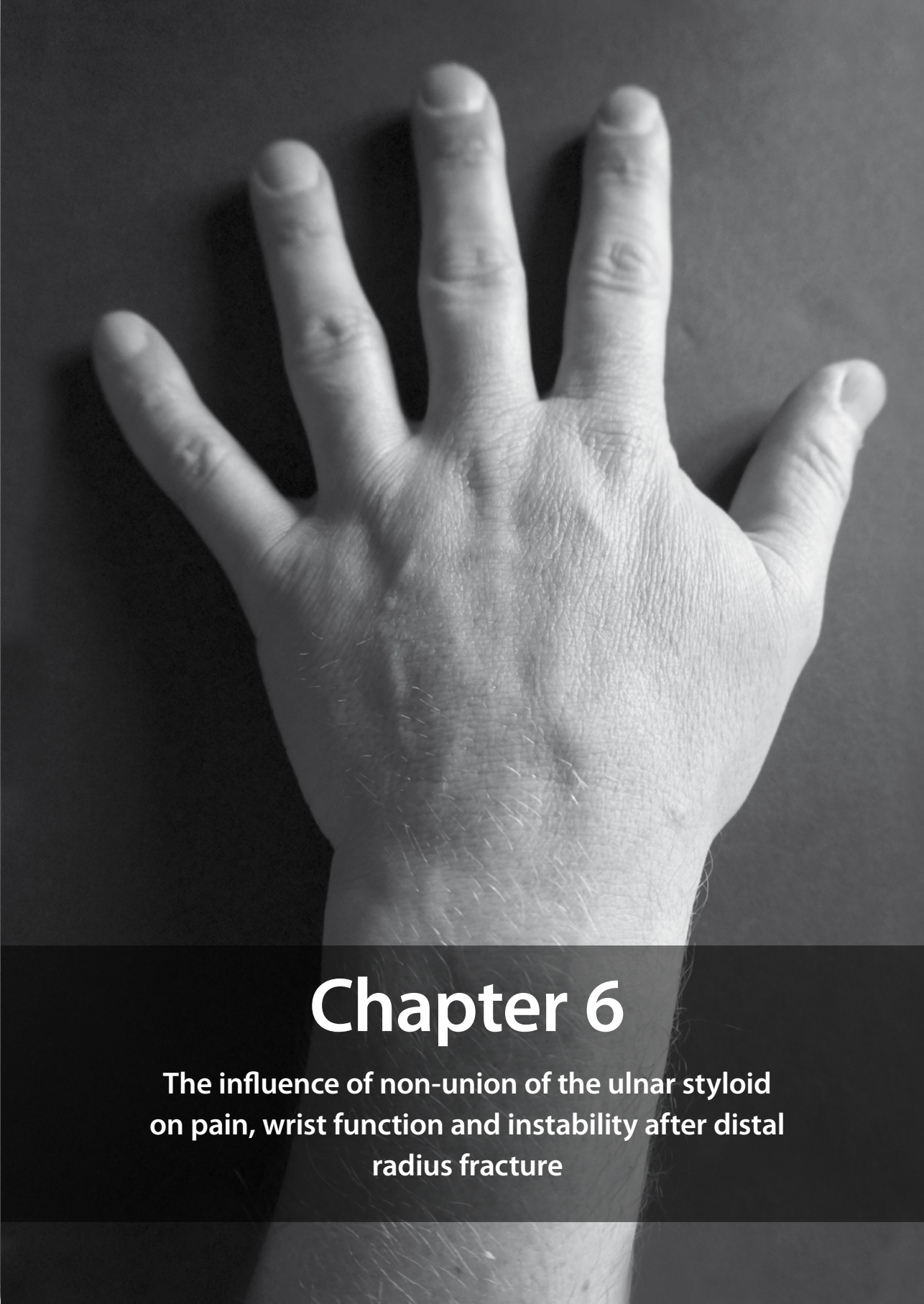

Chapter 6

The influence of non-union of the ulnar styloid on pain, wrist function and instability after distal radius fracture

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Journal of Hand and Microsurgery. 2011 Jun;3(1):11-4.

ABSTRACT

The influence of non-union on the outcome of distal radius fractures is debated. We tested the null hypothesis that there is no difference in pain, wrist function, or instability between patients with union or non-union of an ulnar styloid base fracture after operative treatment of a fracture of the distal radius. Eighteen adults with an ulnar styloid base non-union were compared to 16 patients with union of an ulnar styloid base fracture with a mean post-operative follow-up of 30 months. None of the patients had distal radioulnar joint instability, there were no significant differences in pain, complications, or function, and patients with non-union had significantly greater grip strength. Ulnar styloid non-union is not associated with pain, instability, or diminished function after fracture of the distal radius.

INTRODUCTION

Substantially displaced fractures of the distal radius disrupt the distal radioulnar ligaments, either by directly tearing them or by disrupting the origin of the ligaments via fracture of the base of the ulnar styloid. The long-standing concern about base of ulnar styloid fractures[2, 6, 7, 9, 10,12, 14–16] has been questioned by four recent studies that found such fractures did not affect outcome after volar plate fixation.[4, 8,13,17] Both Kim et al. and Souer et al. focused on the presence of an ulnar styloid base fracture more then non-union of this fracture. No adverse influence on outcome of distal radius fractures was found if a fractured ulnar styloid was present.

There has been concern about non-union of the ulnar styloid as a potential source of ongoing ulnar-sided wrist pain after fracture of the distal radius[1,6]; however, recent studies have also questioned this concept.[4,17] Buijze et al. presented the shortterm results of volar plating of distal radius fractures analyzing the influence of an accompanying ulnar styloid base non-union. Zenke et al. reported results of outcome of volar plating of distal radius fractures with special attention for the non-union of the accompanying ulnar styloid fracture. Both studies showed no difference in patients with a non-united ulnar styloid base fracture.

Another concern is that a base-of-styloid fracture would increase the risk of problems with distal radioulnar joint (DRUJ) instability in distal radius fractures.[6,18] Neither Zenke and colleagues nor Buijze and colleagues encountered DRUJ instability, but this was not consistently formally tested by Buijze and colleagues.

Our aim was to look at the same question using a different data set in order to further test the null hypothesis that there is no difference in outcome between patients with union and non-union of the ulnar styloid base fracture with focus on function, pain, distal radioulnar joint stability, grip-strength and outcome of health assessment questionnaires.

MATERIAL AND METHODS

Participants

A single surgeon operated on 120 adult patients with an unstable fracture of the distal radius with a fracture at the base of ulnar styloid between 2000 and 2007. For the purposes of this investigation, a fracture of the ulnar styloid base was defined as a fracture at least 50% of the total height on the posteroanterior radiograph of the wrist. In nine patients the ulnar styloid base fracture was more than 2-millimeters radially translated after anatomical fixation of the radius and was therefore reduced and secured with a

tension band wire construct. No specific treatment was provided to the remaining 111 patients.

Using a protocol approved by our Human Research Committee, we reviewed medical records and invited patients with less then 6 months follow-up to return for a free follow-up. We excluded 77 patients with fewer than 6 months follow-up that either could not be contacted (46 patients) or declined to return (31 patients). Nineteen patients had at least 6 months follow-up in the medical record and 15 returned for a research specific evaluation.

Non-union of the ulnar styloid was defined as a visible fracture line on conventional posteroanterior radiographs at least 6 months after trauma. Sixteen patients were diagnosed with union and 18 with non-union of the ulnar styloid base fracture.

Union of the ulnar styloid base

Among patients with union of the ulnar styloid base fracture there were five men and 11 women with a mean age of 57 years (range 41 to 75 years). The fractures were classified according to the Comprehensive Classification of Fractures as follows: 2 A2 fracture, 1 A3, 1 B1, 3C1, 2C2, and 7C3 fractures.[11] The left hand was involved in 11 patients (three dominant), the right in 5 (four dominant). The operative technique included volar locked plating in nine patients, percutaneous pinning in 1, external fixation in 4, combined volar and dorsal plating in 2.

Non-union of the ulnar styloid base

Among patients with non-union of the ulnar styloid base fracture there were seven men and 11 women with a mean age of 54 years (range 25 to 81). The fractures were classified according to the Comprehensive Classification of Fractures as follows: 2 A2 fracture, 2 A3, 1 B2, 8C1, 4C2 and 1C3 fractures.[11] The left hand was involved in 14 patients (two dominant), the right in 4 (three dominant). The operative technique included volar plating in 16 patients and percutaneous pinning in 1, combined volar and dorsal plating in 1. No significant differences were found in baseline characteristics between the two groups.

Evaluation

Pain and function were evaluated using the Mayo modified wrist score[3] and the Gartland and Werley score.[5] Fifteen patients returned for a research-specific evaluation that was done by an investigator not involved in the care of the patients and consisted of measurement of range of motion and grip-strength. Instability in the DRUJ was evaluated in these 15 patients (7 with union and 8 with non-union of the ulnar styloid) that returned for a research specific visit, by comparing anterioposterior translation of the distal ulna under stress of the injured wrist to the uninjured wrist, after manual fixation

of the distal radius, with elbow in 90° flexion and wrist in neutral position. Grip-strength was measured by the investigator as the average of three attempts using a handheld dynamometer (Preston; Jackson, MI) with the arm at the side, the elbow at 90° flexion, and the forearm and wrist in neutral position. Grip strength and range of motion of the involved arm was compared to the opposite side and the percentage (involved/non-involved arm) was calculated. Range of motion was measured using a goniometer. All patient files were reviewed for complications and subsequent surgeries.

Statistical analysis

Pre- and postoperative characteristics and outcome scores of both groups were compared using independent sample t- test for continuous data. Categorical data were compared between groups using Independent Samples test with two outcomes or Pearson's Chi-square with more than two outcomes. P-values of less then 0.05 were considered statistically significant.

RESULTS

Patients with non-union of the ulnar styloid were evaluated an average of 31 months (range: 6 to 74 months) after injury and patients with union of the ulnar styloid after 30 months (range 7 to 73 months). ($p = 0.8$)

Complications and subsequent surgeries

No post-operative infections, tendon ruptures, loss of reduction, or implant failures were encountered. Seven patients had a second surgery for plate removal: 5 with union and two with non-union of the ulnar styloid ($p = 0.147$).

Pain

Among patients with union of the ulnar styloid, 11 patients reported no pain, three mild discomfort, and two patients moderate pain. Among patients with non-union of the ulnar styloid 11 patients reported no pain, six mild pain and one patient moderate pain.

Range of motion

In patients with union of the ulnar styloid base fracture the flexion and extension averaged 55° (range, 20–90°) and 57° (range, 30–75°) respectively. These averages were both 81% comparing the injured to the uninjured arm. Radial deviation averaged 21° (range 0–56°) which is 86% compared to the uninjured arm. Ulnar deviation averaged 40° (range 20–60°) which is 74% compared to the uninjured arm. The average pronation and supination measured 84° (range, 20–95°) and 78° (range, 20–90°) respectively.

Compared to the uninjured arm these averages were 95% for pronation and 93% for supination. The average grip strength was 80% of the uninjured arm.

In patients with non-union of the ulnar styloid base fracture the flexion and extension averaged 57° (range,30–80°) and 64° (range, 40–94°) respectively. These averages were 84% and 87% respectively comparing the injured to the uninjured arm. Radial deviation averaged 29° (range 10–66°) which is 100% compared to the uninjured arm. Ulnar deviation averaged 39° (range 14–60°) which is 87% compared to the uninjured arm. The average pronation and supination measured 84° (range, 35–95°) and 88° (range, 60–90°) respectively. Compared to the uninjured arm these averages were 97% for pronation and 98% for supination. The average grip strength was 94% of the uninjured arm. The Gartland and Werley averaged 4 (range 0–12). Categorical ratings were excellent outcome in ten patients, good in five patients, and fair in two patients. One patient failed to fill out questionnaires properly.

Functional rating scales

Among patients with union of the ulnar styloid the Mayo-score averaged 78 (range 60–95). The categorical ratings were excellent outcome in two patients, good in five patients, and fair in nine patients. The Gartland and Werley averaged 5 (range 0–21). Categorical ratings were excellent outcome in eight patients, good in seven patients and poor in one patient. Among patients with non-union of the ulnar styloid the Mayo-score averaged 81 (range 60–100). The categorical ratings were excellent outcome in three patients, good in eight patients, and fair in one patient.

Statistical analysis

There were no significant differences between cohorts in terms of flexion, extension, pronation, supination, ulnar deviation, radial deviation, Mayo-score ($p = 0.45$) or Gart-

Table 6.1. Comparison of patients with union and non-union of the ulnar styloid

	Union (degrees) (% of non-injured side)	Non-union (degrees) (% of non-injured side)	p-value
Flexion	55 (81)	57 (84)	0.67
Extension	57 (81)	64 (87)	0.39
Radial deviation	21 (86)	29 (100)	0.26
Ulnar deviation	40 (74)	39 (87)	0.19
Pronation	84 (95)	84 (97)	0.80
Supination	78 (93)	88 (98)	0.35
Grip *	80	94	0.05

* % of non-injured side

land and Werley score (p =0.06). Grip-strength (p = 0.05) was found significantly better in patients with non-union of the ulnar styloid (Table 6.1).

DRUJ instability

None of the 15 patients who visited our hospital for this research specific evaluation was diagnosed with DRUJ instability during physical examination.

DISCUSSION

Distal radius fractures are often accompanied by an ulnar styloid base fracture and there is no consensus regarding optimal treatment of this part of the injury. In this study non-union of an ulnar styloid base fracture did not affect outcome of operatively treated distal radius fractures in this study, with the exception of grip-strength, which was found to be significantly better in patients with an ulnar styloid non-union. The higher grip strength may be spurious given the relatively small number of patients and the absence of other plausible explanations.

Our findings are consistent with the findings of Zenke et al and Buijze et al.[4,17] They found no relationship between ulnar sided wrist pain and union of the ulnar styloid. In our study we were only able to evaluate pain in the wrist, without specification of location, nevertheless we did not find any difference in pain between patients with union of the ulnar styloid compared to those with non-union.

Given that non-union of the ulnar styloid is common, and ulnar sided pain persisting for upwards of 1 year after fracture of the distal radius is also common (in patients with and without an ulnar styloid fracture), it is unclear what relationship, if any, the non-union has to persistent wrist pain.[6,17] Hauck and colleagues[6] classified symptomatic non-union of ulnar styloid fractures dependent on stability of DRUJ. Resection of the fragment in 15 patients resulted in a good outcome if DRUJ-stability was never disturbed or was restored during operation. All three patients treated with open reposition and internal fixation of the fractured ulnar styloid experienced pain relief. Speculative sources for pain include injury to the TFCC attachments, irritation from the non-united fragment and impingement of the extensor carpi ulnaris tendon sheath by a fibrous non-union, but most patients with displaced fractures have TFCC or ulnar styloid injury and few have pain. Better experiments are needed to determine the correlation between persistent wrist pain and ulnar styloid non-union.

The shortcomings of this study include the small number of patients, loss of many patients, reliance on the medical record in many patients, and relatively short-term follow- up. On the other hand, this data is worth considering given that so few publications have focused on non-union of ulnar styloid base fractures.

Non-union of an ulnar styloid base fracture is not clearly associated with pain or wrist dysfunction after operative treatment of a distal radius fracture. Patients and surgeons should be mindful that ulnar side wrist pain can persist for upwards of a year after fracture of the distal radius—with or without an ulnar styloid fracture. The idea that a non-union of the ulnar styloid is a good surgical target for improving comfort and function may lead to unneeded operative intervention. So we conclude from our study that non-union of ulnar styloid base has little influence on the outcome of distal radius fractures. We urge caution in electing operative treatment of ununited ulnar styloid fractures until better scientific support for treatment of pain associated with an ulnar styloid non-union is available.

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