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Tibial shaft fractures in Finland between 1997 and 2014

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ABSTRACT

Introduction: Tibial shaft fracture is common, accounting for 2% of all adult fractures. Large epidemiological follow ups are lacking and previous studies have shown great variation in incidence rates and trends. The aim of this population-based nationwide study was to analyze all tibial shaft fractures in Finland in 1997–2014 and to provide an update on current epidemiological data.
Patients and methods: Patient data was collected from the Finnish National Hospital Discharge Register (NHDR) from 1997 to 2014. The study covered the entire adult (18 years and older) population. The primary outcome was the annual number of hospitalization due to a fresh tibial shaft fracture.
Results: A total of 14,150 patients with a fresh tibial shaft fracture were identified during the 18-year study period. The total fracture incidence decreased from 27.3 per 100,000 person-years in 1997 to 13.5 per 100,000 person-years in 2014. In men, the incidence was 34.9 in 1997 vs. 15.6 in 2014, while in women the corresponding numbers were 20.2 in 1997 vs. 11.5 in 2014.
Conclusions: The incidence of tibial shaft fractures has markedly decreased in Finland between 1997 and 2014, mainly because of a declining trend in the incidence of fall-induced low-energy fractures. Reasons for this development are uncertain and therefore more comprehensive population-based epidemiological studies are needed to reveal the factual reasons behind the decrease.

Introduction

A fracture of the tibial shaft accounts for approximately 2% of all adult fractures [1]. Yet, rather few epidemiological studies have been made concerning the incidence and mechanism of this injury. Most of the previous epidemiological studies have been case series from single hospitals or cohorts from smaller geographically defined areas and not based on entire population [1–8]. Prior to this study only Weiss et al. [7] have conducted a population-based epidemiological study on tibial shaft fractures in 1998–2004 thus indicating a clear need for up-to-date information.

Previous studies have showed a great variation in the overall incidence of tibial shaft fracture, the incidence varying from 14 per 100,000 person-years to 27 per 100,000 person-years. This variation can be explained by different study designs, cultural differences in the populations at risk and by different time periods [1–6]. Recent studies have also reported decreasing incidence rates of tibial shaft fractures [4,7,8], a phenomenon not fully explained.

Traditionally, the most typical cause of a tibial shaft fracture, especially in men, has been a major trauma, such as a traffic collision or a high-energy fall [1,7–9]. Some authors have hypothesized that the decreased incidence rates may partly be due to improved road safety, leading to reduction of tibial fractures especially in young men [4]. In general, it seems that fracture distribution has shifted from younger men towards elderly women [2,3].

To our knowledge, there are no national epidemiological studies concerning adults' tibial shaft fractures. Therefore, the aim of the current nationwide study was to analyze all tibial shaft

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fractures in Finland in 1997–2014 and to provide an update on current epidemiological data.

Patients and methods

Patient data was collected from the Finnish National Hospital Discharge Register (NHDR) between 1st of January 1997 and 31st of December 2014. Only patients 18 years of age or older were included. The Finnish NHDR, founded in 1967, provides an excellent injury database including variables such as age, sex, domicile of the subject, duration of hospital stay, external cause of injury, primary and secondary diagnoses, procedures performed during the hospital stay and trauma mechanism. The data collected by the Finnish NHDR is obligatory for all health care institutions, both public and private. The NHDR has excellent validity regarding both coverage and accuracy of the database, especially in orthopaedic traumas, but it does not provide comprehensive data on patients' co-morbities [10–14].

The main outcome variable for this study was the number of annual hospitalizations due to a fresh tibial shaft fracture. A patient was selected in the study if any of the diagnosis codes (primary or secondary) was a tibial shaft fracture (The International Classification of Diseases-10 code, ICD-10, S82.2). Only the first hospitalization was counted. To compute the incidence rates of tibial shaft fractures, the annual mid-population of Finland was obtained from the Official Statistics of Finland, a statutory electronic population register of the country.

The incidence rates of tibial shaft fractures (per 100,000 persons) were based on entire adult population of Finland (persons 18 years of age or older) rather than cohort or sample-based estimates, and thus, 95% confidence intervals or other statistical estimation methods were not calculated. Injury mechanisms codes related to patients' fractures were analyzed according to the ICD-10 external cause for injury codes and grouped into eight categories: fall on the same level, fall from height, fall from stairs, unspecified fall, traffic accidents, accident with mechanical device, other injury and unknown cause. Due to change in ICD-coding from ICD-9 to ICD-10 in 1997, external causes were underreported in 1997 to 1999 and thus these years were excluded when reporting injury mechanism. Currently it is mandatory to document external codes for all injuries. Statistical analysis was performed using IBM SPSS Statistics 23.0.

Results

A total of 23,459 hospitalizations with a diagnosis of tibial shaft fracture were registered in the Finnish NHDR during the 18-year study period. The total number of hospitalized patients with a fresh fracture was 14,150. There were 8109 (57.3%) men and 6041 (42.7%) women. The mean age (SD) at the time of hospitalization was 48 (18) years. During the study period patient's mean age increased from 46 years to 51 years. Men (mean age 44 (SD 16) years) were younger than women (mean age 56 (SD 18) years). The mean age in men increased from 42 years in 1997 to 46 years in 2014, and in women from 54 years in 1997 to 58 years in 2014. The age distribution curve of the study population is shown in Fig. 1.

The mean length of hospitalization was 8.5 days (SD 17.6, range 1–585). The mean length of hospital stay decreased from 10.2 days (SD 28.7, range 1–428) in 1997 to 7.3 days (SD 11.7, range 1–113) in 2014. Women (SD 9.9 days, range 1–585) were hospitalized for a longer time than men (SD 7.4 days, range 1–239). The mean hospital stay was shorter with patients treated operatively than those treated conservatively.

The incidence of hospitalizations due to a fresh tibial shaft fracture decreased from 27.3 per 100,000 person-years in 1997 to 13.5 per 100,000 person-years in 2014. The incidence decreased in both men and women. In men, the incidence was 34.9 per 100,000 person-years in 1997 and 15.6 per 100,000 person-years in 2014. The corresponding numbers for women were 20.2 per 100,000 person-years in 1997 and 11.5 per 100,000 person-years in 2014 (Fig. 2).

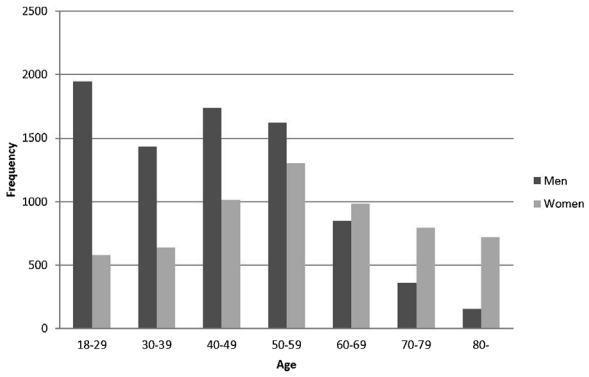

Fig. 1. Age distribution of hospitalized male and female patients with a tibial shaft fracture.

The highest incidence figures (26.7 per 100,000 person-years) were observed in men between 18–29-years of age. It was notable that the incidence in men was rather stable between 18 and 59 years and thereafter decreased towards the older age groups (12.4 per 100,000 person-years in men aged 70–79). In contrast, the incidence in women increased with age and reached the peak (26.5 per 100,000 person-years) after the 80 years of age while the lowest figures were seen in women aged 18–29 (8.4 per 100,000 person-years) (Fig. 3)

Between 2000 and 2014 the most common injury mechanism leading to a tibial shaft fracture was, in both men and women, a low-energy fall on the same level, accounting for 50% of all injuries (Fig. 4). In women a simple fall was more often the cause on the injury than in men (61% vs. 41%).

Traffic accident was the second most common injury mechanism in the study period, accounting for 15% of all injuries (Fig. 4). Contrary to low energy injuries, traffic accidents were more often the injury mechanism for men than for women. This was especially seen in the younger age group of men (18–29 years-olds) who showed the highest frequency in traffic accidents among all age groups. In this age group, 79% of all traffic accidents occurred in men. Further, young men (18–29 years-olds) were the only age group who primarily injured by traffic accidents. This was contrary to all the other age groups who were primarily injured by the fall on the same level. The highest number of low-energy trauma (fall on the same level) leading to tibial shaft fracture was seen between ages 40–60 years.

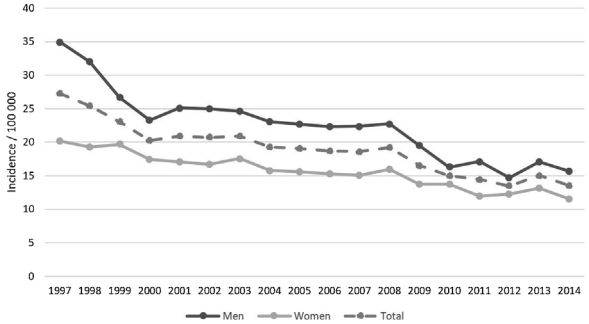

Fig. 2. The incidence of hospitalizations by gender due to fresh tibial shaft fracture in Finnish adults (per 100,000 person-years) between 1997 and 2014.

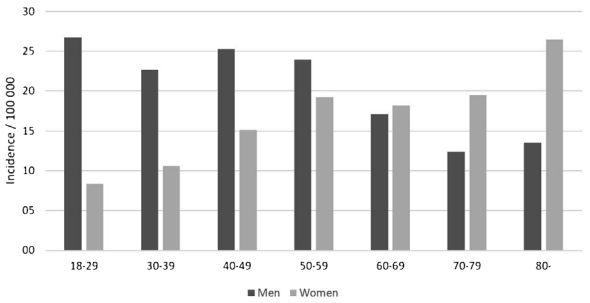

Fig. 3. The incidence of hospitalizations due to a fresh tibial shaft fracture stratified by age groups in adult Finnish men and women during 1997–2014.

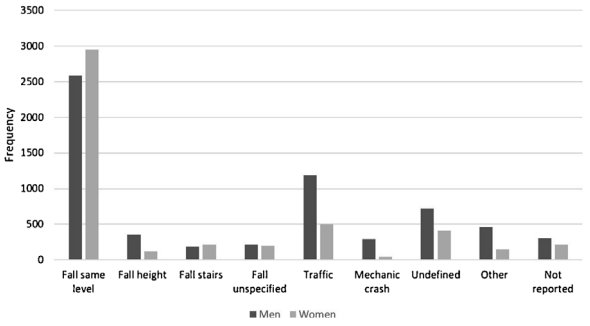

Fig. 4. Frequency of different injury mechanisms in tibial shaft fractures in adult Finnish men and women in.2000–2014.

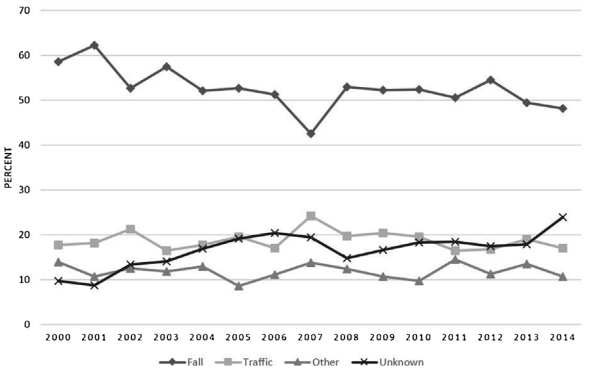

Fig. 5. The proportional injury mechanisms in tibial shaft fractures in adult Finnish men between 2000 and 2014.

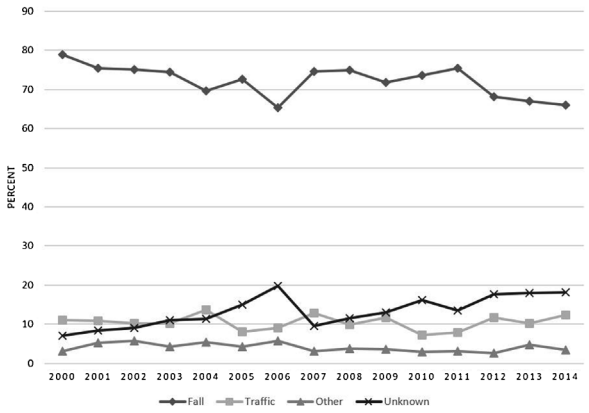

Fig. 6. The proportional injury mechanisms in tibial shaft fractures in adult Finnish women between 2000 and 2014.

Fig. 7. Incidence of falls on the same level resulting in a tibial shaft fracture in adult Finnish men and women in.2000–2014.

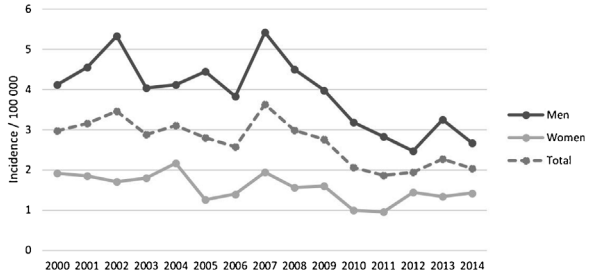

Fig. 8. Incidence of traffic accidents resulting in a tibial shaft fracture in adult Finnish men and women in.2000–2014.

During the study period the overall proportion of traffic accidents and the proportion of falls on the same level as the cause for a fresh tibial shaft fracture remained quite constant both in men and women (Figs. 5 and 6). At the same time, however, the incidence of falls on the same level resulting in a tibial shaft fracture decreased in both men and women (Fig. 7). In men, the incidence was 11.0 per 100,000 person-years in 2000 and 5.9 per 100,000 person-years in 2014. The corresponding numbers for women were 11,7 per 100,000 person-years in 2000 and 6.4 per 100,000 person-years in 2014. Also, the incidence of traffic accident as a cause for tibial shaft fracture decreased between 2000 and 2014 (Fig. 8). This decreasing trend was more obvious in men than in women. In men, the incidence was 4.1 per 100,000 person-years in 2000 and 2.7 per 100,000 person-years in 2014. In women, the incidence decreased from 1.9 to 1.4 per 100,000 person-years between 2000 and 2014.

Discussion

In our nationwide study, we analyzed incidence trends of hospitalization due to a fresh tibial shaft fractures in the entire Finnish adult population. The main finding was that the incidence rate of hospitalization due to tibial shaft fractures decreased markedly in Finland during the 18-year study period (from 27.3 to 13.5 per 100,000 person-years). This continuous steady decrease was seen in both men and women and throughout the age groups. The incidence rate decreased in men from 34.9 to 15.6 per 100,000 person-years and in women from 20.2 to 11.5 per 100,000 person-years between 1997 and

2014. The decrease could be explained by the decreased incidence of fractures caused by falls on the same level, and, partly due to decreased incidence of traffic accidents (Figs. 7 and 8).

A previous large study conducted in Sweden [7] reported a similar decreasing incidence rate from 18.7 per 100,000 person-years in 1998 to 16.1 per 100,000 person-years in 2004. Much earlier studies [3,4] made in Sweden comparing 3- to 5-year period from different decades found no changes in tibial shaft fracture incidences. Nevertheless, in both studies the incidence of tibial shaft fracture was higher than that in our study. In fact, earlier studies have demonstrated a great variation on tibial shaft fracture incidence. Court-Brown et al. [1] reported an incidence of 21.5 per 100,000 person-years, Larsen et al. [8] correspondingly 16.9 per 100,000 person-years and Donaldson et al. [6] the lowest total incidence rate, 4.1 per 100,000 person-years. Such differences in the incidence rates could be due to different study designs, a variation in the size of the study populations, cultural and regional differences, and different time periods.

Weiss et al. [7] and Larsen et al. [8] reported the lowest tibial shaft fracture incidence rates in females between 20 and 29 years of age (6.0 per 100,000 person-years) and in males over 80 years of age (12.4 per 100,000 person-years). This is in accordance with our study. The highest incidence (39.4 and 43.5 per 100,000 person-years) in men was seen in both of these previous studies between 10 and 19 years of age. Such a high incidence rate could be due to a fact that children were included in those studies and they are more prone to tibial shaft fractures than adults. We, in contrast, found the highest incidence rate in men aged 18–29 years (26.7 per 100,000 person-years) while children were excluded.

Larsen et al. [8] and Grutter et al. [15,16] reported the highest incidence rates (21.3 per 100,000 person-years) and frequencies in women in the age group between 20 and 40 years. This is in contrast to our and Weiss et al. [7] studies which showed a steady increase in female incidence rates from younger age groups towards older groups reaching a peak value in women over 80 years of age. In our study, women had a highest number of tibial shaft fractures in the age between 50 and 59. Main proportion of these fractures were a result of a fall on the same level (61%).

According to our present study the leading cause for tibial shaft fracture was fall on the same level (50%). This was more evident for women than for men (61% vs 41%). Between 2000 and 2014 the incidence of falls on the same level as a cause for tibial shaft fracture decreased in both men and women. When this external injury cause (fall on the same level) was analyzed between age groups, the major decrease was especially seen in women from 50 to 79 years of age. The steepest decrease was seen in the age group between 50 and 59 years, from 17.7 to 5.9 per 100,000 person-years during study period. The biggest decrease in men's incidence (fall on the same level) was from 14.4 to 5.4 per 100,000 person-years, also in the age group between 50 and 59 years of age. Contrary to women, there were two age groups of men (60–69 years-olds and 80–89 years-old), in which incidence of falls on the same level increased during study period, but only minimally, from 10.5 to 11.3 per 100,000 person-years in the first group and from 4.2 to 6.5 per 100,000 person-years in the latter group. The highest incidence of fractures caused by falls on the same level was in women over 80 years of age. This incidence remained high throughout the study period and it was 19.7 per 100,000 person-years in 2000 and 17.5 per 100,000 person-years in 2014. In this age group 69% of tibial shaft fractures were due to fall on the same level and this proportion rose during study period.

Based on our present results most of the tibial shaft fracture patients are 40 to 60 years old. In these groups the incidence of falls on the same level resulting in tibial shaft fracture has markedly decreased during last two decades making overall tibial shaft fracture incidence to decrease. The same kind of decreasing trend has previously seen in hip fractures in Finland [17]. Previous studies [18–20] have shown that in the elderly people average functional ability, muscle strength, balance and coordination has improved in recent decades and this could reduce the risk of falling and fractures. However, in our study the incidence of fall-induced tibial shaft fracture did not markedly changed in women 80 years of age and older, and in same-aged men the incidence even increased from 4.2 to 6.5 per 100,000 person-years. This is in contrast to elderly persons' hip fractures which have, according to Clement et al. [21] and Connelly et al. [22], same kind of features and patient profiles than elderly persons' tibial shaft fractures.

Traffic accident as a cause for a tibial shaft fractures remained quite constant during our study period and it accounted for 10% – 20% of external causes of tibial shaft fractures. Between 2000 and 2014 the overall incidence of traffic accident resulting in a tibial shaft fracture decreased only minimally, from 2.9 to 2.0 per 100,000 person-years (Fig. 8). There were no marked changes even when analyzed by age groups. This was in accordance with the previous study of Weiss et al. [7] in Sweden. Regardless of improved road and car safety in recent years, it seems that the number of hospitalization due to traffic-induced tibial shaft fracture has remained quite constant.

Our study corroborates previous reports that the incidence rate of tibial shaft fractures has decreased during recent decades in all age groups. Also, it seems that the patient profile of a tibial shaft fracture is continuously changing towards more fragile and elderly persons instead of young and high-energy trauma patients.

A strength of our study is the excellent national coverage of hospitalized fresh tibial shaft fractures; all adults' tibial shaft fractures in Finland between 1997–2014 were included in this study. In fact, we had thus far the largest number of tibial shaft fractures analyzed. A clear strength was also that previous studies have reported the coverage and accuracy of the Finnish NHDR injury and diagnosis codes to be over 90% [10–14].

A weakness of this study is that the exact incidence rate of tibial shaft fractures cannot be assessed using NHDR data alone because some of the fractures could be treated on outpatient basis only. The actual incidence rate could therefore be higher than we reported. On the other hand, in Finland the treatment protocol of tibial shaft fractures very rarely succeeds without at least a short hospitalization period, since all these patients, whether operated on or not, require adequate pain management, assessment of compartment syndrome, and physical therapy. Another weakness of our study was that the NHDR is a hospital discharge register lacking information from co-morbidities and other risk factors for fractures - an obvious limitation associated with all register-based studies.

Conclusions

This study demonstrated a markedly decreasing incidence rate of tibial shaft fractures in Finnish adults during 1997–2014. The main reason for this phenomenon appeared to be the declining trend in fractures caused by falls on the same level. Reasons for this development are uncertain, but it could be that an average functional ability of older people in Finland may have improved in recent years and there may have been positive changes in some external risk factors of falling (polypharmacy, alcohol consumption, living arrangements) that could lower the fracture risk [23]. Also since the majority of tibial fractures are caused by fall on the same level, changes in recreational training, sports activity and sport injury prevention may play a role [24–26]. More comprehensive epidemiological population-based studies are needed to better understand the secular trends of a tibial shaft fracture.

Conflict of interest statement

Each author certifies that he or she has no commercial associations (eg, consultancies, stock ownership, equity interest, patent/licensing arrangements, etc) that might pose a conflict of interest in connection with the submitted article.

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