

Radiographs late in the follow up of uncomplicated distal radius fractures: are they worth it? Clinical outcome and financial implications

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Abstract

Fractures of the distal radius are common. Displacement can quickly lead to secondary osteoarthritis. Early follow up radiographs are subsequently paramount to facilitate for early attempts at reduction. Developing callus eventually makes this impractical. In the absence of complications we propose that radiographs may become obsolete at the later stages of follow up. We investigate whether clinical deformity, range of wrist movement and grip strength are independent of radiographs taken later than 2 weeks into the follow up of uncomplicated cases. Local cases between May 2009 and December 2011 were reviewed. Devised criteria regulated case selection. Data was collected from radiological software and occupational therapy clinical notes. Fractures were placed in short or term follow up groups dependant on whether they were imaged later than 2 weeks into follow up. *T*-tests compared our outcomes measures between these groups. 138 cases were included; 77 short term; 61 long term. No cases reported visible clinical deformity. There were no significant differences between grip strength or range of wrist movement for the short and long term groups. No cases required intervention for late displacement. Although complications may justify delayed imaging, our results suggest radiographs late in the follow up of uncomplicated distal radius fractures have no impact on our outcome measures. Further studies are required to confirm this. Financial regulation means any potential benefits from the removal of these unnecessary radiographs should be recognised. Established radiological follow up regimes need to be devised.

Introduction

Distal radius fractures are one of the commonest encountered by orthopaedic surgeons. The injury constitutes 18% of all human fractures, and over one sixth of those seen in the emergency department.^{1,2} Depending on fracture configuration, operative or non-operative treatment may be appropriate. Kirschner wires,

external fixators, and palmar or dorsal plates all provide potential surgical options.^{3,4} Non-operatively managed fractures are usually manipulated (if warranted by displacement) and immobilised in plaster. Resolution of soft tissue swelling and poor cast application leaves these cases at risk of displacement.⁵ This is particularly true if there is dorsal radial tilt, dorsal comminution or an intra-articular radiocarpal component to a fracture.⁶ The radiocarpal joint is formed by the distal radius and the proximal carpal row. Loss of congruity between these structures can quickly lead to uneven joint loading, osteoarthritis and a poor functional outcome.⁷ This makes the early accurate reduction of displacement paramount. Within the first two weeks of follow up this be achieved with relative ease and a good outcome.^{2,8} Later, the formation of osteoid callus makes the process increasingly difficult and eventually impractical. At this stage we propose imaging asymptomatic cases subsequently become obsolete. Currently very little formal guidance exists for surgeons choosing when to perform follow up radiographs for distal radius fractures. We found only two published regimes. The first involved plain radiographs taken at initial presentation and then again ten days later.⁹ The second included radiographs on a weekly basis for the first three weeks post injury and finally at 6 weeks post injury.¹⁰

Our research question is whether radiographs taken more than 2 weeks into the follow up of uncomplicated distal radius fractures have a significant effect on clinical outcome. We are unaware of any previous studies investigating this. Our primary outcome measure was visible clinical deformity. Our secondary outcome measures were range of wrist movements and grip strength. If outcomes are shown to be independent, results would form the basis of an argument to remove *late* radiographs from the radiographic follow up regime of these cases. We also highlight the financial and staffing benefits which would result from the removal of any unnecessary radiographs.

Materials and Methods

We performed a retrospective review of cases. Consecutive distal radius fractures treated at our unit between May 2009 and December 2011 were reviewed. The inclusion and exclusion criteria below were devised to regulate case selection and define uncomplicated cases.

Inclusion criteria

- Extra-articular fractures within the distal 3 cm of the radius (AO 23-A2.1, 23-A2.2 and 23-A3.1/2/3).
- Patients discharged by local occupational therapy following a complete course of hand therapy.

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- Documented values of grip strength, wrist flexion, extension, radial deviation and ulna deviation up to occupational therapy discharge.

Exclusion criteria

- Patients aged less than 16.
- Cases initially treated operatively.
- Intra-articular fractures (AO 23-B1/2/3 / AO 23-C1/2/3).
- Goyrand-Smith fractures (AO 23-A2.3).
- Open fractures.
- Fractures associated with distal neurovascular symptoms or signs.
- Fractures not initially managed at our emergency department.
- Cases without initial and all follow up radiographs available.
- Cases with palpable instability, loading pain or tenderness at the fracture site during follow up.

When discharged policy dictates that patients are routinely referred to local outpatient occupational therapy (OT) departments for hand therapy. Here serial measurements of wrist flexion, extension, and radial and ulna deviation are recorded with the use of a goniometer. Grip strength is also recorded with a dynamometer. One of three therapists routinely record these values using consistent technique. A spreadsheet was formulated to aid data extraction. Data collected included patients' age, sex, laterality of the fracture and date of injury. To assess our primary outcome measure a note of any visible clinical deformity was recorded. To address

our secondary outcome measures the values of grip strength and range of wrist movements at time of OT discharge were recorded. Two authors systematically collected this data from clinical notes. Next patients' radiographs were systematically reviewed using local software.

In general 2 radiographic follow up regimes are currently used by local surgeons. The first consists of radiographs at initial presentation, and again at 1 and 2 weeks post injury. The second regime is initially the same, but an additional radiograph is performed at 6 weeks post injury prior to clinic discharge. For the purpose of our study cases only imaged within the first 2 weeks of follow up were placed in a *short term* follow up group. Cases imaged later than 2 weeks into follow up were placed into a *long term* follow up group. At presentation displaced fractures were reduced by our local emergency department using a haematoma block. Adequacy of reduction was accepted on an individual patient basis. Two tailed unpaired t-tests looked for significant differences between groups.

Results

A total of 201 patients were referred for outpatient OT during our capture period. Following analysis of clinical notes and radiographs 63 cases were excluded. Reasons for exclusion are shown in Table 1. Of the eligible 138 cases 77 were placed in the short term group and 61 in the long term group. 84 fractures involved the left wrist and 54 the right wrist. 17 of the eligible 138 patients were male. The demographics of each subgroup are shown in Table 2. No cases were identified with clinically detectable deformity. There were no statistically significant difference between the grip strengths or range of movements of the short term and long term follow up groups at discharge (Table 2). P-values varied from 0.21 to 0.91. Further analysis showed no significant differences between short and long term follow up groups when those aged more than 50, or less than 50 were analysed in isolation. The same was true when patients were segregated according to sex and compared. No asymptomatic cases from the long term group underwent surgery based on findings of *late* radiographs. No cases required surgical intervention after discharge from clinical care.

Discussion

Nonunion of distal radius fractures is uncommon.¹¹ In contrast, malunion rates have been reported as high as 17%.¹² Malunion often occurs when a secondary loss of fracture reduction is missed during follow up.^{12,13} Loss of reduction may result from a combination of

poor cast application, resolution of soft tissue swelling, fracture comminution or mechanical forces spanning the radiocarpal joint. Unsurprisingly non-operatively managed cases are at highest risk of this.¹²

Several well recognised radiological indices have been devised to help surgeons define acceptable reduction for distal radius fractures.¹⁴ These are radial inclination, radial length, ulnar variance, radial tilt and radial shift. Although the clinical significance of these parameters is debated,^{7,15-17} groups have shown that correcting these variables in cases of established symptomatic malunion increases patient satisfaction. More specifically wrist and hand function appear to improve, and wrist pain is reduced.^{18,19}

When recognised early enough fracture displacement is most commonly corrected by repeated attempts at closed reduction, or open reduction followed by surgical stabilisation. If malunion becomes established osteoid callus makes this impossible. In these cases a formal osteotomy may be required. These highlights the importance of recognising and correcting malunion as early as possible during follow up, and early follow up radiographs to facilitate this.²⁰

Fractures of the distal radius are extremely common. It has been estimated that 71,000 adult men and women sustain the injury in Britain each year.²¹ At present there is mounting financial regulation within the Health Service. Our results suggests that radiographs performed more than 2 weeks into the follow up of uncomplicated distal radius fractures have no effect on final grip strength or range of wrist movement. They also suggest that no cases of late displacement would be missed if these radiographs were removed from the rou-

tine follow up regime. Prospective studies have calculated the average cost of managing a distal radius fracture is £ 320.50, with 90% of this costs being defined as service costs and not consumables.²² The current cost of a radiograph in our department is £ 25.90. This highlights the clear financial benefits that would result from the removal of *late* radiographs from the routine follow up of uncomplicated cases. The time taken to carry out radiographs and the exposure of staff and patients to radiation should also be recognised.

Our report has limitations. The small sample size makes it difficult to draw definitive conclusions. Local practice dictates that patients are followed up in fracture clinic for a minimum of 6 weeks. Throughout this period before they are discharged to the care of hand therapists patients are examined by senior members of the orthopaedic team. The retrospective design of this study, small number of participants and quick rotation of orthopaedic registrars meant we were unable to categorise our results according to individual observers. Results are consequently reliant on the examination skills and findings of many surgeons. Retrospective data collection also meant ranges of wrist movement and grip strengths were not available for patients' contralateral uninjured wrists for comparison.

Future trials are required to confirm our results and an agreed radiographic follow up regime for these cases. These should ideally take the form of multi centred prospective randomised trials. Given the bimodal incidence of distal radius fractures we recommend that cases are segregated according to age and analysed independently. Work showing the elderly as particularly susceptible to malunion further supports this.²³

Table 1. Cases excluded from our study and reasons.

Reasons for exclusion	Number of cases
Intra articular fractures	14
Inadequate documentation	9
Goyrand-Smith fractures fractures	8
Fractures managed operatively	32

Table 2. Demographics and outcome for included cases.

Group	Mean age (range)	Grip strength (kg)	Flexion	Mean values		
				Extension	Radial deviation	Ulnar deviation
Short term (77)	63 (17-91)	15.3	64.3°	58.7°	22.7°	30.3°
Long term (61)	62 (17-93)	15.0	64.5°	56.9°	23.7°	32.0°
	P	0.82	0.91°	0.37°	0.31°	0.21°

Conclusions

In summary we propose that the removal of late radiographs from the follow up of non-operatively managed extra-articular distal radius fractures may have no adverse effects on clinical outcome, whilst providing financial, staffing and timing benefits. Larger trials should be devised to confirm this. We suggest follow up radiographs are organised only at weeks 1 and 2 post index injury. We recognise however that complications may justify delayed imaging, and that the need for further radiographs should be guided by clinical examination and the presence of concerning symptoms.

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