Clinical Results of Patients with Combined Aptis Distal Radioulnar Joint Arthroplasty and Total Wrist Arthroplasty

Shirley D. Stougie, BHS[1,*] Hero J.A. Zijlker, MD[1,*] J. Henk Coert, MD, PhD[1]

[1] Department of Plastic, Reconstructive and Hand Surgery, University Medical Center Utrecht, Utrecht, The Netherlands

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Address for correspondence Shirley D. Stougie, BHS, Department of Plastic, Reconstructive and Hand Surgery, University Medical Center Utrecht, Utrecht, The Netherlands (e-mail: s.d.stougie@umcutrecht.nl).

Abstract

Background: Severely destroyed wrists can be managed by combined radiocarpal and distal radioulnar joint (DRUJ) replacement that reduces pain while mobility is ought to be reserved. The combination of these arthroplasties is rarely reported in the literature.

Purpose: This article describes the clinical outcomes of six consecutive patients with both total wrist and Aptis DRUJ arthroplasty with a median follow-up of 50 months (range: 18–108 months).

Patients and Methods: Patients with a TWA combined with an Aptis DRUJ arthroplasty were retrospectively identified. The patients were treated between 2011 and 2020.

Results: The flexion-extension arc was slightly decreased in three cases while forearm rotation was improved in three patients. Pain was adequately reduced in four patients and significant pain was seen in two patients. Although three of four patients could not return to previous work, all patients claimed to be satisfied with the result of the procedure.

Conclusion: This article demonstrates the possible feasibility of this combined arthroplasty in patients with a destroyed and unstable wrist.

Level of Evidence: III

Keywords
- Aptis
- distal radioulnar joint arthroplasty
- total wrist arthroplasty
- total wrist implant

Wrist trauma leading to destruction of the radiocarpal and distal radioulnar joint (DRUJ) is likely to compromise wrist function and decrease quality of life. The treatment of this combined pathology is very challenging. Total joint replacement aims to simultaneously reduce pain and preserve motion and is nowadays considered a standard therapy. The conventional treatment for this combined pathology consists of radiocarpal joint replacement combined with the Sauvé–Kapandji or Darrach procedure that aims to maintain wrist function, this however often leads to an unstable and inherently painful DRUJ.[1] Scheker et al[2] addressed this issue by developing a semiconstrained ball-and-socket arthroplasty with good results and high survival rates and patient satisfaction.[3,4] In the literature only one paper describes a case with (semi-) constrained replacement of both the radiocarpal and DRUJ.[5] This article describes the clinical outcomes of six consecutive patients with combined (semi-) constrained Aptis DRUJ and total wrist arthroplasty (TWA).

Methods

Study Design

Patients with a TWA combined with an Aptis DRUJ arthroplasty were retrospectively identified. The patients were treated between 2011 and 2020 at University Medical Centre Utrecht.. Clinical data were anonymously extracted from the patient's medical files: demographics, medical history, revisions, complications, wrist range of motion (ROM), visual analog scale (VAS), grip strength, and X-rays. Written informed consent was obtained during medical follow-up.

* *Both authors contributed equally to the manuscript.*

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Table 1 Sequence of implant placement

Implant sequence	Case
Aptis DRUJ arthroplasty after Universal 2 TWA	1, 2, 3, and 4
Universal 2 TWA after Aptis DRUJ arthroplasty	5
Simultaneous Remotion TWA and Aptis DRUJ arthroplasty	6

Abbreviations: DRUJ, distal radioulnar joint; TWA, total wrist arthroplasty.

Surgical Technique (Tips and Tricks) and Postoperative Treatment

The sequence of the implant placement (►**Table 1**) differed somewhat. All operations were performed by the Senior Author: JHC with an experience level V according to Nakamura.[6]

DRUJ Arthroplasty in Wrists with TWA In Situ

The DRUJ was approached through a longitudinal hockey stick incision (or via the scar of previous surgery), then through the fifth extensor compartment followed by opening the dorsal DRUJ capsule longitudinally. The distal ulna ($n=3$) or ulnar head implant (Herbert, KLS Martin Medizin, Tuttlingen, Germany, $n=1$) was removed. The volar lip of the radius was flattened with a saw blade to prepare placement of the radial component more proximally than originally described by Scheker et al.[2] The trial radial component was placed and fixated with two Kirschner wires. Drilling for peg placement until touching the TWA stem. Next step is checking with Fluoroscan and measuring the length of the peg. The peg on the definite radial component was shortened as measured (►**Fig. 1**). The placement of the screws is done in the standard fashion taking into consideration that the first distal screw could touch the TWA. Here, we check with the Fluoroscan again. Hand therapy will start after 10 days of casting.

Noteworthy, in case 4, the Universal 2 TWA (Integra LifeSciences, Plainsboro, NJ) prior to Aptis (Aptis Medical, Louisville, KY) was replaced during the same operation due to loosening of the distal component. The implant was approached through the existing longitudinal scar. The third and fourth extensor compartments were opened and the tendons retracted radially and ulnarly. The dorsal wrist capsule was opened as a distally based flap. Osteotomes were used to remove the Universal 2 TWA, taking care to preserve as much carpal and metacarpal bone stock as possible. The bone stock was used to reconstruct the distal row using a tricortical and iliac crest. The new proximal implant was placed according to the operative technique described by Adams,[7] followed by radiology control for final position.

Universal 2 TWA in Wrist with Aptis DRUJ Arthroplasty In Situ

The radial component of the Aptis DRUJ arthroplasty needs to be removed to prepare the radius for implantation of the TWA. Approach to the DRUJ and the radiocarpal joint was as described before. The Universal 2 TWA was performed uncemented according to Adams.[7] It is important not to "overstuff" the radius with the radial component. Choose the smaller size when in doubt. The radial component of the Aptis DRUJ arthroplasty was repositioned with new and shorter screws after shortening the peg and distal screw. Position of both implants was evaluated under Fluoroscan. Hand therapy will start after 10 days of casting.

Aptis DRUJ Arthroplasty and Remotion TWA in Patients with Radiocarpal and DRUJ Arthrodesis

The total wrist arthrodesis was converted to a Remotion TWA (Small Bone Innovation, Morristown, PA) due to a persisting nonunion of the wrist after several attempts. Placement of both implants was performed as described. It is important not to "overstuff" with the radial component of the TWA. Choose the smaller size when in doubt. This will facilitate the Aptis DRUJ arthroplasty easier. Hand therapy will start after 14 days of casting.

Radiographic Assessment

Postoperative plain films were reviewed at follow-up for positioning and signs of implant loosening.

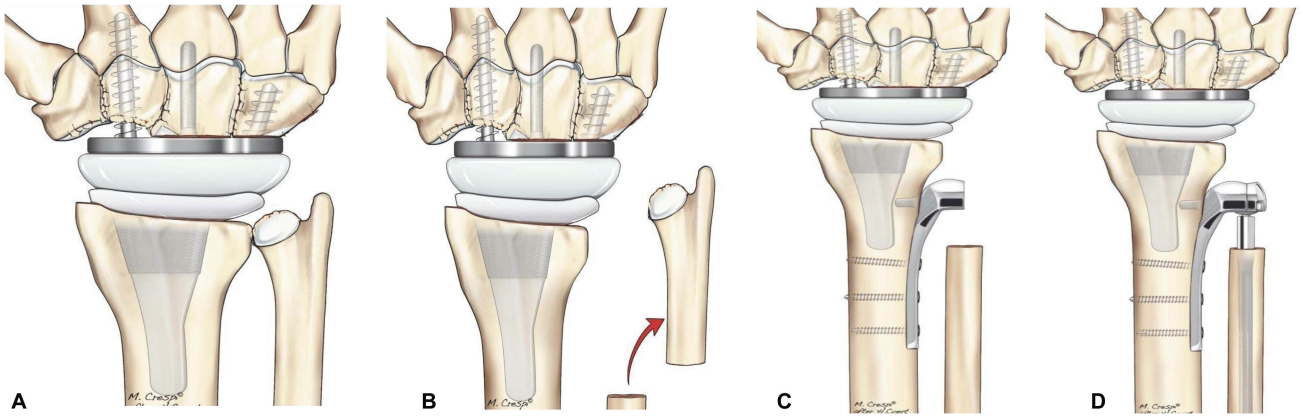

Fig. 1 (**A**) Total wrist arthroplasty (TWA) in situ. (**B**) Excision of the ulna head. (**C**) Placement of the radial Aptis distal radioulnar joint (DRUJ) component just proximal of the sigmoid notch with shortened radial transverse fixation peg. (**D**) Placement of the ulnar Aptis DRUJ component.

Statistics

Gaussian variables are presented as means with standard deviations and non-Gaussian variables are presented as medians with range.

Results

Follow-Up and Demographics

The database search identified three men and three women with a median age of 52 years (range: 34–65 years) (►**Table 2**). The dominant hand was operated in three patients. All patients had undergone two to seven surgeries prior to TWA or Aptis DRUJ arthroplasty. The median follow-up was 50 months (range: 18–108 months).

Case 1

A 65-year-old retired man with a history of left wrist trauma, third ray amputation, two Universal 2 TWA revisions with the use of autologous iliac bone graft, Bower's procedure, CMC-I arthroplasty (Avanta, Stryker, Mahwah, NJ), and metallosis debridement presented with severe wrist pain and limited forearm rotation. The symptoms were caused by a destroyed DRUJ with neo-ossification and ulnar instability for which Aptis DRUJ arthroplasty was performed. The procedure was complicated by a thrombus in the ulnar artery that was adequately treated by anticoagulants. After 67 months of follow-up the forearm rotation had improved 70 degrees (110 to 180 degrees) and the flexion extension arc decreased 20 degrees (75 to 55 degrees). The VAS was 5. X-rays showed subluxation of the CMC-I Avanta implant and impingement with the trapezium or small remainder of the scaphoid and ulnar translation of the carpus (►**Fig. 2**). Due to persistent pain an additional bone scan was conducted that showed signs of distal Universal 2 component loosening. Exploration during surgery showed no signs of implant loosening, specimens for bacterial cultures and histology were collected and the patient was treated with antibiotics. The patient was satisfied with the procedure, was able to lift 50 kg, and even resumed recreational cycling and playing golf 3 months postoperatively.

Case 2

A 48-year-old man with a history of a left-sided scaphoid nonunion advanced collapse, distal scaphoid pole and trapezoid resection, Universal 2 TWA, Bower's procedure, and ulnar shortening osteotomy presented with severe wrist pain because of a destroyed DRUJ and ulnar instability. To address this issue an Aptis DRUJ arthroplasty was performed. The procedure was complicated by a temporary extension deficit of the fifth digit due to displacement of the extensor digiti quinti tendon. After 44 months of follow-up the forearm rotation had decreased 15 degrees (180 to 165 degrees) while the pain was described as mild. X-rays show good implant positioning without signs of loosening (►**Fig. 3**). The patient was satisfied with the procedure, returned to work as a full-time warehouse worker, and could resume recreational cycling. Unfortunately, goalkeeping during soccer matches seemed impossible.

Table 2 Patient demographics and clinical results

Case	Age (y) M/F	FU (m)	Flex (degrees) pre/post	Total (degrees)	Ext (degrees) pre/post	Total (degrees)	Sup (degrees) pre/post	Total (degrees)	Pro (degrees) pre/post	Total (degrees)	Grip post (kg)	VAS pre/post	Patient satisfaction
1	65 M	67	30/15	−15	45/40	−5	80/90	+10	30/90	+60	–	-/5	Satisfied
2	48 M	44	–	–	–	–	90/90	0	90/75	−15	23	4/ "mild pain"	Satisfied
3	53 F	52	15/30	+15	30/30	0	45/60	+15	45/90	+45	–	-/0	Satisfied
4	65 F	48	20/25	+5	45/50	+5	45/90	+45	90/90	0	12	3/1	Satisfied
5	51 F	18	40/15	−25	40/40	0	80/80	0	60/90	+30	–	4/0	Satisfied
6	34 M	108	0/20	+20	0/20	+20	-/70	–	- /90	–	12	8/5	Satisfied
Mean	53	56	21/21	0	32/36	+4	68/80	+14	63/87.5	+24	16	5/2	Satisfied

Abbreviations: F, female; FU, follow-up; M, male; post, postoperative; pre, preoperative; VAS, visual analog scale.

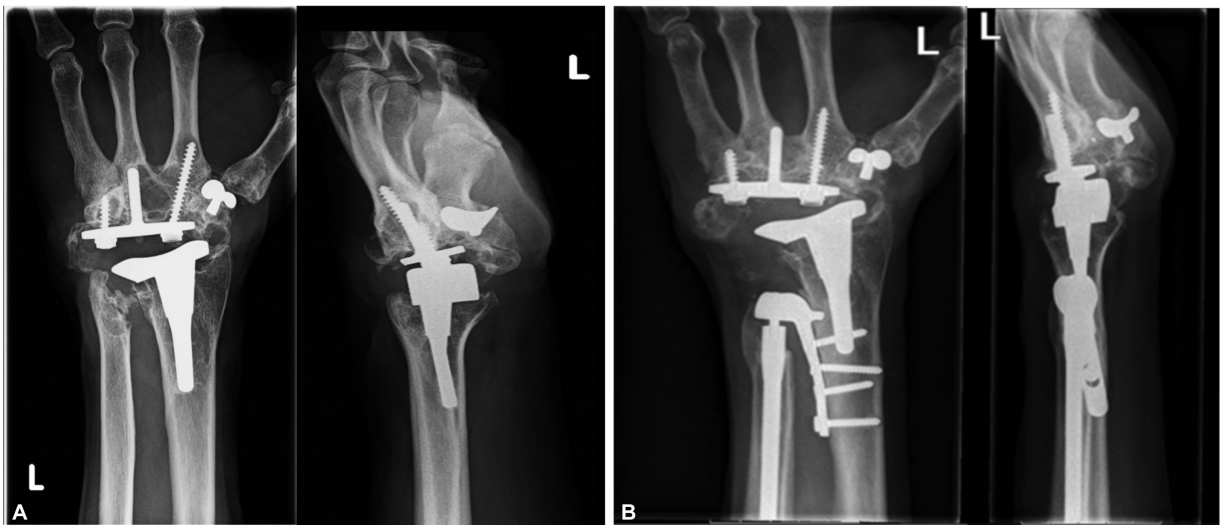

Fig. 2 (A) Lateral and anteroposterior X-rays of case 1 before Aptis distal radioulnar joint (DRUJ) implantation. (**B**) Lateral and anteroposterior X-rays of case 1 after Aptis DRUJ implantation. Note the ulnar translation of the carpus.

Fig. 3 (A) Lateral and anteroposterior X-rays of case 2 before and after Aptis distal radioulnar joint (DRUJ) implantation. (**B**) Lateral and anteroposterior X-rays of case 2 after Aptis DRUJ implantation.

Case 3

A 53-year-old woman with Universal 2 TWA and ulnar head replacement (Herbert, KLS Martin Medizin, Tuttlingen, Germany) presented with severe wrist pain due to a hemiarthroplasty with ulnar instability, for which reason the ulnar head implant was removed and Aptis DRUJ arthroplasty was performed. The Universal 2 TWA was revised twice because of recurrent subluxation (6 and 30 months postoperatively). Twenty-two months after the last Universal 2 TWA revision the forearm rotation had improved 60 degrees (90 to 150 degrees) and the flexion-extension arc had decreased 5 degrees (45 to 40 degrees). The VAS pain score was zero. Good implant positioning without signs of loosening was seen on follow-up (►**Fig. 4**). It was not possible to return to work in health care for which reason the patient started as an administrative assistant. Nordic walking was also not possible anymore.

Case 4

A 65-year-old retired woman with a Universal 2 TWA and ulnar head resection of the left wrist presented with severe wrist pain because of distal component loosening and a destroyed DRUJ and ulnar instability. In a single operation, the Universal 2 TWA was replaced with the use of autologous iliac bone graft and an Aptis DRUJ arthroplasty was performed. After 48 months of follow-up the forearm rotation had improved 45 degrees (135 to 180 degrees) and the flexion-extension arc had improved 10 degrees (65 to 75 degrees). The VAS pain score at rest was zero (3 preoperatively) and during activities one (6 preoperatively). X-rays show ulnar translation of the carpus and osteolysis at the radial component of the Universal 2 TWA (►**Fig. 5**). The patient was satisfied with the procedure.

Fig. 4 (**A**) Lateral and anteroposterior X-rays of case 3 before Aptis distal radioulnar joint (DRUJ) implantation. (**B**) Lateral and anteroposterior X-rays of case 3 after Aptis DRUJ implantation.

Fig. 5 (**A**) Lateral and anteroposterior X-rays of case 4 before Aptis distal radioulnar joint (DRUJ) implantation. (**B**) Lateral and anteroposterior X-rays of case 4 after Aptis DRUJ implantation. Note the ulnar translation of the carpus and osteolysis at the radial component of the Universal 2 total wrist arthroplasty (TWA).

Fig. 6 (A) X-rays of case 5 before total wrist arthroplasty (TWA) implantation. (B) X-rays of case 5 after TWA implantation.

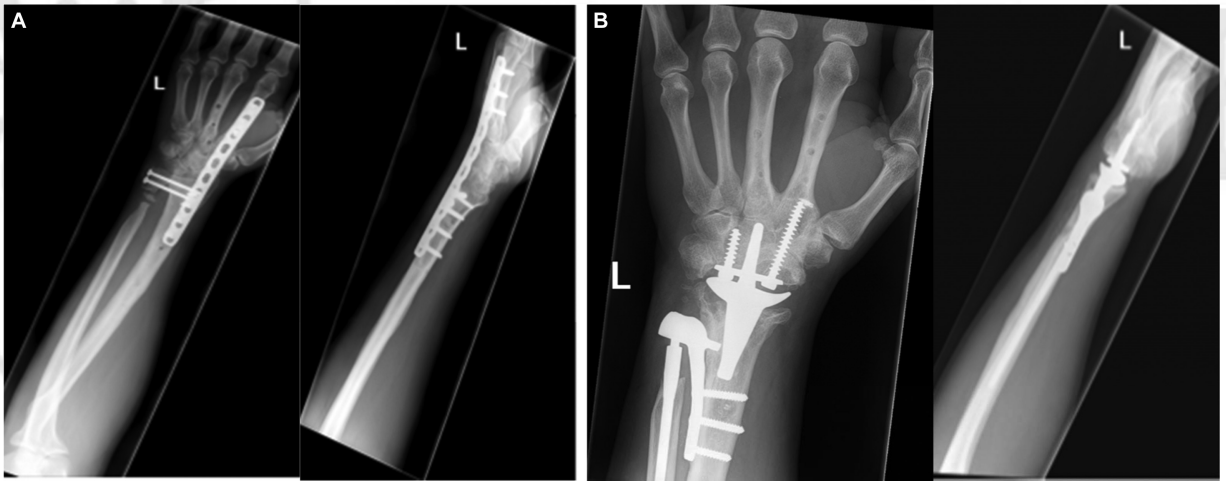

Fig. 7 (A) Lateral and anteroposterior X-rays of case 6 before insertion of the Aptis distal radioulnar joint (DRUJ) and Remotion implant. (B) Lateral and anteroposterior X-rays of case 6 after insertion of the Aptis DRUJ and Remotion implant. Note periprosthetic osteolysis at the Remotion implant near the joint and the ulnar screw was not optimally placed.

Case 5

A 51-year-old woman with a history of proximal row carpectomy, ulnar head replacement, and Aptis DRUJ arthroplasty presented with severe pain in the right wrist due to loss of cartilage at site of the proximal capitate bone and lunate fossa. For this reason Universal 2 TWA was performed. After 18 months of follow-up the forearm rotation had improved 30 degrees (140 to 170 degrees) and the flexion-extension arc had decreased 25 degrees (80 to 55 degrees). The VAS pain score at rest was zero (4 preoperatively) and during activities 6. X-rays show that the Aptis DRUJ arthroplasty and the Universal 2 TWA remained in a good position without signs of loosening (►**Fig. 6**). The patient was not able to resume her work as sales manager nor could play tennis, but was nonetheless satisfied with the procedure.

Case 6

A 34-year-old man with a history of left-sided Galeazzi fracture, Sauvé–Kapandji procedure, and radiocarpal arthrodesis presented with severe wrist pain due to fractured radiocarpal pseudoarthrosis and ulnar instability. In an attempt to reduce pain, regain radiocarpal motion, and stabilize the DRUJ, the wrist was converted to Remotion TWA and Aptis DRUJ arthroplasty. The procedure was complicated by a snapping extensor pollicis longus tendon, which was adequately rerouted. After 108 months of follow-up the forearm rotation was 160 degrees and the flexion-extension arc had improved from 0 to 40 degrees. The VAS pain score at rest was 5 and during daily activities 8. Periprosthetic osteolysis of the Universal 2 implant and no optimal placement of the ulnar screw were shown on X-rays

(►**Fig. 7**). The patient was satisfied despite the pain and the fact that it was impossible to return to work as a scaffolding builder.

Discussion

When symptomatic radiocarpal osteoarthritis occurs together with a destroyed and an unacceptable instability of the DRUJ, a true challenge arises! As most patients prefer to preserve motion while reducing the pain. Our article evaluates the clinical outcomes of six patients with combined DRUJ (semiconstrained) and TWAs at a median follow-up of 50 months. The senior author (J.H.C.) has performed four types of challenging salvage procedures of which three have not been described in literature yet.

These operative procedures are prone to complications due to the combination of the vast operative history and the extent of the dual implant procedure. For example, there is one case with recurrent Universal 2 subluxation that needed implant revision, another case with suspicion of distal component loosening, and some cases with tendon issues. Two wrists with ulnar translation probably due to radioscaphocapitate rupture. Furthermore, only one out of four patients could return to their previous job and some could also not perform their previous hobby. The flexion-extension arc was slightly decreased in three cases and forearm rotation only improved in three cases. Pain was sufficiently decreased in four patients. Significant pain remained present in two patients. Nonetheless, all patients were satisfied with the result of the procedure, despite the disadvantages described above. One case was very satisfied because wrist motion was regained after converting a total wrist arthrodesis to TWA.

In the literature there is only one case described with both TWA and Aptis DRUJ arthroplasty, with an implant survivability of 3 years.[5] In our article the implant survivability was up to 9 years in one case. However, the short-term results are somewhat unpredictable and the long-term results are still unknown.

This study is limited by its retrospective nature, small and heterogeneous group, variation in surgical procedures, extensive medical history, and short- to medium-term follow-up. Pre- and postoperative data in terms of ROM, grip strength, and patient-related functional outcome measures were not available in all patients and postoperative examination did not take place at standardized moments. Due to the small group size statistical analysis was not possible which is another drawback of this study.

Despite these study drawbacks, we believe that the combination of the radiocarpal and DRUJ replacement is a feasible solution for demanding patients with symptomatic radiocarpal osteoarthritis together with a destroyed and unacceptable unstable DRUJ who are not ready yet for fusion of the wrist. Especially when flexion-extension motion is reasonable. Patients should be aware of the high risk of complications. For the future, a combined device that simultaneously replaces the radiocarpal and DRUJ could be a major asset in treating this combined joint issue.

Ethical Approval

The medical ethical committee of the UMCU has approved this study.

Informed Consent

Written informed consent was obtained from a legally authorized representative(s) for anonymized patient information to be published in this article.

Authors' Contributions

All named authors were actively involved in the planning, enactment, and writing up of the study.

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Conflict of Interest

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this paper.

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