

“Remotion” Total Wrist Arthroplasty: Preliminary Results of a Prospective International Multicenter Study of 215 Cases

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Abstract

This study reports the current results of an international multicenter study of one last generation total wrist arthroplasty (TWA) (“ReMotion,” Small Bone Innovation, Morristown, PA).

The two first authors (G.H. and M.B.) built a Web-based prospective database including clinical and radiological preoperative and postoperative reports of “ReMotion” TWA at regular intervals. The cases of 7 centers with more than 15 inclusions were considered for this article.

A total of 215 wrists were included. In the rheumatoid arthritis (RA; 129 wrists) and nonrheumatoid arthritis (non-RA; 86 wrists) groups, there were respectively 5 and 6% complications requiring implant revision with a survival rate of 96 and 92%, respectively, at an average follow-up of 4 years. Within the whole series, only one dislocation was observed in one non-RA wrist. A total of 112 wrists (75 rheumatoid and 37 nonrheumatoid) had more than 2 years of follow-up (minimum: 2 years, maximum: 8 years). In rheumatoid and non-RA group, visual analog scale (VAS) pain score improved by 48 and 54 points, respectively, and QuickDASH score improved by 20 and 21 points, respectively, with no statistical differences. Average postoperative arc of wrist flexion–extension was 58 degrees in rheumatoid wrists (loss of 1 degree) compared with 63 degrees in non-RA wrists (loss of 9 degrees) with no statistical differences. Grip strength improved respectively by 40 and 19% in rheumatoid and non-RA groups ($p = 0.033$). Implant loosening was observed in 4% of the rheumatoid wrists and 3% of the non-RA wrists with no statistical differences.

A Web-based TWA international registry was presented. Our results suggest that the use of the “ReMotion” TWA is feasible in the midterm both for rheumatoid and non-RA patients. This is a significant improvement compared with the previous generation TWA. The level of evidence for this study is IV.

Keywords

- ▶ total wrist arthroplasty
- ▶ multicenter study
- ▶ wrist arthritis
- ▶ wrist arthrosis

Total wrist arthroplasty (TWA) is one of the most controversial procedures in surgery of the arthritic wrist.¹ The high rate of complications of the first generation TWA is well known.²⁻⁵ The early results of last generation metal-polyethylene TWA with new designs seem to be better both in terms of clinical results and incidence of complications as shown in some recent studies.^{6,7} However, few cases were included in these studies. Another recent study of 24 cases of one last generation TWA at a minimum of 5 years of follow-up showed a high rate of failure, most often because of carpal component loosening.⁸ The improvement of survival rate and complications with last generation TWA remains to be proven. We made the hypothesis that a well-designed prospective multicenter study of one last generation TWA could provide larger numbers of patients and useful information. The purpose of this article was to report the results of this multicenter international study.

Methods

Only the ball and socket “ReMotion” TWA (Small Bone Innovation, Morristown, PA) resurfacing implant was used in this study. The two first authors (G.H. and M.B.) of this article built a Web-based database including clinical and radiological preoperative and postoperative reports at 6 weeks, 6 months, 12 months, and on a yearly basis. The database was built in cooperation with the Technical University of Denmark (S.M.). In addition to the etiology of the arthritis and classic clinical criteria (visual analog scale pain score, active wrist and forearm motion, grip strength with Jamar Dynamometer), QuickDASH score figures and patient’s satisfaction were recorded. Operative data were recorded as well as complications and reoperations.

Radiological criteria included the subjective evaluation by the surgeon of the position of the implants (optimal, suboptimal, poor) and signs of loosening. All patients were included through a specifically designed Web site. Each surgeon participating in the study received a confidential code to enter his data. Statistics and survival rates were automatically generated and updated.

A total of 215 wrists in 210 patients operated on between 2003 and 2012 were included. All surgical centers were subspecialized for wrist surgery. The database could sort the cases according to surgeons and surgical centers. Only cases from surgical centers with more than 15 wrists were included in this series.

The etiology of wrist arthritis was RA in 129 wrists (60%) and non-RA in 86 wrists (40%). The significant number of non-RA wrists allowed the authors to consider separately the results of these two categories. Of the non-RA wrists, 62% were posttraumatic. The percentage of non-RA etiologies increased over the years (→ Fig. 1). Within the rheumatoid group, the female to male ratio was 76 to 24 and the average age was 63 years (minimum: 31 years, maximum: 86 years). Within the non-RA group, the female to male ratio was 66 to 34 and the average age was 63 years (minimum 33 years, maximum 84 years). A total of 112 wrists had more than 2 years of follow-up with an average of 4 years and a

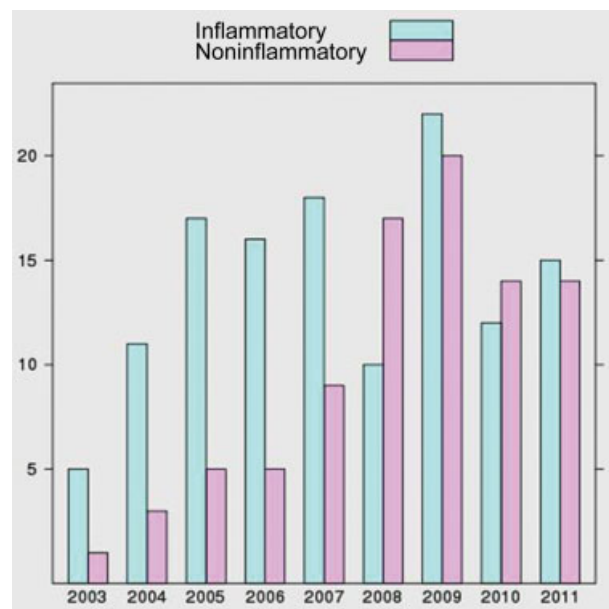


Figure 1 Increase of nonrheumatoid indications over the years.

maximum of 8 years. Within these 112 wrists, 75 (67%) were rheumatoid wrists and 37 (33%) were non-RA wrists. The TWA was used without cement in most cases. Cement was used for both radial and carpal components in seven wrists and for the radial component in one wrist.

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 signed rank test was used for data that were not normally distributed (QuickDASH scores and patient satisfaction) and the parametric Student *t* test was used for normally distributed data (flexion, extension, radial deviation, ulnar deviation, pronation, supination, and VAS scores). Significance was set at a *p* value of less than 0.05.

Results

Complications and Survival Rate of the Whole Series of 215 Wrists

Overall, there were 6 (5%) complications requiring implant revision (implant loosening: 4, wrist ankylosis: 1, and deep infection: 1) in the rheumatoid group. Four wrists sustained subsequent fusion and two wrists sustained reimplantation of a TWA. There were 5 (6%) complications requiring implant revision (implant loosening: 2, dislocation: 1, malposition: 1, ankylosis: 1) in the non-RA group. Three wrists sustained subsequent fusion and two wrists sustained reimplantation of a TWA.

There were respectively 2% (carpal tunnel syndrome) and 7% (carpal tunnel syndrome, reflex sympathetic dystrophy) of complications not requiring revision in rheumatoid and non-RA groups of patients.

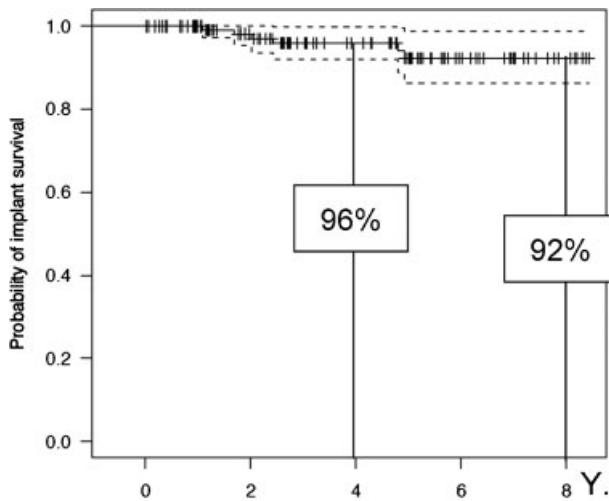


Figure 2 Probability of implant survival in rheumatoid patients (failure defined as revision).

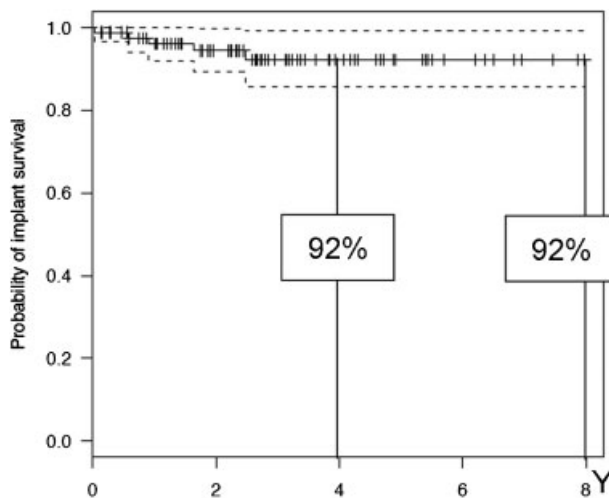


Figure 3 Probability of implant survival in nonrheumatoid patients (failure defined as revision).

The Kaplan–Meier survival graphs are shown in ►Figs. 2 and 3. At the average follow-up of this study, the survival rate (with failure defined as implant revision) was 96% in the rheumatoid group of wrists and 92% in the non-RA group.

Clinical and Radiological Results of 112 Wrists with More Than 2 Years of Follow-Up

The clinical results (mean: 4 years; minimum: 2 years, maximum: 8 years) are reported in ►Table 1. Except for radial deviation and grip strength improvement, we could not find any statistically significant differences between rheumatoid and non-RA wrists. Patient's satisfaction was high both in the rheumatoid (88% very satisfied or satisfied) and in the non-RA groups (95% very satisfied or satisfied).

In terms of radiological results, implant positioning was subjectively judged by the operating surgeon as optimal (86%) or suboptimal (11%) in 97% of the rheumatoid wrists and 100% of the non-RA wrists (optimal: 79% and suboptimal: 21%). Loosening with implant migration was observed in 4% of the rheumatoid wrists and 3% of the non-RA wrists (nonsignificant [ns], $p = 1.000$). Loosening without implant migration was observed in 8% of the rheumatoid wrists and 15% of the non-RA wrists (ns, $p = 0.2520$). Overall, the incidence of signs of periprosthetic loosening was 12% in the rheumatoid group compared with 18% in the non-RA group (the Fischer exact test; level of significance 0.05).

Discussion

The use of TWA to treat end-stage rheumatoid and non-RA arthritis is very controversial due to the high range of complications reported in previous series.¹ Historically, the first total silicone wrist implants were abandoned because of unacceptable revision rates.⁵ They were followed by a first generation of metal-polyethylene total wrist arthroplasties that still had high complications and revisions rates.⁹ Even some newer metal-polyethylene prostheses designs showed at first promising results followed by unacceptable longer follow-up results.^{10,11} A recent systematic meta-analysis of a large series of total wrist arthroplasties (most of the first generation metal-polyethylene TWA) concluded that existing data do not support widespread application of TWA for rheumatoid arthritic wrists.⁵

This is why many surgeons prefer total wrist fusion to treat end-stage rheumatoid or non-RA wrist arthritis. Indeed, total wrist fusion will remain the only option for a destroyed RA wrist with bony destruction and complete loss of the carpal architecture.¹² However, there are many debatable issues

Table 1 Clinical Results of TWA in 112 Wrists with At Least 2 Years of Follow-Up

	Rheumatoid	Nonrheumatoid	Statistical Significance (p)
VAS pain improvement (100-point scale)	48 points	54 points	ns
QuickDASH improvement	20 points	21 points	ns
Wrist extension, degrees	29 (+2)	36 (–4)	ns
Wrist flexion, degrees	29 (–3)	37 (–5)	ns
Ulnar deviation, degrees	24 (+7)	28 (+2)	ns
Radial deviation, degrees	5 (–1)	10 (–4)	0.015
Grip strength improvement (% of preoperative value)	40	19	0.033

ns, not significant; TWA, total wrist arthroplasty; VAS, visual analog scale.

Table 2 Comparisons of Survival Rates between the First and the Last Generation TWA

	Name of TWA	Survival Rate for Revision at Maximal Follow-Up
Cobb and Beckenbaugh ²²	Biaxial	83% at 10 years
Meuli ²³	Meuli	77% at 10 years
Takwale et al ⁹	Biaxial	83% at 8 years
Krukhaug et al ²	Biaxial	77% at 10 years
Current study	ReMotion (new generation)	92% at 8 years

TWA, total wrist arthroplasty.

about total wrist fusion for end-stage arthritic wrist. It cannot be considered as a panacea for several reasons, both in rheumatoid and non-RA destroyed wrists. Wrist fusion may not provide optimal results in terms of daily activities as personal hygiene care, combing, dressing, or if multiple upper extremity joints are involved, or if there is bilateral wrist involvement.¹³ A wrist fusion implies the loss of the synergistic motion of wrist extension and long fingers flexion, which is very important to provide a good prehension. Wrist fusion may be followed by complications as hardware problems, secondary tendon ruptures, or carpal tunnel syndrome.¹⁴⁻¹⁶ The optimal position of the fusion for prehension, that is, slight extension and ulnar deviation is not always obtained.¹⁷ In some series of first generation total wrist arthroplasties where rheumatoid patients had a fusion on one side and a TWA on the other side, they almost always preferred arthroplasty.¹⁸ In osteoarthritic patients, total wrist fusion for end-stage destruction may leave a high percentage of residual pain or substantial dysfunction.^{19,20}

Little has been written regarding the results of the newest resurfacing metal-polyethylene implants characterized by a smaller size allowing for minimal bone resection. The series are small and the follow-ups are still short or medium term.^{6,7} The only series with long-term follow-up showed a high percentage of revisions.⁸ Our current preliminary short-term results suggest that one last generation TWA may have better outcomes than those reported on more limited numbers of patients or old generation TWA. The results in terms of pain are good and active motion is consistent with functional wrist motion (30-degree extension, 5-degree flexion, 15-degree ulnar deviation, and 10-degree radial deviation)

according to Palmer et al.²¹ The percentage of radiological loosening was relatively low and similar in rheumatoid and non-RA wrists (3 and 4%, respectively). The significance of periprosthetic osteolysis without loosening is unclear and needs further investigation. The overall revision rate is lower than those previously reported. The current survival rate of our study exceeds 90% at an average of 4 years of follow-up, both in rheumatoid and non-RA wrists.

In comparison with the first generation metal-polyethylene TWA, our current results suggest a significant improvement in terms of survival rate for revision (► **Table 2**). In comparison with the few articles⁶⁻⁸ reporting the results of new generation TWA, our results are based on much larger groups of patients, which allowed analyzing rheumatoid and non-RA wrists, separately, for the first time. Indeed, these are very different categories of patients with very different lives, prognoses, and functional needs. The survival rates of these two groups were surprisingly high and similar (► **Table 3**).

This study has limitations. It is a multicenter study, and the current follow-up is only a midterm follow-up. The radiographs were not gathered electronically and the radiological criteria were based on surgeon's judgment. This may have led to slightly different interpretations. The strengths of this study are the homogeneous recording into the database, the automatic update of statistics, and the large number of patients, which allows for the first time to individualize a consistent non-RA group of patients.

Our study suggests that the ReMotion TWA is feasible in the midterm and may be used in selected non-RA patients. Our results need to be confirmed at a longer follow-up.

Table 3 Comparisons of Survival Rates within New Generation TWA Series

		Ratio Rheumatoid/Nonrheumatoid Etiologies	Survival Rate for Revision at Average Follow-Up
Ward et al ⁸	UTW1	24/0	60% at 7 years
Ferreres et al ⁶	UTW2	14/7	100% at 5.5 years
Herzberg ⁷	ReMotion	13/6	100% at 2.8 years
Current series	ReMotion	129/86	RA: 96% at 4 years Non-RA: 92% at 4 years

TWA, total wrist arthroplasty; UTW, Universal total wrist; RA, rheumatoid arthritis.

Conflict of Interest

There was no conflict of interests from any of the authors of this article.

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