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Original Research

Retrospective and Prospective Outcomes of Distal Radioulnar Joint Prosthesis Arthroplasty at a Single Center

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Purpose: Distal radioulnar joint (DRUJ) arthritis can cause painful and limited motion of the forearm leading to decreased function. When conservative treatment options are exhausted, surgical treatments are the next step. The purpose of this study was to retrospectively and prospectively evaluate outcomes of Scheker DRUJ total arthroplasty at a single center and add to the limited data on this procedure.
Methods: In a retrospective and prospective cohort of 12 patients, 13 DRUJ prosthetics implanted from 2014 to 2021 were evaluated from a single center. The primary outcome was patient satisfaction with the procedure, including comparisons of preoperative and postoperative visual analog scale, Disabilities of the Arm, Shoulder, and Hand, and willingness to repeat the procedure. Secondary outcomes included range of motion, subjective grip strength, need for hardware revision, subsequent procedures, and postoperative complaints.
Results: Out of 12 patients that were at least 1-year after surgery from DRUJ arthroplasty, 1 was deceased at the time of final survey and 1 underwent bilateral DRUJ arthroplasty. Seven of 12 available patients were surveyed over the phone. On average, patient range of motion after surgery was 76° in each direction for pronation and supination. There was a clinically significant improvement in the Disabilities of the Arm, Shoulder, and Hand score and a statistically significant improvement in visual analog scale pain rating. Seventy-five percent of patients surveyed were satisfied with their outcomes and would undergo the surgery again. Only one patient required additional surgery, and there were no instances of hardware failure at an average follow-up of 40 months.
Conclusions: Our study has shown positive outcomes with decrease in pain, improvement in function via Disabilities of the Arm, Shoulder, and Hand evaluation, and subjective patient satisfaction, with a 100% prosthesis survival rate. The DRUJ arthroplasty prosthesis is a viable alternative to other DRUJ salvage procedures.
Type of study/level of evidence: Therapeutic Level III.

The distal radial ulnar joint (DRUJ) is the articulation between the sigmoid notch of the distal radius and ulnar head. The DRUJ and soft tissue support of the triangular fibrocartilage complex,[1] along with the proximal radial ulnar joint and the bow of the radial shaft allow for pronation and supination of the forearm. Arthritis at the DRUJ can cause painful and limited pronation and supination of the forearm, leading to decreased function of the upper extremity. Distal radial ulnar joint arthritis can be caused by various processes including traumatic, inflammatory, congenital, or degenerative causes. Conservative treatment options for DRUJ arthritis include bracing, injections, and topical and oral anti-inflammatories; however, when such treatment options are exhausted, surgical treatments are the next step. Historically, resection of the ulnar

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head has been the surgical treatment of choice; however, instability and impingement of the distal ulnar stump on the radius can result in pain and dysfunction, leading to unsatisfactory results.[2] To manage these complications, soft tissue stabilizing techniques and DRUJ arthroplasty have been developed.[3] The total DRUJ (Fig. 1) is unique from other resection arthroplasties and ulnar head replacements in that it replaces all the components of the DRUJ, including the ulnar head, triangular fibrocartilage complex, and sigmoid notch.[4] Total DRUJ arthroplasty is an option for DRUJ arthrosis that has shown satisfactory results in terms of pain relief and improved motion.[5–8] However, a paucity of data exists as it is an uncommon procedure and frequently performed as a salvage procedure for failed resection arthroplasties. The purpose of this study was to retrospectively and prospectively evaluate the outcomes of the Scheker DRUJ total arthroplasty at a single center and add to the limited data on this procedure.

Materials and Methods

The study was conducted between 2014 and 2021 at a single center. Two surgeons from the same center contributed cases to the study. Indications for surgery were painful wrist DRUJ arthritis with painful or limited pronation and supination. All patients that had undergone a DRUJ arthroplasty with a prosthesis at our center were included if the procedure had occurred at least more than 1 year ago. The Aptis–Scheker prosthesis (Aptis Medical, Louisville, KY) was the implant used for the procedure. This study was approved by the Institutional Review Board.

Surgical technique

The surgical technique performed by the primary surgeons was followed as described by Scheker.[6,9] An 8–9 cm ulnar longitudinal incision is made over the distal forearm/wrist just radial to the extensor carpi ulnaris. A full-thickness skin flap is elevated off of the fascia, so that the second extensor compartment can be reached. An ulnarly-based extensor retinaculum flap is elevated from the second compartment and reflected to the DRUJ, to be later used as a barrier between the tendons and the prosthetic. Next, with the flap retracted ulnarly, an incision is made between the extensor carpi ulnaris and extensor digiti quinti while taking care to protect the dorsal ulnar sensory nerve. Next, the extensor carpi ulnaris is mobilized ulnarly and the extensor digitorum communis tendons are elevated off the interosseus membrane. This allows for further visualization of the ulnar head. Retractors are used to protect the surrounding soft tissue, and the ulnar head is resected with an oscillating saw approximately 2 cm proximal from the distal aspect of the head or at the narrowest portion of the neck. If the radial attachment of the triangular fibrocartilage complex is found intact, it is dissected from the ulnar head and left in place to function as a barrier between the carpus and the implant. Once the ulnar head is resected, the ulna can be displaced volarly to allow for visualization of the radial sigmoid notch and interosseus crest of the radius. All osteophytes from the DRUJ are removed. Next, 8–9 cm of the interosseus membrane is elevated from the dorsal radius or until full pronation and supination is achieved. The radial plate is then trialed, and it is important to ensure that it is directed toward the ulna and not rotated dorsally or volarly. The plate should be aligned with the volar edge of the radius, and it must be 3–20 mm proximal from the distal edge of the radius (to prevent carpal impingement). The trial is pinned in place, and fluoroscopic imaging is used to confirm position. Once an acceptable position is achieved, the screw holes are drilled, the trial is removed, and the final plate is placed. Next, additional ulna is resected based on the mated guide. The ulnar canal is then prepared with sequential drilling and broached up to the appropriate size. The final stem is then inserted, and the prosthesis is assembled connecting the radial plate to the ulnar stem. The wrist is taken through a range of motion to ensure full pronation and supination. The wound is irrigated to remove all bony fragments, and the flaps are closed with braided nonabsorbable sutures in the reverse order they were created.

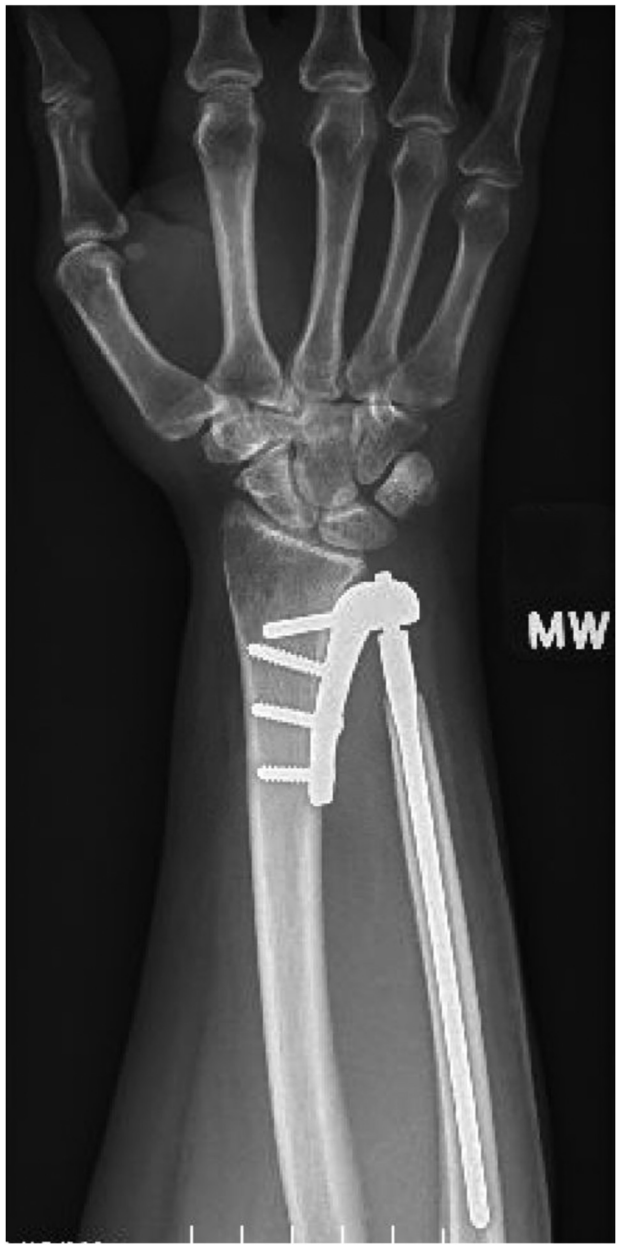

Figure 1. Distal radioulnar joint prosthesis in the right wrist.

Data collection

For the retrospective portion of the study, patient charts were reviewed. Demographic data were collected including patient age, sex, handedness, laterality of surgical intervention, prior procedures, history of prior trauma, and time to follow-up. Other data points collected from the chart included preoperative visual analog scale (VAS) scores, preoperative Disabilities of the Arm, Shoulder,

and Hand (DASH) scores, preoperative physical examination, and indications for surgery. Postoperative data points were also collected from the chart, and these included patient satisfaction, range of motion in pronation and supination, postoperative complaints, subsequent procedures, and radiographic assessment evaluating the implant for loosening via presence or absence of osteolysis around the implant. For the prospective part of the study, the patients were called and asked if they were willing to participate in a phone survey. Verbal consent through the phone was obtained before proceeding with phone survey questions. The data collected during the phone survey included a *Quick*DASH, VAS score, satisfaction with procedure, willingness to repeat procedure, and perceived grip strength of contralateral hand.

Statistics

Paired *t* test was used to evaluate the improvement in outcomes, and an independent *t* test was used to compare study outcomes between dichotomous study variables. A minimal clinically important difference of 16 points was used for *Quick*DASH. Means and standard deviations were reported for continuous variables, percentages, and categorical variables. Significance was considered for alpha as <0.05.

Results

There were a total of 12 patients at our center that had undergone DRUJ prosthesis arthroplasty between November 2014 and March 2021 using the Scheker prosthesis for a total of 13 cases. The average postoperative follow-up at time of survey for the eight patients surveyed was 40 months (range, 13–61 months). Average age of patients was 60 years, with 3 (23%) of 13 female cases and 10 (77%) of 13 male cases. Six (46%) of 13 patients had DRUJ arthroplasty of the right hand, 7 (54%) of 13 of the left hand, and 1 patient had bilateral DRUJ arthroplasty. Eight (62%) of 13 patients had prior procedures performed on the same hand as DRUJ arthroplasty. Three (23%) of 13 patients had history of trauma to the wrist prior to DRUJ arthroplasty. Preoperative DASH score was recorded in 8 (62%) of 13 patients, with an average of 54 (range, 23–80). Preoperative VAS score was recorded in 11 (85%) of 13 patients, with an average of 7.2 (range, 6–8.5). The most common preoperative physical examination complaints were pain with pronation/supination and tenderness to palpation at the DRUJ in 6 (46%) of 13 patients, and DRUJ instability demonstrated by a positive shuck test in 5 (38%) of 13 patients. All patients required surgical intervention secondary to degenerative or posttraumatic pathology.

In the postoperative period at last clinical follow-up, 11 (85%) of 13 patients were happy with the results, 1 (8%) of 13 was unhappy, and 1 patient's satisfaction was not recorded. Average pronation/supination at last postoperative clinic visit was 76° in both directions. Average flexion (68°) and extension (63°) of the wrist was recorded for only 6 (46%) of 13 patients. There were 4 (31%) of 13 patients with prior radiocarpal fusion limiting motion in this plane. Flexion and extension were recorded as full for 2 (15%) of 13 patients, and 1 (8%) of 13 patients had no range of motion data recorded. The most common complaint at last postoperative visit was ulnar-sided wrist pain in 4 (31%) of 13 patients. There were no complications directly related to DRUJ arthroplasty. One patient underwent subsequent surgery, requiring carpal tunnel release. At final clinical follow-up, no patients had radiographic evidence of hardware lucency.

A prospective telephone survey was completed with 8 (62%) of 13 patients participating. One patient was deceased at the time of survey. Average preoperative VAS score recalled by patients in the survey was 75, whereas postoperative VAS at the time of the survey was 28.8. There was a statistically significant reduction in pain ($P \leq .007$), indicating successful pain reduction outcomes. Of the available patients, six had paired preoperative and postoperative QuickDASH scores, with averages of 53.8 (1st and 3rd interquartile ranges: 31.3, 74.8) and 30.7 (1st and 3rd interquartile ranges: 0, 66.3), respectively. There was no statistically significant difference in preoperative and postoperative DASH scores; however, when using a minimal clinically important difference of 16, 5 of 6 pairs met the criteria demonstrating meaningful improvement in 83% of patients, with average improvement of 23 points. On average, patients believed that postoperative grip strength of their affected wrist was 73% of their nonsurgical wrist. Of eight patients surveyed, six were satisfied with the outcome of the procedure and would choose to undergo the procedure again, whereas two were dissatisfied and would not undergo the same procedure.

Discussion

Dysfunction of the DRUJ can be caused by several factors, including degenerative osteoarthritis, inflammatory osteoarthritis, posttraumatic changes, or congenital abnormalities. There are various options for the treatment of DRUJ dysfunction. Several surgical procedures available include the Darrah procedure, hemi resection procedures, the Sauve–Kapandji procedure, and total ulnar head arthroplasty. These procedures have been shown to have drawbacks, such as altering the DRUJ relationship or progression to an unstable ulnar stump despite soft tissue stabilization procedures.

The Scheker DRUJ arthroplasty is unique from other salvage procedures in that it restores the main components of the DRUJ and has been shown to be a reliable, reproducible alternative to previously described DRUJ procedures with good outcomes.[4] In their retrospective case series, Brannan et al[7] evaluated the clinical and radiographic outcomes of 21 patients who underwent DRUJ arthroplasty using the Scheker prosthesis. They found that patients demonstrated good clinical outcomes with a median postoperative DASH score of 26.7 and median VAS pain score of 0.6 at rest and 2.1 with activity. Patients had restoration of supination strength, mild levels of pain, and a moderate complication rate of 29%. In our case series, we found similar results. Overall, our patients demonstrated excellent postoperative range of motion in pronation and supination, clinically significant improvement in function, statistically significant decrease in pain, and subjective high satisfaction with their outcomes. Although the lack of statistically significant differences in DASH score might be related to our relatively small sample size, it is also possible that DRUJ arthroplasty, in fact, does not offer significant improvement in function while still improving pain. Large studies are needed to better understand how function is improved after DRUJ arthroplasty. Interestingly, the majority of patients were still subjectively satisfied with their outcomes. This is likely because all patients reported preoperative pain, whereas only approximately half had limited range of motion at the forearm. As demonstrated by our results, DRUJ arthroplasty seems to be most effective in pain reduction, which afflicted all patients prior to surgery. This could explain why patients were satisfied with their outcome despite not being able to show a statistically significant improvement in function.

Arthrosis of the DRUJ causes considerable pain and discomfort with range of motion in the plane of pronation and supination. Studies have shown that the Scheker prosthesis resolves such pain and restores this plane of motion.[10–12] In our study, although we did not consistently document preoperative range of motion, we did note that patients had nearly full pronation and supination after surgery and had no complaints of pain in this plane of motion.

Prior studies have also demonstrated good outcomes of DRUJ arthroplasty in wrists that have undergone prior radiocarpal arthrodesis.[11,12] In our series, 7 (54%) of 13 cases had prior ipsilateral wrist surgery, including 4 with prior wrist arthrodesis. Our data did not show statistically significant differences in pain reduction or DASH score improvement when comparing patients that did and did not have prior procedures on the ipsilateral hand or wrist.

After an average follow-up of 40 months, there were no revisions and no signs of lucency of the DRUJ arthroplasty, with only one subsequent surgery following the arthroplasty (carpal tunnel release). Our results support various other studies that demonstrated similar high survivability of the DRUJ prosthesis. One study showed 100% survival after an average of 60 months of follow-up,[10,12,13] whereas another study similarly found a 5-year survival rate of 96%.[11]

Patients who said they would undergo the procedure again did not have a statistically significant increase in functional improvement. Although we saw a difference of 24 points between the 2 groups regarding their DASH scores, there was no statistically significant difference in postoperative DASH scores in patients that were and those that were not satisfied secondary to the high standard deviation of scores. This is likely due to the small sample size of the series. However, it is interesting to note that despite not having statistically significant improvement in function demonstrated by DASH scores, most patients would undergo the procedure again and were satisfied with their outcomes. On average, patients who have a preoperative DASH score of 50 have moderate difficulty with regular daily activity activities and a moderate amount of daily pain. When this score goes down to 25 after surgery, patients only have mild difficulty with regular daily activities and a mild amount of daily pain. However, there is a statistically significant difference in preoperative and postoperative VAS scores in patients that are satisfied and patients that are not satisfied at the time of the survey and between patients that would undergo and patients that would not undergo the procedure again. This demonstrates a positive correlation between satisfied patients and decrease in pain level.

There are several limitations to this study. One such limitation is the small sample size of the patients. Because DRUJ total arthroplasty is not a common procedure, we hope to continue collecting data at our center while more such procedures are completed to strengthen the results of our data. There was also inconsistent follow-up among patients that may have potentially skewed our data. Although a major subset of our patients (75%) was reached for a prospective survey, this was still a small sample size.

Despite the small sample size in our study, we have shown positive outcomes in terms of decrease in pain, improvement in function via DASH evaluation, good range of motion in the plane of pronation and supination, and subjective patient satisfaction, in addition to a 100% survival rate of the prosthesis. The DRUJ arthroplasty prosthesis is a viable alternative to prior DRUJ salvage procedures.

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References

1. Palmer AK, Werner FW. The triangular fibrocartilage complex of the wrist–anatomy and function. *J Hand Surg Am*. 1981;6(2):153–162.
2. Hartz CR, Beckenbaugh RD. Long-term results of resection of the distal ulna for post-traumatic conditions. *J Trauma*. 1979;19(4):219–226.
3. Breen TF, Jupiter JB. Extensor carpi ulnaris and flexor carpi ulnaris tenodesis of the unstable distal ulna. *J Hand Surg Am*. 1989;14(4):612–617.
4. 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(1):18–28.
5. Schuurman AH, Teunis T. A new total distal radioulnar joint prosthesis: functional outcome. *J Hand Surg Am*. 2010;35(10):1614–1619.
6. Scheker LR. Implant arthroplasty for the distal radioulnar joint. *J Hand Surg Am*. 2008;33(9):1639–1644.
7. Brannan PS, Ward WA, Gaston RG, Chadderdon RC, Woodside JC, Connell B. Two-year clinical and radiographic evaluation of scheker prosthesis (aptis) distal radioulnar joint arthroplasty. *J Hand Surg Am*. 2022;47(3):290.e1–290.e11.
8. Scheker LR, Scheker JM. The distal radio ulnar joint: a journey of discovery and invention of the Aptis prosthesis. *J Hand Surg Eur Vol*. Published online December 15, 2022. https://doi.org/10.1177/17531934221142169
9. Scheker LR, Babb BA, Killion PE. Distal ulnar prosthetic replacement. *Orthop Clin North Am*. 2001;32(2):365–376.
10. Galvis EJ, Pessa J, Scheker LR. Total joint arthroplasty of the distal radioulnar joint for rheumatoid arthritis. *J Hand Surg Am*. 2014;39(9):1699–1704.
11. 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(7):1397–1403.e3.
12. Lans J, Chen SH, Jupiter JB, Scheker LR. Distal radioulnar joint replacement in the scarred wrist. *J Wrist Surg*. 2019;8(1):55–60.
13. Kachooei AR, Chase SM, Jupiter JB. Outcome assessment after aptis distal radioulnar joint (DRUJ) implant arthroplasty. *Arch Bone Jt Surg*. 2014;2(3):180–184.