Survival Rate on a 10-Year Follow-Up of Total Wrist Replacement Implants: A 23-Patient Case Series

Sophie Honecker, MD¹ Yuka Igeta, MD^{1,2} Ali Al Hefzi, MD¹ Chiara Pizza, MD¹
 Sybille Facca, MD, PhD¹ Philippe A. Liverneaux, MD, PhD¹

¹Department of Hand Surgery, SOS main, CCOM, University Hospital of Strasbourg, FMTS, University of Strasbourg, Illkirch, France

²Department of Orthopaedic Surgery, Juntendo University, Tokyo, Japan

Address for correspondence Philippe A. Liverneaux, MD, PhD, Department of Hand Surgery, Strasbourg University Hospitals, 10 Avenue Baumann, F-67403 Illkirch, France (e-mail: Philippe.liverneaux@chru-strasbourg.fr).

J Wrist Surg 2019;8:24–29.

Abstract

Background According to current literature, the estimated average survival rate for Remotion, the total wrist implants, is above 90% on an 8-year follow-up. We examined our series of Remotion to calculate its survival rate on a 10-year follow-up.

Case Description A total of 23 cases of total wrist implants were reviewed. The case series included 22 patients, 18 females and 4 males, of an average age of 55 years. The case series included 19 inflammatory rheumatic diseases, 3 Kienböck disease, and 1 posttraumatic arthrosis.

Conclusion The average survival rate of our case series was 95.7% on a 4-year follow-up, 91.3% on a 6-year follow-up, and 69% on a 10-year follow-up. On our review, the QuickDASH score, pain, wrist extension range of motion, and grip strength were improved post-operatively. No difference was shown between preoperative and postoperative values for wrist flexion, pronation, and supination. The case series included a septic case, treated by arthrodesis, and three total wrist implants displacements, two of which were treated by carpal implant, and the remaining one was treated by arthrodesis.

Clinical Relevance The survival rate of the total wrist replacement implant Remotion was estimated to be 69%.

Keywords

- ▶ implant
- ▶ wrist
- ▶ rheumatoid arthritis
- ▶ TWA

Most of the case series on total wrist replacement published before the year 2000 described poor outcomes.^{1–9} New generation implants respect carpal biomechanics and allow limited bone resections, providing an average survival rate of the implant on a 5-year follow-up of more than 90%.^{10,11} For the wrist implant Remotion, the survival rate described on an 8-year follow-up was estimated above 90%.^{10,12,13} We could not find any study in the current literature reviewing the survival rate on a 10-year follow-up of the total wrist implant Remotion.

The main hypothesis of this study is that the survival rate of the implant on a 10-year follow-up was above or equal to 90%. The secondary hypothesis of this study is that the wrist function assessed in terms of QuickDASH score, pain, range of motion (flexion/extension), and grip strength had improved after total wrist replacement for radiocarpal chondropathy on a 5-year follow-up.

Materials and Methods

All the clinical records relevant to the patients who underwent radiocarpal prosthetic arthroplasty in our department between 2006 and 2012 have been reviewed. We excluded all the patients aged less than 18 years, pregnant women, and patients who underwent unicompartamental radiocarpal prosthetic arthroplasty. We included all the patients who underwent a total radiocarpal arthroplasty. A total of 23 cases of total prosthetic radiocarpal arthroplasty were reviewed. Our case series included a total of 22 patients, 18 females and 4 males, aged 25 to 77 years with an average age of 55 years (▶ **Table 1**). We included 19 inflammatory rheumatic diseases, 3 Kienböck disease, and 1 posttraumatic arthrosis. Six patients had a past medical history of homolateral wrist surgery.

received

November 3, 2017

accepted after revision

June 29, 2018

published online

August 7, 2018

Copyright © 2019 by Thieme Medical Publishers, Inc., 333 Seventh Avenue, New York, NY 10001, USA.
 Tel: +1(212) 584-4662.

DOI <https://doi.org/10.1055/s-0038-1668152>.
 ISSN 2163-3916.

Table 1 Casuistic of a 22-patient series operated on with 23 total wrist replacements with an average of 6-year follow-up

Patient (n)	Age (y)	Gender (M/F)	Dominant side (R/L)	Injury side (R/L)	Etiology	Medical history of homolateral wrist surgery
1a	64	F	R	R	RA	
1b	66	F	R	L	RA	
2	70	F	L	L	RA	
3	41	M	R	R	PA	
4	62	M	R	L	RA	
5	74	F	R	L	RA	Denervation/Prothese radio carpienne (Swanson)
6	71	F	R	R	RA	
7	65	F	R	R	RA	
8	32	F	R	L	SA	
9	58	F	R	L	Kienböck disease	
10	43	F	R	L	RA	Synovectomy
11	77	F	R	L	SCAC	
12	62	F	R	R	RA	
13	61	M	R	L	RA	Denervation
14	73	F	R	R	Kienböck disease	
15	30	F	R	R	RA	
16	53	F	R	L	RA	
17	50	F	R	L	RA	Arthrodesis radioulnar + SK/Synovectomy
18	49	M	R	R	Posttrauma arthrosis	ORIF poignet
19	25	F	R	R	RA	
20	44	F	L	L	RA	
21	50	F	R	L	Kienböck disease	Multiopere (prothese lunatum/ablation/tendon ball/PRC)
22	58	F	L	R	RA	

Abbreviations: F, female; L, left; M, male; ORIF, open reduction and internal fixation; PA, psoriatic arthritis; PRC, proximal row carpectomy; R, right; RA, rheumatoid arthritis; SA, ankylosing spondylitis; SCAC, Scaphoid Chondrocalcinosis Advanced Collapse; SK, Sauvé Kapandji.

All the patients were operated on by a single surgeon on a day surgery regime. After undergoing regional anesthesia, the patient was positioned in a supine position, and the tourniquet was used. A dorsal approach was preferred, and no skin undermining on the radial side of the wrist was performed. Dorsal veins were strictly preserved. After radial side preparation with dedicated jigs, the radial and carpal components of the prosthesis were implanted (Remotion, Small Bone Innovation, Morrisville, PA). After analysis of the ligament balance, a polyethylene implant was inserted. Layered suture closure was performed, and no drains were left in place. Thirteen patients were operated performing Darrach technique, and two cases underwent a Sauvé-Kapandji procedure. A volar splint of 30° wrist extension was used postoperatively. A perineural catheter for analgesia (Ropivacaine 0.75%) was applied postoperatively, had been kept for 3 days following the surgery, and was removed at home according to the continuous postoperative analgesia technique or APC.¹⁴ Sutures and splint were removed 15 days after the surgery, and self-rehabilitation was performed.

The outcomes were assessed in terms of objective, subjective, and radiological criteria before the surgery and on the last follow-up appointment in our outpatient clinic. As the last follow-up date we considered either the date of the last clinic appointment, or the date of decease, or the day the patient was taken back to theater for revision surgery.

Among the subjective criteria, we examined the QuickDASH questionnaire from 0 (normal upper limb) to 100 (non-functional upper limb), and pain was quantified from 0 (no pain) to 10 (maximum pain) on a visual analog scale (VAS).

Postoperative wrist mobility has been assessed in degrees with a goniometer in flexion, extension, pronation, and supination. The grip strength was measured with a Jamar dynamometer on setting 2 in the neutral position of the wrist. Postoperative complications were systematically recorded. The survival rate was assessed on a 10-year follow-up, and the three patients who died before implant displacement were not included in this review. The data relevant to the deceased patients were taken into account and processed according to the concurrent risks adjustment

model. All the data were processed with the help of software R in its 3.2.2 version (<https://www.r-project.org/>).

We considered the following findings as radiological evidence of implant displacement: the presence of a periprosthetic border and implant migration signs (radial component, central spacer, and/or the carpal component screw).

The statistical analysis focused on comparing the averages and deviations of seven quantitative variables. One of the weaknesses of our study is the small sample size of patients of our series, and given to this, a classical “frequentist” statistical model based on the *p*-value would not have been suitable for our data analysis. The analysis has been performed by using a Bayesian model, which allows calculate the likelihood of finding a difference or not. This model provides stronger evidence. The probability of finding a difference or not was calculated as a value/figure between 0 and 1, which provided more accurate information compared with the binary information of the *p*-value ($p < 0.05$ or > 0.05). A probability of difference of credible intervals between the two groups higher than 90% indicated a strong difference, higher than 95% a very strong difference, and higher than 97.5% a significant difference. All data were processed through the software “R” in its 3.2.2 version.

Results

The average survival rate reported in our case series was 95.7% on a 4-year postoperative follow-up, 91.3% on a 6-year follow-up, 69% on an 8-year follow-up, and 69% on a 10-year follow-up (► Fig. 1). The average follow-up in our case series was 6 years.

The analysis results are presented in ► Tables 2 and 3.

From a quantitative point of view, on the last follow-up appointment, the QuickDASH was found to be in average 57.9/100 preoperatively and in 37.9 postoperatively. The difference between the preoperative and the postoperative value was 18.9 [−29.6; −7.9]. The QuickDASH improved significantly postoperatively.

Pain indicated an average value of 6.8/10 preoperatively and was significantly low as 2.8/10 postoperatively. The difference between the preoperative and the postoperative value was 4.4 [−5.51; −3.25].

Fig. 1 Kaplan–Meier survival curve on a 22 patients case series who underwent a total of 23 wrist replacements with Remotion. On the x-axis, time in months and on the y-axis, survival.

Wrist flexion was in average 35.4° preoperatively and 38.7° postoperatively. The difference between the preoperative and the postoperative value was a 5.3 [−4; 14.49]. Flexion might improve slightly.

The mobility in extension was found to be in average 34.3° preoperatively and significantly improved as 44.3° postoperatively. The difference between the preoperative and the postoperative value was 10.8 [2.37; 19.07].

The mobility in pronation was found to be in average 72.3° preoperatively and 75.1° postoperatively. The difference between the preoperative and the postoperative value was 5 [3.58; 13.64].

The mobility in supination was found to be in average 68.3° preoperatively and 77.8° postoperatively. The difference between the preoperative and the postoperative value was 5 [3.58; 13.64].

The grip strength was found to be in average 7.6 kg preoperatively and significantly increased to 13.9 kg postoperatively. The difference between the preoperative and the postoperative value was 3.5 [0.12; 6.85]. From a quantitative point of view, eight complications (four major and four minor) were observed. Among the major complications we observed were one case of sepsis without displacement, which eventually led to implant removal and radiocarpal arthrodesis, and three cases of displacement of the carpal component, which were treated by carpal implant replacement (Prosthelast, Argomedical, Cham, Suisse). One of them subsequently underwent radiocarpal arthrodesis, following implant fracture. Among the minor complications, we noted two cases of carpal tunnel syndrome, one case of extensor pollicis longus rupture treated by extensor indicis proprius transfer and one case of wrist synovial cyst which subsided spontaneously.

From a radiological point of view, we did not observe any migration sign of the radial component, but we observed nine periprosthetic loosening on the radial component. The carpal component did not show any isolated periprosthetic loosening of the central stem, but suffered three migrations and three isolated loosening signs of the screws.

Discussion

The outcomes of radiocarpal fusion versus total wrist prosthetic replacement are controversial. Some authors believe there is no difference in terms of outcomes between the two treatment options¹⁵; some others reported better results with arthrodesis,¹⁶ and other authors described better results with total prosthetic replacement.¹¹ Generally, patients prefer prosthetic replacement.^{17,18}

Current literature describes an average survival rate of the total wrist replacement implant Remotion above or equal to 90% on an 8-year follow-up. A case series of 65 total wrist replacements described a survival rate of 90% on a 5-year follow-up and 90% on a follow-up from 5 to 9 years.¹¹ Another case series of 215 total wrist replacements reported a survival rate equal to 92% with a follow-up from 2 to 8 years.¹² A third cases series of 87 total wrist replacements reported an average survival rate of 99% on a 5-year follow-up, and of 94% with a follow-up from 5 to 9 years.¹⁰ Our case

Table 2 Clinical results of a 22-patient series operated on with 23 total wrist replacements with an average of 6-year follow-up

Patient (n)	Follow-up (m)	DRUJ (D/SK)	QuickDASH (0–100)		Pain (0–10)		Flexion		Extension		Pronation		Supination		Grasp		Complications	Revision
			Preop	Postop	Preop	Postop	Preop	Postop	Preop	Postop	Preop	Postop	Preop	Postop	Preop	Postop		
1a	87	D	59.09	59.09	8	5	45	55	35	30	50	80	40	85	9	8	–	–
1b	62	D	65.91	59.09	8	5	30	30	30	50	80	75	80	85	2	4	CTS	CTS
2	63	D	75	13.64	8	0	35	65	65	80	80	80	80	90	2	12	–	–
3	20†	D	31.82	22.73	9	0	50	60	–10	30	70	90	50	60	4	9	Sepsis	fusion (M20)
4	87	–	59.09	36.36	5	0	35	50	35	70	50	85	80	85	14	8	Loosening	CIC (M71)
5	57† (63)	–	34.09	50	8	0	40	20	40	15	90	85	90	85	4	7	–	–
6	63	D	65.91	65.91	8	5	70	45	70	70	90	35	90	20	19	8	–	–
7	92	D	56.82	27.27	5	1	40	60	40	40	70	75	90	85	6	18	–	–
8	75	D	61.36	0	5	0	35	5	30	40	90	70	90	90	5	24	–	–
9	94	–	31.82	29.55	10	3	50	15	40	35	90	70	90	80	5	14	–	–
10	73	D	97.73	84.09	8	7	–10	20	20	40	30	85	50	75	1	4	–	–
11	15† (40)	–	68.18	36.36	7	/	40	50	40	50	80	90	80	90	12	8	–	–
12	12† (43)	D	68.18	45.45	8	1	50	50	40	45	85	85	85	85	5	8	–	–
13	117	–	/	29.55	6	2	30	40	50	40	80	75	80	60	23	24	–	–
14	67	–	50	20.45	6	1	15	10	15	40	90	80	70	80	4	21	–	–
15	76	D	65.91	20.45	7	0	10	30	20	45	60	80	40	85	5	24	–	–
16	65	D	38.64	27.27	7	4	40	60	20	60	90	80	90	85	8	16	Rupture EPL	Tendon transfer (M4)
17	124	SK	84.09	65.91	8	3	20	30	30	30	90	75	90	75	7	8	CTS	CTS
18	77	SK	52.27	52.27	4	8	30	0	20	20	80	80	40	60	5	4	–	–
19	52	–	43.18	47.73	6	1	40	40	40	30	90	75	60	65	4	4	Loosening	CCI (M36) then fusion
20	79	D	52.27	36.36	6	1	40	60	50	55	70	80	85	90	9	6	Loosening	CCI (M58)
21	75	–	47.73	4.55	3	3	40	55	40	75	90	90	90	90	13	14	GC	–
22	64	D	63.74	38.64	7	5	40	45	30	30	50	80	40	85	8	4	–	–

Abbreviations: CCI, change of carpal implant; CTS, carpal tunnel syndrome; D, Darrach; EPL, extensor pollicis longus; GC, ganglia cyst; M, month after revision; SK, Sauvé Karpandji.

Table 3 Radiological results of a 22 patients series operated on with 23 total wrist replacements with an average of 6 year follow-up

Patient (n)	Follow-up (m)	Radius		Carpus		
		Loosening (Y/N)	Migration (Y/N)	Loosening central stem (Y/N)	Loosening screw (Y/N)	Migration (Y/N)
1a	53	N	N	N	N	N
1b	30	N	N	N	N	N
2	63	N	N	N	N	N
3	20†	N	N	N	N	N
4	87	Y	N	Y	Y	Y
5	57†	N	N	N	N	N
6	63	N	N	N	N	N
7	92	N	N	N	N	N
8	75	N	N	N	Y	N
9	94	Y	N	N	N	N
10	73	N	N	N	N	N
11	15†	N	N	N	N	N
12	12†	N	N	N	N	N
13	117	Y	N	N	N	N
14	67	N	N	N	N	N
15	76	N	N	N	N	N
16	65	Y	N	N	N	N
17	112	Y	N	N	Y	N
18	77	N	N	N	N	N
19	40	Y	N	Y	Y	Y
20	79	Y	N	Y	Y	Y
21	75	Y	N	N	N	N
22	64	Y	N	N	Y	N

Abbreviations: N, no; Y, yes.

series showed an average survival rate almost equal to the above mentioned (91.3% on a 5-year follow-up), dropping to a 69% survival rate on an 8-year follow-up and eventually remained stabilized on a 69% rate on a 10-year follow-up.

Many reasons would explain this discrepancy. The first one is that two of the three case series above mentioned were multicentric and lacked an independent observer.^{11,12} The second reason is that our survival rate has been calculated on a 10-year follow-up with an average follow-up of more than 6 years, while the average follow-up rate was sometimes higher than ours in the above-mentioned series. Unlike the other authors we included all the patients of our case series while calculating the follow-up rate: Boeckstyns et al¹² excluded five revision surgeries, and eight patients lost to follow-up while calculating their follow-up rate (which corresponded to an average follow-up rate of 6 years and a half on 52 patients and a survival rate calculated on 65 patients). Herzberg et al excluded 103 patients with less than 2-year follow-up to calculate their average follow-up (which corresponded to an average follow-up rate of 4 years on 112 patients and a survival rate calculated on 215 patients).¹³ In

this last case series, despite the data described, the follow-up was sometimes extremely short and that almost half of the patients (103) were assessed on a less than 2-year follow-up which makes the survival rate calculation less reliable. The third reason is that all radiologically diagnosed loosening underwent revision surgery. This was the case for three patients of our case series. Other authors do not consider the finding of any radiological sign of loosening an indication for revision surgery. In the Boeckstyn case series,¹² 6 of the 52 patients who underwent total wrist replacement, presented with radiological signs of loosening and implant migration did not undergo revision surgery. The data presented in the other case series in terms of survival rate were probably not accurate and were overestimated.

It is difficult to identify the risk factors, especially the etiology, to explain the total wrist replacement implants survival. Some authors reported poor outcomes with the Uni2 implants in patients suffering from rheumatoid polyarthritis, due to a lower bone stock.¹⁹ However, other authors reported an increased survival rate on a 5-year follow-up of 4% in patients suffering from rheumatoid polyarthritis.¹² In

our case series, the four patients who underwent revision surgery suffered from a systemic disease (three rheumatoid polyarthritis and one psoriatic rheumatism). Given the small sample size of our study of our case series, we cannot state that patients suffering from a systemic disease are more prone to complications and undergo more frequently revision surgery.

As in other cases series, the clinical results of total wrist replacement surgery in our case series were significantly improved compared with the preoperative data, except for wrist flexion.²⁰ All the complications described in our case series have been found in the literature.²¹ Unlike some authors who reported two cutaneous complications needing resurfacing with a full thickness skin graft and a radial forearm flap,²² we did not experience any cutaneous complication in our case series. From a radiological point of view, a periprosthetic line inferior or equal than 4 mm (found in more than 50% of the cases on the radial component and on the carpal component) was not considered as a radiological sign of loosening. Radiological findings of displacement were reported in 14% of the patients in a 44-patient case series.²³ The carpal component was more frequently displaced and was migrated distally. These findings were observed in our case series.

The survival rate of the total wrist replacement implant Remotion on a 10-year follow-up was lower than 90%. Wrist function according to the QuickDASH score, pain score, extension range of movement, and wrist strength were improved after a total wrist arthroplasty in patients suffering from radiocarpal chondropathy on a follow-up longer than 6 years. Wrist flexion was not found to be improved postoperatively.

Conflict of Interest

Philippe A. Liverneaux has conflicts of interest with Newclip Technics, Argomedical, Zimmer Biomet, Biomodex. None of the other authors has any conflict of interest.

Acknowledgment

The authors wish to thank François Lefebvre, Département d'informatique Médicale, Hôpitaux Universitaires de Strasbourg, Strasbourg, France.

References

- Jolly SL, Ferlic DC, Clayton ML, Dennis DA, Stringer EA. Swanson silicone arthroplasty of the wrist in rheumatoid arthritis: a long-term follow-up. *J Hand Surg Am* 1992;17(01):142–149
- Cooney WP III, Beckenbaugh RD, Linscheid RL. Total wrist arthroplasty. Problems with implant failures. *Clin Orthop Relat Res* 1984;(187):121–128
- Volz RG. Total wrist arthroplasty. A clinical review. *Clin Orthop Relat Res* 1984;(187):112–120
- Lamberta FJ, Ferlic DC, Clayton ML. Volz total wrist arthroplasty in rheumatoid arthritis: a preliminary report. *J Hand Surg Am* 1980;5(03):245–252
- Dennis DA, Ferlic DC, Clayton ML. Volz total wrist arthroplasty in rheumatoid arthritis: a long-term review. *J Hand Surg Am* 1986;11(04):483–490
- Menon J. Universal total wrist implant: experience with a carpal component fixed with three screws. *J Arthroplasty* 1998;13(05):515–523
- Cobb TK, Beckenbaugh RD. Biaxial total-wrist arthroplasty. *J Hand Surg Am* 1996;21(06):1011–1021
- Fourastier J, Le Breton L, Alnot Y, Langlais F, Condamine JL, Pidhorz L. [Guépar's total radio-carpal prosthesis in the surgery of the rheumatoid wrist. Apropos of 72 cases reviewed]. *Rev Chir Orthop Repar Appar Mot* 1996;82(02):108–115
- Ferlic DC, Clayton ML. Results of CFV total wrist arthroplasty: review and early report. *Orthopedics* 1995;18(12):1167–1171
- Sagerfors M, Gupta A, Brus O, Pettersson K. Total wrist arthroplasty: a single-center study of 219 cases with 5-year follow-up. *J Hand Surg Am* 2015;40(12):2380–2387
- Ferreres A, Lluch A, Del Valle M. Universal total wrist arthroplasty: midterm follow-up study. *J Hand Surg Am* 2011;36(06):967–973
- Boeckstyns ME, Herzberg G, Merser S. Favorable results after total wrist arthroplasty: 65 wrists in 60 patients followed for 5–9 years. *Acta Orthop* 2013;84(04):415–419
- Herzberg G, Boeckstyns M, Sorensen AI, et al. "Remotion" total wrist arthroplasty: preliminary results of a prospective international multicenter study of 215 cases. *J Wrist Surg* 2012;1(01):17–22
- Pourtales MC, Kuntzmann H, Bertrand F, Pottecher T, Gouzou S, Liverneaux P. Continuous at-home postoperative analgesia using a catheter in the case of hand surgery: preliminary study about 40 cases. *Chir Main* 2010;29(02):82–87
- Murphy DM, Khoury JG, Imbriglia JE, Adams BD. Comparison of arthroplasty and arthrodesis for the rheumatoid wrist. *J Hand Surg Am* 2003;28(04):570–576
- Cavaliere CM, Chung KC. A systematic review of total wrist arthroplasty compared with total wrist arthrodesis for rheumatoid arthritis. *Plast Reconstr Surg* 2008;122(03):813–825
- Herzberg G. Management of bilateral advanced rheumatoid wrist destruction. *J Hand Surg Am* 2008;33(07):1192–1195
- Trieb K. Treatment of the wrist in rheumatoid arthritis. *J Hand Surg Am* 2008;33(01):113–123
- Adams BD. Wrist arthroplasty: partial and total. *Hand Clin* 2013;29(01):79–89
- Boeckstyns ME. Wrist arthroplasty—a systematic review. *Dan Med J* 2014;61(05):A4834
- Yeoh D, Turret L. Total wrist arthroplasty: a systematic review of the evidence from the last 5 years. *J Hand Surg Eur Vol* 2015;40(05):458–468
- Bidwai AS, Cashin F, Richards A, Brown DJ. Short to medium results using the remotion total wrist replacement for rheumatoid arthritis. *Hand Surg* 2013;18(02):175–178
- Boeckstyns ME, Herzberg G. Periprosthetic osteolysis after total wrist arthroplasty. *J Wrist Surg* 2014;3(02):101–106