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

Antti P. Launonen, MD, PhD a,b, Minna K. Laitinen, MD, PhD a, Bakir O. Sumrein, MD a, Seppo T. Niemi, PhD b, Pekka Kannus, MD, PhD b, Ville M. Mattila, MD, PhD a

a Department of Orthopaedics, Unit of Musculoskeletal Surgery, Tampere University Hospital, Tampere, Finland
b UKK Institute for Health Promotion Research, Tampere, Finland

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.

© 2019 The Authors. Published by Elsevier Inc. on behalf of American Shoulder and Elbow Surgeons. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).
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 S270 to S279 (traumatic hemothorax and/or pneumothorax or injuries to the lung). Special attention was paid to plate fixation of the scapula (codes NB52 and NB93) 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. 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).

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%...
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.\(^2\)\(^,\)\(^9\)\(^,\)\(^10\)\(^,\)\(^16\)\(^,\)\(^17\) 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 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).\(^2\)\(^,\)\(^5\)\(^,\)\(^10\)\(^,\)\(^16\)\(^,\)\(^17\) 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.

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.

**References**

1. Ada JR, Miller ME. Scapular fractures. Analysis of 113 cases. Clin Orthop Relat Res 1991;174–80.
2. Armstrong CP, Van der Spuy J. The fractured scapula: importance and management based on a series of 62 patients. Injury 1984;15:324–9.
3. Cole PA, Freeman G, Dubin JR. Scapula fractures. Curr Rev Musculoskelet Med 2013;6:79–87. https://doi.org/10.1007/s12178-012-9151-x.
4. Court-Brown CM, Caesar B. Epidemiology of adult fractures: a review. Injury 2006;37:691–7. https://doi.org/10.1016/j.injury.2006.04.130.
5. Egol KA, Connor PM, Karunakar MA, Sims SH, Bosse MJ, Kellam JF. The floating shoulder: clinical and functional results. J Bone Joint Surg Am 2001;83-A:1189–94.
6. Huttunen TT, Kannus P, Lepola V, Pihlajamaki H, Mattila VM. Surgical treatment of clavicular fractures in Finland—a register based study between 1987 and 2010. Injury 2013;44:1899–903. https://doi.org/10.1016/j.injury.2013.09.006.

7. Huttunen TT, Kannus P, Pihlajamaki H, Mattila VM. Pertrochanteric fracture of the femur in the Finnish National Hospital Discharge Register: validity of procedural coding, external cause for injury and diagnosis. BMC Musculoskelet Disord 2014;15:98. https://doi.org/10.1186/1471-2474-15-98.

8. Huttunen TT, Kannus P, Rolf C, Fellander-Tsai L, Mattila VM. Acute Achilles tendon ruptures: incidence of injury and surgery in Sweden between 2001 and 2012. Am J Sports Med 2014;42:2419–23. https://doi.org/10.1177/0363546514540995.

9. Ideberg R, Grevsten S, Larsson S. Epidemiology of scapular fractures. Incidence and classification of 338 fractures. Acta Orthop Scand 1995;66:395–7.

10. Imatani RJ. Fractures of the scapula: a review of 53 fractures. J Trauma 1975;15:473–8.

11. Königshausen M, Coulibaly MO, Nicolas V, Schildhauer TA, Seybold D. Results of non-operative treatment of fractures of the glenoid fossa. Bone Joint J 2016;98-B:1074–9. https://doi.org/10.1302/0301-620X.98B8.35687.

12. Leung KS, Lam TP, Poon KM. Operative treatment of displaced intra-articular glenoid fractures. Injury 1993;24:324–8.

13. Maqueira GJ, Espinosa N, Gerber C, Eid K. Non-operative treatment of large anterior glenoid rim fractures after traumatic anterior dislocation of the shoulder. J Bone Joint Surg Br 2007;89:1347–51. https://doi.org/10.1302/0301-620X.89B10.19273.

14. Mattila VM, Huttunen TT, Sillanpaa P, Niemi S, Pihlajamaki H, Kannus P. Significant change in the surgical treatment of distal radius fractures: a nationwide study between 1988 and 2008 in Finland. J Trauma 2011;71:939–42. https://doi.org/10.1097/TA.0b013e3182231af9. discussion 942-933.

15. Mattila VM, Silvonen R, Palonena J, Fellander-Tsai L. Changes in rates of arthroscopy due to degenerative knee disease and traumatic meniscal tears in Finland and Sweden. Acta Orthop 2016;87:5–11. https://doi.org/10.3109/17453674.2015.1066209.

16. McGahan JP, Rab GT, Dublin A. Fractures of the scapula. J Trauma 1980;20:880–3.

17. McGinnis M, Denton JR. Fractures of the scapula: a retrospective study of 40 fractured scapulae. J Trauma 1989;29:1488–93.

18. Palvanen M, Kannus P, Niemi S, Parkkari J. Update in the epidemiology of proximal humeral fractures. Clin Orthop Relat Res 2006;442:87–92. https://doi.org/10.1097/01.blo.0000194672.79634.78.

19. Rikli D, Regazzoni P, Renner N. The unstable shoulder girdle: early functional treatment utilizing open reduction and internal fixation. J Orthop Trauma 1995;9:93–7.

20. Sund R. Quality of the Finnish Hospital Discharge Register: a systematic review. Scand J Public Health 2012;40:505–15. https://doi.org/10.1177/14034981245637.

21. Zlowodzki M, Bhandari M, Zelle BA, Kregor PJ, Cole PA. Treatment of scapula fractures: systematic review of 520 fractures in 22 case series. J Orthop Trauma 2006;20:230–3. https://doi.org/10.1097/00005131-200603000-00013.