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Published in:
Archives of orthopaedic and trauma surgery

DOI:
10.1007/s00402-017-2743-6

IMPORTANT NOTE: You are advised to consult the publisher's version (publisher's PDF) if you wish to cite from it. Please check the document version below.

Document Version
Publisher's PDF, also known as Version of record

Publication date:
2017

Link to publication in University of Groningen/UMCG research database

Citation for published version (APA):

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Routine follow-up radiographs for distal radius fractures are seldom clinically substantiated

N. L. Weil1 • M. El Moumni2 • S. M. Rubinstein3 • P. Krijnen1 • M. F. Termaat1 • I. B. Schipper1

Abstract

Introduction The value of routine radiographs during follow-up after distal radius fractures is unclear. The aim of this study was to evaluate whether routine radiographs performed during the follow-up period in patients with a distal radius fracture influenced clinical decision making.

Methods This retrospective cohort study included patients aged ≥18 years who were treated for a distal radius fracture at four hospitals in The Netherlands in 2012. Demographic and clinical and radiographic characteristics were collected from medical records.

Results 1042 patients were included. In 121 (14%) of the 841 radiographs, a clinical indication was reported. Treatment was affected by 22 (2.6%) radiographs, including 11 (1.5%) radiographs that were categorized as routine, 9 (1.2%) of which led to prolonged cast immobilization and 2 (0.2%) to surgery for conservatively treated patients.

Conclusion Although it is common practice to take radiographs after distal radius fractures, the study results indicate that routine radiographs seldom affect treatment. This finding should be weighed against the high health care costs associated with these fractures. We hope that the results of our study will trigger the awareness among surgeons that in the current practice, many radiographs are taken on routine without influencing clinical decision making and can probably be omitted.

Level of evidence Level III.

Keywords Distal radius fracture(s) • Wrist fracture(s) • (Routine) radiography • Radiographs • Imaging

Introduction

Distal radius fractures are a common and costly health care problem. The incidence of this fracture is about 70–160 per 100,000 persons per year and accounts for approximately 18% of all fractures [1–3]. Routine radiography during follow-up for fractures is known to contribute to rising health care costs [4]. Health care costs have increased significantly over time, and the cost-effectiveness of diagnostic imaging has become an increasingly important consideration; nonetheless, routine radiographs remain a common practice during outpatient clinical visits by patients with a distal radius fracture [5–7].

The value of these routine radiographs is currently under discussion. Several studies that investigated the value of radiographs obtained at the first post-operative visit and post-splinting radiographs have demonstrated that radiographs without a clear clinical indication do not lead to changes in treatment strategy; however, these radiographs contribute to increased radiation exposure and greater
health care costs [4, 8–12]. This discussion also applies to
the use of routine radiographs during follow-up (of the
fracture healing process). In general, the higher the level of
expertise of the treating physician, the lower the number of
control radiographs will be. Though, expert physicians
cannot answer the question whether control radiographs
during follow-up can be abolished completely. This is
shown by Bohl et al. A survey among orthopaedic surgeons
showed a large variability in the number of routine radi-
ographs during the follow-up after surgical distal radius
repair and they suggested to conduct an analysis of sur-
geons actual medical records [13].
Due to ageing populations, the incidence of distal radius
fractures is expected to increase substantially in coming
decades. It is, therefore, worthwhile to establish the clinical
value of routine radiographs for monitoring fracture heal-
ing and delivering high-quality care. The aim of this study
was to evaluate whether routine radiographs performed
during the follow-up period in patients with a distal radius
fracture influenced clinical decision making, with the
hypothesis that routine radiographs in the majority of cases
do not lead to changes in treatment strategy.

Methods

Patients

Consecutive patients from two academic hospitals and two
large teaching hospitals in The Netherlands (all of which
are level I trauma centres) were retrospectively analysed.
Patients who were aged 18 years or older with a distal
radius fracture that occurred between 1 January 2012 and
31 December 2012 were eligible for inclusion. The
exclusion criteria were an absence of follow-up data,
pathologic fractures, open fractures, and one or more
simultaneous fractures of the extremities.

Study procedure

A case record form was developed to extract the following
data from medical records: baseline patient characteristics
(age and gender); fracture type according to the Arbeits-
gemeinschaft für Osteosynthesefragen/Orthopaedic
Trauma Association (AO/OTA) classification [14]; treat-
ment strategies (conservative treatment or operative treat-
ment); radiograph dates, numbers (a series of two
radiographs, i.e., AP and lateral, were recorded as one
radiographic intervention), and indications (i.e., pain, new
trauma, decreased range of motion (ROM), patient anxiety,
etc.); and any changes in the management of fractures
following radiography (conservative to operative treat-
ment, prolonged cast immobilization, and removal of
osteosynthesis material (OSM), i.e., any kind of therapy
change mentioned in the medical chart was collected and
stored in the case record forms). Fracture type was classi-
fied based on radiographs taken in the emergency depart-
ment or during the first consultation visit (i.e., when the
patient was first treated in a different emergency
department).

A radiograph was designated as ‘clinically indicated’
when a clinical indication (i.e., pain, new trauma, decreased
ROM, etc.) was found in the medical chart. A
radiograph was designated as ‘routine’ if no clinical indi-
cation could be found in the medical chart. Furthermore, a
distinction was made between radiographs that were
obtained (1) during the first 3 weeks after the trauma (i.e.,
during the treatment period, when operations are likely to
be performed) and (2) after this period (i.e., during the
follow-up period).

Statistical analysis

Descriptive statistics are reported for baseline, fracture, and
radiographic characteristics. Statistics are reported for the
overall group and separately for patients who received
conservative treatment and patients who received operative
treatment.

Results

Among the 1375 identified patients, 333 did not satisfy the
inclusion criteria; thus, 1042 patients remained for analy-
sis. The study group consisted of 755 (72%) females and
287 (28%) males; the included patients had a mean age of
58.5 years [standard deviation (SD) 19.6 years].
In total, 804 (77%) patients received conservative
treatment, and 238 (23%) patients received operative
treatment. Baseline characteristics are presented in
Table 1.

Table 2 provides details regarding the use of radio-
graphs and the influence of radiographs on treatment
strategy. Overall, 1956 radiographs were obtained (mean
1.88, SD 1.43). During the treatment period, 1115 radio-
graphs were acquired (mean 1.07, SD 0.83). During the
follow-up period, 841 radiographs were acquired (mean
0.81, SD 0.99). In total, 720 (86%) of the radiographs
obtained during the follow-up period were categorized as
routine radiographs, and in 121 (14%) radiographs, a clear
clinical indication was reported. Twenty-two (2.6%) of the
841 radiographs altered treatment strategy, including 11
(1.5%) radiographs categorized as routine, 9 (1.2%) of
which led to prolonged cast immobilization, and 2 (0.2%)
of which led to surgery for conservatively treated patients.
Figure 1 provides a flow chart regarding the radiographs
and the influence of radiographs on treatment strategy during the follow-up period.

In the conservative treated patients, 406 (87.5%) of the 464 obtained radiographs during the follow-up period were categorized as routine. Twelve (2.7%) of the 464 radiographs altered treatment strategy, including nine (2.2%) categorized as routine. In the operative-treated patients, 314 (83%) of the 377 obtained radiographs were

<table>
<thead>
<tr>
<th>Table 1 Baseline characteristics</th>
<th>Total cohort ((n = 1042))</th>
<th>Conservative treatment ((n = 804))</th>
<th>Operative treatment ((n = 238))</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>287 (28%)</td>
<td>222 (28%)</td>
<td>65 (27%)</td>
</tr>
<tr>
<td>Female</td>
<td>755 (72%)</td>
<td>582 (72%)</td>
<td>173 (73%)</td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean (SD)</td>
<td>58.5 (19.6)</td>
<td>59.0 (20.3)</td>
<td>56.9 (17.1)</td>
</tr>
<tr>
<td>18–39 years</td>
<td>202 (20%)</td>
<td>156 (19%)</td>
<td>46 (19%)</td>
</tr>
<tr>
<td>40–64 years</td>
<td>421 (40%)</td>
<td>314 (39%)</td>
<td>107 (45%)</td>
</tr>
<tr>
<td>≥65 years</td>
<td>419 (40%)</td>
<td>334 (42%)</td>
<td>85 (36%)</td>
</tr>
<tr>
<td>Fracture type</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AO 23A</td>
<td>467 (45%)</td>
<td>414 (51%)</td>
<td>53 (22%)</td>
</tr>
<tr>
<td>AO 23B</td>
<td>321 (31%)</td>
<td>271 (34%)</td>
<td>50 (21%)</td>
</tr>
<tr>
<td>AO 23C</td>
<td>254 (24%)</td>
<td>119 (15%)</td>
<td>135 (57%)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table 2 Radiographic follow-up</th>
<th>Total</th>
<th>Conservative treatment</th>
<th>Operative treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment period(^a)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No. of radiographs (mean, SD)</td>
<td>1115 (1.07, 0.83)</td>
<td>754 (0.94, 0.82)</td>
<td>361 (1.52, 0.69)</td>
</tr>
<tr>
<td>Follow-up period(^a)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total no. of radiographs (mean, SD)</td>
<td>841 (0.81, 0.99)</td>
<td>464 (0.58, 0.77)</td>
<td>377 (1.58, 1.21)</td>
</tr>
<tr>
<td>No. of routine radiographs (mean, SD)</td>
<td>720 (0.69, 0.86)</td>
<td>406 (0.50, 0.69)</td>
<td>314 (1.32, 1.06)</td>
</tr>
<tr>
<td>No. of radiographs on clinical indication (mean, SD)</td>
<td>121 (0.12, 0.40)</td>
<td>58 (0.07, 0.30)</td>
<td>63 (0.26, 0.60)</td>
</tr>
<tr>
<td>Total no. of changes in treatment strategy (%)</td>
<td>22 (2.6%)</td>
<td>12 (2.7%)</td>
<td>10 (2.4%)</td>
</tr>
<tr>
<td>No. of changes in treatment strategy after a routine radiograph (%)</td>
<td>11 (1.5%)</td>
<td>9 (2.2%)</td>
<td>2 (0.06%)</td>
</tr>
</tbody>
</table>

\(^a\) Treatment period: the first 3 weeks after trauma. Follow-up period: the time after the first 3 weeks

Fig. 1 Flow chart
undisplaced) and treatment strategies (operatively and (intra-articular and extra-articular fractures, displaced and patients with distal radius fractures. All fracture types explored the use of routine radiographs in a large cohort of patients [4, 16, 17].

Decision making, but did increase health care costs other types of fractures. These studies concluded that clinical efficiency of radiographs has been investigated for Eastley et al. [9] demonstrated that for extra-articular distal radius fractures, management in minimally displaced fractures. In addition, radiographs in acute settings do not alter fracture management. These 11 radiographs were routine or were acquired due to a clinical indication that was present but not documented. Thus, we feel that it is safe to conclude that changes in treatment strategy are rarely based on routinely taken radiographs.

These findings should be considered in the context of increasing health care costs and unnecessary radiation exposure.

Our results are consistent with the findings of prior studies. Chaudhry et al. [8] demonstrated that serial radiographs in acute settings do not alter fracture management in minimally displaced fractures. In addition, Eastley et al. [9] demonstrated that for extra-articular distal radius fractures, the late displacement would not be missed if routine radiographs are removed from the guidelines. Furthermore, Huffaker et al. [15] demonstrated for operatively treated AO/OTA-type 23A fractures that 94% of the radiographs that were obtained post-operatively did not influence clinical decision making. Stone et al. [11] showed a change in treatment strategy in only three (1%) patients on the 2-week post-op radiograph. These three patients all had suffered a new trauma and would have been identified clinically if radiographs were not standard at the first post-operative visit. Johnson et al. showed that an average number of 3.8 radiographs were taken per patient, while a single follow-up radiograph may be sufficient to identify complications. They concluded that their results suggest an opportunity to reduce post-operative radiographs [12]. The clinical efficiency of radiographs has been investigated for other types of fractures. These studies concluded that routine radiographs did not significantly influence clinical decision making, but did increase health care costs [4, 16, 17].

In contrast with the above-mentioned studies, this study explored the use of routine radiographs in a large cohort of patients with distal radius fractures. All fracture types (intra-articular and extra-articular fractures, displaced and undisplaced) and treatment strategies (operatively and conservatively treated patients) were included. Thus, this large cohort is an adequate representation of daily practice and may be regarded as broadly generalizable.

However, this study has certain limitations. Due to the retrospective study design, clinically relevant information that may affect fracture healing (such as smoking habits [18]) could not be retrieved from medical records for many patients. Perhaps, most importantly, clinical indications were not always documented; this issue could potentially have resulted in underestimation of the number of radiographs performed with a clinical indication. Despite this probable underestimation, the actual number of routine radiographs will still be gigantic. Therefore, these findings must be replicated in a prospective study. If the results obtained in this study are confirmed, routine radiographs may be avoided to reduce both health care expenditures and unnecessary radiation exposure. Bohl et al. [13] showed that 90% of the surgeons at this point think that it is not acceptable to reduce radiographs to save costs. Our results will hopefully trigger the awareness among surgeons that in the current practice, most radiographs are taken without influencing clinical decision making and can probably be omitted without compromising the quality of care and at the same time can save costs. Our study is the first step towards protocols with radiographs only on clinical indication; therefore, our results should be repeated in a randomized controlled trial.

Conclusion

Although it is common practice to routinely take radiographs during follow-up for distal radius fractures, the current results suggest that these radiographs seldom influence clinical decision making. This lack of clinical relevance should be weighed against the considerations of high health care costs and unnecessary exposure to radiation.

Acknowledgements We would like to thank W. P. Zuidema MD, S. A. G. Meylaerts MD, Ph.D., and H. G. W. M. van de Meulen MD, for providing study subjects, M. van Tulder Ph.D., for critically reviewing the manuscript, and J. Groen MD for contributing to the data collection.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Funding One author of this study (MFT) received a grant from The Netherlands Organisation for Health Research and Development (ZonMw 837002403) for “Is routine radiography following the initial 2-week follow-up of trauma patients with wrist and ankle fractures necessary?” These funds were used to pay NLW’s salary.
Ethical statement Our investigation complies with the current laws and ethical standards of The Netherlands. All data are stored in accordance with Dutch privacy legislation.

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