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Original article

Epidemiology of distal femur fractures in France in 2011–12

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ABSTRACT

Introduction: Epidemiological study of femoral fractures has been dominated by proximal fractures. Distal fracture requires equal attention for correct management.
Patients and methods: A prospective study in 12 French hospital centres between June 1st, 2011 and May 31st, 2012 recruited cases of non-pathologic distal femoral fracture in patients over 15 years of age without ipsilateral knee prosthesis.
Results: There were 183 fractures in 177 patients. Mean age was 63.5 years. Female patients (60.5%) were significantly older than males (mean age, respectively 73 versus 48.4 years). Walking was unrestricted in only 83 patients (46.89%). On the AO/OTA (Orthopaedic Trauma Association) classification, there were 86 type A fractures (47%), 29 type B (15.8%) and 68 type C (37.2%). Fractures were open in 32 cases (17.5%), most frequently in male, young patients and type C fracture. Causal trauma was low-energy (fall from own height) in 108 cases, most frequently in female patients and type A fracture. Forty-five patients were proximal femoral implant bearers.
Conclusion: Distal femoral fracture shows highly variable epidemiology. AO/OTA type A fracture mainly involves elderly, relatively dependent female subjects. Outcome study requires radiographic data and assessment of functional capacity.
Level of evidence IV: Prospective cohort study.

1. Introduction

In fracture, epidemiology is often overlooked, but may in fact forecast probable treatment option results. In the femur, interest tends to focus on the proximal part, due to the frequency and severity of fracture, especially in an aging population. In contrast, little recent information is available in France concerning the distal femur. A previous study by the SoFCOT [1] dealt with a very different population from that of other European series [2–4]; the aim of this SoFCOT study being to determine sex ratios and patient age according to fracture type in a prospective cohort study.

2. Material and method

A prospective study, conducted between June 1st, 2011 and May 31st 2012 in 12 French hospital centers[1], included distal femoral (segment 3.3 on the AO/OTA classification [5]) fractures in subjects aged more than 15 years, excluding pathologic fracture and patients with ipsilateral knee prosthesis. Baseline AP and lateral X-ray was systematic. Two senior surgeons categorized the fractures on the AO classification as modified by the Orthopaedic Trauma Association (OTA) [5]. CT scans, performed according to institutional routine and availability, were also made use of. Age, gender, preoperative walking capacity, history in the concerned body region, uni-/bi-laterality, open status according to Gustilo and Anderson [6] and injury mechanism were recorded. Thirty-three A1.1

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Table 1
Epidemiological data for "Unrestricted walking" and "Minor accident", figures are number of patients, with number of fractures in brackets (to take account of bilateral cases).

	Whole series	Male	Female	AO A overall	AO A Male	AO A Female	AO B overall	AO B Male	AO B Female	AO C overall	AO C Male	AO C Female
Mean age	63.5	48.4	73	69.8	52.4	78	57.7	44.9	69.6	57.8	46.5	67.2
Median age	65	48	79	76	55.5	82	53.5	43	80	59	47.5	71.5
Min. age	15	16	15	20	20	40	18	22	18	15	16	15
Max. age	101	99	101	101	94	101	99	99	93	95	86	95
Open	32	23	9	7	6	1	3	2	1	22	15	7
Unrestricted walking	83 (86)	50 (52)	33 (34)	25 (26)	14	11 (12)	17	10	7	42 (43)	27 (28)	15
Minor accident	108 (110)	21	87 (89)	63 (64)	13	50 (51)	16	4	12	30	4	26
Number of patients	177	70	107	84	27	57	29	14	15	66	30	36
Number of fractures	183	72	111	86	27	59	29	14	15	68	31	37

AO A, AO B, AO C: fracture type A, B or C on the AO classification.

(epicondylar) fractures were excluded, as liable to be associated with ligament sprain and hence likely to be overlooked.

Statistical analysis (chi^2 independence test, non-parametric Mann–Whitney and Kruskal–Wallis tests; significance threshold, $P < 0.05$) was performed by EVAMED (Evamed, Hérouville-Saint-Clair, France) on R software.

3. Results

There were 183 fractures in 177 patients (6 bilateral); 107 female, 70 male; mean age, 63.5 years (median 65, range 15–101 years). Female patients were significantly older (mean 73, median 79 years, versus 48.4 and 48 years; $P = 7.7 \times 10^{-16}$). Half of the patients were aged over 65 years and one-third over 80 years; 28% were under 50 (Table 1, Fig. 1).

Walking was unrestricted in 83 patients (46.9%): 33 female (30.8%) and 50 male (71.5%) ($P = 8.5 \times 10^{-8}$). Eighteen patients (10.2%) were bed-ridden (16 female, 14.8%) and 5 unable to walk (4 male, 5.8%: paraplegia or severe myopathy). Fracture types comprised 86 type A (47%), 29 type B (15.8%) and 68 type C fractures (37.2%), covering all groups (Table 2). Bilateral fractures were symmetrical for type in 4 out of 6 cases but for group in only 1.

Age at trauma was systematically greater in women (type A, $P = 3.97\ 10^{-6}$; type B, $P = 0.03$; type C, $P = 4.09 \times 10^{-5}$: Figs. 2–4). Type A was associated with the greatest age ($P = 0.0009$). Walking capacity was poorer in types A than types B and C ($P = 7.9 \times 10^{-5}$). Causal trauma was a fall from the patient's own height in 108 cases, especially in women ($P = 9.2 \times 10^{-12}$) and type A fracture ($P = 7.9 \times 10^{-5}$).

Thirty-two fractures were open (17.5%), mainly in male patients ($P = 7.9 \times 10^{-5}$), young patients ($P = 1.14 \times 10^{-9}$) and type C fractures: 3 Gustilo I, 14 Gustilo II, 12 Gustilo IIIA, 1 Gustilo IIIB and 2 Gustilo IIIC.

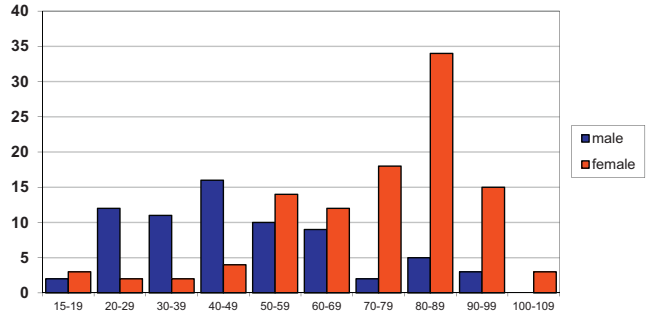

Fig. 1. Distribution by age and gender for the series as a whole.

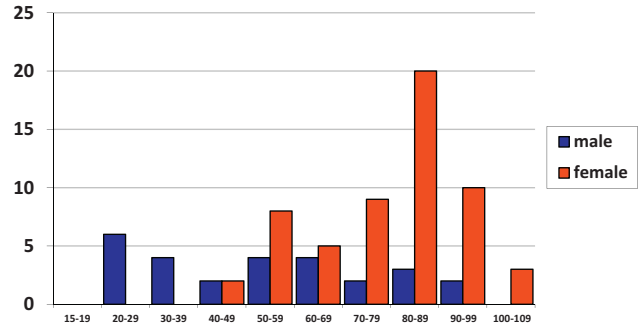

Fig. 2. Distribution by age and gender for type A fractures.

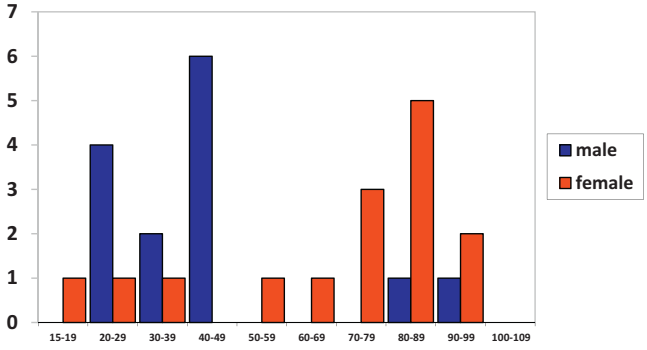

Fig. 3. Distribution by age and gender for type B fractures.

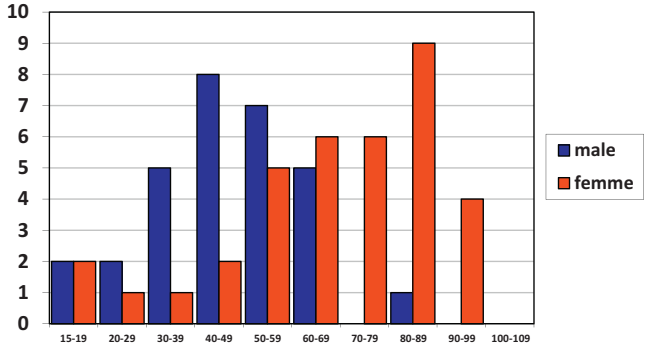

Fig. 4. Distribution by age and gender for type C fractures.

Table 2
Distribution of AO/OTA fracture types.

Type	Number	%	Group	Number	%	Type	Number	%
A	86	47	A1	43	23.5	A1.1		
						A1.2	24	13.1
						A1.3	19	10.4
			A2	23	12.6	A2.1	7	3.85
						A2.2	9	4.9
						A2.3	7	3.85
			A3	20	10.9	A3.1	3	1.6
						A3.2	13	7.1
						A3.3	4	2.2
B	29	15.8	B1	11	6	B1.1	5	2.7
						B1.2	5	2.7
						B1.3	1	0.6
			B2	9	4.9	B2.1	7	3.8
						B2.2	2	1.1
						B2.3	0	0
			B3	9	4.9	B3.1	1	0.5
						B3.2	8	4.4
						B3.3	0	0
C	68	37.2	C1	15	8.2	C1.1	14	7.7
						C1.2	0	0
						C1.3	1	0.5
			C2	41	22.4	C2.1	8	4.4
						C2.2	19	10.4
						C2.3	14	7.6
			C3	12	6.6	C3.1	3	1.6
						C3.2	6	3.4
						C3.3	3	1.6

Forty-five patients had proximal femoral implants; 29 hip replacements; 8 short trochanteric nails; 1 long trochanteric nail; 1 Ender nail; 3 proximal plates; 3 cephalic screws.

4. Discussion

Comparison with other series [1–4,7–10] is hindered by exclusion of 33 A1.1 (epicondylar) fractures from the present study due to their risk of being overlooked and their association with knee ligament injury. Also, patients under 15 years of age were excluded, unlike in most other series, as were pathologic fractures and cases with ipsilateral knee implant.

Patient age matched recent data for Western countries according to Kolmert and Wulf [2] (mean, 65 years; median, 68 years), with the exception of Asencio's [1] median of 30 years, which cannot be accounted for simply by the exclusion of type B fractures but also doubtless involved bias in recruitment or in treatment strategy. As early as 1967, Neer et al. [7], in a series of 110 patients treated between 1942 and 1966, reported a median age in the 6th decade of life, with 9 patients in the 9th (8.2%), close to the figures reported by Martinet et al. [3] for the AO Documentation series between 1980 and 1989. On the other hand, Zhang [8], reporting the experience of the Hebei Orthopedic Hospital (China) for 2003-07 (667 fractures), found a median in the 4th decade, with only 7.8% of patients aged over 60 and 0.75% over 80–in contrast to 60 (33.9%) in the present series.

The present considerably higher rate of female patients (61%) was greater than those reported by Zhang [8] (23.7%), Neer et al. [7] (41%) or Martinet et al. [3] (48.5%), but lower than those of Kolmert and Wulff [2] or Ng et al. [9] (73%). Furthermore, age at fracture was greater in female patients [8,9],

The predominance of elderly patients was reflected in the predominant causal mechanism: minor trauma was implicated in 61% of cases, comparably to Neer et al. [7] rate of 45% in 1967, confirmed by Kolmert and Wulff [2] with 66%, for whom, as in the present series, this etiology even exceeded 75% in type A fracture. Martinet et al. [3], on the other hand, report a 53% rate of road accidents and only 33% household trauma in their series as a whole, although it should be borne in mind that female patients are more frequently concerned by minor trauma [9].

For open fracture, Neer et al. [7] reported a rate of 27–50% higher than in the present study; they found 39% in the most severe lesions, comparable to the 32% open fracture rate in type C lesions in the present series, despite differences in classification.

Type A (extra-articular) fractures were the most frequent, followed by type C, with type B very much in a minority, as in the reports by Martinet et al. [3] and Zhang [8], but markedly unlike that by Kolmert and Wulff [2], in which type C predominated, with types A and B almost equal. In terms of group, the present order of for the "top three" (A1, C2, A2) differed from that of Martinet et al. [3] (A2, C2, A1) despite his inclusion of sub-group A1.1, and even more from that of Zhang [8] (A1, A3, B1-B2-C2).

A more interesting point is the age/gender curve, which Court–Brown and Caesar [10] classified in 8 types, from A to H, based on peak incidence according to age and gender. The age pyramid for the French population (excluding overseas territories) shows gender parity for age brackets (< 10% female predominance) up to 75 years [11], whereafter women become an increasing majority. The raw data can thus be taken to be equivalent to rates of relative incidence and hence, real incidence curves according to Court–Brown and Caesar [10].

In the present series, the curve approximates Court–Brown's curve A (unimodal young man/unimodal older woman) [3] better than curve E (unimodal older woman) [2,4,10] but differs from curve F (unimodal older man/unimodal older woman) [10]. There is thus a relative concordance with Western series, from whatever period [7]. Moreover, the incidence curve reported from Malmö (Sweden) evolved over a 30-year period from curve E (unimodal older woman) to F (unimodal older man/unimodal older woman) [4] with an increasing proportion of subjects over 60 years of age of both genders. It is completely different from curve C (unimodal young man/unimodal young woman) reported by Zhang [8], probably due to the high level of road accident trauma in China in a population with fewer elderly people.

This pattern changes distribution if the population is segmented by fracture type, type A showing a typical E curve (unimodal older woman) (Fig. 2), type B a no less typical A curve (unimodal young man/unimodal older woman) (Fig. 3), like type C (although here there is a shift in peak to the right) (Fig. 4). The shorter series resulting from this segmentation, however, mean that interpretation should be cautious. Moreover, patients with type A fracture were older, and much more clearly so than in Kolmert and Wulff's series [2]. Numbers in the groups and subgroups were too small for any realistic incidence curve to be calculated.

The two expected typical patterns thus emerge: firstly, elderly women with restricted independence, having fallen from their own height, inducing type A closed fracture, versus younger, independent men, sustaining high-energy trauma inducing often open type C fracture.

The main limitation of the present study was the lack of actual incidence rates for the general population: none of the participating centres were the sole local trauma-care service available. The spread of the study population over the whole territory of France should, on the other hand, have smoothed away regional specificities.

5. Conclusion

Epidemiology is the mirror of society, both in demographics and in lifestyle and behavior. The large proportion of elderly persons in the present series corresponds to population aging. Conversely, the falling rates of road and work accident trauma accounts for the smaller number of young and male subjects, and is not outweighed by extreme sports. These trends will probably continue, and in the long run, this fracture location may, like so many others, come to be seen as osteoporotic. However, as no comparable previous studies exist for the same kind of population, only time will tell if this is so. Finally, the term "distal femoral fractures" covers a variety of phenomena. This requires critical consideration of treatment options, and a clear definition of the object of study so as to obtain results from truly comparable groups.

Disclosure of interest

The authors declare that they have no conflicts of interest concerning this article.

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