Misdiagnosed and maltreated scaphoid fractures – costly both for society and patients: A review of filed claims to the Swedish National Patient Insurance Company 2011–2018

Jonny K Andersson1,2, Pelle Gustafson3,4 and Philippe Kopylov3,5

1Department of Surgery, Aspetar Orthopaedic and Sports Medicine Hospital, Doha, Qatar
2Department of Orthopaedics, Institute of Clinical Sciences, The Sahlgrenska Academy, University of Gothenburg, Göteborg, Sweden
3Department of Clinical Sciences – Orthopedics, Lund University, Lund, Sweden
4The Swedish National Patient Insurance Company, Stockholm, Sweden
5Department of Orthopedics, Hässleholm-Kristianstad Hospitals, Hässleholm, Sweden

- Misdiagnosed and maltreated scaphoid fractures filed to the Swedish National Patient Insurance Company (LÖF) 2011–2018 were analyzed in terms of complications and costs for society. All filed claims are database-registered (altogether 200 000 claims since 2000). This database was assessed in June 2019 through injury ICD10-SWE-diagnoses. Demographics, complications, complaints, corrective surgeries and costs were analyzed. The numbers of claims for scaphoid fractures were reviewed and compared with all claims.
- There was a statistically significant trend towards decreasing numbers of notified scaphoid fracture cases during this time. This is not the case compared with the total annually notified injuries to LÖF during the same time, where we instead can see statistically significant increased numbers.
- Median age for the 128 patients was 24 years. Men represented 76%. Seventy-eight of the 128 (61%) claims were judged as avoidable, compared with 42% in terms of all notified injuries. Pseudoarthrosis dominated as complication ($n = 71$). Total numbers of complications were 117, and 47 of the 78 patients had medical invalidity as a consequence. Up to six secondary corrective surgeries per patient were required. Complications and disabilities were more severe if patients needed more than one surgery. The total costs were calculated to €1 226 193.
- Level of Evidence: LoE III, Therapeutic.

Introduction

Scaphoid fractures account for 60% of carpal fractures, 11% of hand fractures and 2% of all fractures. The estimated incidence is shown to be 29–43 fractures/100 000 persons/year (1, 2, 3, 4). Most commonly, it occurs in young males from 15 to 25 years of age (3, 4).

Scaphoid fractures are common in an active population, for example in different sports, and are notorious for being difficult both to diagnose and to treat (5, 6). Algorithms on how to diagnose and treat acute scaphoid fractures have been long internationally established (1, 2). After a fall on an extended hand, with radial wrist pain and pain on palpation at fossa tabatière and/or axial compression of the thumb, an X-ray examination should be performed, including special projections of the scaphoid. If the clinical status is typical and a fracture can be seen on radiographs, the patient has to be treated for his scaphoid fracture according to the recommendations, usually with an appropriate cast. If the clinical status is typical, but no fracture can be seen on X-rays, the patient should be treated with an appropriate cast and reexamined in 7–10 days including X-ray, CT and/or MRI. If this reveals a scaphoid fracture, it should be treated usually with a cast.

The potentially serious consequences of a non-united scaphoid fracture, as well as missed scapholunate
ligament (SL) injuries with progressive osteoarthritis (7, 8), have resulted in restrictive treatment protocols for acute scaphoid fractures, historically, with long-time immobilization. Most scaphoid fractures are, however, non-displaced or minimally displaced (<1 mm) and have a good prognosis with limited time of immobilization as 90% of them heal in 6 weeks (2). Only more displaced fracture needs reduction and operative treatment. It is also important to bear in mind the SL injury as a negative result from MRI is unable to rule out the possibility of a clinically relevant SL injury (9).

On the other hand, good and developed treatment protocols can most probably prevent misdiagnosis and maltreatment of scaphoid fractures, leading to pseudoarthrosis and degenerative arthritis. The reasons for misdiagnosis and maltreatment may vary, but considering the potentially serious consequences, it is of importance to try to address them.

Since 1975, Sweden has a national insurance system for compensation of financial losses due to healthcare-related injuries. Patients can themselves file a claim to LÖF to seek redress for an avoidable patient injury. LÖF is responsible for the investigation and collects all available and relevant information from the caregiver. Claims are analyzed by an independent expert physician, one of the most experienced senior colleagues acting as a medical advisor, with a documented specialist competence within the specific specialty where the injury occurred. The expert physician is asked for an opinion on whether the adverse event was avoidable according to the insurance terms (based on best practice at the time of injury), and, if an injury has resulted in added treatment and/or permanent damage, for a degree of medical invalidity. A filed claim will, if the injury is considered avoidable by use of best practice at the time of treatment, be settled, and the patient compensated for actual and expected financial losses. If questions and particularly complicated cases, the issues are assessed and discussed among experts in a special group of experienced colleagues of medical advisors.

The role of databases of claims is established in other countries than Sweden and a few studies of National Health Service Litigation Authority claims (10, 11, 12) and medical-neglected cases in terms of hand and wrist, including scaphoid fractures (13) have been published the last 10 years.

The purpose of this review was to analyze misdiagnosed and maltreated scaphoid fractures in Sweden filed as claims between 2011 and 2018 to the Swedish National Patient Insurance Company (LÖF).

We wanted to assess and analyze the most common complications, demographics, indemnity for disability and/or pain and suffering, loss of income, as well as direct and indirect costs for the society.

With the original research data, we also wanted to analyze the trends over time with a comparison between all filed claims and filed claims for scaphoid fractures.

**Methods**

All filed claims to LÖF are registered in a database, today encompassing more than 200 000 claims, since 2000. This database was assessed in June 2019 in terms of the injury ICD10-SWE-diagnoses displayed in Table 1.

The broad search strategy was performed to reduce the risk of missing any scaphoid fracture and to find scaphoid fractures with concomitant injuries.

The search resulted in 1808 claims filed between 1 January 2011 and 31 December 2018, 128 of which were claims concerning scaphoid fractures (Fig. 1).

**Data extraction**

Data extraction was performed by the first author (JKA) during 2019 and 2020 and discussed with the third author (PK). All filed claims had a decision at the time of extraction.

**Demographics**

Age at injury, gender, side, occupation, injury type, localization of the fracture, type of patient’s complaint as well as possible concomitant injuries were assessed and analyzed.

**Complications**

The number of settled claims for scaphoid fractures was reviewed and compared to all filed claims and settled patient injuries. Reasons for avoidance, type of complications, as well as numbers and types of correcting surgical procedures, were reviewed. Furthermore, results after corrective surgery were assessed.

**Table 1**

ICD10-SWE diagnoses used for identifying scaphoid fractures.

| Diagnosis code – ICD10-SWE | Diagnosis                                    |
|----------------------------|----------------------------------------------|
| S62.0                      | Scaphoid fracture                            |
| S63.3                      | Ligament injury wrist, hand                  |
| M24.2D                     | Ligament instability wrist, hand             |
| S52.5                      | Distal radius fracture                       |
| S52.6                      | Distal radius and ulna fracture              |
| M19.1D / M19.2D            | Post traumatic degenerative arthritis        |
| S63.5                      | Sprain/distortion wrist                      |
| S63.7                      | Sprain/distortion wrist, hand without        |
| S63.0                      | specification                                |
| S60.2                      | Dislocation wrist                            |
| S60.7                      | Contusion wrist, hand                        |
| S60.8                      | Multiple superficial injuries wrist, hand    |
| S60.9                      | Other spec superficial injuries wrist, hand  |
| T92.3                      | Late problems fracture wrist, hand           |
| T92.1                      | Late problems ligament injury wrist, hand    |
Medical invalidity was assessed using standard tables from the Swedish Insurance Association ([https://www.svenskforsakring.se/vagledningar/personskador/medicinska-tabellverk/](https://www.svenskforsakring.se/vagledningar/personskador/medicinska-tabellverk/)) (in Swedish). Medical invalidity was assessed in patients with sequelae after the fracture, but only when the condition was stable, and never earlier than 12 months after the injury.

Costs

**Direct costs**

The total exact payment to patients with misdiagnosed and mistreated scaphoid fractures was noted and added up, as well as separated into pain and suffering, disability, income and retirement reduction and costs for the patient.

**Indirect costs**

Indirect costs are estimated as the least possible costs, as the individual personal costs for each one of the patients are impossible to exactly calculate from the available data in the register.

Indirect costs, or production losses, are the cost of reduced working ability due to health reasons. Here, production losses due to a temporary ailment or disease constitute the cost of sick listing. The human capital method ([14](#)) was used to estimate indirect costs. The measurement used for sick listing was the actual salary, including payroll taxes.

According to Statistics Sweden (SCB), the average annual income during 2011–2018 was €31 684. We did not have access to each individual’s annual income in our database, but since the proportion of blue-collar workers or healthcare staff among the included patients in our study were similar to the general Swedish population (50%), we used this sum for the calculation of indirect costs.

The numbers and length of ongoing episodes of sick leave due to scaphoid fractures (S62.0) were analyzed after information from the Swedish Social Insurance Agency (Försäkringskassan).

**Statistical analysis**

Linear regression was used to detect trends. ANOVA with Bonferroni post hoc test was used for group comparisons of continuous variables. Chi-square-test was used on group comparisons of categorical variables. Significant level was set at $P < 0.05$. For multiple comparisons, Bonferroni adjustment was used.

All data were coded and analyzed in IBM SPSS Statistics for Windows, Version 21.0. Armonk IBM Corp. Data were shown as frequencies and percentages for categorical variables and for continuous variables, the central tendency was presented using means and median and measures of variability were presented using S.D. and interquartile ranges. We computed the percentage of accepted claims from the total claims submitted for all general complaints and compared it against scaphoid fracture-related complaints for each year from 2011 to 2018. A t-test was performed to determine if there was any significance between yearly acceptance rates between scaphoid fractures and general complaints. Linear regression was used to detect if there was an increasing or decreasing trend in the number of registered complaints versus the number of accepted complaints from 2011 to 2018.

Informed consent was given by all patients in the study when filing the claim to LÖF. Patients who did not give their consent were never entered in the search. The study was approved by the Swedish Ethical Review Authority (Dnr: 2019-01569).

**Results**

During 2011 to 2018, 128 claims were filed that in some way included a scaphoid fracture. Seventy-eight of these claims (61%) were judged avoidable by the claim registry and the expert physician, and thus classified as settled claims. There was a trend toward decreasing numbers of filed claims for scaphoid fractures over time ($P$-value for trend 0.021) and for number of settled claims ($P$-value for trend 0.013) 2011–2018 ([Figs 2](#) and [3](#)). The total number of filed claims to LÖF has increased by an average
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of 6% annually for a cumulative increase of 60% during 2011–2018 (P-value for trend 0.011). The annual trend in number of general complaints and settled complaints was always increasing (P-value for trend P < 0.001 for each) (Fig. 4). The frequency of settled claims of scaphoid fractures was 20% higher than for general complaints.

Demographics

The average age for the 128 patients was 28 years and the median age was 24 years (range 10–77). Only 11 (9%) patients were over 50 years old. There were 97 males (76%), and the right wrist was injured in 61 patients (48%).

Sports injuries were responsible for 60 injuries (47%) and high-energy injuries for 11 (8.6%). Sixty-three patients (49%) were blue-collar workers or healthcare staff, a proportion which is similar to the general Swedish population.

Seventy-two (92%) of the 78 claims that were judged as avoidable were filed because of delayed diagnosis and consequently delayed treatment. This seems to be the key problem.

Among the 78 patients, pseudoarthrosis dominated as a complication (Table 2).

Sixteen proximal pole fractures (13%) were found. However, these cases were not associated with worse complications. Scaphoid fractures with concomitant injuries were found in 12 patients (distal radius fracture; n = 7 and SL injury; n = 5).

The total numbers of complications among the 78 patients were 117, a median of 1 injury (range 1–4) per patient. As many as up to six secondary corrective surgical procedures per patient were required, and 71 patients needed surgical procedures for pseudoarthrosis. Forty-seven of the 78 patients had medical invalidity as a consequence of the avoidable injury.

Complications and disability seemed to be more severe if patients needed more than one surgical procedure (Table 3).

Analysis of reasons for avoidance

Primary care and Accident and Emergency (A/E) departments represented 81% (n = 63) of where the injury was caused. The most common cause for injury was diagnostic errors, including diagnostic delay; 72% (n = 56),
followed by treatment errors, including treatment delay during non-operative care; 22% (n = 17) and treatment errors during surgery; 6% (n = 5) (Table 4). Thirty-seven patients had X-rays taken of the injured wrist but without special projections of the scaphoid, 32 of these were between 17 and 50 years of age.

**Direct costs**

The type and level of costs in terms of payment from LÖF were in total calculated to be €518 084, on average €6642 (range €0–24 406) per patient (Table 5). The mean medical disability was 1.9%, median 1% (range 0–22%).

**Indirect costs**

The median length of sick leave was estimated to 44 days (Table 6), with the calculated average indirect cost of €5532 per patient.

This was calculated as 21 working days a month plus extra days multiplied by 2 months (=44 days, the median length of sick leave) with the average monthly income in Sweden (€31 684). In total for the 128 patients, the indirect costs were estimated to be €708 109. Thus, the total costs (direct and indirect) were calculated to €1 226 193. The indirect costs are most probably underestimated but are judged being at least this high.

**Table 2** Types and frequency of the complications in 78 patients with settled claims after misdiagnosed/maltreated scaphoid fractures.

| Type of complication | Number |
|----------------------|--------|
| Pseudoarthrosis       | 71     |
| Secondary degenerative arthritis | 12     |
| Sensory nerve injury  | 5      |
| Synovitis             | 3      |
| Carpal tunnel syndrome| 2      |
| Cysts or necrosis of the proximal pole | 2      |
| Delayed union (=healing after more than 6 months) | 8      |
| Malunion              | 1      |
| Cast mistreatment     | 4      |
| CRPS (complex regional pain syndrome) | 3      |
| Vessel injury         | 1      |
| Tendon injury         | 1      |
| Complication with osteosynthesis material (protrusion of screws) | 3      |
| Infection             | 1      |
| **Total**             | **117**|

**Table 3** Complications and level of disability in 78 patients with settled claims after misdiagnosed/maltreated scaphoid fractures.

| Complications                                      | n | Disability, median |
|----------------------------------------------------|---|--------------------|
| No further treatment needed                        | 21 | 0% (0–2)           |
| One surgical procedure                             | 40 | 1% (0–4)           |
| More than one surgical procedure needed             | 17 | 3% (1–10)          |

**Discussion**

This article is novel, as no former national studies on scaphoid fractures have focused on costs and disability (15).

The main finding in this study and review was that despite improved treatment protocols for scaphoid fractures (1, 2), avoidable treatment errors do still occur. They pose a particular problem since patients are often young (median 24 years in this study) (3, 4), men and blue-collar workers (almost 50% in this study), as well as physically active, and the treatment errors often result in medical invalidity, lasting the life of the patient.

The total costs for misdiagnosed and mistreated cases of scaphoid fracture during 2011–2018 were calculated to €1 226 193 (direct costs: €518 084, indirect costs: €708 109).

The individual personal costs for each one of them, in terms of disability, impossibility to fulfill their current occupations and leisure life are most probably considerable but impossible to properly calculate from our data in this review.

If diagnosed and treated within a few days, we know that 90% of the scaphoid fractures heal without measurable disability within 6 weeks (2). Ninety-two percent of the claims judged as avoidable in our study were filed because of delayed diagnosis and consequently delayed treatment. This seems to be the key problem and it is in line with Ring et al. (12), where the most common reasons for lost claims were due to incorrect, missed, or delayed diagnosis and alleged mismanagement (73%).

An important finding in this study was that the total numbers of complications in this cohort of 128 cases were as high as 117. Pseudoarthrosis dominated as complication (n = 71). As many as up to six secondary corrective surgical procedures per patient were required, and 71 patients needed pseudoarthrosis surgical procedures, which is a substantial impact on the health care system. Scaphoid pseudoarthrosis can be treated by bone grafting and pin- or compression screw fixation (16, 17, 18, 19), and salvage procedures, if degenerative arthritis, usually consists of for example four-corner fusion and proximal row carpectomy (20, 21, 22, 23), all techniques used on the patients in our study.

Approximately 60% of the notified scaphoid fractures were classified as avoidable treatment errors. This could be compared with approximately 40% approved patient injuries of all notified injuries to The Swedish National Patient Insurance Company (LOF) during 2011–2018 (unpublished data, LÖF).

There was a statistically significant trend toward decreasing numbers of notified scaphoid fracture cases during the time. Probably this is due to increased knowledge and coping strategies with the presented...
Table 4 The cause of injury, level of care and type of error in the 78 patients with avoidable injuries. The level of care where the injury was caused was in 32 patients primary care, in 31 accident and emergency (A/E) departments, in 6 patients radiology departments, and in 9 in orthopedic/hand surgery departments. The most common cause for injury was diagnostic errors \((n = 56)\), followed by treatment errors during non-operative care \((n = 17)\) and treatment errors during surgery \((n = 5)\).

| Cause for injury | Level of care | Type of error (regardless of level of care) |
|------------------|--------------|------------------------------------------|
| Diagnostic \((n = 56)\) | Primary care \((n = 25)\) | No scaphoid X-rays (only wrist) \((n = 37)\) |
| | A/E \((n = 25)\) | No X-rays at all \((n = 13)\) |
| | Radiology \((n = 6)\) | Missed X-rays \((n = 6)\) |
| Treatment error non-operative treatment \((n = 17)\) | Primary care \((n = 7)\) | Suspected fracture but no PoP and follow-up \((n = 7)\) |
| | A/E \((n = 6)\) | Too-short immobilization \((n = 4)\) |
| | Specialist care \((n = 4)\) | Treatment but no fracture \((n = 3)\) |
| | | Injury due to PoP \((n = 2)\) |
| | | No referral to hand surgeon \((n = 1)\) |
| Treatment error operative treatment \((n = 5)\) | Orthopedics \((n = 3)\) | Misplaced screw \((n = 2)\) |
| | Hand surgery \((n = 2)\) | No bone transplant \((n = 1)\) |
| | | Perioperative scaphoid fracture \((n = 1)\) |
| | | Compartment syndrome leg \((n = 1)\) |

PoP, plaster of Paris.

algorithms of diagnostics and treatment of scaphoid fracture and diagnosis (2), and we believe that further coping with these treatment protocols for scaphoid fractures – described in our introduction – in all A/E departments, diagnostic and treatment errors could further decrease.

However, since no reliable nationwide registration of scaphoid fractures exists, we cannot rule out that a decrease of incidence can at least partly explain the decreasing number of settled claims. Assessment of the Swedish fracture register shows that 3594 scaphoid fractures were registered between 2013 (when the register started) and 2018, which gives 513 scaphoid fractures annually, but the reporting frequency was low in the beginning of that register and during 2018 approximately 75% of the health care centers reported to the register, with a risk of inclusion bias and inappropriate calculation of annual numbers of scaphoid fractures.

On the contrary, in terms of the total annually notified injuries to LÖF during the same time, we could see statistically significant increased numbers. This is in line with the increasing numbers of total clinical negligence claims over the past 30 years in orthopedic surgery, seen in the UK (10).

Higher awareness and mandatory duty for health care staff to provide information in terms of avoidable injuries, more annual health care performed during the time and an increasing population in Sweden could have contributed to the increasing trend of claimed total injuries.

Notable is the relatively high number of avoidable injuries, where an X-ray of the wrist has been performed, but without special projections of the scaphoid. The reasons for this are unclear but raises the question of lack of knowledge.

Concomitant injuries with scaphoid fractures do exist, as seven concomitant distal radius fractures and five cases of concomitant SL ligament injury were found. This is in line with Richards et al. (24) and Jørgsholm et al. (25) findings. SL injuries can be present in approximately 20% of the patients with scaphoid waist fractures (25). Missed SL injuries also lead to the same complication as misdiagnosed scaphoid fractures (7, 8), and are easy to misdiagnose clinically and by MRI (9, 26). Wrist arthroscopy is here still the gold standard in diagnostics (9).

Limitations

There are several limitations to this study. The wrong diagnosis according to ICD10 could be determined in the register of The Swedish National Patient Insurance Company (LÖF). But the broad search strategies in this study most probably decreased the possible missed cases. X-rays for secondary assessment of the fractures by the

Table 5 The type and level of direct costs.

| Type of costs | Charges in Euros |
|--------------|-----------------|
| Disability   | 198 775         |
| Pain and suffering | 181 215       |
| Scar         | 69 526          |
| Loss of income | 56 583        |
| Loss of retirement income | 4065        |
| Patient costs | 7920           |
| Total        | €518 084        |

Table 6 Length of sick leave in patients with current scaphoid fracture diagnosis according to the Swedish Social Insurance Agency (Försäkringsskan) in June 2020.

| Interval of sick leave (days) | Patients \((n)\) |
|------------------------------|-----------------|
| 1–28                         | 159             |
| 29–59                        | 216             |
| 60–89                        | 63              |
| 90–364                       | 103             |
| 365–730                      | 15              |
| 730+                         | 28              |
| Total                        | 584             |
| Median sick leave 44 days    |                 |
authors were not available, only the reports. The length of the individual period of sick leave was not possible to retrieve from the register, only the median length. As these cases were associated with many difficult complications, the length of sick leave and the level of indirect costs are although not overestimated.

**Conclusion**

The total costs for misdiagnosed and mistreated scaphoid fractures during 2011–2018 were calculated to €1 226 193 (direct costs: €518 084, indirect costs: €708 109). Pseudoarthrosis dominated (n = 71) as complication.

Seventy-eight out of 128 of the notified injuries were approved to be avoidable patient injuries (61%). This could be compared with 42% approved patient injuries of all notified injuries to The Swedish National Patient Insurance Company (LÖF) during 2011–2018. There was a statistically significant trend toward decreasing numbers of notified scaphoid fracture cases during the time. This is not the case compared with the total annually notified injuries to LÖF during the same time, where we instead can see statistically significant increased numbers.

Misdiagnosed scaphoid fractures are costly for both the patient and the society. Following the recommendations and algorithms of diagnostics and treatment of acute scaphoid fracture is beneficial for both patients and the society.

**ICMJE Conflict of Interest Statement**

The authors declare that there is no conflict of interest that could be perceived as prejudicing the impartiality of the work reported.

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