Single-centre study of hip fractures in Prague, Czech Republic, 1997–2007

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Abstract This study examines the epidemiological data of patients with hip fractures from 1997–2007. Adult patients treated for hip fracture between the years 1997–2007 were included in the study. Retrospective statistical assessment of continually gathered data focussed on epidemiology and demographics. The study involved 3,683 patients (2,678 women and 1,005 men). Patients older than 70 years accounted for 82% of all cases. There were 2.7 times more women; in patients younger than 60 years men significantly outnumbered women ($p < 0.001$). The mean patient age was 77.9 years ($SD \pm 12.6$; women, 80.3 years; men, 71.5 years). There was a slight increase in the average age in both sexes. Trochanteric fractures accounted for 54.7% and femoral

neck fractures accounted for 45.3% of fractures. The ratio of men to women was the same in femoral neck (AO-31B) and trochanteric (AO-31A) fractures. The average year-to-year increase in the number of fractures was 5.9%. For femoral neck fractures (AO-31B), there was a statistically insignificant increase in the number of fractures ($p = 0.63$); for intertrochanteric fractures (AO-31A3) there was a statistically insignificant decrease ($p = 0.65$). There was an increase in the number of hip fractures resulting in a significant increase in pertrochanteric fractures (AO-31A1+2) ($p < 0.001$). The ratio of trochanteric to neck fractures increased from 0.99 to 1.53. Continual monitoring of patients with hip fracture offers data which allows comparisons between regions and countries. There has been a continual increase in the number of patients with hip fractures.

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Introduction

Hip fractures are the cause of up to 30% of all hospital admissions for fracture [1]. Their incidence is influenced by the complex morphological and biomechanical characteristics of bones [2, 3].

The increase in the number of proximal femur fractures in developed countries is caused by an increase in the life expectancy and an increasing incidence of postmenopausal and senile osteoporosis [4–6]. In the over-50 population, the incidence of proximal femur fractures has risen exponentially and some authors warn that in the future it may develop an epidemic-like character [4, 6, 7].

Most single-centre studies are short and include a relatively small number of fractures [8–10]. Multicentre studies often involve more than a thousand patients with hip fractures [7, 11–16], but they concentrate only on

Fig. 1 Femoral neck fractures (AO-31B). **a** Intracapsular neck fracture. **b** Extracapsular neck fracture

specific data. The aim of our study was to gather basic demographic and epidemiological data from one specific area over a period of 11 years, as well as follow-up data.

Materials and methods

Adult patients treated for hip fracture from January 1997 through to the end of December 2007 at the Department of

Fig. 2 Trochanteric fractures (AO-31A). **a** Pertrochanteric fracture. **b** Intertrochanteric fracture

Fig. 3 Yearly average increase of hip fracture, 1998–2007. $p=0.042$, $R^2=0.36$, yearly average increase $5.9\pm2.7\%$. Statistical regression analysis was used

Orthopaedics and Traumatology in Prague, Czech Republic, were included in the study. Patients younger than 18 years and patients with pathological, metastatic fractures were excluded.

The aim of this study was to compare the development of epidemiological data from one department and one region. Patients included in the study were from an older urban area of Prague and the area has been precisely defined demographically. In this part of the city, men over 65 account for 6.2% of the inhabitants and women over 65 account for 10.1%. We did a retrospective assessment of continuously gathered data during the course of hospital treatment. The data included information on gender, age, type of fracture, type of treatment, mobility before injury, social background, mobility on discharge from hospital, type of discharge from hospital, and the number of deaths during primary hospital care. This study presents the results of the demographic and epidemiological data from this period of observation.

Terminology associated with proximal femur fractures is often inaccurate and confusing or misleading. For clarity we have used the AO/OTA classification system. The study

Table 1 Hip fractures in 1997–2007, basic characteristics of the set

Gender	N	%	Age (years)				
			Mean	SD	Q25	Median	Q75
Female	2,678	72.7	80.3	9.8	16.0	82.0	87.0
Male	1,005	27.3	71.5	16.5	61.0	76.0	83.0
Overall	3,683	100	77.9	12.6	73.0	81.0	86.0

SD standard deviation

Q25, Q75: 25th and 75th percentiles

Table 2 Male/female ratio (M/F) and yearly mean age, 1997–2007

Characteristic	Year										
	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
N	248	330	338	283	330	360	348	342	365	398	341
Male/female (%)	24/76	29/71	27/73	27/73	27/73	27/73	25/75	28/72	27/73	31/69	27/73
Mean age (years)	77.1	76.9	76.4	78.1	78.4	78.0	79.5	77.2	78.8	78.3	77.6

evaluated two basic groups of fractures: (1) femoral neck fractures (AO-31B) and (2) trochanteric fractures (AO-31A). With regard to femoral neck fractures, the study distinguished between intracapsular and extracapsular fractures (Fig. 1). Trochanteric fractures were subdivided into pertrochanteric fractures (AO-31A1+2) and intertrochanteric fractures (AO-31A3) (Fig. 2). Each patient received a questionnaire to obtain relevant demographic and social information. Fractures were classified by three of the authors based on initial X-ray documentation and the operative and postoperative images. Standard imagery involved X-rays using an anteroposterior (AP) view, axial views were used only in undisplaced fractures; in situations where standard imaging was inconclusive, magnetic resonance imaging was done [17].

The Wilcoxon and Kruskal-Wallis tests were used to analyse the results of this study, followed by an ANOVA and chi-square test. The average year-to-year increase in the number of fractures was calculated using statistical regression analysis. Significance was set at $p \leq 0.05$.

Results

Number of fractures

The study group consisted of 3,683 patients (2,678 women, 1,005 men). The increase in the number of fractures over the 11-year period was significant ($p=0.042$). According to statistical regression analysis, between 1998 and 2007 there was a yearly average increase of 5.9% (Fig. 3).

Age and gender

Detailed information is depicted in Tables 1 and 2. The age range of patients was between 18 and 102 years. The average age was 77.9 years with a yearly average range of 76.6–79.5 years. Patients older than 70 years accounted for 82% of the entire set, most patients were in their seventies and eighties (72%) (Fig. 4). The average age of women in the study was 80.3 years and 71.5 years for men. Over the 11-year period there was only a minor increase in the average ages of males and females; however, the increase

was only statistically significant in females ($p<0.05$) (Fig. 5). Men were statistically much younger ($p<0.001$) (Fig. 6). Overall, there were 2.7 times more females in the study than males (females=73%: males=27%) and the ratio remained constant over the duration of the 11-year study. However, among younger patients, less than 60 years old, men significantly outnumbered women ($p<0.001$) and the ratio was converse and reached 0.48. A quarter of the males (24.8%) suffered fractures while less than 60 years of age, while this figure was only 4.4% for females (Fig. 7).

Types of fracture

Statistics

Femoral neck fractures (AO-31B) appeared in 45.3% of patients and trochanteric fractures (AO-31A) appeared in 54.7% of patients. Among neck fractures, intracapsular was more common (92%) than extracapsular (8%); and among trochanteric fractures, pertrochanteric was more common (88%) than intertrochanteric (12%).

The increase in the number of neck fractures was not significant ($p=0.63$), while the increase in the number of trochanteric fractures increased significantly ($p=0.001$).

Fig. 4 Age histogram of hip fractures, 1997–2007. Patients older than 70 years accounted for 82% of the entire set of patients, the largest group consisted of patients in their seventies and eighties (72%)

Fig. 5 Evolution of the average age of patients (males and females) with hip fracture between 1997 and 2007. Only women demonstrated statistically significant change in average age (statistical regression analysis)

This shows a major shift in the representation of the two types of fractures, as can be seen in Table 3. Over the study period (1997–2007) the ratio of trochanteric to neck fractures increased from 0.99 to 1.53.

Extracapsular neck fractures accounted for only 3.4% of all fractures. For trochanteric fractures, the study found a statistically insignificant decrease in the number of intertrochanteric fractures (AO-31A3) ($p=0.65$); however, surprisingly, there was a significant increase in pertrochanteric fractures (AO-31A1+2) ($p<0.001$) (Fig. 8).

Age

The details concerning age are depicted in Table 4. The average age of patients with femoral neck fractures (AO-31B) was 77.7 years and tended to be slightly younger than

Fig. 6 Age incidence of hip fractures, 1997–2007, and distribution as a function of gender

patients with trochanteric fractures (AO-31A) (78.1 years). Age differences based on subgroups were also interesting. With regard to patients with fractures of the femoral neck, there was only a slight difference (0.9 years) between the age of patients with intracapsular (77.8 years) and extracapsular (76.9 years) fractures. Patients with pertrochanteric fractures (79.1 years) were 8.3 years older than patients with intertrochanteric fractures (70.8 years) and this difference was highly significant ($p<0.001$).

Gender

Different average ages of men and women did not affect the representation in neck and trochanteric fractures. Trochanteric fractures were, by far, the most common hip fractures in both genders, accounting for 55.7% in men and 54.4% in women.

Femoral neck fractures followed the same pattern as trochanteric fractures with regard to the ratio of men to women in the study. The pattern was particularly evident in the two dominant subgroups, i.e. intracapsular neck (74% females) and pertrochanteric fractures (73% females). For minor fractures, i.e. extracapsular neck and intertrochanteric fractures, women accounted for 65% and 64% of fractures, respectively.

Discussion

Our study is unique in that it allows a comparison of trends over a period of 11 years and within one urban region with a sizeable older population. Most large studies involving thousands of fractures are either multicentre [7, 11, 12, 14–16, 18] or retrospective studies

Fig. 7 Male/female ratio by age (in decades) of the study population. At ages less than 60 years, males with hip fractures (68%) outnumbered females ($p<0.001$)

Table 3 The number of femoral neck and trochanteric fractures in 1997–2007

Type of fracture	Year										
	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
N	248	330	338	283	330	360	348	342	365	398	341
Neck fx, n (%)	117 (46.4)	166 (50.3)	171 (50.6)	129 (45.6)	163 (49.4)	168 (46.7)	150 (43.1)	143 (41.9)	153 (41.9)	176 (44.2)	135 (39.6)
Trochanteric fx, n (%)	135 (53.6)	164 (49.7)	167 (49.4)	154 (54.4)	167 (50.6)	192 (53.3)	198 (56.9)	199 (58.1)	212 (58.1)	222 (55.8)	206 (60.4)

fx fracture

[7–9, 14–16, 18]. Many of these large studies fail to gather meaningful demographic and social information. While national registries can provide an abundance of information, registries may be burdened with inaccuracies associated with data input [13].

Generally, the time frame for most of these studies is much shorter [15, 16, 19, 20, 21]. The group of patients in this study is one of the largest dealing with proximal femur fractures and treatment in one department [8, 22–28]. The significance and concern over the increasing number of hip fractures, in patients managed in our department, matches the observations and concerns of other authors [7, 8, 23, 29]. Lešič et al. showed a significant increase in hip fractures, for both sexes, in patients over 50 years [7]. The rise in the number of fractures in our study was 5.9%. The step increase reported in the number of fractures between 1997 and 1998 was due to an increase in the catchment area of the hospital, and therefore the yearly increase was calculated starting in 1998.

Very similar findings came from de Deuxchaisnes et al. [30], who reported an increase of 5.6%. Fin et al. on

the other hand did not find a statistically significant increase in fractures [31]. However, this is probably related to the fact that longevity in Scandinavia has been in a plateau phase for many years, whereas longevity is still increasing in the Czech Republic. However, it is clear that, in general, the number of fractures is increasing exponentially with age [19, 21, 32, 33]. According to the Czech Statistical Office, the average age of citizens in the Czech Republic has increased from 40.6 in 1997 to 41.7 years in 2007. Life expectancy during the years of the study (1997–2007) increased for males by 3.2 years (70.5 vs. 73.7) and for women by 2.2 years (77.5 vs. 79.9).

The progressive increase in life expectancy is why we believe that the threat of an epidemic of hip fractures represents a real risk in the not so distant future.

The average age of the entire set of patients was virtually unchanged, reflecting an aging population, and was comparable with other studies [7, 13, 19, 34, 35]. Part of the European population, i.e. northern and more advanced states, have higher average ages of hip fractures. A slight increase in the age of both sexes was observed, but a demonstrated statistical significance was only found in women, which is in line with the finding of Caniggia et al. [23]. Aging therefore only increases the number of fractures rather than the average age of hip fractures. Men were significantly younger than women. The lower age of men has also been reported in other studies [8, 15, 19, 22, 36].

Many authors report prevalence of women over men [7, 13, 19, 20, 22, 29, 32, 34, 36–38], which we noted as well. However, we also noted the prevalence of men in patients younger than 60 years, as have other authors [8, 19, 39]. There are two reasons: (1) younger patients are more often injured as a result of accidents, e.g. traffic, sports and work accidents, involving high-energy trauma, and (2) men naturally die younger and therefore make a smaller contribution to age-related fractures. The age of 60 is the watershed between the two different groups of fractures: high-energy and osteoporotic fractures.

Fig. 8 Year-to-year progress in different types of fractures. Statistical regression analysis demonstrating an increase in the number of ptertrochanteric fractures (AO-31A1+2)

Table 4 Types of hip fracture

Fracture type	N	%	Age (years)				
			Mean	SD	Q25	Median	Q75
Neck fx	1,667	45.3	77.7	11.6	73.0	80.0	85.0
Intracapsular	1,540	41.8	77.8	11.3	73.0	80.0	85.0
Extracapsular	127	3.4	76.9	3.4	14.1	72.0	80.0
Trochanteric fx	2,016	54.7	78.1	13.5	74.0	81.0	87.0
Pertrochanteric	1,773	48.1	79.1	12.1	75.0	81.0	87.0
Intertrochanteric	243	6.6	70.8	19.3	62.0	77.0	85.0
Overall	3,683	100	77.9	12.6	73.0	81.0	86.0

fx fracture, SD standard deviation

Q25, Q75: 25th and 75th percentiles

The ratio of femoral neck to trochanteric fractures in our group of patients can be compared with other studies [26, 32, 35, 39–42]. Most authors compare only the average age relative to fractures of the neck and trochanteric fractures [4, 7, 43]. An interesting result of our study is the statistical importance of the difference between the age of patients with pertrochanteric fractures (AO-31A1+2) and patients with intertrochanteric fractures (AO-31A3). We confirmed that a significant increase in the number of hip fractures were trochanteric fractures. Comparable findings have been reported by de Deuxchaisnes et al. [30], who, also over an 11-year monitoring period (1971–1982), found an increasing prevalence of trochanteric fractures. We also found that the increase in trochanteric fractures (AO-31A) came only from pertrochanteric fractures (AO-31A1+2). Intertrochanteric fractures (AO-31A3) are associated with younger patients, but with the increasing age of the population pertrochanteric fractures are becoming more frequent. Such refinement of the cause of the increase in hip fractures has not yet been published. It is linked to skeletal osteoporosis, because the older the patient with a pertrochanteric fracture, the more unstable the fracture [44]. Walloe et al. [21] found that unstable trochanteric fractures were not only associated with older patients, but the reduction of cortical bone trabecula, which occurs with aging, creates a predisposition toward hip fractures [45]. The change in the representation of fractures toward trochanteric fractures has been confirmed by Finsen et al. [31] who noticed that in the 1970s trochanteric fractures accounted for 32% while in the 1990s trochanteric fractures accounted for 68% of all hip fractures. Hanson et al. [46] also confirmed an increase in trochanteric fractures, but only in women. Women generally live longer and therefore have a higher risk of hip fracture; this is reflected in the prevalence of numbers over men.

In summary, continuous tracking of hip fracture data from a single region enables a comparison of the acquired data with other regions. Continuous monitoring also offers a source of information needed for a detailed examination

of specific problems relative to specific subgroups of patients with proximal femur fractures.

The assessment of epidemiological and demographic data of patients with proximal femur fractures, collected over the past 11 years, enables us to state the following:

1. There has been a continuous increase in the number of patients with hip fractures.
2. Generally, hip fractures are more common among women and their average age at time of fracture was much higher than that of men.
3. With regard to hip fractures in people less than 60 years old, men significantly outnumbered women.
4. Trochanteric fractures were much more common than femur neck fractures.
5. The increase in the number of hip fractures involved only pertrochanteric fractures.
6. Patients with intertrochanteric fractures tended to be significantly younger than patients with pertrochanteric fractures or fractures of the neck of the femur.

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