The Journal of Foot & Ankle Surgery ■■ (2018) ■■–■■

Contents lists available at ScienceDirect

The Journal of Foot & Ankle Surgery

journal homepage: www.jfas.org

Original Research

Routine Follow-Up Radiographs for Ankle Fractures Seldom Add Value to Clinical Decision-Making: A Retrospective, Observational Study

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ARTICLE INFO

Level of Clinical Evidence: 3

Keywords:
ankle trauma
clinical relevance
Lauge-Hansen
radiology
surgery
Weber

ABSTRACT

Currently, the routine use of radiographs for uncomplicated ankle fractures represents good clinical practice. However, radiographs are associated with waiting time, radiation exposure, and costs. Studies have suggested that radiographs seldom alter the treatment strategy if no clinical indication for the imaging study was present. The objective of the present study was to evaluate the effect of routine radiographs on the treatment strategy during the follow-up period of ankle fractures. All patients aged ≥18 years, who had visited 1 of the participating clinics with an eligible ankle fracture in 2012 and with complete follow-up data were included. The data were retrospectively analyzed. The sociodemographic and clinical characteristics and the number of, and indications for, the radiographs taken were collected from the medical records of the participating clinics. We assessed the changes in treatment strategy according to the radiographic findings. In 528 patients with an ankle fracture, 1174 radiographs were performed during the follow-up period. Of these radiographs, 936 (79.7%) were considered routine. Of the routine radiographs taken during the follow-up period, only 11 (1.2 %) resulted in changes to the treatment strategy. Although it is common practice to take radiographs routinely during the follow-up period for ankle fractures, the results from the present study suggest that routine radiographs seldom alter the treatment strategy. This limited clinical relevance should be weighed against the health care costs and radiation exposure associated with the use of routine radiographs. For a definitive recommendation, however, the results of our study should be confirmed by a prospective trial, which we are currently conducting.

Routine radiography during outpatient fracture treatment is known to contribute to the increasing costs of health care (1). The cost-effectiveness of diagnostic imaging has become an increasingly important factor in clinical decision-making with health care costs increasing globally (2). Despite this, routine radiographs performed during outpatient clinical visits of patients with an ankle fracture are a common worldwide practice (3,4). The arguments for routine radiography include monitoring of bone healing, identification of complications, resident education, reassurance for the physician and patient, and medicolegal motives (5). Currently, the added value of routine radiographs is under discussion. Several studies examining the value of radiographs immediately after splinting and radiographs taken at the first postoperative outpatient clinic visit have suggested that

Financial Disclosure: None reported.
Conflicts of interest: None reported.
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https://doi.org/10.1053/j.jfas.2018.03.035

radiographs without a clear clinical indication (e.g., pain, loss of mobility, or subsequent trauma to the ankle) will not lead to changes in treatment strategies (1,6–11). These radiographs did, however, contribute to additional radiation exposure and unnecessary costs. In the Netherlands, with a population of 17 million people, the costs of radiographs during the follow-up period for ankle fractures has been ~3 million Euros annually, based on an incidence of 15,000/y and 4 occasions per patient when a radiographic assessment is performed, costing €50 each (12). Considering that the incidence of ankle fractures is expected to increase worldwide in the coming decades owing to an aging population (13), the clinical value of routine radiographs for monitoring fracture healing and delivering good quality care must be established.

We undertook a retrospective cohort study to identify cases in which an outpatient clinic visit during the follow-up period of ankle fractures, which included a routine radiograph that led to a change in treatment strategy. The objective of the present study was to evaluate whether routine radiographs performed during the follow-up period for patients with an ankle fracture altered the treatment strategy. We hypothesized that routine radiographs during the follow-up period of uncomplicated ankle fractures would not alter the treatment strategy.

Patients and Methods

Study Population

We retrospectively analyzed the information from consecutive patients with complete follow-up data available from 4 level 1 trauma centers in the Netherlands, 2 university hospitals and 2 large teaching hospitals. Patients aged ≥18 years with non-Weber type A ankle fractures (unimalleolar, bimalleolar, or trimalleolar fractures with a Lauge-Hansen classification of supination adduction II, supination eversion II-IV, pronation eversion I-IV, or pronation abduction I-III) (14) that had occurred from January 1, 2012 to December 31, 2012 were eligible for inclusion. Distortions and isolated Danis-Weber classification type A fractures (15) were not included. The exclusion criteria were pathologic fractures, open fractures, multiple fractures, and severe injuries (injury severity score ≥16). The follow-up period consisted of the time the patient was receiving treatment at 1 of our affiliated hospitals. No active monitoring was pursued after this period.

Study Procedure

The present investigation was performed in compliance with the current laws and ethical standards in the Netherlands. All data were stored in accordance with Dutch privacy legislation. All participating centers used a follow-up protocol that recommends radiographs at follow-up consultations 1, 2, 6, and 12 weeks after trauma or surgical fixation. The following data were extracted from the medical records: baseline patient characteristics, including age, sex, and American Society of Anesthesiologists score; fracture type according to Lauge-Hansen (14) and Danis-Weber (15) classification schemes; treatment strategies; the date of trauma and date of discharge from monitoring; the dates and number of, and indications for, the radiographic assessments; and whether the initial treatment strategy was changed by the information obtained from the radiographs.

In the present study, the standard set of anteroposterior, lateral, and mortise views was counted as 1 radiographic assessment. The fracture type was classified according to the radiographs taken at the emergency department or, when the patient had first been treated at a different emergency department, during the first consultation visit. A radiograph was considered routine if the physician had not documented the clinical indication for performing the radiograph in the medical record.

A distinction was made between radiographs taken during the first 3 weeks after trauma (defined as the treatment period, during which a treatment strategy was drafted and surgical fixation might be performed) and radiographs taken after the first 3 weeks (defined as the follow-up period, in which the main reasons for taking radiographs were to monitor bone healing and assess for complications. In the present study, we focused solely on the radiographs taken during the follow-up period. The patients were stratified into 2 groups according to the treatment strategy (i.e., surgical or conservative treatment).

Statistical Analysis

Descriptive statistics are reported for the baseline characteristics, fracture type, and radiographic characteristics. The outcome values are reported separately for conservatively and surgically treated patients. Categorical data were compared using a χ^2 test. Continuous data were compared using an unpaired t test. Statistical significance was defined at the 5% level ($p \leq .05$). All analyses were performed using SPSS statistics, version 23 (IBM Corp., Armonk, NY).

Table 1
Baseline characteristics

Characteristic	Total Cohort (n = 528)	Conservative Treatment (n = 261)	Surgical Treatment (n = 267)	*p* Value
Male sex	238 (45)	121 (46)	117 (44)	.56
Age (y)	49.9 ± 19.5	53.5 ± 20.5	46.5 ± 18.0	< .05*
ASA score				
1	281 (53)	135 (52)	146 (55)	.50
2	166 (32)	72 (28)	94 (35)	.06
3	71 (13)	48 (18)	23 (9)	< .05*
unknown	10 (2)	6 (2)	4 (1)	.50
Fracture type				
Lauge Hansen SA	7 (1)	7 (3)	0 (0)	< .05*
Lauge Hansen SE	360 (68)	198 (76)	162 (61)	< .05*
Lauge Hansen PE	135 (26)	40 (15)	95 (36)	< .05*
Lauge Hansen PA	15 (3)	7 (3)	8 (3)	.87
Posterior malleolar only	10 (2)	8 (3)	2 (0.7)	.51
Weber C stress fracture only	1 (0.1)	1 (0.3)	0 (0)	.311

Abbreviations: ASA, American Society of Anesthesiologists; PA, pronation abduction; PE, pronation exorotation; SA, supination adduction; SE, supination exorotation.
* Statistically significant ($p < .05$).
Data presented as n (%) or mean ± standard deviation.

Results

In the cohort of 601 consecutive patients with an ankle fracture, 73 were excluded by the exclusion criteria. The study group included 528 patients, 238 (45%) males and 290 females (55%). The mean age of all patients was 49.9 ± 19.5 years (standard deviation). Of the 528 patients, 261 (49%) were treated conservatively and 267 (51%) were treated surgically. The baseline characteristics are listed in Table 1. The median follow-up period was 14.1 (range 1.1 to 133) weeks for all patients.

The details regarding the use of radiographs and the influence of the radiographic findings on the treatment strategy are listed in Table 2. In the conservatively treated patients, 257 radiographs were performed during the treatment period (median per patient of 1; range 0 to 3), and 415 radiographs were performed during the follow-up

Table 2
Usage of routine radiographs in the follow-up protocol of ankle fractures

Variable	Patients (n = 528)	Conservative Treatment (n = 261)	Surgical Treatment (n = 267)
Radiographs taken during treatment period			
Total	621	257	364
Median	1	1	1
Range	0 to 4	0 to 3	0 to 4
Radiograph taken during follow-up period (n)			
Total	1174	415	759
Median	2	2	3
Range	0 to 11	0 to 6	0 to 11
Routine radiographs	936 (80%)	373 (90%)	563 (74.2%)
Radiographs for clinical indication	238 (20%)	42 (10%)	196 (25.8%)
Radiographs leading to a change in treatment strategy	23 (2.0%*)	8 (1.9%*)	15 (2.0%*)
Routine radiographs leading to a change in treatment strategy	11 (1.2%†)	6 (1.6%†)	5 (0.9%†)

* Radiographs leading to a change in treatment strategy per number of radiographs taken during the follow-up period.
† Routine radiographs leading to a change in treatment strategy per number of routine radiographs.