Conversion of Total Wrist Arthroplasty to Arthrodesis with a Custom-Made Peg

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Abstract

Conversion of a failed total wrist arthroplasty to arthrodesis can be difficult. A custom-made titanium alloy peg was constructed to enable arthrodesis with the original arthroplasty components in situ. Two out of three patients were especially challenging cases with little bone available. Bony union was achieved in 2 to 3 months. The peg simplified a difficult revision situation and gave good, predictable results at follow-up.

Keywords

- arthrodesis
- arthroplasty
- revision
- uncemented
- wrist

Introduction

Total wrist arthroplasty may fail by loosening, infection, dislocation, or fixed malposition. Loosening of the distal component and instability/dislocation are the most frequent causes of revision.[1–3] More widespread use and expanded indications for wrist replacement have led to an increased number of failures.

A wrist arthrodesis is one of the options as a salvage procedure for a failed implant arthroplasty. Arthrodesis after arthroplasty can be a troublesome procedure.[4,5] Removal of bone during the primary procedures, bony erosion, and bone loss during implant extraction will decrease the bone stock that is available for arthrodesis. Large auto- or allografts may be used, but fixation and bony union can be difficult.[4–6] Soft tissue coverage may also be a problem.

The Motec Wrist Joint Prosthesis (Swemac Orthopaedics AB, Linköping, Sweden) is a cementless modular metal-on-metal ball-and-socket articulation with a diameter of 15 or 18 mm. It consists of a modular system with screw-shaped implants for bony fixation in the radius and (through the capitate) the third metacarpal, which are fixed to the implants by a Morse taper (►**Fig. 1**).

The screws are grit-blasted and coated with Bonit (DOT, Rostock, Germany), a resorbable calcium phosphate coating. The cones of the ball and socket are identical; therefore the thinner and longer distal screw can be used for fixation to the radius in cases of inadequate bone stock.

For conversion of a stable arthroplasty using the Motec prosthesis to an arthrodesis, a custom-made peg was developed to avoid carpal shortening and extensive bone removal. The peg was made of grit-blasted titanium alloy (Ti_6Al_4V) to facilitate osseointegration and was designed to fit into the base of the proximal and distal implants of the Motec prosthesis (►**Fig. 2**).

Technique

A dorsal approach between the third and fourth extensor, used during the primary insertion of the arthroplasty, was

Fig. 1 The modular Motec wrist arthroplasty. Thick and short radial screw to the left and a thin and long capitate/third metacarpal screw on the right. A Morse taper is used for fixation of the articulation.

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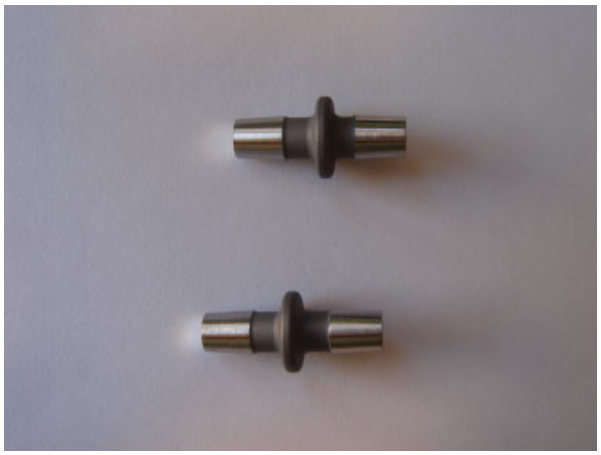

Fig. 2 The arthrodesis peg consists of identical cones on both sides with a crest in the middle of the peg. (**a**) 10 mm long midsection. (**b**) 12 mm long midsection.

developed again. The ball-and-socket articulation was removed and the bony fixation of the screws confirmed. The peg was inserted into the base of the proximal and distal implants by hitting the crest of the peg both proximally and distally. Corticocancellous grafts from the ipsilateral iliac crest were placed between the carpal bones and the radius on the radial and ulnar sides of the peg, supplemented by cancellous graft. The capsule and the extensor retinaculum were repaired, and a forearm cast was applied for 8 weeks.

Patients and Methods

We previously reported our results over an 8-year period with the Motec Wrist Joint Prosthesis.[7] It was implanted in 16 patients/wrists with scaphoid nonunion advanced collapse (SNAC; grades 3 or 4) and 14 wrists with scapholunate advanced collapse (SLAC, grades 3–4) in 30 patients (20 men) The mean age of the patients was 52 years (31 to 71). All prostheses integrated well radiologically. At a mean follow-up of 3.2 years (1.1 to 6.1) no subluxation or implant breakage occurred. The arthroplasty has also been used in patients with other diagnoses including rheumatoid arthritis (RA), juvenile rheumatoid arthritis (JRA), lunate malacia, sequelae after distal radius fracture, primary arthrosis, and sequelae after larger wrist injuries.

We performed a wrist arthrodesis using the peg in three patients: two with pain and fixed malposition and one with unexplainable pain (►**Fig. 3a–c**). Patients 1 and 2 had bilateral wrist involvement and finger involvement due to RA and JRA; the first patient also had sequelae after a distal radius fracture. These patients were retired or disabled prior to the arthroplasty surgery and had multiple RA joint involvement. Thin and fragile bone made removal of the well-integrated components difficult. Patient 3 had a SNAC wrist and had been on sick leave for 18 months. The characteristics of the patients are given in ►**Table 1**.

Results

Patient 3 had postoperative median nerve paresthesia, treated with carpal tunnel release 2 weeks following surgery, but then developed a complex regional pain syndrome at follow-up at the local hospital. It resolved after 24 months. Bony union was seen in two patients after 8 weeks and in one after 12 weeks No additional surgery was necessary during the follow-up period (0.6, 4.1 and 4.3 years). The wrist was fixed in neutral position in the frontal plane and in neutral (patient 1) and 5° of flexion (patients 2 and 3) in the lateral

Fig. 3 Preoperative radiographs of **(a)** patients 1, **(b)** 2, and **(c)** 3. In patients 1 and 2, metacarpal screws were used for fixation in the radius.

Table 1 Preoperative patient characteristics

Case no.	Sex	Diagnosis	Age at revision (yrs)	Survival (yrs)	Preop wrist AROM	Supination	Pronation	Pain at rest[a]	Pain during activity[a]	QDASH
1	Female	RA/sequelae distal radius fracture	75	2.8	0°	10°	80°	4	5	68.3
2	Female	JRA	24	2.7	0°	80°	80°	8	10	90
3	Male	SNAC	32	1.4	80°	80°	80°	4	8	39.3

Abbreviations: AROM, active range of motion; QDASH, quick disability of arm, shoulder and hand.
[a]A visual analog scale (VAS) from 0 to 10 was used for pain assessment.

plane measured on the follow-up radiographs. The latest frontal radiographs are shown in ►**Fig. 4**.

The clinical results were satisfactory with retained or increased forearm rotation and a substantial pain reduction, as shown in ►**Table 2**. The patients used no pain medication at the latest follow-up.

Two more sophisticated systems (with a similar operative procedure) have been developed and tested in cadavers. The first may be angled 0°, 15°, or 25° for optimizing the position of the wrist according to the patient's preferences (►**Fig. 5a, b**). The second system is intended for arthroplasties with a well-fixed proximal component and distal loosening. After removal of the loose distal component, a distal intramedullary nail is introduced and fixed with locking screws for bony fixation to occur (►**Fig. 6a, b**). Bone transplantation is performed in the same manner as described for the original peg.

Discussion

Bony wrist fusion and a good clinical result were achieved in three patients. Implants joining the bone-fixed parts of wrist arthroplasties for fusion have to our knowledge not been available so far. Orbay et al, however, have described a locked intramedullary implant for a primary wrist arthrodesis, which is similar to our technique in many ways.[8] Replacing the articulation with a stable construct requires a modular system on both sides of the articulation. Of the contemporary, available concepts—Universal 2 (Integra LifeSciences, Plainsboro, NJ, USA); RE-MOTION (SBI, Morrisville, PA, USA); Maestro (Biomet Orthopedics, Warsaw, IN, USA); and TMW (OrthoCube AG, Baar, Switzerland)—such a modularity is found only in the TMW prosthesis. The former three concepts utilize a proximal monoblock with a concave articulation, precluding conversion of a

Fig. 4 Follow-up radiographs. (**a**) 0.5 year (patient 1). (**b**) 4.1 years (patient 2). (**c**) 4.3 years (patient 3) after surgery.

Table 2 Clinical results at follow-up

Case no.	FU (years)	Supination (°)	Pronation (°)	Pain at rest (0–10)	Pain during activity (0–10)	Grip strength preop (kg)	Grip strength postop (kg)	Key pinch operated (kg)	Key pinch opposite side (kg)	QDASH
1[b]	0.5	20	70	0	0					
2	4.1	90	90	0	2	0	11	5	4.5	40,9
3	4.3	90	90	3	5	20	15	5	10.5	50

Abbreviations: QDASH, Quick Disability of Arm, Shoulder and Hand.
[a]A VAS from 0 to 10 was used for pain assessment.
[b]Patient died of an unrelated cause 1 year after arthrodesis surgery; strength and QDASH not measured at 6 months.

failed arthroplasty to arthrodesis with any of the original components in situ. Contemporary arthroplasties have demonstrated promising results and a lower rate of revision compared with prior generations, but problems with instability and distal loosening persist,[2,9,10] and revisions must be expected.

In cases with insufficient soft tissue coverage, an intramedullary system can prevent the need for soft tissue transplantation, and the peg system can maintain the desired carpal length without shortening.

A disadvantage of the fixed peg that we used is the inability to position the wrist in extension, which is often the desired position of the arthrodesis. In the more sophisticated systems with angulation possibilities this shortcoming may been overcome theoretically, but we have not used this clinically as yet.

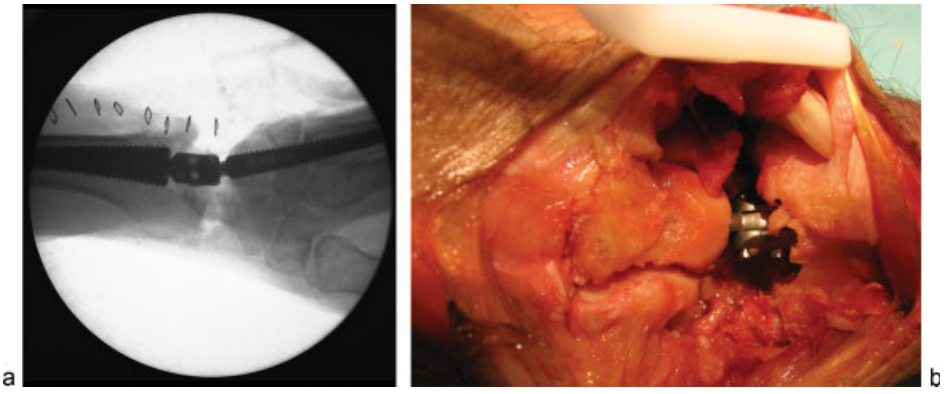

Fig. 5 Peg with angulation possibilities, the angle is adjusted after insertion and locked with the two small screws. (**a**) Fluoroscopic lateral view in cadaver. (**b**) In situ from the dorsal aspect.

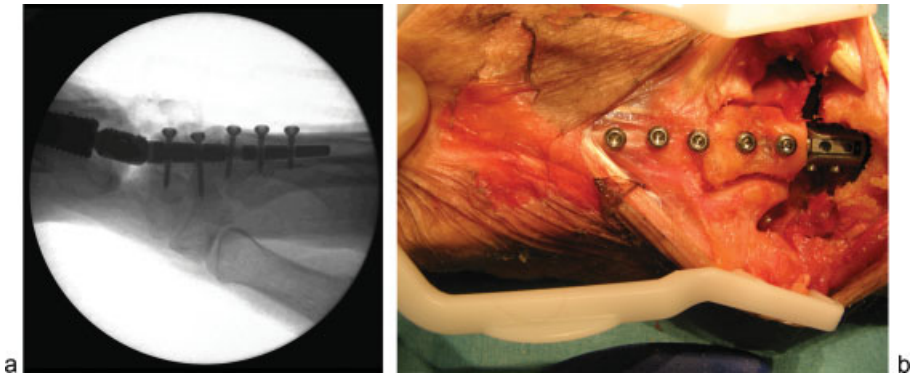

Fig. 6 Intramedullary nail in the capitate and third metacarpal with locking screws. (**a**) Lateral fluoroscopic view in a cadaver, angulation according to the patient's preferences. (**b**) In situ from the dorsal aspect.

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Conflict of Interest
None

References

1 Kretschmer F, Fansa H. BIAX total wrist arthroplasty: management and results after 42 patients [in German]. Handchir Mikrochir Plast Chir 2007;39(4):238–248
2 Ward CM, Kuhl T, Adams BD. Five- to ten-year outcomes of the Universal total wrist arthroplasty in patients with rheumatoid arthritis. J Bone Joint Surg Am 2011;93(10):914–919
3 Cooney WP III, Beckenbaugh RD, Linscheid RL. Total wrist arthroplasty. Problems with implant failures. Clin Orthop Relat Res 1984; 187(187):121–128
4 Beer TA, Turner RH. Wrist arthrodesis for failed wrist implant arthroplasty. J Hand Surg Am 1997;22(4):685–693
5 Rizzo M, Ackerman DB, Rodrigues RL, Beckenbaugh RD. Wrist arthrodesis as a salvage procedure for failed implant arthroplasty. J Hand Surg Eur Vol 2011;36(1):29–33
6 Ferlic DC, Jolly SN, Clayton ML. Salvage for failed implant arthroplasty of the wrist. J Hand Surg Am 1992;17(5):917–923
7 Reigstad O, Lütken T, Grimsgaard C, Bolstad B, Thorkildsen R, Røkkum M. Promising one- to six-year results with the Motec wrist arthroplasty in patients with post-traumatic osteoarthritis. J Bone Joint Surg Br 2012;94(11):1540–1545
8 Orbay JL, Feliciano E, Orbay C. Locked intramedullary total wrist arthrodesis. J Wrist Surg 2012;1(2):179–184
9 Herzberg GB, Sorensen MA, Axelsson I, et al. "Remotion" total wrist arthroplasty: preliminary results of a prospective international multicenter study of 215 cases. J Wrist Surg 2012;01:17–23 PubMed
10 Rahimtoola ZO, Hubach P. Total modular wrist prosthesis: a new design. Scand J Plast Reconstr Surg Hand Surg 2004;38(3): 160–165