Trauma and Emergency Care

Case Study

The Maestro™ Wrist Reconstructive System for treatment of posttraumatic wrist joint osteoarthritis after a devasting course of a distal radius fracture: Case presentation and technical note to the implant

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Abbreviations

DRF: distal radius fracture; ORIF: open reduction and internal fixation; LVP: locked volar plating; SLD: scapholunate dissociation; PA: posteroanterior; OA: osteoarthritis; TWA: total wrist arthroplasty; WRS: Wrist Reconstructive System; TWF: total wrist fusion

Case presentation

A 53-year-old right-handed and obese male sustained an intraarticular distal radius fracture (DRF) right due to a high energy injury that was primarily treated in another hospital with open reduction and internal fixation (ORIF) using locked volar plating (LVP), one screw, and two Kirschner-wires. At first presentation in our hospital three month after primary surgery, the patient reported severe pain in his right wrist. Radiographically, there was a failed ORIF with distinctive displacement of the dorsal main fragment associated with an unacceptable intraarticular step-off due to primary insertion of LVP metaphyseal screws that proved to be of inadequate length; and additionally, an untreated complete scapholunate dissociation (SLD) Lindau grade 3 (Figure 1A). It is unknown to the authors whether SLD existed on the primary radiographs at time of injury. All internal osteosynthesis material was removed. Another three months later, the posteroanterior (PA) and lateral radiographs revealed advanced posttraumatic wrist joint osteoarthritis (OA) associated with distinctive impaction of the scaphoid bone into the distal radius metaphysis due to instability of proximal row (Figure 1B). The motion-preserving total wrist arthroplasty (TWA) using the relatively new angle-stable Maestro™ Wrist Reconstructive System (WRS, Biomet, Warsaw, Indiana / USA) accompanied by excision of the entire scaphoid bone was performed (Figure 2A). One year after TWA, there was an impingement between the ulnar head and radial component of TWA due to bony resorption of the sigmoid notch without any signs of implant loosening or subsidence (Figure 2B), that was treated with ulnar head hemiresection (Bowers procedure). Two years after the TWA the positioning of TWA was unchanged, without implant loosening or subsidence. Also noted was no convergence instability of the distal ulnar stump or radioulnar impingement radiographically (Figure 2C). Function in patient-rated wrist evaluation score (0-100 points) and pain in visual analogue score (0-10 points) improved from 76 and 9 before TWA to 26 and 2. In order to preserve motion, the patient reported that he would undergo the same TWA a second time were it necessary.

Despite the rapidly increasing use of VLD for ORIF of DRF over the past 20 years, recent evidence shows that this procedure is not without complications. Rates have been noted to range from 18-22% [1,2]. To avoid this high complication rate which has been associated with a significant negative impact on the patient's activities of daily living and independence in their personal, professional, and social environment, primary wrist hemiarthroplasty or early TWA after a failed primary osteosynthesis can be an option for the treatment of DRF especially in older and elderly patients [3-8]. However, long-term data using these procedures are not available currently. Intraarticular DRF can be associated in 5, 1 % of cases with SLD Lindau grade 3, and temporary scapholunate joint fixation is strictly recommended at time of injury to avoid instability in the proximal row [9,10].

Rheumatoid arthritis remains the most common indication for TWA with relative portion ranging from 51-71% of all patients receiving TWA [11,12]. However, TWA has proven to be useful as a motion-preserving alternative to total wrist fusion (TWF) for treatment of posttraumatic wrist joint OA as well [13]. TWA has also resulted in a significantly better outcome than in patients who underwent a primary TWF [14]. Demanding physical occupations are not generally considered a contraindication for TWA [7,15]. The relatively new angle-stable Maestro™ WRS that was used in our case, is one of the modern biaxial-anatomical third generation type that is currently in use [7,8,16-18]. This type is the further development of the non-angle stable Maestro™ Total Wrist that was developed in 2002 by Strickland / Palmer / Graham. The implant was designed for use in an uncemented manner, but it is recommended to insert the radial component with it titanium alloy stem with cementation if the bone stock is poor [7]. Such as in our case, the goal of both types is that the design allows the excision of the entire scaphoid bone accompanied with its replacement utilizing a carpal component that incorporates various scaphoid augments (Figure 2A). Thus, it is not always necessary to attempt fusion of the distal pole of scaphoid bone to the surrounding carpal bones, and the carpal plate has a sufficient support onto the base of trapez bone

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[18,19]. In a single-center study, published in 2015, the cumulative implant survival after eight years (N=68) is reported to be 95%, and at the 5-year follow-up radiographic loosening was present in 2% of all cases only [20]. Currently, the Maestro™ total wrist achieves the most favorable functional outcome as compared to other third-generation types, and it may be justified in preserving resection-related carpal height due to its three various carpal heads in combination with its design of ellipsoid surface articulation [21]. The implant was designed for use as a carpal hemiwrist arthroplasty as well [17]. In one study, the use of implant as a radial hemiwrist arthroplasty was described, but the results were poor due to polyethylene wear and/or fracture, and Cooney noted that care must be taken when applying this procedure in such an "off-label" manner [22,23]. The main disadvantage of implant is that the ultra-high molecular weight polyethylene insert is fixed to the radial monobloc component, therefore, revision of the entire component becomes necessary if polyethylene wear or fracture occurs. The new features of the Maestro™ WRS compared to the first type are: first, the carpal plate is inserted with green colored polyaxial or blue colored monoaxial screws to reduce the shear forces at the implant-bone-interface (Figure 2A); and second, the intercalated cobalt-chrome carpal heads are placed externally onto the conus of the primarily inserted carpal plate, therefore, revision of the entire component is not necessary if an exchange of carpal head would be required. This is especially the case with dislocation of the implant (Figure 3A-B). However, patients undergoing treatment with TWA must be prepared that it might end with TWF; therefore limited bone resection is a common feature of all contemporary wrist replacements [24]. The Maestro™ implants have demonstrated uncomplicated conversion to TWF [17,20,21,25]. A recent study revealed that the outcome of TWF after a failed TWA is comparable with those after primary TWF [26].

Bony resorption of the sigmoid notch is known from the use of an ulnar head replacement with or without TWA [8,27]. Why it occured in our case is unclear. The Bowers procedure is one option for treatment of distal radioulnar joint disease such as in our case. However, the main problem of (hemi-)resection procedures (Bowers, Darrach) of the distal ulna is that the radius and ulna are "uncoupled", creating an intrinsically unstable construct, and most patients dramatically alter their patterns of usage and are limited by painful convergence instability or radio ulnar impingement [28]. For those cases, an ulnar head

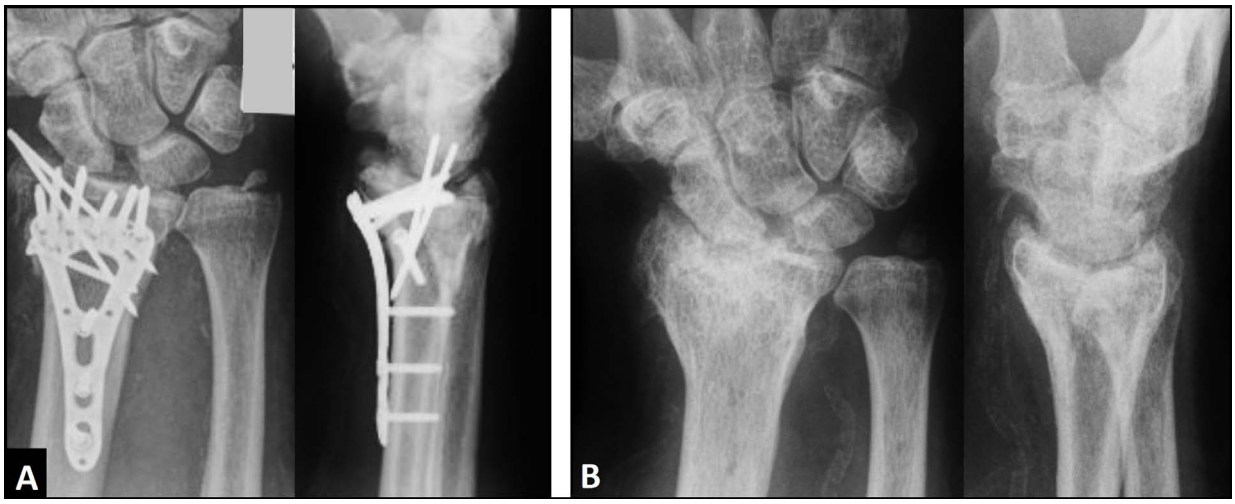

Figure 1. (A) PA and lateral radiographs demonstrating failed primary LVP, note the migration of the metaphyseal screws into radiocarpal joint and concomitant SLD *Lindau* grade 3; (B) PA and lateral radiographs demonstrating advanced posttraumatic wrist joint OA six months after primary procedure, note the distinctive impaction of the scaphoid bone into the distal radius metaphysis.

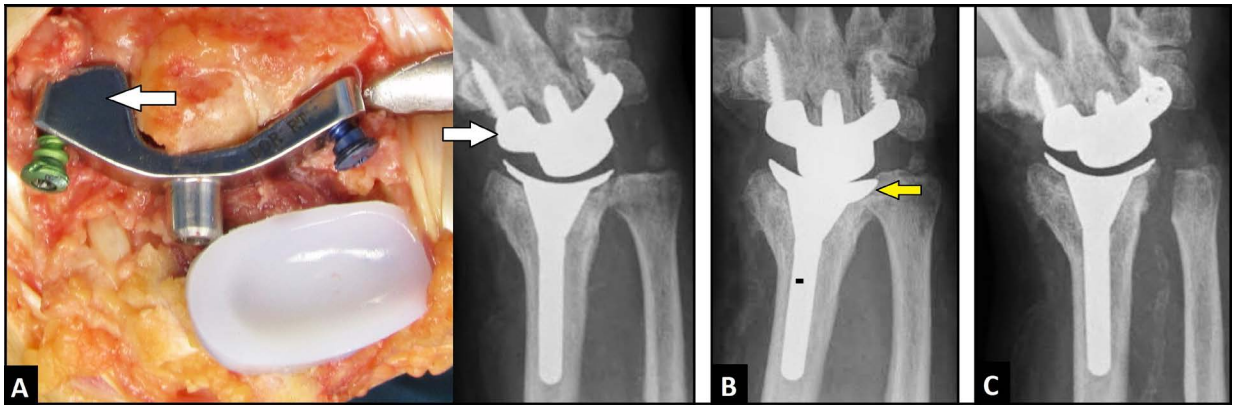

Figure 2. (A) Intraoperative clinical photograph and postoperative PA radiograph demonstrating uneventful TWA, note the use of carpal plate with scaphoid augment after excision of the entire scaphoid bone (arrows), the angle-stable carpal plate is inserted with a green coloredpolyaxial screw into the 2nd metacarpal bone and with a blue coloredmonoxial screw into the hamate bone, and the intercalated cobalt-chrome carpal head is to be inserted externally onto the conus of carpal plate after its insertion; (B) PA radiograph one year after TWA demonstrating bony resorption of sigmoid notch resulting in impingement between the ulnar head and radial component of TWA (arrow) without loosening or subsidence of radial component; (C) PA radiograph two years after TWA demonstrating unchanged correct positioning of TWA, there was no convergence instability of the distal ulnar stump nor radioulnar impingement one year after Bowers procedure.

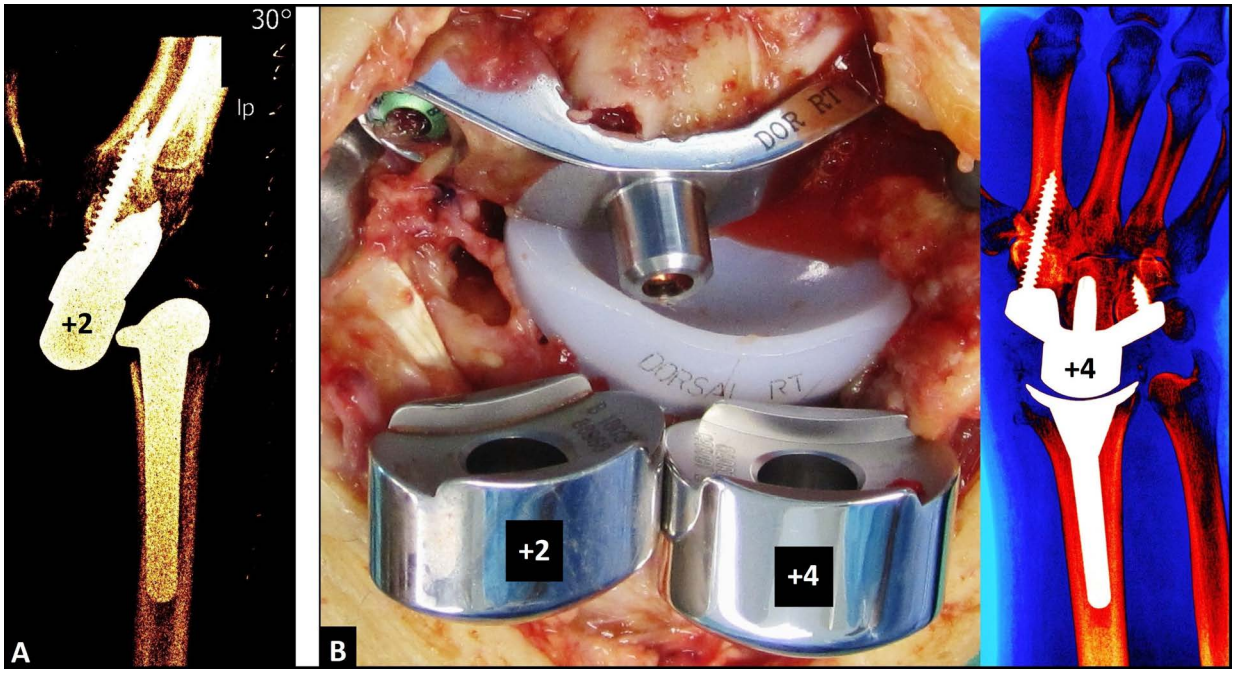

Figure 3. (Example for early atraumatic dislocation of MaestroTM WRS): (A) Dislocation in volar direction; (B) Same patient, exchange of primarily inserted carpal head size +2 to size +4 without necessity of revision of the entire carpal plate.

replacement is the salvage option, and it can be combined with both Maestro™ implants [29]. Additionally, the design of both Maestro™ implants allows a combination with a thumb carpometacarpal total joint replacement [30].

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None.

Declarations

The author declares that he has none conflict of interests concerning this article.

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