Advances in Total Wrist Arthroplasty

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Introduction

Much has been written on the history of the use of total wrist arthroplasty (TWA) to treat rheumatoid patients [1]. TWA for rheumatoid patients is still a controversial issue [2–5]. For this reason, the reader should keep in mind that total wrist fusion (TWF) remains the standard in which all wrist arthroplasty procedures are judged. TWA is a challenger of TWF. It is a more ambitious procedure because patients always prefer motion [6], but failures can occur despite recent improvements. Because TWA is a relatively new procedure, only time and experience will provide more consistent outcomes when TWA is chosen for a particular patient.

The purpose of this chapter was to provide current concepts about the indications, contraindications, and current results of TWA for end-stage rheumatoid arthritis.

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Indications and Contraindications

The indication for TWA in RA is a painful pancarpal arthritic wrist. This means a stage IV or V according to Larsen's classification [7] or a stage II according to Simmen and Herren's classification [8]. We prefer to use Simmen's classification because it highlights the "arthrosis" type 2 stage (Fig. 12.1) compared with the "ankylosing" type 1 stage (Fig. 12.2) and the "destructive" type 3 stage (Fig. 12.3).

Volar carpal subluxation in type 2 RA wrists should not be considered as a contraindication. However, the surgeon should not expect good results with TWA for Simmen type 1 or 3 RA wrists.

The use of walking aids or nonfunctional/irreparable wrist motors are contraindications to TWA as well as severe stiffness of both wrists especially if non-reducible flexion deformity is present. Active infection is the classic contraindication to any implant surgery. Active RA with difficulties in medical treatment adjustments is a contraindication to any major wrist surgery.

Specifications and Current Results of Recent TWA Designs

The use of the Maestro total wrist system (Biomet, Warsaw, IN) was recently reported by Nydick [9] in 5 RA wrists within a series of 23

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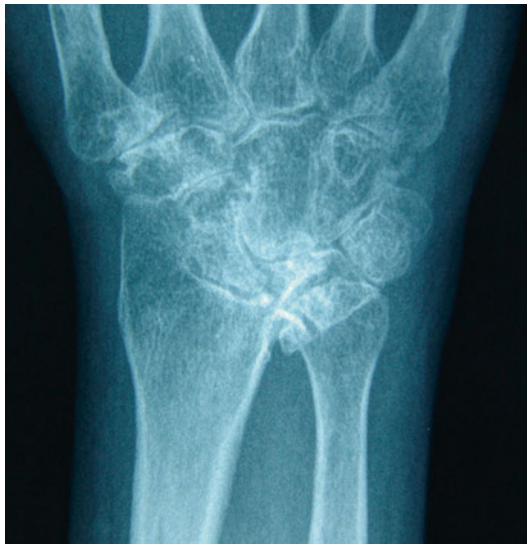

Fig. 12.1 Simmen stage II end-stage rheumatoid wrist is a good indication for TWA in a compliant patient understanding the risk–benefit issue of TWA compared with TWF

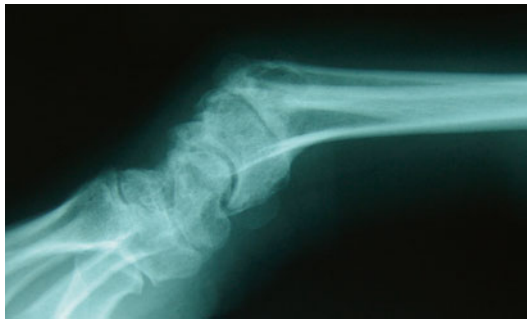

Fig. 12.2 Simmen stage I ankylosing rheumatoid wrist may not be currently considered as a good candidate for TWA

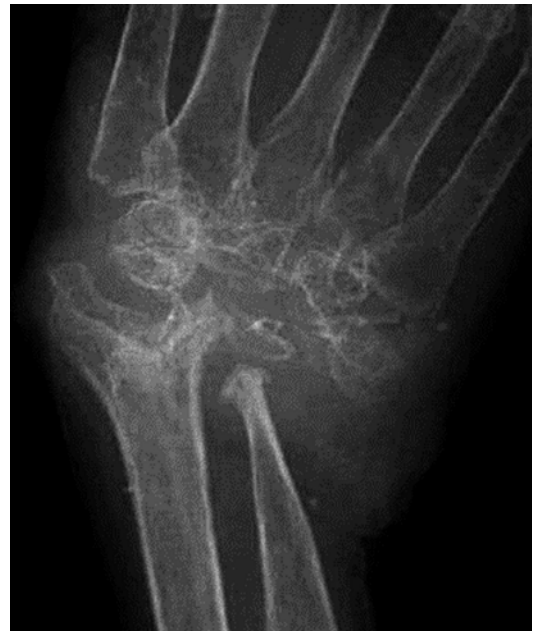

Fig. 12.3 Simmen stage III osteolytic unstable rheumatoid wrist should still be treated with total wrist fusion

TWA. The Maestro TWA comprises of press-fit radial and carpal components. The carpal component fixation is augmented with non-locking screws into the second metacarpal and hamate, with care being taken not to cross the fourth and fifth carpometacarpal joints. Distal ulna resection was associated in 3 of these 5 Maestro cases. Nydick et al. reported the results of their five RA wrists at a mean follow-up of 28 months. The average VAS pain improved by seven points, and postoperative wrist motion gain was 4° meaning that wrist motion was essentially maintained. The average postoperative DASH score was 54 points, and the average postoperative Mayo wrist score was 49 % (poor according to Cooney's stratification). The postoperative forearm rotation arc was not reported. A total of two complications (40 %) were reported within the five RA wrists. One patient had persistent wrist flexion contracture with loss of extension (0° of extension, 60° of flexion) despite flexor carpi radialis tenotomy and flexor carpi ulnaris lengthening. One patient had a volar wrist dislocation that occurred from a fall shortly after surgery and was successfully treated with closed reduction and extension splinting for 2 weeks. Nydick's study was not specifically aimed at rheumatoid patients. Thus, the numbers are very small, and it is too early to get valid conclusions about the use of this new implant to treat the end-stage rheumatoid wrist.

The use of the first-generation UTW TWA (KMI) was reported by Ward [10] using the technique described by Menon [11]. The radial component and the central stem of the carpal component were fixed with cement. The carpal component was further secured with two screws into the carpus. The distal part of the ulna was resected in all cases. Ward et al. reported the

results of a prospective series of 19 "UTW1" TWA in 15 patients with rheumatoid arthritis disease at a mean follow-up of 7.3 years. The DASH score improvement was 22 points, ranging from 62 pts preoperatively to 40 pts postoperatively. The mean improvement in wrist flexion–extension arc was 14°. The postoperative forearm rotation arc and VAS pain were not specifically reported. A total of nine wrists (47 %) underwent revision surgery because of carpal component loosening. A total of two additional wrists had radiographic evidence of carpal component subsidence at the time of latest follow-up. The implant survival rate at follow-up was 60 %. These results with the UTW1 implant were far from satisfactory regarding the revision rate. In our opinion, this series should be considered as historical since this implant is no longer available and has been replaced by the UTW2 implant.

The use of the UTW2 TWA (Integra LifeSciences, Plainsboro, NJ) was reported by Ferreres in 2011 [12] in 21 wrists of which 14 had rheumatoid arthritis. The mean follow-up was 5.5 years. The distal part of the ulna was resected in all cases. Pain during activities of daily living was absent or slight in 81 % of the patients. The postoperative PRWE averaged 24 %. Looking specifically at the results of the rheumatoid patients in this series, the average postoperative wrist flexion–extension arc was 69°. Mean postoperative PRWE for pain was 14. Mean postoperative PRWE for pain was 16. A total of five patients were very satisfied, eight patients were satisfied, and one was not satisfied. Ferreres reported two minor postoperative complications and one ulnar subsidence with periprosthetic osteolysis. These results were by far superior to those reported by Ward. These results confirm how important TWA design and instrumentation are with respect to clinical outcomes and implant survival.

We reported in 2011 [13] the use of the Remotion (SBI) TWA in a single-center study of 13 RA wrists at a mean follow-up of 32 months. VAS pain improvement was 6/10 points. The average postoperative wrist flexion–extension arc was 53°, which is a 12° decrease from preoperative measurements but still a functional range of active motion. Grip strength improved from 7 kg preoperatively to 11 kg postoperatively. A total of 11 patients subjectively felt much improved and two felt improved. There were no reoperations or dislocations at this short-term evaluation, but we observed two loosenings, one carpal and one radial, none of which symptomatic enough to warrant revision. The fact that true loosening with implant subsidence could be well tolerated was a new finding that in our opinion was directly related to the implant design regarding its primary stability.

A European multicentre study using the Remotion (SBI) TWA at a much larger scale (75 patients at mean follow-up of 4 years) provided similar results [14]. VAS pain improvement was 4.8/10 points. The average postoperative wrist flexion–extension arc was 58°. Postoperative grip strength improvement reached 40 %. The mean quick DASH improvement was 20 pts. There were 5 % complications requiring implant revision and 2 % minor complications not requiring revision. We observed a 12 % rate of periprosthetic radiological loosening. The survival rate at a mean of 4-year follow-up was 96 %. These results were confirmed in a subsequent analysis with longer follow-up [15]. Currently the Remotion (SBI) TWA has the largest reported outcomes compared with other implants. These results make it easier when discussing with a patient about the outcome he or she can expect if operated on with TWA for complete wrist destruction from rheumatoid disease. This does not mean that this implant is better than any other last-generation TWA since no paper reported any comparative study between different implants. Here are some tips and tricks about the Remotion surgical technique.

Preoperative templating with scaled X-rays is very important to make sure that rheumatoid carpal collapse does not preclude the TWA insertion. The implant should not be oversized. A Darrach procedure is most often combined with TWA. The combined use of ulnar head implant and TWA has seldom been reported and cannot be recommended at this time. The capsulotomy should allow satisfactory view of the destroyed carpus, provide access to the ulnar head, and

allow for closure at the end of the procedure so that the implant is covered and not in direct contact with the extensor tendons. We currently recommend a "Z" capsulotomy of the wrist combined with an extension toward the ulnar neck. In order to properly orient radial and carpal stems, the wrist should be flexed 90° once bony resections are done. Because proper rotation of the components is critical, we recommend the surgeon to be seated at the end of the upper extremity. Fluoroscopy should be available in the OR so that proper stem positioning can be checked. The stem of the carpal component should be aligned with the third metacarpal. The carpal implant should be seated into a fused distal carpus. If the fusion is not completed by the disease at the time of the operation, it should be performed simultaneously around the carpal component using the cancellous part of the resected bone. It is our opinion that the second and third CMC joints should ideally not be crossed by any part of the carpal component of the implant (stem or screws) in order to keep some carpometacarpal micromotion. This micromotion may act as a shock absorber to compensate for the modified biomechanics of the prosthetic wrist. This remark is not valid if the second and third CMC joints are already fused by the disease, but in any event the stem should not go too far into the third metacarpal. The dorsal retinaculum should be anatomically closed at the completion of the procedure.

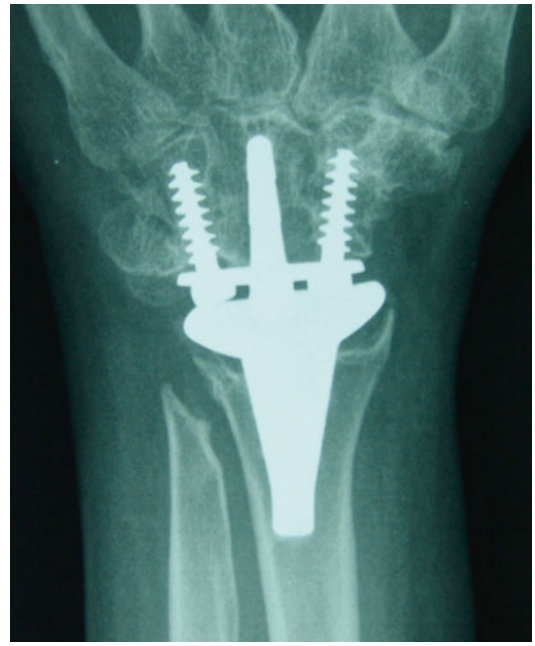

Fig. 12.4 Example of Remotion TWA in the nondominant rheumatoid wrist of a 44-year-old female 3 years after surgery. The patient was much improved compared to her preoperative status and very satisfied. Her postoperative PRWE was 7pts; Quick DASH was 14 pts. Active flexion–extension arc was 45°

Conclusions

There has been a major breakthrough about the use of TWA to treat rheumatoid wrists since 2000 [13–16]. Several new designs have been proposed, all featuring smaller implants. When compared with the older-generation metal on polyethylene TWA, the results and survival rates with the current designs are much better. Experience and follow-ups are gradually increasing. Arthroplasty surgery using new-generation TWA designs has become a reliable procedure (Fig. 12.4) for most rheumatoid patients with stage II Simmen "osteoarthritic-like" wrists even if there is a volar subluxation of the carpus with respect to the radius. The procedure is even more justified if the rheumatoid involvement is bilateral and if a TWF is chosen on the other side [5, 17]. When dealing with rheumatoid Simmen stage II panarthritis of the wrist, the patient's and surgeon's decision-making should consider several factors. First of all, TWF for end-stage rheumatoid arthritis for whatever Simmen's stage is a time-honored standard procedure with reliable long-term results. However, complete loss of wrist motion has obvious negative consequences on wrist function [18]. This is particularly true if there is multiple joint involvement of the ipsilateral upper extremity [6]. In this situation or when dealing with a patient who wishes to keep some active motion or if there is bilateral wrist involvement, it is now possible to consider TWA. Given the still limited experience with the above-described new-generation implants, the patient must be aware that complications and revision cannot be excluded. Among complications of these new TWA designs, periprosthetic osteolysis

[19, 20] is a concern and is currently under investigation. The patient should be informed of this potential complication before surgery is undertaken. In other words, because revision of failed TWA usually consists of TWF, TWA can now be considered as a motion-preserving option before eventual TWF in a compliant and motivated patient who is well aware of the potential complications. In our opinion, given the fact that we are now more confident with the use of Remotion TWA, arthroplasty is our first choice in a compliant patient presenting with a Simmen 2 rheumatoid wrist whether the involvement is bilateral or not. We consider TWA as an option "before" TWF and TWF as a revision option should the TWA fail. In this situation, conversion of the TWA to TWF can be done in one or two stages. If two stages are required, there is a need for a temporary cement spacer for 3 months before TWF. In any event, in rheumatoid patients, the TWF does not require a massive bone graft since implant's volume was limited. Fixation of TWF with a dorsal pre-contoured plate is seldom possible in our experience because of the wrist distortion and skin fragility, and we prefer to use temporary K-wires.

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