JSES International 4 (2020) 59–62

Contents lists available at ScienceDirect

JSES International

journal homepage: www.jsesinternational.org

Trends in scapular fractures: a nationwide 17-year study in Finland

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ARTICLE INFO

Keywords:
Scapula
fracture
incidence
national database
hospitalization
registry
operational treatment

Level of evidence: Epidemiology Study; Large Database Analysis

Background: The aim of this study was to examine the trends in the number and incidence of scapular fractures causing hospitalization in the Finnish adult population between 1998 and 2014.
Methods: We assessed the number and incidence of scapular fractures resulting in hospital admission and fixation with a plate in Finland in 1998 through 2014 using the Finnish National Hospital Discharge Register as the database. In each year, the study included the entire Finnish adult population.
Results: A total of 3843 adult patients with scapular fractures were hospitalized, and the incidence of fracture increased from 4.8 (per 100,000 person-years) in 1998 to 6.6 in 2014. The fracture was operated on with plating in 476 cases (12.4%). The annual number and incidence of scapular fixation with plates did not show constant trend changes during the study period except in the years 2011 through 2013, when there was a sudden increase in the number of these operations. This increase leveled off in 2014.
Conclusion: The incidence of hospital-treated scapular fractures increased in Finland in 1998 through 2014. Treatment of scapular fractures with a plate did not show consistent trend changes in Finland during this period.

Scapular fractures are relatively uncommon injuries, accounting for fewer than 1% of all fractures and having an incidence between 3.2 and 10 per 100,000 person-years.[4,9] According to the literature, the average age of scapular fracture patients is around 40 years, with a clear sex difference: Male patients account for more than 65% of the cases, and their average age is 10 to 15 years lower than that of their female counterparts.[9,16,21]

A scapular fracture usually results from a severe blunt impact force, and up to 90% of scapular fractures have been reported to occur as a result of a high-energy collision, mostly involving a motor vehicle.[16] Direct force may cause fractures in all regions of the scapula, whereas indirect force through humeral head impaction toward the glenoid fossa may cause both glenoid and scapular neck fractures. Among these fractures, anterior glenoid rim fractures, usually accompanied by dislocation of the glenohumeral joint, are more frequent and have a good outcome when treated nonoperatively.[11,13]

Treatment strategies for a scapular fracture vary. Most fractures respond well to nonoperative treatment. The criteria for surgery are mostly based on the personal experience of the surgeons and outcomes of published case series (level IV). Intervention depends on fracture site location, involvement of the other structures of the shoulder, and fracture displacement. Surgical treatment has been advised for intra-articular displacement of more than 5 mm, medial displacement of more than 10 mm, angular deformity of over 40°, or an unstable shoulder girdle including a clavicular fracture.[1,5,11,12,19]

The aim of this study was to examine the trends in the number and incidence of scapular fractures causing hospitalization in the Finnish adult population between 1998 and 2014. Special attention was paid to those undergoing plate fixation of the fracture.

Materials and methods

Our study included the entire Finnish adult population aged 20 years or older between January 1, 1998, and December 31, 2014. The size of the population, according to the Official Statistics of Finland, was 3.9 million in 1998 and 4.3 million in 2014. Study patients were obtained from an electronic database, the National Hospital Discharge Register (NHDR) of Finland, which includes all patients admitted alive to any hospital in Finland. The coverage and accuracy of the Finnish NHDR have been shown to be excellent.[6,8,15] In Finland, public health care, including surgical treatment, is equally available for all citizens.[20]

Institutional review board approval was not required for this database analysis study.

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https://doi.org/10.1016/j.jses.2019.10.111

The Finnish NHDR data set contains information on the patient's age, sex, place of residency, length of hospitalization, diagnoses, and surgical procedures performed during the hospital visit. In Finland, the *International Classification of Diseases, Tenth Revision* (ICD-10) has been in use since 1996.

The main outcome variable in this study was the number of hospitalized patients with a primary or secondary diagnosis of a scapular fracture. The ICD-10 code was S42.1 (fracture of the scapula). The secondary outcome variables were primary or secondary diagnoses of injuries to the thorax, cervical spine, and head, as well as fractures of the clavicle. The ICD-10 codes were S22.1 to S22.9 (fractures of the sternum, rib, and other bony parts of the thorax), S06.1 to S06.9 and S12.0 to S12.9 (head and neck injuries), and S27.0 to S27.9 (traumatic hemothorax and/or pneumothorax or injuries to the lung). Special attention was paid to plate fixation of the scapula (codes NBJ52 and NBJ93) because literature on scapular surgery outside of bony Bankart or glenoid rim fracture treatment is scarce.

Statistical analysis

When calculating the sex- and age-specific incidences of scapular fractures and their plating, we obtained the annual midyear populations from the Official Statistics of Finland, the statutory, computer-based population register of the country. Because the incidences were calculated using the entire adult population instead of a cohort or sample, no statistical probability estimation methods (intrinsically needed in cohort-based estimations) were used. This method was in full accordance with our previous nationwide studies.[7,14] Continuous variables between the groups were compared by the Mann-Whitney *U* test. Differences in proportions were assessed using the Fisher exact test. Mean values were compared between the groups by the analysis of variance test. Statistical analysis was performed with SPSS software (version 21.0; IBM, Armonk, NY, USA).

Results

During the study period from 1998 through 2014, altogether 3843 adult patients with scapular fractures were hospitalized in Finland. Of these, 1226 (31.9%) were women and 2617 (68.1%) were men. The mean age at the onset of injury was 56.6 years (range, 20-101 years) overall and was 51.5 years (range, 20-97 years) for male patients and 67.5 years (range, 20-101 years) for female patients. The mean age of patients operated on with a plate for the scapular fracture was 49.0 years (range, 20-85 years). Patients treated with plating were significantly younger than those treated non-operatively ($P < .001$). The age distribution remained the same for the whole study group during the study period, whereas among the male patients, the mean age increased from 50.2 to 54.7 years, a difference that was statistically significant ($P < .001$). In female patients, there was no change in mean age.

The annual number of patients with scapular fractures varied between 157 (in 2000) and 300 (in 2014). The incidence of scapular fractures requiring hospitalization in the Finnish adult population increased from 4.8 per 100,000 person-years in 1998 to 6.6 per 100,000 person-years in 2014 and is shown in Figure 1; Figure 2 shows the number of hospitalizations stratified by sex.

Altogether 476 patients (12.4%) were operated on with plating of the scapular fracture; 344 (72.3%) were men, and 132 (27.7%) were women. The annual number of plating operations did not show consistent trend changes by time, the number being 24 in both 1998 and 2010. Thereafter, it almost doubled for the years 2011 through 2013, decreasing to 27 in 2014 (Fig. 3).

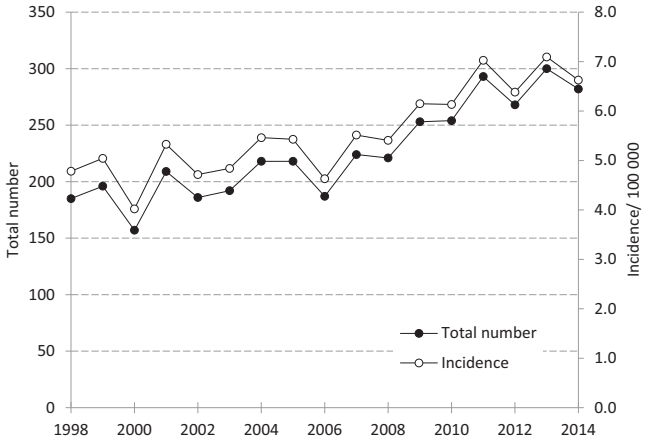

Figure 1 Number and incidence of hospitalization caused by scapular fracture in Finnish adults.

About half of the patients (2119, 55.1%) had concomitant injuries; 1265 (32.9%) were upper-quadrant injuries, and the number of concomitant injuries increased at about the same pace as the number of fracture patients in general (Fig. 4). Concomitant injuries occurred significantly more often in male patients than in female patients, at a rate of 58.8% vs. 43.3% ($P < .001$), and the mean age of these men was lower than that of women, at 51.4 years vs. 64.5 years ($P < .001$). In addition, scapular fractures were more often operated on in male patients with concomitant injuries (166, 48.3%) than in their female counterparts (44, 33.3%).

Of all scapular fracture patients, 261 (6.8%) had an accompanying head or cervical spine injury: 200 men and 61 women. A simultaneous thorax injury was found in 899 patients (23.4%), comprising 736 men and 163 women. Of these, 57 underwent operative treatment of their scapular fractures with open reduction and plating.

Simultaneous clavicular fractures were found in 633 patients (16.5%), comprising 334 men and 299 women. Of these, 107 were operated on with plating of the scapular fracture.

Discussion

The principal finding of this study was that the incidence of patients hospitalized for a scapular fracture increased by about 30%

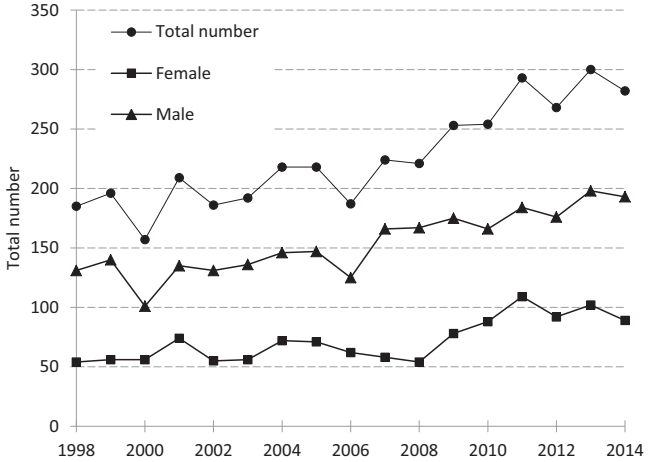

Figure 2 Number of hospitalizations stratified by sex.

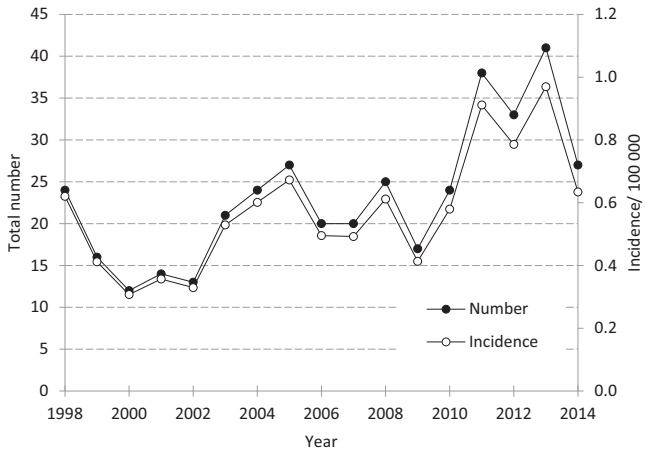

Figure 3 Number and incidence of scapular fracture operations with plating.

in Finland between 1998 and 2014. The incidence of other upper-extremity fractures, such as proximal humeral fractures, has shown a far greater increase in both men and women.[18] However, in contrast to fractures of the proximal humerus and distal radius, a scapular fracture is not a typical fall-induced fracture in an adult but mostly results from a high-energy trauma such as a motor vehicle collision. The mechanism of injury often leads to a high rate of concomitant injuries (55% in this study), especially those affecting the upper body (32% in this study).[2,9,10,16,17] In our study, the increase in the incidence of scapular fractures seemed to originate from high-energy trauma because the number of concomitant injuries increased simultaneously.

Fractures of the scapular body have long been treated non-operatively, whereas currently, recommendations to treat these fractures operatively are usual. Because of the lack of randomized controlled trials, there is still conflicting evidence regarding absolute surgical indications. In our study, we could assume that the number of plate fixation procedures for scapular fractures increased for some years after the marketing of modern anatomic locking screw plates for scapular fractures began in 2010. However, the high volume of plate fixation procedures decreased to the original level after a few years of active use.

Our results do not express whether the very recent change in scapular surgery is long-lasting or not, but we found this result most interesting because modern plating systems with the locking screw method have increased the incidence of plate fixation in many anatomic locations such as the distal radius permanently.[14] The reason for the aforementioned clear reduction in scapular plating in Finland during 2014 is a matter of debate. First, indications for surgical management are not known, and controversy persists regarding which patients are best treated surgically. Second, surgeons may have become more uncertain about the real benefits of scapular surgery because scapular fractures are very demanding to operate on with complex bony and soft-tissue anatomy requiring careful practice and preparation. Finally, the decision to offer surgery is currently based more on beliefs of benefits of fracture reduction and modern rigid fixation rather than evidence-based facts. This conceptual conflict could be one reason for the decrease in the numbers of scapular surgical procedures.

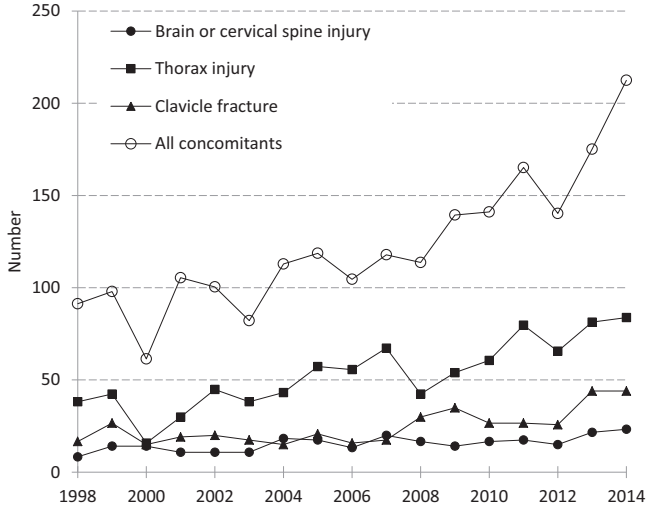

Figure 4 Number of concomitant injuries between 1998 and 2014.

The mean age of both male and female patients as well as the sex distribution in our study is in accord with the current literature.[1,3,9] Younger male patients incurred more high-injury traumas and were operated on more frequently than their female patients. The increase in mean age among men is probably a sign of a more modern society, in which older people live active lives with good economic potentiality.

Our study is the first to assess the nationwide incidence of scapular fractures resulting in hospitalization and surgery. The Finnish NHDR database has been proved to be accurate, and its coverage is excellent.[7,20] One weakness of the study is the unknown number of patients treated only at outpatient clinics, but we believe that scapular fractures are not well-known by GPs and these patients are therefore referred to hospitals. Another weakness of our study is that the exact fracture site could not be assessed from the Finnish NHDR.

Conclusion

We observed a 30% increase in the incidence of scapular fracture hospitalization in adult Finnish patients in 1998 through 2014. The mean age of the male patients also increased during the study period. The number of cases in which plate fixation was performed for the treatment of scapular fractures did not show a consistent trend change in 1998 through 2014. The only exception was a short rise between 2011 and 2013; thereafter, the annual number of plate fixation procedures returned to the original level. The number of concomitant injuries to the upper body also rose during the study period so that in 2014, about two-thirds of the scapular fracture patients had an accompanying injury.

Disclaimer

The authors, their immediate families, and any research foundations with which they are affiliated have not received any financial payments or other benefits from any commercial entity related to the subject of this article.

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