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Original article

Incidence and Risk Factors for Bilateral Proximal Femoral Fractures

Adrien **Van Haecke**^{a,b}, Anthony **Viste**^{a,b*}, Romain **Desmarchelier**^a, Pascal **Roy**^{b,c},
Marcelle **Mercier**^a, Michel-Henri **Fessy**^{a,b}

a Hospices Civils de Lyon, Hôpital Lyon Sud, Service de Chirurgie Orthopédique et Traumatologique, 165 Chemin du Grand Revoyet, Pierre Bénite Cedex, France

b Université de Lyon, Université Claude Bernard Lyon 1, Université Gustave Eiffel, IFSTTAR, LBMC UMRT_9406, Lyon, France

c CNRS UMR 5558, Laboratoire de Biométrie et Biologie Évolutive, Équipe Biostatistique-Santé, Villeurbanne, France

***Corresponding author:** Dr Viste Anthony,

CHU Lyon Sud, 165 Chemin du Grand Revoyet, 69495 Pierre Bénite Cedex, France

E-mail: anthony.viste@chu-lyon.fr,

Tel.: +33 478 863 738

Fax: +33 478 865 934

ABSTRACT

Background:

Proximal femoral fractures (PFFs) are a public health issue due to their high frequency. The frequency of a second PFF on the other side is estimated at 10%. This estimation is controversial, however, and the risk factors have not been evaluated in a large population of

French patients. The objective of this retrospective case-control study was to determine (1) the incidence of second PFFs and (2) their risk factors.

Hypothesis:

The incidence of second PFFs is >2% after 1 year and >5% after 3 years.

Material and Methods:

We conducted a case-control study in a population of consecutive patients managed surgically for PFF at the Lyon Sud Hospital between 2013 and 2014. We analysed the following clinical factors: age, sex, body mass index (BMI), institutionalisation, the Parker score, the American Society of Anesthesiologists score (ASA), comorbidities, and the use of psychoactive drugs.

Results:

We included 474 PFFs (trochanter, n=240 and neck, n=234) of which 36 were bilateral. The contralateral fracture occurred within 1 year of the first fracture in 6/474 (1.3%) cases and within 3 years in all 36 cases (7.6%). The case-control study comprised 49 cases with bilateral PFF and 161 controls with no second hip fracture within 3 years. Risk factors for a second hip fracture were age older than 90 years (odds ratio [OR] = 5.44; 95% confidence interval [95%CI], 1.12-26.42 (p=0.002)) and a history of heart disease (OR, 2.18; 95%CI, 1.06-4.47 (p=0.03)). A Parker score ≥ 6 was protective (OR, 0.84; 95%CI, 0.71-0.99 (p=0.03)). Mortality after 3 years was 42% (201/474), and 13% (63/474) of patients were lost to follow-up.

Discussion:

Age older than 90 years, a Parker score below 6, and a history of heart disease are risk factors for a second PFF within 3 years after the first PFF.

Level of evidence: III; case-control study

Key words: Hip fractures, Second hip fractures, Risk factors.

1. Introduction

Proximal femoral fractures (PFFs) constitute a major public health burden in individuals older than 60 years [1,2]. The number of PFFs was estimated at 2 million in 2010 and is projected to increase by 215% to 6.3 million in 2050 [3]. However, the incidence has declined in France in recent years [4–6]. In France between 2008 and 2009, 95 000 patients older than 54 years, including three-quarters of females, were admitted for a PFF [7]. Among these patients, it is estimated that 9% will experience a second hip fracture within the first year and 20% within the first 5 years [8]. This event is associated with 64% excess mortality within 5 years and with an increase in dependency [9].

New methods of preventing the occurrence of a contralateral hip fracture have been suggested [5]. As early as 2004, preventive cement femoroplasty techniques were developed to strengthen the fragile femoral trabecular bone in patients with osteoporosis [10,11]. To decrease the amount of cement injected, cementing can be combined with the implantation of a radiolucent device [12] such as the Y-STRUT™ system (Hyprevention, Pessac, France) [13,14].

To optimally select candidates for these techniques, the predictors of a contralateral PFF in elderly patients must be identified [5]. Several meta-analyses have determined the characteristics of patients eligible for preventive treatments [9,15–17]. They showed that the absolute risk of a second PFF was associated with many factors including reduced self-sufficiency [18], repeated falls [19], institutionalisation [20], follow-up duration [21], and the efficacy of the osteoporosis treatment after the first fracture [22]. All these meta-analyses are fairly heterogeneous, and the factors identified vary from one study to the next. Importantly, none of these studies focussed on patients in France.

The objective of this retrospective case-control study was to determine (1) the incidence of second PFFs and (2) their risk factors. Our working hypothesis was that the incidence of second PFFs is >2% after 1 year and >5% after 3 years.

2. Material and Methods

2.1 Patients

We conducted a retrospective case-control study without randomisation. We included 474 PFFs seen among 581 eligible patients managed at the orthopaedics surgery department of the Hospital Lyon Sud (Pierre Bénite, France) between January 2013 and December 2014. Inclusion criteria were age older than 60 years and surgery to treat a PFF during the study period. Exclusion criteria were concomitant fracture of both proximal femurs, trauma due to a traffic accident, and femoral resection.

We first conducted a cohort study to determine the incidence of bilateral PFFs. For the case-control analysis, given the small number of patients with bilateral PFFs, we included new patients who experienced a second fracture within 3 years of the first. We matched the cases with bilateral PFFs to controls with unilateral PFFs on age, sex, body mass index, and type of treatment. Each case was matched to 3 controls. Risk factors were identified by comparing the cases and controls.

2.2 Radiological analysis

The radiological analysis was done using the Centricity PACS Radiology Information System (Centricity Enterprise, Web V3.0, GE Healthcare, Barrington, IL, USA). For each patient, the analysis determined the type of fracture, the side, and the type of implanted material. If material was present in the other hip, the date and type of procedure performed were recorded.

2.3 Data collection

For each patient, the Parker functional score [21, 23, 24] was determined at emergency room admission. A telephone interview was conducted to determine the patient's status at last follow-up and to ask whether there had been a contralateral fracture. The other data were taken from the pre-anaesthesia visit records and included the main risk factors for bilateral hip fractures identified in the literature, i.e., age, sex, ASA score [25], comorbidities, visual disturbances [26], neurological abnormalities [16], dementia [26], alcohol abuse, and use of psychoactive agents [26,27].

2.4 Statistical analysis

An unconditional logistic regression model was built (non-parametric analysis). To identify risk factors for a second hip fracture, we compared the log-likelihoods of nested models (likelihood ratio test). Variables for which the likelihood ratio test produced a level of significance below 10% and for which the relative frequency of the least frequent modality was not less than 10% (categorical variables) were selected for the multivariate analysis. For the multivariate model, we entered the variables for which the likelihood ratio test produced a level of significance of less than 5%. All the statistical analyses were done using SPSS 18.0 software (SPSS Inc. Chicago, IL, USA).

3. Results

We included 474 PFFs. Mean follow-up was more than 3 years (SD 14 months; range, 0-50 months). At last follow-up, 201/474 (42%) patients had died and 63/474 (13%) were lost to follow-up; for these patients, we used the last known data for the analysis. None of the patients who died experienced a contralateral PFF. Table 1 reports the main patient characteristics and Table 2 the values of the factors studied. The group of cases comprised

36 patients from the cohort and 13 patients who had been excluded initially due to the presence of material in the contralateral hip (Figure 1). The control group was composed of 161 patients from the initial cohort.

3.1 Incidence of a second hip fracture

The incidence of a contralateral hip fracture was 6/474 (1.3%; 95% confidence interval [95%CI], 0.9-4.1) at 1 year and 36/474 (7.6%; 95%CI, 7.6-14.6) at 3 years.

3.2 Risk factors for a second hip fracture

We identified two factors that increased the risk of a second hip fracture, namely, age older than 90 years (odds ratio [OR] 5.44; 95%CI, 1.12-26.42 (p=0.002)) and a history of heart disease (OR, 2.18; 95%CI, 1.06-4.47 (p=0.03)). A Parker score of 6 or more was protective (OR, 0.84; 95%CI, 0.71-0.99 (p=0.03)) (Table 3). The ASA score, sex, institutionalisation, comorbidities, and risk factors for falls were not significantly associated with the risk of sustaining a second hip fracture.

4. Discussion

Identifying risk factors for second hip fractures is important to design preventive strategies. In our study, the incidence of a second hip fracture was 1.3% within 1 year and 7.6% within 3 years after the first hip fracture. Risk factors for a second hip fracture in our study were age older than 90 years, a Parker score below 6, and a history of heart disease.

4.1 Incidence of second hip fractures

In our study, the incidence of second hip fractures was 1.3% within 1 year and 7.6% within 3 years after the initial fracture. These values are consistent with a prospective study

by Lawrence et al. [28], in which a second hip fracture had occurred in 2.7% of patients at 1 year and 7.8% at 8.5 years. Thus, a fracture of the contralateral hip is not rare in elderly patients, with incidences ranging from 2.3% to 13.8% in retrospective studies [20,26,29–33]. Furthermore, 80% of these second hip fractures occurred within 3 years of the first hip fracture [19,34,35]. Nevertheless, these studies did not consider the high mortality rate. In our study, mortality was 20% at 1 year and 42% at 3 years.

4.2 Risk factors for a second hip fracture

Risk factors for a second hip fracture in our study were age older than 90 years, a Parker score below 6, and a history of heart disease. Age has been established as a risk factor in several studies [3,16,29]. In the Nottingham cohort [36], for instance, the risk of a second hip fracture was increased 45-fold compared to the general population but was about the same as in the population of individuals older than 84 years. The Parker score has rarely been studied, in contrast to institutionalisation [15,37–39], which is a known risk factor. In the 2007 study by Berry et al. [20] on the Framingham cohort, patients with a high functional status had a more than 2-fold increase in risk compared to those with a moderate functional status (hazard ratio [HR], 2.7; 95%CI, 1.1-6.9), whereas a low functional status was non-significantly associated with the risk of a second hip fracture (HR 3.7; 95%CI, 0.9-14.8). The authors of this study suggested that a high functional status may allow better physical recovery [40], which may be associated with longer survival and therefore with an increased risk of a second hip fracture. In contrast, a study by Vochoeteloo et al. [37] confirmed our findings by showing a decreased risk of fracture in patients with a high functional status. Regarding a history of heart disease, in the meta-analysis by Liu et al. [41], heart failure had an OR of 1.3 (95%CI, 1.00-1.78) for the risk of a second fracture. In our study, heart disease was taken to encompass not only heart failure due to any cause

(hypertension, rhythm disorders, valvular disease, or coronary artery disease) but also atrial fibrillation and myocardial infarction. Therefore, the definition may have resulted in selection bias.

On the other hand, risk factors often identified in other studies were not found in our study. Female sex showed no significant association in either of our two analyses despite being identified as a risk factor in many studies [3,15,28,29,39,42–44]. The proportion of females in our population (86%) was similar to that in other studies. Institutionalisation showed non-significant trends in both our analyses ($p=0.859$ for the cohort study and $p=0.214$ for the case-control study). Again, institutionalisation was often found to be a risk factor in other studies [15,37–41]. That the association was not significant in our study may be ascribable to the small sample size. Finally, risk factors for falls (neurological and visual disturbances, alcohol abuse, and use of psychoactive agents) were associated with a second hip fracture in many studies [3,15,16,33,39,42].

4.3 Study limitations

Our study has the limitations inherent in the retrospective design, i.e., a small number of patients with bilateral hip fractures (7.6%), a high mortality rate (42%), and a high rate of patients lost to follow-up (13%). Nevertheless, these proportions were acceptable for this type of elderly patients with a high rate of institutionalisation. The study was not randomised, the population was highly heterogeneous, and we did not estimate the required sample size. Randomisation in each group is not feasible, and obtaining uniform groups among elderly patients who often have multiple comorbidities is extremely difficult. However, these limitations do not detract from our findings, as our study objective was to determine the incidence of second hip fractures. Risk factors cannot be identified in a uniform population, and randomisation is not relevant for determining an incidence. The

strengths of our study are the recruitment of consecutive patients at a single centre and the exhaustive collection of data by clinical examination and telephone interview (missing data accounted for less than 0.7% for major variables). Furthermore, the data were collected by a single investigator to limit interpretation bias. Preventive strategies are being evaluated. Patients at highest risk should be prioritized for receiving these strategies in order to decrease the morbidity and mortality rates in this population.

5. Conclusion

Age older than 90 years, a Parker score below 6, and a history of heart disease are risk factors for a second hip fracture. The incidence of a second hip fracture in our study was 1.3% within 1 year and 7.6% at last follow-up 3 years after the first fracture.

Conflicts of interest

M-H. Fessy receives royalties from DePuy and Serf without relation to the current study. A. Viste is a consultant for Serf without relation to the current study. None of the other authors have any conflicts of interest to declare related or our side the current study.

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None

Contributions of each author

A. Van Haecke collected the data and drafted the manuscript.

A. Viste drafted the manuscript, revised it for important intellectual content, and approved the final version.

P. Roy performed the statistical analyses.

R. Desmarchelier revised the manuscript for important intellectual content.

M. Mercier revised the manuscript for important intellectual content.

M-H. Fessy revised the manuscript for important intellectual content and approved the final version.

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FIGURE LEGENDS

Figure 1: Patient flow diagram

Table 1: Main patient characteristics

	Overall N (%) Mean±SD (range)	Unilateral PFF N (%) Mean±SD (range)	Bilateral PFF N (%) Mean±SD (range)	<i>p</i> value
Patients	474	438 (92%)	36 (8%)	NA
Age, years, mean±SD (range)	84 ± 9.0 (60-110)	83 ± 9.1 (60-110)	86 ± 7.5 (66-101)	0.189
Sex				0.538
Female	363 (77%)	333 (76%)	30 (83%)	
Male	111 (23%)	105 (24%)	6 (17%)	
BMI (kg/m ²)	22.8 ± 4.6 (12-45)	22.7 ± 4.6 (13-45)	23.5 ± 4.7 (12-33)	0.653
Side				NA
Right	235 (50%)	216 (49%)	19 (53%)	
Left	239 (50%)	222 (51%)	17 (47%)	
Type of fracture				0.514
Trochanter	240 (51%)	223 (51%)	17 (47%)	
Neck	234 (49%)	215 (49%)	19 (53%)	
Interventions				0.567
Internal fixation	211 (45%)	196 (45%)	15 (42%)	
Arthroplasty	263 (55%)	242 (55%)	21 (58%)	

NA: Not applicable; PFF: proximal femoral fracture; BMI: body mass index

Table 2: Description of the qualitative variables in the cohort

	Overall	Unilateral PFF	Bilateral PFF	<i>p</i> value	Missing data
	N 474 (%)	N 438 (%)	N 36 (%)		N
	Mean±SD (range)	Mean±SD (range)	Mean±SD (range)		
Parker score	6.80 ± 1.99 (0-9)	6.82 ± 1.99 (0-9)	6.57 ± 1.97 (2-9)	0.143	3
Institutionalisation	138 (29%)	130 (30%)	8 (22%)	0.859	3
ASA score	2.46 ± 0.63 (1-4)	2.45 ± 0.63 (1-4)	2.57 ± 0.65 (1-4)	0.113*	2
I	22 (5%)	21 (5%)	1 (3%)	0.076**	
II	224 (47%)	209 (48%)	15 (42%)		
III	212 (45%)	195 (44%)	17 (47%)		
IV	14 (3%)	12 (3%)	2 (6%)		
Hypertension	266 (56%)	247 (56%)	19 (53%)	0.805	2
Dyslipidaemia	97 (21%)	90 (21%)	7 (19%)	0.708	2
Diabetes	73 (15%)	68 (15%)	5 (14%)	0.980	2
Cancer	131 (28%)	123 (28%)	8 (22%)	0.850	2
Heart disease	168 (35%)	154 (35%)	14 (39%)	0.380	2
Respiratory disease	79 (17%)	15 (17%)	4 (11%)	0.716	3
Neurological disease	147 (31%)	134 (31%)	15 (42%)	0.524	2
Visual disturbances	92 (19%)	85 (19%)	7 (19%)	0.844	4
Dementia	172 (36%)	160 (36%)	12 (33%)	0.791	2
Alcohol abuse	17 (4%)	16 (4%)	1 (3%)	0.976	3
Use of psychoactive agents	242 (51%)	224 (51%)	18 (50%)	0.776	2

* p for heterogeneity; ** p for trend

Table 3: Case-control study: multivariate analysis

Variables	Modalities	N of patients (%)	OR	95%CI	p value*
		Cases/controls			
Age, years	≤ 69	49/161 (77)	1.00		0.017 ⁺
	70-79		1.36	0.24-7.82	0.002 ⁺⁺
	80-89		2.22	0.47-10.54	
	≥ 90		5.44	1.12-26.42	
Parker	< 6	49/161 (77)	1.00		0.027
	≥ 6		0.84 ^{**}	0.71-0.99	
Heart disease	No	27/113	1.00		0.033
	Yes	22/48	2.18	1.06-4.47	

*likelihood ratio test; ** mean value for a 1-point increase in the score; + p for heterogeneity; ++ p for trend

Figure 1 :

