

# Treatment of post-traumatic degenerative changes of the radio-carpal and distal radio-ulnar joints by combining radius, scaphoid, and lunate (RSL) fusion with ulnar head replacement

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**Abstract** Distal radial fractures are a common type of fracture. In the case of intra-articular fractures, they often result in post-traumatic arthrosis. The objective of this study is to describe a novel alternative to the established salvage techniques for the treatment of post-traumatic arthrosis of the radio-carpal and distal radio-ulnar joints (DRUJ). Six patients with radio-carpal and DRUJ arthrosis were treated with a combined radius, scaphoid, and lunate (RSL) arthrodesis and as a Herbert ulnar head prosthesis. Follow-up consisted of both radiographic and functional assessments. Functional measurements were noted both pre- and postoperatively. No non-union or pseudoarthrosis was seen; neither did any of the ulnar head prostheses show loosening. Clinical examination showed an improvement in strength, pain, and range of movement, as well as a decrease in disability. Combining RSL arthrodesis with a Herbert ulnar head prosthesis, which deals with pain while retaining partial wrist movement, can be an alternative to established salvage procedures.

**Keywords** Wrist · Partial arthrodesis · Endoprosthesis · Post-traumatic arthrosis

## Introduction

Fractures of the distal radius are the most common type of forearm fractures. They account for one sixth of all fractures treated at emergency rooms. Although once having believed differently, this type of fracture has a high

complication rate, even more so in the case of intra-articular fractures. One of the most frequent complications is a combination of post-traumatic arthrosis of the radio-carpal and distal radio-ulnar joints (DRUJ), which results in pain and limited wrist and forearm function.

Treatment of this disorder is complicated, and a variety of salvage procedures have been developed. Total wrist arthrodesis is a proven surgical procedure that most often provides pain relief at the expense of wrist motion. Alternatively, a limited wrist arthrodesis or wrist arthroplasty also relieves pain while preserving at least part of the range of motion (ROM). When the preoperative range of motion is satisfactory but painful, one could consider a wrist denervation to relieve pain. Salvage procedures for the DRU joint can either be ulnar head replacement or an excision arthroplasty [1–7].

We report six patients with post-traumatic radio-carpal and DRUJ osteoarthritis following a fracture of the distal radius, with a radioscapulunate fusion in combination with an ulnar head replacement.

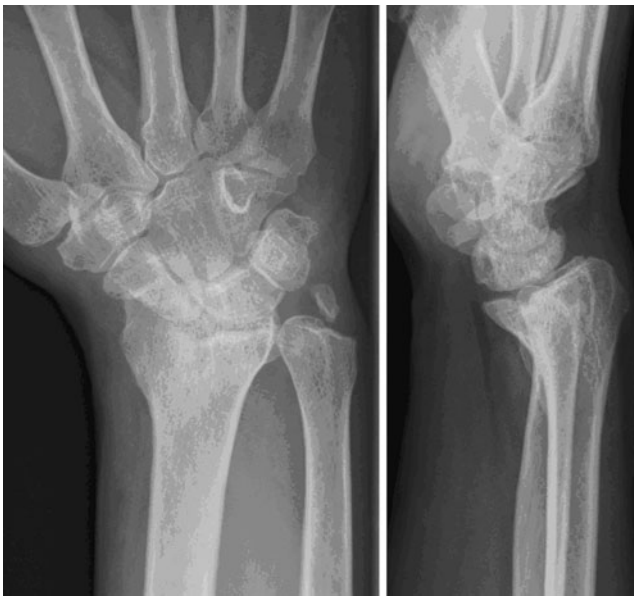
## Material and methods

Five males and one female were treated, with a mean age of 54 (range, 38 to 64) at the time of surgery. All had radio-carpal and DRUJ arthrosis due to a distal forearm fracture (Fig. 1). In two cases, the dominant wrist was involved. Only one patient had prior surgical treatment because of a non-union of the distal radius and proximal ulna.

## Measurements

The mean follow-up was 24 months (range, 12 to 42 months). At follow-up, wrist function was evaluated

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**Fig. 1** Posteroanterior and lateral x-ray of a patient with radio-carpal arthrosis and DRUJ incongruence

by measuring pain, grip strength, and range of motion, and patients completed the Disabilities of the Arm, Shoulder, and Hand (DASH).

Pain was scored using a visual analog score (VAS; range, 0–10). Grip strength was assessed using the Baseline hydraulic hand dynamometer (Fabrication Enterprises, White Plains, NY) in position 2. Range of motion was measured by occupational therapists and consisted of all wrist movements: extension, flexion, radial deviation, ulnar deviation, pronation, and supination. The DASH score was used to evaluate wrist functionality and its consequences for daily activities.

#### Surgical technique

A dorsal approach through the fourth extensor compartment was used to expose the DRU and radio-carpal joints. Using shape metal alloy staples, the radioscapo- and radiolunar joints are fused. During the same procedure, a Herbert ulnar head replacement was performed [7].

Following consolidation of the radius, scaphoid, and lunate (RSL) arthrodesis, the staples were removed, and a distal pole scaphoidectomy was performed.

#### Results

No non-union or pseudoarthrosis was seen; neither did any of the ulnar head prostheses show loosening (Fig. 2).

Clinical examination showed an improvement in grip strength, pain, and range of movement, as well as a

decrease in disability (Table 1). Grip strength improved by a mean of 59% compared to preoperative values. Both pain and disability decreased, showing a mean reduction of 37% of the VAS score and 39% of DASH questionnaire points. Improvement in range of motion is only seen in pronation and supination. No statistical analysis was performed since the sample is too small to produce any significant results.

One patient required a triquetrectomy and an excision of the posterior interosseus nerve because of persistent pain. In a second patient, the ulnar prosthesis head was changed for a smaller size at the time of staple removal and partial scaphoidectomy. They are now free of symptoms.

#### Discussion

When treating intra-articular fractures, the main objectives are to restore anatomy and preserve function. This, however, is not always possible because of extensive degenerative changes. Depending on the amount of damage, several salvage procedures are available.

#### Radio-carpal joint

Total wrist arthrodesis provides patients with a stable wrist and pain relief at the cost of wrist motion. However, the results of the procedure differ widely. While some studies show complete pain relief in 70% to 100% of cases [8–11], other studies report only 25–56% pain relief [12, 13]. More



**Fig. 2** Posteroanterior and lateral x-ray of a patient with complete RSL arthrodesis and an ulnar head prosthesis in situ

**Table 1** Mean pre- and postoperative measurements

	Mean, postoperative									
	Mean, preoperative									
Strength	17 Kg (10–35)	27 Kg (9–40)								
VAS	40.00 (10.00–70.00)	25.00 (0.00–45.00)								
DASH	44 (34–56)	27 (11–53)								
ROM	Extension	28° (18–50°)	Flexion	19° (10–25°)	Radial deviation	12° (8–14°)	Ulnar deviation	7° (0–15°)	Pronation	69° (45–90°)
	Supination	38° (10–60°)	Extension	31° (25–36°)	Flexion	17° (10–25°)	Radial deviation	12° (6–15°)	Ulnar deviation	11° (5–16°)
									Pronation	84° (60–90°)
									Supination	47° (45–70°)

recent studies reported postoperative DASH scores of 44, 46, and 52, the last one also reporting an average pain reduction of 50% compared to the preoperative scores [14–16].

The complication rate for total wrist arthrodesis is high (45–79%), but it includes both major and minor complications. Surgical technique is an important factor. Dorsal plate fixation seems to have the fewest complications and has a fusion rate of nearly 100% [4, 8, 17]. Major complications are non-union (2–18%), deep wound infection, neuroma formation, DRUJ arthritis/ulnar impaction (11%), ulnocarpal impaction, and CTS. [4, 18, 19].

An alternative for total wrist arthrodesis is total wrist arthroplasty. Over the years, several different implants were developed. Two commonly used implants are the Biaxial prosthesis and the Universal 2 Wrist implant [20]. The use of the Biaxial implant gave good pain relief (67%) and good subjective outcome in 69% to 74% of patients [21, 22]. A later study did show a need to revise because of implant damage and dislocation in 26% of the patients after a mean follow-up of 2 years [23]. Studies reporting results of the Universal 2 prostheses demonstrate good pain relief (88%) and wrist function. The average postoperative range of motion is 36° extension, 41° flexion, 7° radial deviation, and 13° ulnar deviation. The most frequent complication seen was dislocation, with an overall complication rate of 32% [24]. It should be taken into account that the above results are mainly from studies concerning patients with rheumatoid arthritis.

A second alternative is a limited wrist fusion of the radius (R), scaphoid (S) and lunate (L). Results in early studies show pain relief between 50% and 100% and grip strength ranging from 49% to 75% of the unaffected side. Average degrees of remaining ROM lie between 10° and 30° for extension, 17° and 30° for flexion, 8° and 9° for radial deviation, and 12° and 24° for ulnar deviation [25–28]. Nagy and Büchler deem the value of limited wrist fusion questionable because of high complication rates, with only seven of 15 patients in their series achieving good results [29]. A later study by Garcia-Elias et al. reports significantly better results for RSL arthrodesis in combination with distal pole scaphoidectomy, which unlocks the midcarpal joint. The average range of motion was 35° extension, 32° flexion, 14° radial deviation, and 19° ulnar deviation. Complete pain relief was obtained in 10 of 16 patients; 3 had slight pain with strenuous loading, and 3 had occasional pain with regular daily activities [30]. Also in this study, arthrodesis was performed using shape metal alloy staples instead of K-wires, which we believe provides better results for difficult fusions [31].

Wrist denervation is also a motion-preserving procedure. Results, however, are unpredictable, ranging from 24% to 90% patient satisfaction [32, 33]. Several studies indicate

that results are worst in patients suffering from post-traumatic arthrosis following a distal radius fracture [6, 34].

### Distal radio-ulnar joint

Conventional treatment of DRUJ arthrosis consists of either excision (Darrach) or fusion (Sauvé-Kapandji) [7]. The major disadvantage of these procedures is that rotation is facilitated by an unstable pseudoarthrosis of the distal ulna, which causes painful impingement and loss of strength [35].

Various alternatives have been devised to try and solve these problems. The hemiresection–interposition technique, developed by Bowers, avoids instability by only resecting the articular surface while keeping the ulnar TFCC attachments intact [36]. A second alternative is interposition of the m. pronator quadratus between the ulnar stump and radius, acting as a spacer [37]. An alternative for all of the previously mentioned techniques is replacement of the ulnar head. With this procedure, the range of motion can be restored without risking impingement. The medium- to long-term results for this procedure are reported as excellent by Herbert and Van Schoonhoven [7]. It does, however, require adequate soft tissue remnants to reconstruct the DRUJ capsule [38]. The latest development in DRUJ reconstruction is total joint prosthesis; this provides good stability without being dependent on soft tissue quality [39].

By combining limited wrist fusion with ulnar head replacement, we have created an alternative salvage procedure for combined radio-carpal and DRU joint arthrosis. A search of the English literature showed one publication in which a similar technique is described; however, no explicit results for the combination are reported [5]. In most cases, arthrosis of the DRUJ is treated with excision arthroplasty or fusion, either concomitantly or consecutively to treatment of the radio-carpal joint [19, 30]. Both RSL arthrodesis and ulnar head replacement have already proven their worth. Limited wrist fusion provides a range of motion up to 30°–0°–30°, which provides patients with an almost completely functional range [26–28, 40–42]. These reports on ulnar head replacement also show good results; they are comparable to those of established DRUJ salvage procedures, but without their complications [43, 44].

### Conclusion

Although the results of this study are not statistically significant, we feel that, by combining RSL arthrodesis with replacement of the ulnar head, we present a viable alternative for the established salvage procedures for the

treatment of post-traumatic arthrosis of the radio-carpal and DRU joints. With this procedure, we provide pain relief and stability without having to sacrifice wrist movement completely.

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