Total Wrist Replacement

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Introduction

Wrist arthritis is a common problem seen secondary to previous trauma, rheumatoid arthritis, or osteoarthritic degenerative changes in the general population. While the majority of these patients can be treated satisfactorily with nonsteroidal anti-inflammatories and wrist splinting, a specific subgroup becomes painful enough that some form of surgical treatment is required. If the wrist arthritis is limited to only one or two portions of the wrist joint, limited procedures such as a proximal row carpectomy or limited intercarpal fusion can be performed to provide pain relief, wrist stability, and a reasonable arc of motion for overall function. If the wrist degenerative arthritis involves the entire radiocarpal joint, then the classic option has always been a total wrist fusion. While total wrist fusion is an extremely predictable procedure which provides good pain relief and strength, by definition complete loss of motion of the wrist occurs with the exception of pronation/supination. Attempts at total wrist joint replacement, such as is frequently seen in the hips and knees, have been tried for many decades. The initial implants were fraught with either dislocation of the implant themselves or loosening of the carpal component due to the insufficient bone stock present for fixation.[1-3] Most total wrist arthroplasties which were performed were utilized in rheumatoid arthritic patients who have a relatively lower demand from a functional basis, thereby decreasing the stresses and forces imparted to the total wrist during activities of daily living. In the last decade, significant improvements in the design of total wrist implants and the instruments available to successfully implant these have become available and have opened up the ability to use this treatment option in patients with rheumatoid arthritis or osteoarthritis of the wrist.[4-8] All the total wrist implants utilized in the United States are approved by the FDA for use with bone cement; however, many of these implants are porous coated and frequent use of these devices in an off-label fashion for bony ingrowth occurs.

Figure 1. The Universal 2 wrist implant (Integra LifeSciences, Plainsboro, NJ).

Implant Design

Essentially, all of the total wrist new generation implants currently available involve a well-designed concave radial component which has an intramedullary stem, frequently porous coated, and some offset to the articular surface to provide greater stability. The carpal component most often utilizes a central stem with porous coating for fixation in the capitate and third metacarpal and two screws that are utilized through the metal plate of the carpal component for fixation in the carpus itself. A polyethylene convex insert is utilized to attach to the carpal component and articulates with the radial component, providing a functional arc of motion of approximately thirty to thirty-five degrees in both extension and flexion. (Figure 1) Currently, the majority of these implants are placed in an uncemented

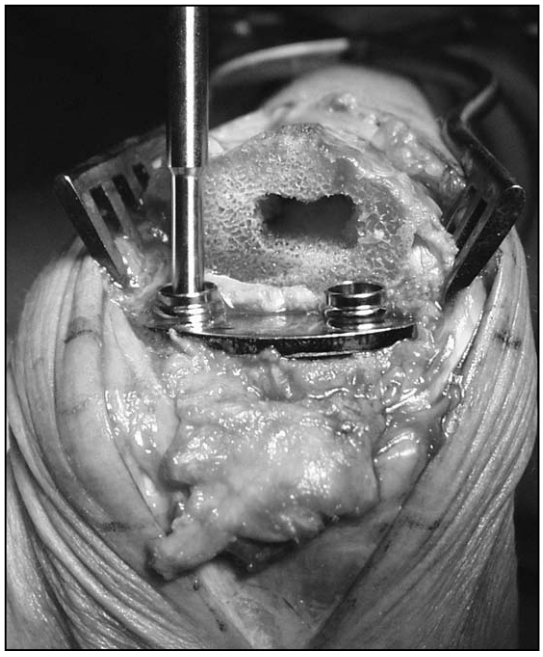


Figure 2. Intra-operative fixation of the carpal component.

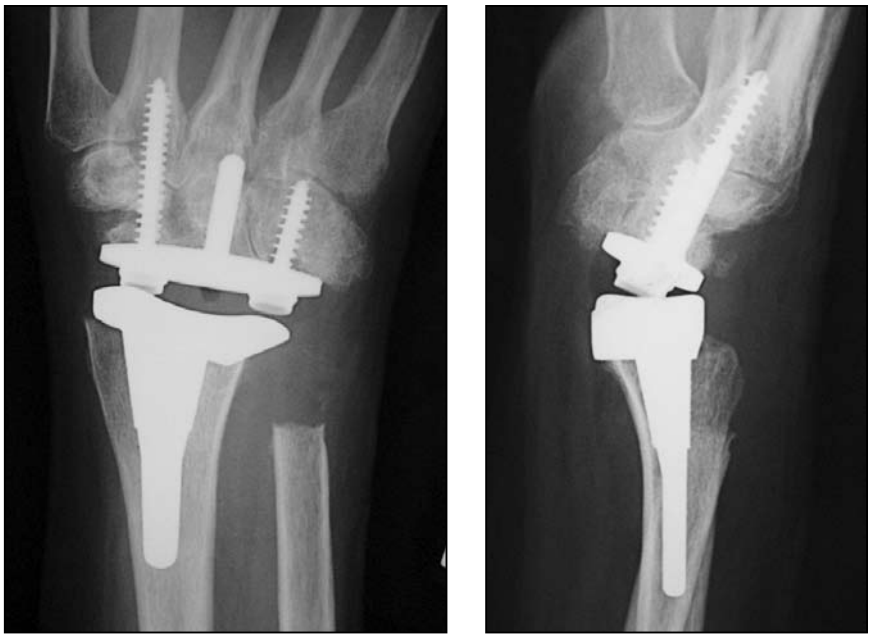
Figure 3. Intra-operative image of a well-aligned total wrist implant.

Figure 3. Intra-operative image of a well-aligned total wrist implant.

fashion to allow bony ingrowth to occur in both the carpal and radial components providing a theoretically greater chance to avoid implant loosening following bony ingrowth. The surgical technique for implanting these devices is in many ways very similar to that utilized in both total hip and total knee replacements. (Figure 2) Instruments with set jigs are used to produce precise bone cuts, allowing a much more predictable alignment of the implant components than was previously afforded with older generation designs. (Figure 3) Nevertheless, there is still an inherent "fiddle factor" in accomplishing a well-aligned total wrist implant placement as compared to hips and knees due to the much smaller architecture of the radius and carpal bones.

Clinical results

We have performed over fifty total wrist replacements in patients with both rheumatoid and osteoarthritis in an uncemented fashion utilizing the newest generation designs with excellent results. The initial patients in this cohort are now up to nine years out from there primary procedure. While the majority of these patients have rheumatoid arthritis, the success of the new generation implants has allowed these to be utilized in low to medium demand osteoarthritics as well. Of our current cohort of patients, only one had a dislocation of the component, which was successfully treated by closed relocation and cast immobilization for one month. In addition, a few patients have developed carpal implant loosening after five years which required revision of the carpal implant to reconstitute the device in a functional manner. No revisions of the radial component have been performed. Pain relief at the wrist has been uniformly excellent and the average range of motion in these patients stabilized at approximately seventy degrees in an extension/flexion plane. Follow up radiographs of these patients indicate excellent bone incorporation into the porous coated radial component and reasonably good bony incorporation into the carpal component although some radiolucent lines without clinical evidence of loosening are noted. (Figures 4a & 4b) Following these radiolucent lines over time does not appear to indicate a worsening problem with implant stability.



Figures 4a and 4b. Postero-anterior (a) and lateral (b) radiographs of a total wrist implant.

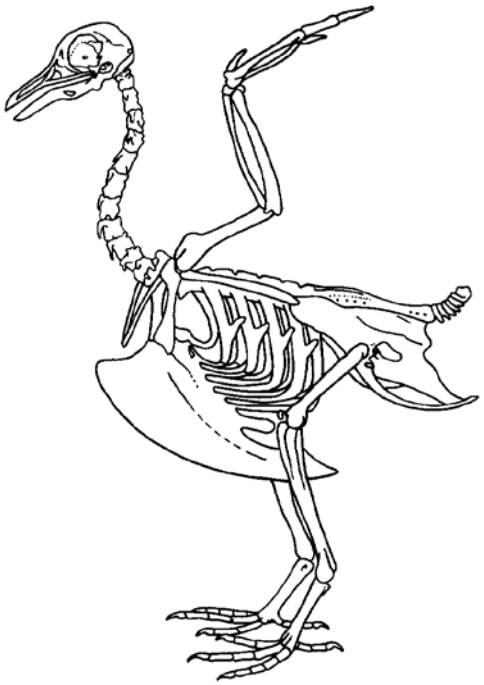
Discussion

Uncemented total wrist arthroplasty appears to be an excellent alternative to total wrist fusion for well-select patients

Figure 5. Extension (a) and flexion (b) 3 months following total wrist arthroplasty.

suffering either rheumatoid arthritis or osteoarthritis mostly of a post-traumatic nature. Newer implant designs have eliminated many of the detrimental characteristics of older designs and have excellent inherent stability. While there is a fairly steep learning curve to the implantation of these implants due to less precise instrumentation, the instrumentation sets have been improving over time and the predictability of alignment and cuts has improved as well. The dislocation rate is extremely low and the loosening rate also quite low over a five- to seven-year follow up interval. Most patients in our series have been advised not to lift greater than ten pounds in the hand which contains the total wrist implant from a safety perspective. While this is a fairly arbitrary number and there's really no data on how much patients can lift with a total wrist implant on a long term basis, we have felt this to be a reasonable weight limit. Nevertheless, we are aware of several patients who lift significantly greater forces without any adverse sequelae in their long term follow up. The overall range of motion of these patients is approximately fifty percent of their normal wrist and this allows almost all activities of daily living to be accomplished without difficulty. (Figures 5a & 5b) The pain relief following this procedure is quite predictable and rivals that associated with other joint replacements having a longer history.

It is our opinion that total wrist replacement is a viable option for patients having complete degenerative changes of the radiocarpal joint and can provide excellent outcomes on a relatively long term basis with improved overall function.



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Disclosure of Financial Interests

Edward Akelman, MD, does not have any financial interest to disclose.

Peter-Arnold C. Weiss, MD, has financial interest in DePuy, Inc.

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