



## Which patients undergo a surgical reintervention following a distal radius fracture ?

Nadine HOLLEVOET, Wim VANHOVE, Akkie RINGBURG, Alex VANDEN BERGHE

*From Gent University Hospital, Gent, Belgium*

**Not all malunited distal radius fractures cause pain or functional impairment, and only few patients require a surgical correction or a salvage procedure. The purpose of this retrospective study was to investigate differences between 38 patients who underwent a reintervention and 65 patients who did not. The only discriminative variable in the current study was age : 46 years in the reintervention group versus 59 years in the non-reintervention group ( $p < 0.0001$ ). Differences in gender or type of malunion were not significant, and thus not discriminative. It can be concluded that patient age may be more often associated with a reintervention than gender or radiological characteristics of wrist fractures.**

**Keywords :** fracture ; distal radius ; reintervention ; age.

### INTRODUCTION

Distal radius fractures are among the most frequent bone injuries seen in emergency departments, but their treatment remains controversial. Fixation of distal radius fractures with palmar plates and locking screws has become more popular during the last years (13,28). This may be explained by the fact that palmar locking plates restore normal anatomy better than closed reduction and plaster cast immobilization, K-wire fixation, or external fixation, especially in elderly patients (1,3,10,16). However, anatomical reconstruction does not always correlate with functional outcome and it has been shown that

the impact of malunion is less pronounced in older than in younger patients (8,11).

Malunion of distal radius fractures can be categorized according to the type of displacement. The main deformities are 1. dorsal or 2. palmar angulation, 3. articular incongruity and 4. shortening of the radius (9). Improvement of function has been reported after corrective osteotomy for dorsal or palmar angulation of the distal radius. These corrective osteotomies were also able to restore the length of the radius in most cases (4,25). Correction of intra-articular step-offs is more difficult ; the results of this procedure are less often reported (23,24). Salvage procedures are performed when a corrective osteotomy of the distal radius is not indicated, as in the

- 
- Nadine Hollevoet, MD, PhD, Assistant Professor.
  - Wim Vanhove, MD, Orthopaedic Surgeon.
  - Akkie Ringburg, MD, PhD, Trauma Surgeon.  
*Department of Orthopaedic Surgery, Ghent University Hospital.*
  - Alex Vanden Berghe, MD, PhD, Honorary Fellow Orthopaedic Surgery, Ghent University Hospital, Orthopaedic Surgeon.  
*Sint-Jozefskliniek, Izegem.*
- Correspondence : Nadine Hollevoet, Department of Orthopaedic Surgery and Traumatology, Ghent University Hospital, De Pintelaan 185, 9000 Ghent, Belgium.  
E-mail : Nadine.hollevoet@ugent.be  
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presence of osteoarthritis or when there is a complex articular malunion. Salvage procedures include wrist denervation (26), proximal row carpectomy (14), and partial or total wrist arthrodesis (18). When the pain is predominantly located in the distal radio-ulnar joint, a corrective osteotomy of the distal radius (12), ulnar shortening (29,30) or a salvage operation such as resection of the ulnar head (Darrach) or a Sauvé-Kapandji procedure (7) can be performed.

The aim of the present study was to identify variables, such as age, gender or a specific type of malunion, which would be associated with a re-intervention after a distal radius fracture.

## PATIENTS AND METHODS

The study was approved by the Ethics Committee of the hospital.

### Radiographic variables

Were measured radiographically : dorsal and palmar tilt, intra-articular steps, radiocarpal alignment, radial inclination, and ulnar variance (20).

### Criteria for malunion

Criteria for malunion were : more than 10° of dorsal tilt, palmar displacement ( $\geq 17^\circ$  palmar tilt and/or palmar shift  $> 2$  mm), intra-articular steps of more than 2 mm, and an increase in ulnar variance of more than 2 mm.

### Four types of malunion

1. Dorsal malunion was diagnosed when the dorsal tilt of the distal radius was greater than 10°. 2. Palmar malunion was reported when the palmar tilt was greater than 16° or when there was a palmar translation of the distal fracture fragment of more than 2 mm. 3. Intra-articular malunion was diagnosed when there was an articular step of more than 2 mm, a palmar tilt less than 17°, a dorsal tilt no more than 10°, and no palmar translation. 4. Radial shortening was noted when the increase in ulnar variance was greater than 2 mm without articular steps, palmar shift or major change in palmar tilt. Normal ulnar variance was estimated from radiographs of the normal wrist or from radiographs taken on the first postoperative day (9).

### Reintervention group and non-reintervention group

The *reintervention group* consisted of 38 patients who underwent a reintervention between March 2006 and October 2011 for malunion, at least three months following a distal radius fracture. Reinterventions included corrective osteotomy of the distal radius or ulna, and salvage procedures (total or partial wrist arthrodesis, proximal row carpectomy, denervation, Sauvé-Kapandji procedure, ulnar head resection). Were excluded : removal of implants and operations for carpal tunnel syndrome, trigger finger, tendon rupture and instability of the carpus or distal radio-ulnar joint. The radiographic data were obtained from the pre-reintervention radiographs.

The *non-reintervention group* consisted of 65 patients with malunion, seen between May 2008 and April 2010. These patients were part of a series described in a previous article (9). The radiographic data were obtained from the radiographs taken 5 or 6 weeks after the fracture.

### Statistical analysis

Inter-group differences in age, gender or type of malunion were analyzed with the Mann-Whitney U test or the Chi-square test.

## RESULTS

In the reintervention group (38 patients) the mean interval between fracture and secondary procedure was 40 months (range, 3-420 months). Eighty-nine percent of the reinterventions took place within two years after the distal radius fracture. These 38 secondary procedures included 22 osteotomies of the distal radius, nine radiocarpal wrist fusions, four ulna osteotomies, one proximal row carpectomy, one total wrist joint fusion and one wrist denervation. There were 26 women and 12 men. The mean age of the patients was 46 years (range, 22-78 years). The initial treatment of the distal radius fracture included cast immobilization in 10 cases, percutaneous K-wire fixation in 12, plate and screws in 4, external fixation in 5 and single screw fixation in one. As to the other 6 patients, no information could be found about the initial treatment.

### Age was the only discriminating variable

The mean age was 46 years in the reintervention group and 59 years in the non-reintervention group.

The difference was significant ( $p < 0.0001$ ). Gender played no role : in the reintervention group 12 out of 38 patients (31.5%) were males, and in the non-reintervention group 23 out of 65 patients (35%) ( $p = 0.83$ ). Also the radiographic variables played no role. The mean palmar tilt was  $1^\circ$  in the reintervention group and  $3^\circ$  in the non-reintervention group ( $p = 0.69$ ). The mean radial inclination was  $22^\circ$  ( $p = 0.94$ ) in both groups, and the mean ulnar variance 2 mm ( $p = 0.94$ ). In the reintervention group 13 patients (34%) had an intra-articular step, versus 19 patients (29%) in the non-reintervention group ( $p = 0.66$ ). Radiocarpal malalignment was more frequently observed in the reintervention group, 51% versus 38%, but the difference was not significant ( $p = 0.30$ ). Also the distribution of the various types of malunion was comparable in both groups. Indeed, in the reintervention group dorsal malunion was present in 10 wrists (26%), palmar malunion in 9 (24%), intra-articular malunion in 11 (29%) and radial shortening in 6 (16%); in two cases no malunion was present. In the non-reintervention group dorsal malunion was observed in 17 wrists (26%), palmar malunion in 17 (26%), intra-articular malunion in 15 (23%) and radial shortening in 16 (25%). Again, there was no significant difference between groups ( $p = 0.32$ ).

## DISCUSSION

If a malunited distal radius fracture is associated with stiffness and pain in the wrist, a corrective osteotomy of the distal radius or ulna can be performed. Several studies have reported improvement in mobility, pain and functional outcome after this procedure (2,4,21,24,25,29,30). However, as opposed to osteotomies, salvage procedures have been less efficient. Denervation was more successful to treat radial-sided than ulnar-sided wrist pain (18,26). Total wrist joint fusion was less successful than when performed for rheumatoid arthritis, avascular necrosis of the lunate or other wrist trauma (18). Radioscapholunate arthrodesis reduced pain and restored function, but restricted wrist flexion and extension substantially. In some patients the partial wrist fusion had to be transformed into a total wrist arthrodesis (18). A Darrach resection or a Sauvé-Kapandji

procedure gave unpredictable results in patients under 50 years of age (7).

## Age

The current study led to one single conclusion : the patients in the reintervention group were significantly younger than those in the non-reintervention group. Previous studies have shown that malunion has a smaller impact in older patients (8,11). This can be explained by the fact that the demands of young individuals may be higher than those of older people. However, also younger patients with a malunited distal radius fracture may not require a secondary procedure. Indeed, Forward *et al* (5) reported after an average follow-up of 38 years that malunited fractures of the distal radius, sustained before age 40, did not necessitate reintervention.

In the current study the mean age of patients who underwent a reintervention after a distal radius fracture was 46 years. In studies of patients who had only a corrective osteotomy of the distal radius, the mean age was lower and ranged from 34 to 44 years (2,4,21,24,25,31). However, osteotomies have also been performed in older patients : Lozano-Calderón *et al* (15) described a series of 6 patients with a mean age of 60 years. Srinivasan *et al* (29) reported a mean age of 53 years in a series of 18 patients who had an ulnar shortening osteotomy for ulnocarpal abutment after a malunited distal radius fracture ; Tatebe *et al* (30) mentioned 48 years. The mean ages of patients who underwent a radioscapholunate fusion after a distal radius fracture ranged from 36 to 49 years in the studies of Mülhdorfer-Fodor *et al* (17), Garcia-Elias *et al* (6), and Nagy and Büchler (19).

The current study indicates that patient age may be more important than radiological characteristics. Therefore, not all older patients with impending or established malunion need a reintervention.

## Radiographic variables not discriminant

Distal radius fractures with radial shortening may lead to ulnocarpal abutment, intra-articular malunion may cause early cartilage degeneration, and palmar displacement may cause more functional

problems than dorsal displacement, as palmar malunion has been associated with supination loss (22). Therefore, one of these types of malunion might be more frequent in the reintervention group. However, no significant difference could be identified.

### Limitations

The follow-up period in the non-reintervention group was too short to allow for painful cartilage degeneration. Furthermore, the classification of malunion into four types may be inaccurate. For instance, when categorizing into a dorsal or palmar malunion, no difference was made between intra- and extra-articular fractures. However, the percentage of wrists with intra-articular steps was similar in both groups. Complaints of patients in the reintervention group, who were operated on within one year after the original fracture, might have disappeared without additional surgery (29).

Malunion is not yet clearly defined, as there is no threshold for acceptable radiological variables applicable to all patients.

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