatic cases, three had a malunited distal radial fracture, one had a Galeazzi's type forearm fracture, one had a scaphoid non-union advanced collapse (SNAC), one had sequelae after a triangular fibrocartilage complex (TFCC) injury, and one had a previous infection of the DRUJ (► Fig. 1). Operation time averaged 99 (range: 45–180) minutes and tourniquet time averaged 97 (range: 45–172) minutes.

Clinical Results at Follow-up

Three patients died from unrelated causes. None of these cases had been revised. One patient died 5 months after operation. This patient was not included in the analysis of the clinical results. Neither did three patients who had been revised. The mean follow-up time in the remaining 16 patients was 5 years (range: 2–15 years). The clinical results are summarized in ► Table 1. Wrist extension, flexion, and ulnar and radial deviation did not change to a clinically or statistically significant extend and are therefore not presented in the table.

Osteolysis, Revision Rate, and Cumulated Implant Survival

In all cases, osteolysis at the collar of the implant already showed on radiographs after 3 months. At the final follow-up, the mean width of the osteolytic area was 4 mm (range: 2–17 mm) without having caused implant subsidence.

Three UHRs were revised. In one patient with an isolated UHR, the implant was removed after 1.5 years due to persistent pain and restricted supination. Two patients, both diagnosed with a rheumatoid arthritis (RA) of the wrist, with combined UHR and TWA, had ultimately both implants revised. One of these two patients was originally operated in another institution, with a Remotion TWA. When seen by us 5 years later, due to painful rheumatoid arthritis of the DRUJ, the patient was offered an ulnar head prosthesis. Surgery went successfully but we had to remove the implant after 1 year because of persistent pain and instability of the DRUJ. Ten years after the initial TWA the patient fell and dislocated the TWA. Closed reduction and later replacement with a thicker polyethylene insert failed in stabilizing the wrist and finally a wrist arthrodesis was performed.

In the second patient, a TWA was originally performed. After 4 years, the implant was revised because of subsidence



Fig. 2 62-year-old woman with a combined TWA and UHR arthroplasty, radiological status at a 14 years follow-up. UHR, ulnar head replacement; TWA, total wrist arthroplasty.

Table 1 The clinical results of the study

Measure	Type of replacement			
	uHead alone	uHead + Remotion	uHead + stability	Total ^a
Number of patients:	6	7	3	16
Pain (VAS score) Mean (range)				
Preoperative	58 (16–92)	66 (38–97)	72 (55–83)	66 (16–97)
Postoperative	21 (0–51)	14 (0–45)	13 (0–33)	16 (0–51) $p < 0.001$
Function (qDASH score) Median (range)				
Preoperative	56 (52–59)	55 (45–68)	54 (36–75)	56 (36–75)
Postoperative	21 (5–47)	22 (4–47)	6 (4–18)	19 (4–47) $p < 0.006$
Grip strength (kgF) Mean (range)				
Preoperative	10 (4–20)	15 (7–22)	10 (6–12)	12 (4–22)
Postoperative	20 (8–30)	24 (16–30)	19 (6–36)	21 (6–36) $p = 0.005$
Pronation (degrees) Mean (range)				
Preoperative	73 (60–85)	76 (60–90)	77 (70–80)	75 (60–90)
Postoperative	73 (60–90)	74 (60–90)	77 (70–80)	75 (60–90) $p = 0.92$
Supination (degrees) Mean (range)				
Preoperative	70 (10–100)	79 (65–90)	85 (80–95)	77 (10–100)
Postoperative	63 (45–80)	78 (60–95)	77 (70–80)	73 (45–95) $p = 0.54$
Satisfaction (number of patients)				
(Very) satisfied	6	7	3	16
(Very) disappointed	0	0	0	0

Abbreviations: qDASH, quick disabilities of the arm, shoulder, and hand; VAS, visual analogue score.

^aThree revised patients and one patient who died 5 months after operation excluded.

of both components. One year later, an UHR was performed because of pain and degenerative disorder of the DRUJ. After 1.5 years, the patient developed wrist pain, swelling, fever, and high levels of C-reactive protein (CRP) and leukocyte was suggestive to infection. Bacteriological cultures revealed *Staphylococcus epidermidis*. All the implants were removed. A relevant antibiotic treatment was given for 3 months, the patient's wrist/DRUJ was temporary immobilized with a removable orthosis and finally a total wrist arthrodesis was performed.

The cumulative survival rate curve in the total cohort is shown in ►Fig. 3.

Discussion

While three of the 20 patients in our cohort had to be revised because of pain problems and/or unsatisfactory forearm rotation in two cases and infection in one, 17 had an uncomplicated postoperative course. All these patients were satisfied with the result. The clinical outcomes in the nonrevised patients in our study are similar to those reported in other publications with isolated UHR.^{15–20}

Pain, function, and grip strength, all were improved, while motion did not change clinically or statistically significant. Three of our patients had to be revised. However, our cumulated implant survival and complication rate correspond well with what is generally reported.^{21,22}

In the recent systematic review presented by Moulton and Giddins,²² the authors found the total complication and revision rate of 28 % (100 out of total 355 cases) in the reports of UHRs and correspondingly, in 28% (88 out of 315 cases) in reports of total DRUJ arthroplasties. Only the complicated cases that need surgery were counted. The implant survival rate was 93% at a mean follow of 45 months and 97% at a mean of 56 months in reports of UHR and total DRUJ replacements, respectively.

It must be noted that two of the revisions in our series were needed in complex cases of combined UHR and TWA. The most common complications reported in the literature are instability and sigmoid notch erosion. We encountered instability in one case only and sigmoid notch erosion was not a problem in our series. We tried to avoid this problem by using the stability component in selected cases. It was used in three cases without complications; this

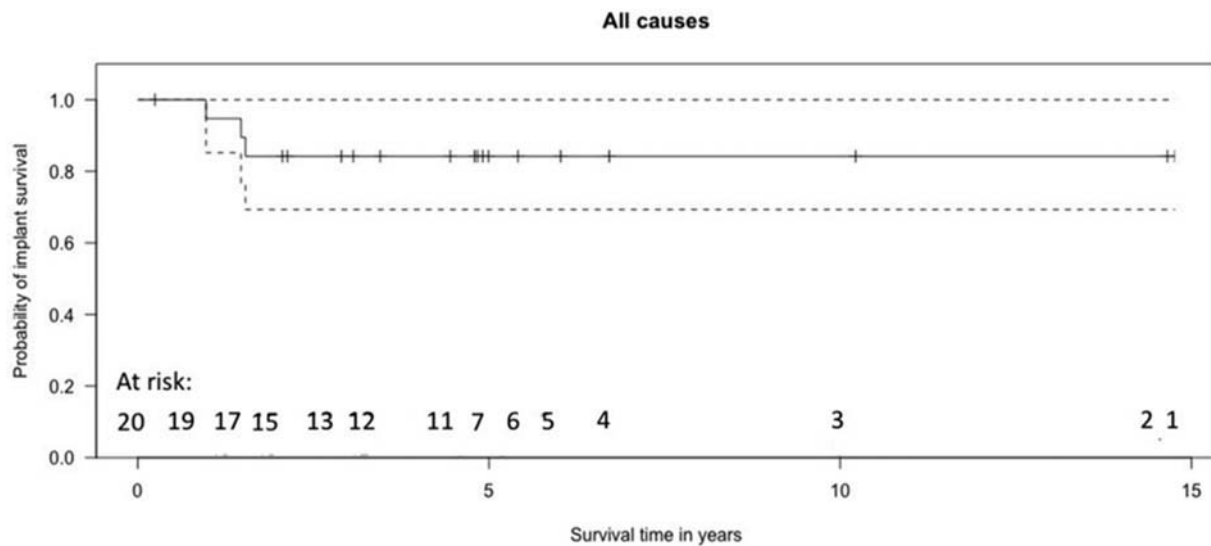


Fig. 3 Implant survival. The probability of revision is visualized in the graph below. The solid line indicates the probability of implant survival and the dashed lines are the corresponding 95% confidence bands. Patients are censored at their last visit. The numbers at risk on the X-axis indicate the patients that did not experienced revision within the period they were observed.

unconstrained but total DRUJ replacement efficiently improves the stability of the joint and can safely be used in a situation where total DRUJ replacement is required, as an alternative to a semiconstrained total DRUJ implant design. However, further results with larger series are needed to support this evidence.

Bone resorption at the prosthetic neck is frequently encountered. It tends to stabilize with time and does not cause prosthetic loosening.¹⁵ Our findings agree with this opinion in none of our cases this osteolysis had caused prosthetic subsidence. All three revisions were performed in an early stage when bone resorption was not important.

In the studies of Axelsson et al¹⁶ and Kakar et al,¹⁸ authors found previous surgery of the wrist to constitute a risk of poor outcome. These findings were observed as a tendency, without statistical significance. We could not confirm that an extended collar constituted a risk factor, as supposed by Kakar et al.

Strength and Limitations

One strength of our study is that we were able to report on combined UHR and TWA, which we have not encountered in other publications. UHR without the use of stability makes it possible to perform a simultaneous TWA if needed. In our cases, the clinical results after combined UHR and TWA were similar to those after simple UHR. Another strength of the study is that we had preoperative clinical data on all patients and that we systematically did follow-up examinations.

The limitation of our study is the relatively small number of cases, especially in the subgroups. For this reason, we decided not to make any calculation of significance in comparing combined cases with UHR only cases. Another weakness is the lack of control with other procedures, first of all ulnar head resection, the Sauvé-Kapandji procedure, and

the frequently used semiconstrained total DRUJ prosthesis, Aptis (Aptis Medical, Glenview, KY).²³ Especially, we cannot conclude on the possible benefit of using UHR rather than Darrach's procedure when performing TWA in cases that also have a destroyed DRUJ.

Conclusion

Ulnar head arthroplasty (uHead) showed significant improvement in pain, grip strength, and the function of the patients with a painful disability of the DRUJ, without impairment on mobility on the midterm follow-up. The overall implant survival over the time and the complication rate was acceptable.

Conflict of Interest

None declared.

References

- van Schoonhoven J, Fernandez DL, Bowers WH, Herbert TJ. Salvage of failed resection arthroplasties of the distal radioulnar joint using a new ulnar head prosthesis. *J Hand Surg Am* 2000;25(03):438-446
- Herbert TJ, van Schoonhoven J. Ulnar head replacement. *Tech Hand Up Extrem Surg* 2007;11(01):98-108
- van Schoonhoven J, Mühlendorfer-Fodor M, Fernandez DL, Herbert TJ. Salvage of failed resection arthroplasties of the distal radioulnar joint using an ulnar head prosthesis: long-term results. *J Hand Surg Am* 2012;37(07):1372-1380
- Cooney WP, Berger RA. Distal radioulnar joint implant arthroplasty. *J Am Soc Surg Hand* 2005;5:217-231
- Willis AA, Berger RA, Cooney WP III. Arthroplasty of the distal radioulnar joint using a new ulnar head endoprosthesis: preliminary report. *J Hand Surg Am* 2007;32(02):177-189
- Scheker LR, Babb BA, Killion PE. Distal ulnar prosthetic replacement. *Orthop Clin North Am* 2001;32(02):365-376, x
- Laurentin-Pérez LA, Goodwin AN, Babb BA, Scheker LR. A study of functional outcomes following implantation of a total distal radioulnar joint prosthesis. *J Hand Surg Eur Vol* 2008;33(01):18-28

- 8 Savvidou C, Murphy E, Mailhot E, Jacob S, Scheker LR. Semiconstrained distal radioulnar joint prosthesis. *J Wrist Surg* 2013;2(01):41–48
- 9 Schuurman AH. A new distal radioulnar joint prosthesis. *J Wrist Surg* 2013;2(04):359–362
- 10 Garcia-Elias M. Eclipse: partial ulnar head replacement for the isolated distal radio-ulnar joint arthrosis. *Tech Hand Up Extrem Surg* 2007;11(01):121–128
- 11 Bigorre N, Saint Cast Y, Cesari B, Rabarin F, Raimbeau G. Intermediate term evaluation of the Eclipse distal radio-ulnar prosthesis for rheumatoid arthritis. A report of five cases. *Orthop Traumatol Surg Res* 2016;102(03):345–349
- 12 Ewald TJ, Skeete K, Moran SL. Preliminary experience with a new total distal radioulnar joint replacement. *J Wrist Surg* 2012;1(01):23–30
- 13 Yen Shipley N, Dion GR, Bowers WH. Ulnar head implant arthroplasty: an intermediate term review of 1 surgeon's experience. *Tech Hand Up Extrem Surg* 2009;13(03):160–164
- 14 Warwick D, Shyamalan G, Balabanidou E. Indications and early to mid-term results of ulnar head replacement. *Ann R Coll Surg Engl* 2013;95(06):427–432
- 15 Herzberg G. Periprosthetic bone resorption and sigmoid notch erosion around ulnar head implants: a concern? *Hand Clin* 2010;26(04):573–577
- 16 Axelsson P, Sollerman C, Kärrholm J. Ulnar head replacement: 21 cases; mean follow-up, 7.5 years. *J Hand Surg Am* 2015;40(09):1731–1738
- 17 Kaiser GL, Bodell LS, Berger RA. Functional outcomes after arthroplasty of the distal radioulnar joint and hand therapy: a case series. *J Hand Ther* 2008;21(04):398–409
- 18 Kakar S, Swann RP, Perry KI, Wood-Wentz CM, Shin AY, Moran SL. Functional and radiographic outcomes following distal ulna implant arthroplasty. *J Hand Surg Am* 2012;37(07):1364–1371
- 19 Sauerbier M, Arsalan-Werner A, Enderle E, Vetter M, Vonier D. Ulnar head replacement and related biomechanics. *J Wrist Surg* 2013;2(01):27–32
- 20 Sabo MT, Talwalkar S, Hayton M, Watts A, Trail IA, Stanley JK. Intermediate outcomes of ulnar head arthroplasty. *J Hand Surg Am* 2014;39(12):2405–11.e1
- 21 Calcagni M, Giesen T. Distal radioulnar joint arthroplasty with implants: a systematic review. *EFORT Open Rev* 2017;1(05):191–196
- 22 Moulton LS, Giddins GEB. Distal radio-ulnar implant arthroplasty: a systematic review. *J Hand Surg Eur Vol* 2017;42(08):827–838
- 23 Rampazzo A, Gharb BB, Brock G, Scheker LR. Functional outcomes of the aptis-scheker distal radioulnar joint replacement in patients under 40 years old. *J Hand Surg Am* 2015;40(07):1397–1403.e3