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# Patient injury claims involving fractures of the distal radius

## 208 compensated claims from the Finnish Patient Insurance Center

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**Background and purpose** — Optimal treatment for distal radius fractures remains controversial, with a significant number of fractures resulting in complications and long-term morbidity. We investigated patient injury claims related to distal radius fractures to detect the critical steps in the treatment leading to avoidable adverse events

**Patients and methods** — We analyzed all compensated patient injury claims in Finland between 2007 and 2011. Claims were collected from the Patient Insurance Center's (PIC) nationwide claim register. Patients of all ages were included. Each claim decision, original patient records, and radiographs related to treatment were reviewed.

**Results** — During the study period, the PIC received 584 claims regarding distal radius fractures, of which 208 (36%) were compensated. Pain and impaired wrist function were the most common subjective reasons to file claims among compensated patients. In 66/208 patients, more than 1 adverse event leading to patient injury was detected. The detected adverse events could be divided into 3 main groups: diagnostic errors (36%, n = 103), decision/planning errors (30%, n = 87), and insufficient technical execution (32%, n = 91). Issues related to malalignment were the main concerns in each group. Diagnostic errors were often related to incorrect assessment of the fracture (re)displacement (75%, n = 78). All of the decision-making errors concerned physicians' decisions to accept unsatisfactory fracture alignment. The most common technical error was insufficient reduction (29%, n = 26).

**Interpretation** — We identified avoidable adverse events behind patient injuries related to distal radius fracture treatment. This study will help physicians to recognize the critical steps in the treatment of this common fracture and enhance patient safety. ■

Distal radius fractures account for approximately 15% of all fractures treated in emergency departments (Chung and Spilson 2001) and the age distribution is bimodal (Flinkkilä et al. 2011, Wilcke et al. 2013). Despite increasing scientific evidence and published current care guidelines, there is a wide variation in the treatment practice for distal radius fractures (Egol et al. 2010, Lichtman et al. 2010, Arora et al. 2011, Costa et al. 2014, Distal radius fracture: Current Care Guidelines, 2016). It seems that subjective opinions (Walenkamp et al. 2016) and the specialty (Chung et al. 2011) of the physician influence treatment decisions. There is a wide variety of fracture patterns and varying degrees of experience among physicians treating distal radius fractures. Therefore, the treatment of distal radius fractures is understandably susceptible to adverse events and complications leading to patient injuries (Khan and Giddins 2010, Mahdavian Delavary et al. 2010, Statistics of Finnish Patient Insurance Center, 2014, Lutz et al. 2014, Mathews and Chung 2015).

Although patient injuries usually represent the more severe end of adverse events, the mechanisms behind severe adverse events and adverse events in general are often similar. Patient injuries therefore provide important data to help prevent adverse events and to improve patient safety (Mikkonen 2004, Järvelin 2012).

In accordance with the revised patient injury act (Patient Injury Act. 25.7.1986/585), the Finnish Patient Insurance Center (PIC) covers and handles all suspected patient injuries in public or private health care in Finland that occur during medical treatment. New Zealand and the Nordic countries, including Finland, use the no-fault patient insurance system, as opposed to the tort insurance system used in the United

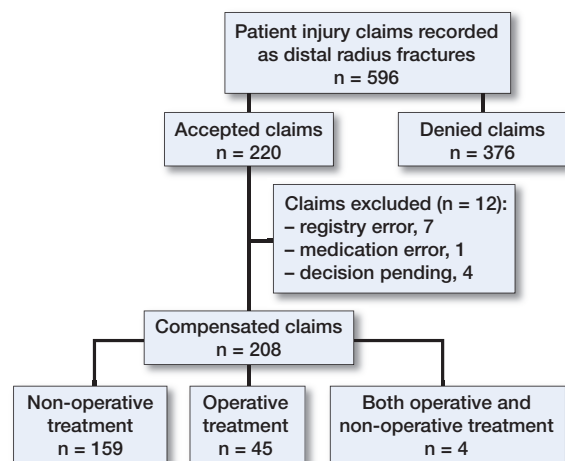


Figure 1. Flowchart of patient injury data collection.

Kingdom and United States (Mikkonen 2004). The primary task of both tort and no-fault systems is to determine whether patients' claims are eligible for compensation, as well as the amount of monetary compensation (Järvelin 2012). In both systems, the consequences of the adverse event must always be severe enough to merit compensation. However, the no-fault system does not aim to find out who is to blame and therefore only rarely do claims advance to legal courts. 7 compensation criteria are defined in the Patient Injury Act (Patient Injury Act. 25.7.1986/585) and the criterion most often used is the so-called "preventability rule"; i.e., is it likely that an experienced medical professional would have avoided the patient injury event by taking a different action. Exceptions to this rule include infections and unreasonable injuries that are generally unavoidable and therefore compensated in accordance with the "tolerability" rather than the "preventability" concept (Helkamaa et al. 2016).

The main objective of this study was to investigate compensated avoidable patient injuries related to fractures of the distal radius and to determine the underlying reasons for these severe adverse events.

## Patients and methods

### Data collection

We analyzed all patient injury claims concerning the treatment of distal radius fractures that had been filed between January 1, 2007 and December 31, 2011. Claims ( $n = 596$ ) were collected from the national claim register (Figure 1). To find all the claims, we used the International Classification of Diseases, tenth revision (ICD-10) for diagnosis code S52.5 (distal radius fracture) and the Nordic Medico-Statistical Committees Classification of Surgical Procedures (NCSP) for procedure codes (NCJ40-99, NDJ40-99, NDK00-99). Each case (original patient records, radiographs, and claim decisions) was

individually analyzed by an independent researcher (HS). We collected the following data: patient characteristics, detailed information concerning the treatment and reoperations, subjective reasons for filing claims, and reasons for compensation.

### Patient injury classifications

All of the compensated patient injury claims we identified were compensated based on the "preventability rule" (see above). For injuries caused by medical management, we used the term "adverse event." We further classified all adverse events into 5 subgroups based on our own analyses and the evaluation of the PIC's external medical advisors for reasons of reimbursement: diagnostic errors, decision-making errors, technical errors, follow-up planning errors, and other errors (Figure 2).

### Statistics

We estimated the nationwide number of distal radius fractures using the age- and sex-specific annual mid-population obtained from the Finnish Official Statistics (Statistics Finland) and the previously published age- and sex-specific incidence of distal radius fractures from Finland, which included patients treated in public as well as private clinics (Flinkkilä et al. 2011). We compared the risks for a compensated patient injury in each age group and for both sexes, using regression models and Poisson-based confidence intervals. All analyses were carried out using SPSS for Windows version 22.0 (IBM Corp, Armonk, NY, USA), STATA 13.0 (StataCorp, College Station, TX, USA) and Confidence Interval Analysis (CIA) 2.2 software. 95% confidence intervals (CI) were calculated using Wilson's exact method.

### Ethics, funding, and potential conflicts of interest

Approval for the study was obtained from the PIC and Finnish Ministry of Social Affairs and Health.

Funding support was provided by the Finnish Medical Association, Patient Insurance Center (PIC), and Helsinki University Central Hospital. No competing interests declared.

## Results

### Claims and claimants

After reviewing all patient injury claims and excluding registry errors, we found 584 closed patient injury claims that concerned distal radius fracture treatment. Compensation was granted for 208 (36%) claimants (Figure 1 and Table 1), of whom 5 were children under 16 years of age, 119 were adults (age 16–64), and 84 were elderly over 65 years of age. Among compensated claimants, pain was the main reason to file a claim (67%), followed by impaired wrist function (62%), suspicion of incorrect treatment (38%), and malalignment of the wrist (31%). Reporting the reason for filing a claim was

Table 1. Patient characteristics

	n	%	range
Patients	208		
Female	153	74	
Mean age	59		(8–90)
Injured side			
Right	94	45	
Injury type			
Leisure/sports	176	85	
Work related	24	12	
Traffic	6	3	
School/college	2	1	
Injury mechanism			
Low-energy trauma <sup>a</sup>	142	68	
High-energy trauma	66	32	
Occupation			
Retired	104	50	
Post-fracture physiotherapy received	146	70	
AO fracture classification			
A2	50	24	
A3	35	17	
B1	6	3	
B2	1	0.5	
B3	4	2	
C1	25	12	
C2	57	27	
C3	14	7	
Radiographs unavailable	16	8	

<sup>a</sup> Falling on the same level while standing or walking.

an official part of the claim filing process. Only 1 claimant had not specified a reason for the claim (Table 2). The average times for claimants to file and for PIC to handle the claims were 9 (1–36) months from the injury and 4 (1–17) months, respectively.

### Reasons for adverse events

We detected 288 discrete adverse events in 208 compensated claimants. 66/208 patients had more than 1 adverse event during their treatment. All compensated patient injury claims concerned management of the index fracture and all were considered to be avoidable injuries by PIC's medical advisors. We further classified adverse events into subgroups based on error types and their temporal occurrence during treatment (Figure 2).

Diagnostic errors accounted for 103 (36%) adverse events. Three-fourths of the diagnostic error subtypes concerned failure to diagnose primary displacement of the fracture or re-displacement of an adequately reduced fracture during follow-up (n = 78, 75%). In these cases the physician explicitly failed to notice the displacement and unintentionally treated the fracture, as the fracture alignment would have been satisfactory. In 12 cases the diagnostic error was repeated in consecutive follow-ups.

Decision-making errors accounted for 53 (18%) adverse events. In these cases the physicians correctly diagnosed the

Table 2. Claimants' subjective reasons for filing a claim

	n	%
Pain	139	67
Impaired wrist function	129	62
Incorrect treatment	79	38
Visual deformity	65	31
Loss of income/additional expenses	48	23
Prolonged recovery time	33	16
Poor doctor–patient relationship	12	6
Cosmetic harm (e.g., scar)	10	5
Mental stress	7	3
Need of professional re-education	1	0
Corneal erosion during anesthesia	1	0

207 claimants out of 208 had a total of 524 subjective reasons for claims.

fracture displacement, accepted it, and intentionally continued the treatment without any interventions (Figure 2, legend).

Technical errors accounted for 91 (32%) adverse events. Half of the adverse events in non-operative treatment occurred because of inadequate casting technique or insufficient reduction of the fracture. As in the non-operative group, failure to reduce the fracture was a common problem among patients operated on, accounting for 27% of adverse events in this group (n = 14).

Follow-up planning errors accounted for 34 (12%) adverse events. Inadequately timed or lacking follow-up visits in the early post-treatment period accounted for 59% of these adverse events (n = 20). In non-operative treatment, 55% of the adverse events occurred at the follow-up visits whereas in operative treatment 80% of adverse events occurred during the primary operation. Adverse events were considered compensable if the first 2 controls were missed altogether or if the 2-week control was missed or arranged too late when fracture union had already occurred.

For age and sex, there were no statistically significant differences for the different subgroups or the combinations of errors.

### Evaluation of the study population

From 2007 to 2011, we estimated that a total of 64,990 fractures of the distal radius occurred in Finland: approximately 13,000 fractures per year (Flinkkilä et al. 2011, Statistics Finland). There was a strong relationship between the number of compensated patient injuries and the total number of distal radius fractures (estimate) regarding 2 confounding factors, age and sex (Figure 3). The calculated risk for a compensated patient injury varied from 0.06% (CI 0.01–0.32) to 0.5% (CI 0.28–0.91) among different age groups and sexes. The differences between groups were not statistically significant. Based on our estimation, the risk for a patient injury, defined as a compensated PIC claim, in distal radius fracture treatment was 0.3% in Finland.

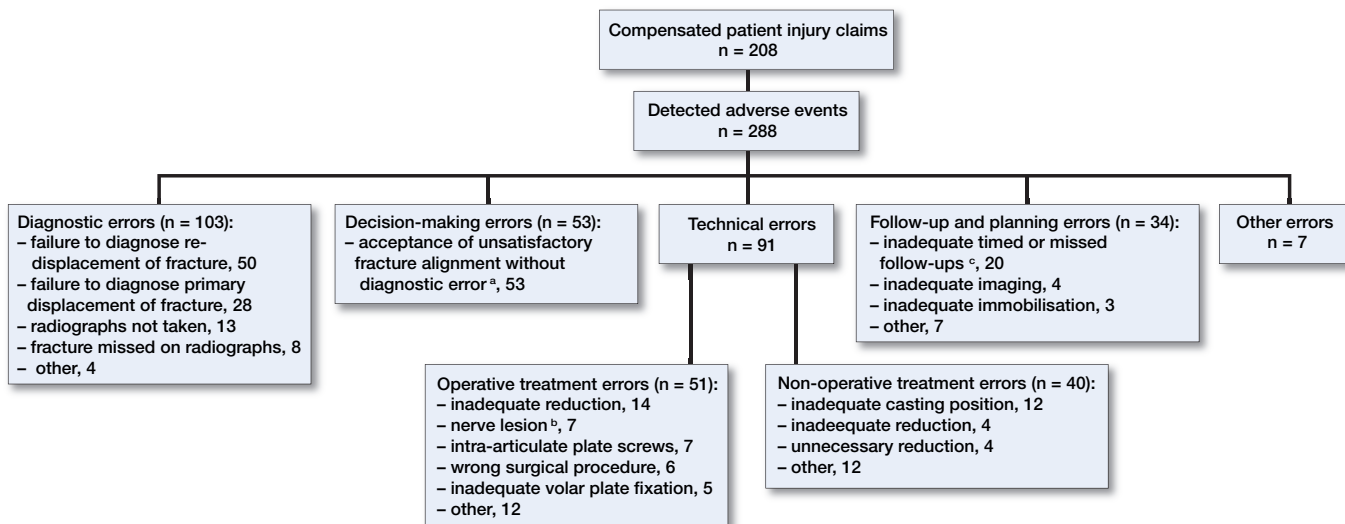


Figure 2. Reasons for adverse events. Treatment injuries, referred to as adverse events in the text, were further classified into subgroups by error type and their consecutive occurrence during treatment.

<sup>a</sup> Fracture was not primarily reduced or re-reduced during follow-up. Non-operative treatment was not switched to operative treatment or the patient was not referred to a specialist.

<sup>b</sup> Distribution of 7 nerve lesions: Median nerve (3), superficial radial nerve (2), ulnar nerve (1), bone graft: lateral femoral cutaneous nerve (1).

<sup>c</sup> Normal follow-up visits at 1, 2, and 5 weeks, with radiograph taken at 1 and 2 weeks.

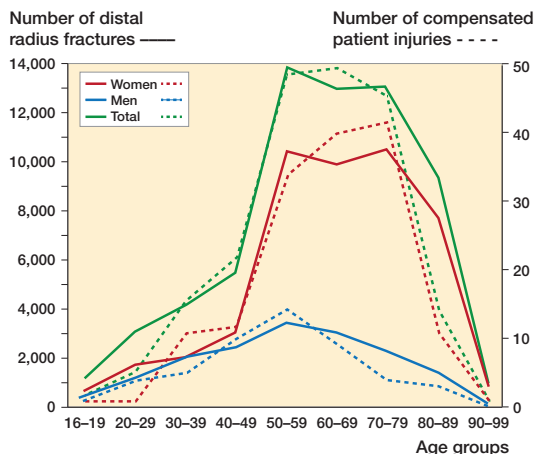


Figure 3. Estimate of the total number of fractures of the distal radius and compensated claimants during the study period (2007–2011) in Finland. For men, the total number of fractures of the distal radius (continuous line) and compensated claimants (dashed line) was highest in the 50–59 years age group, whereas for women it was in the 70–79 years age group.

### Discussion

To our knowledge, this is the first nationwide analysis of compensated patient injury claims among patients treated for fractures of the distal radius. Our analysis of adverse events revealed that errors could be divided into 3 main groups based on the stage at which the adverse event occurred: diagnostic, decision/planning, and technical. Each group accounted for approximately one-third of all adverse events. All of these

errors were avoidable. Over half of all adverse events comprised situations where the fracture displacement was misdiagnosed or where it was diagnosed correctly but mismanaged.

At best, fractures of the distal radius heal completely without significant functional limitations. However, a significant number of distal radius fracture treatments result in complications and long-term morbidity (Friedman 2005). Several studies of complications after distal radius fracture treatment have focused on clinical outcome (McKay et al. 2001, Lutz et al. 2014). However, there is surprisingly little information about adverse events associated with distal radius fracture treatment leading to complications and even less information regarding why these adverse events occur and how they can be avoided (DeNoble et al. 2014, Mathews and Chung 2015).

Diagnostic errors were the most common adverse events that we detected. Several previous medical reports have noted similar findings (Guly 2001, Brown et al. 2010, Saber Tehrani et al. 2013, Ring et al. 2014, Talbot et al. 2014). The majority of diagnostic errors (73%) that we identified in our study were due to physicians failing to assess displacement or re-displacement of the fracture. Diagnostic errors were recently acknowledged to be one of the most common and harmful patient safety problems (Singh and Graber 2015). Since 2008, working groups, conferences, and societies have been established to address this large and seldom-discussed problem (Croskerry 2012). A recent report by the National Academies of Sciences emphasized diagnostic error and proposed recommendations to reduce these adverse events (National Academies of Sciences 2015). In 2000, Svensson et al. (2000) had already addressed these problems and proposed many of the

same recommendations for distal radius fracture treatment. Incorrect assessment of fracture (re)displacement is a common error that can be prevented by increasing the physician's clinical expertise and following treatment recommendations stated in current care guidelines (Wyrick 2016). Checklists have also been shown to be promising interventions to reduce diagnostic errors in emergency room settings (Graber et al. 2014). A checklist for distal radius fractures could include: (1) instructions on how to correctly measure the radiological parameters, (2) the radiological criteria for non-operative and operative treatment according to the guidelines, (3) common pitfalls, (4) instructions for adequately consenting patients, especially patients older than 65 years with an unstable fracture, for whom surgical fixation is not recommended. Computer-aided diagnostic systems (CADx) for the characterization of distal radius fractures might also offer interesting new opportunities to help physicians interpret radiographs and accordingly reduce diagnostic errors in distal radius fracture treatment.

Over half (56%) of adverse events in non-operative treatment occurred during early follow-up visits. This is important, because in recent years the rationalization of follow-up visits has been a trend in orthopedic outpatient clinics in Finland (Ovaska et al. 2016). Based on this finding the follow-up visit, especially of non-operatively treated distal radius fracture patients, may not be an ideal visit type to be reduced when the productivity of outpatient clinics is optimized.

There are several limitations to our study to consider when results are interpreted. Studies of patient injuries have been considered to be vulnerable to a few sources of bias, including non-standardized sources of data, selection bias, and hindsight bias.

In Finland, the PIC claims register constitutes a unique nationwide database that covers all claims filed by patients from public and private healthcare sectors. It contains all necessary information about care of the claimants, including medical records, radiographs, MRI and CT files, and laboratory results. Therefore, data collection, handling, and recording are optimally standardized.

As the claim-filing process is patient derived and many factors affect the likelihood that a patient will file a claim after an adverse event (Bismark et al. 2006), there is potential selection bias in this study. According to some estimates, only 1–3% of all patients with a severe, compensable adverse event ever file a claim (Mikkonen 2004, Bismark et al. 2006). Thus the PIC claims register represents only a portion of all adverse events that qualify as patient injuries and any estimates of incidence based on reported claims must be assessed with caution. Furthermore, our data comprised only compensated patient injury claims, as we did not review denied claims. Numbers of non-compensated and total claims should thus be used with caution. For the risk analysis, we estimated the total number of fractures of the distal radius using the incidence reported by Flinkkilä et al. (2011). An accurate number of distal radius fractures nationwide is difficult to obtain, because these frac-

tures are treated at a variety of health facilities and there is no national register where the total number of all distal radius fractures is reported. However, the incidence for fractures of the distal radius reported in a large, Swedish registry-based study (Wilcke et al. 2013) is very similar to the incidence reported by Flinkkilä et al. (2011), upon which we based our estimate.

Hindsight bias is a phenomenon in which the individuals evaluating claims are more eager to grant compensation when the consequences of the adverse event are more severe regardless of the quality of the treatment provided. One might assume that this kind of bias would be less likely in a system which functions based on the “preventability rule,” where only the quality of the given treatment is assessed.

Furthermore, the external medical advisors' assessments of the claimants' treatment are subjective. However, the assessments, based on the then prevailing national current care guidelines, are made by experienced orthopedic surgeons or hand surgeons, with access to all patient records and radiographs.

The strengths of this study include the nationwide study design and the thorough review of each claim, the original patient records, and radiological images. Furthermore, although a selective group of patients, the compensated claimants represent the general distal radius fracture population regarding age and sex.

In summary, we describe here the typical avoidable patient injuries related to distal radius fracture treatment. We also categorize the types and the typical causes of these severe adverse events. The adverse events fall into 3 main groups: diagnostic errors, decision/planning errors, and technical errors. This study will hopefully help physicians to recognize the critical steps in the treatment of this common fracture, enhance patient safety, and diminish adverse events.

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HS designed the study, collected the data, analyzed the data, reviewed the literature, and prepared the manuscript. TH and EW designed the study, analyzed the data and prepared the manuscript. EH, JV and TR contributed to study design, interpreting the results, and preparation of the manuscript. HH performed the statistical analyses.

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