Epidemiology of clavicle fractures

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An epidemiologic study of 535 isolated clavicle fractures treated in a hospital of a large metropolis during an 11-year period was performed. Data regarding patient's age and sex, side involved, mechanism of injury, and season in which the fracture occurred were obtained from the clinical records. Radiographic classification was performed with the Allman system. Clavicle fractures represented 2.6% of all fractures and 44% of those in the shoulder girdle. Most patients were men (68%), and the left side was involved in 61% of cases. Fractures of the middle third of the clavicle, which were the most common (81%), were displaced in 48% of cases and comminuted in 19%. Fractures of the medial third were the least common (2%). The prevalence of midclavicular fractures was found to decrease progressively with age, starting from the first decade of life when they represented 88.2% of all clavicle fractures and were undisplaced in 55.5% of cases. In adults, the incidence of displaced fractures, independent of location, was higher than that of undisplaced fractures. Traffic accidents were the most common cause of the injury. In the period under study, the incidence of fractures showed no significant change over time and no seasonal variation. (J Shoulder Elbow Surg 2002;11:452-6.)

Several studies[3,5,7–9,11–16] have provided epidemiologic data on clavicle fractures, but only one survey has been devoted to the epidemiology of these fractures.[10] However, the patients in that study lived in a Swedish harbor city with 230,000 inhabitants whose life customs are inevitably different from those of metropolitan inhabitants. Furthermore, the study referred to fractures that had occurred, in the vast majority of cases, in the 1970s or in earlier decades, when lifestyles were somewhat dissimilar to those of more recent decades.

We are presenting the first epidemiologic survey of a large number of clavicle fractures that occurred between 1990 and 2001 in patients living in a wide metropolitan area.

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MATERIAL AND METHODS

We examined the clinical records and radiographs of all patients who were treated at our hospital for a clavicle fracture between January 1990 and March 2001. To calculate the proportion of clavicle injuries with respect to all fractures in the shoulder girdle, fractures of the proximal humerus and scapula occurring in the same period were also recorded. Excluded from the study were all clavicle fractures associated with acromioclavicular or sternoclavicular dislocation or with other fractures in the shoulder or elsewhere, as well as birth fractures of the clavicle. The data obtained from the clinical charts included patient's age and sex, side involved, mechanism of injury, and season in which the fracture occurred.

Radiographic classification of clavicle fractures was done with use of the Allman system,[2] which identifies 3 groups and 3 subgroups of fractures. Group I includes fractures of the middle third, group II includes those of the lateral third distal to the conoid tubercle, and group III includes those of the medial third. The subgroups a, b, and c include undisplaced, displaced, and comminuted fractures, respectively. The latter are those fractures with a third, usually displaced, fragment or even more free fragments. Only group I includes a subgroup c. We arbitrarily classified as displaced those fractures in which the distance between the inferior border of one bone fragment and that of the corresponding border of the other fragment at the fracture site exceeded 3 mm (radiographic magnification 11%). We did not select a shorter distance, as used by other authors,[8] because it could risk overestimation of displaced fractures, given that anteroposterior radiographs had been carried out with use of different inclinations of the central beam. The radiographs were classified independently by 3 observers. When the examiners disagreed, the fracture was classified based on the majority of the opinions.

Statistical analysis was performed with use of the χ^2 test and Student *t* test, with $P < .05$ being considered significant. Changes in the incidence of fractures during the 2 decades under study were evaluated by a linear trend test.

RESULTS

Of 20,501 patients treated at our hospital for a fracture in the time interval under study, 533 (2.6%) had a clavicle fracture. Isolated clavicle fractures represented 44.1% of all fractures in the shoulder girdle. There were 362 men (67.9%), 2 of whom had

Table I Distribution of the entire cohort of clavicle fractures in the Allman groups and subgroups

Fractures	Group		
	I	II	III
Total	435 (81.3%)	89 (16.6%)	11 (2.1%)
Undisplaced (subgroup a)	144 (33.1%)	42 (47.2%)	3 (27.3%)
Displaced (subgroup b)	209 (48.0%)	47 (52.8%)	8 (72.7%)
Comminuted (subgroup c)	82 (18.9%)	—	—

a bilateral fracture, and 171 women (32.1%). The left side was involved in 60.7% of cases ($P < .005$).

The fractures were classified as group I in 435 cases (81.3%), group II in 89 cases (16.6%), and group III in 11 cases (2.1%). In group I the fracture was undisplaced in 33.1% of cases, displaced in 48.0%, and comminuted in 18.9% ($P < .001$). In group II there were similar numbers of undisplaced and displaced fractures. Most fractures in group III were displaced (Table I). Overall, 64.7% of patients had a displaced fracture.

A group I fracture was found in 303 of 362 men (83.7%) and 133 of 171 women (77.8%); in this group, irrespective of sex, displaced fractures were more common than those in the other subgroups, the difference being statistically significant ($P = .014$). Displaced fractures of group I were significantly more common in male patients ($P = .044$), whereas those of group II and III occurred in both sexes with similar proportions ($P = .33$) (Figure 1).

The mean age was 29.3 ± 22.0 years for the entire cohort of patients and 26.7 ± 20.6 years, 37.2 ± 24.0 years, and 56.5 ± 20.1 years in groups I, II, and III, respectively ($P < .001$). Patients with undisplaced fractures were significantly younger than those with displaced fractures (23.1 ± 22.0 years vs 32.4 ± 21.0 years, $P < .001$).

We analyzed children and adolescents (ie, the subjects with open physes) separately from young and middle-aged adults (18-60 years) and elderly persons (>60 years) with regard to fracture distribution in the Allman groups and subgroups. The vast majority of children aged 10 years or less had a group I fracture, and none had a group III fracture. In group I there were similar proportions of undisplaced and displaced fractures, whereas 83% of the fractures in group II were undisplaced (Table II). Subjects aged 11 to 17 years had, in the vast majority of cases, group I fractures, but the displaced fractures were more prevalent than the undisplaced fractures (Table II). In the latter age cohort, a small minority of patients had a comminuted fracture.

In patients aged 18 to 30 years (Table III), as compared with the previous age cohort, there was an increase in comminuted fractures ($P = .01$), as well as an increase in prevalence of displaced fractures ($P > .5$). In patients aged 41 to 60 years, the prevalence of comminuted fractures still remained high but showed a marked decrease. Undisplaced and displaced group I fractures showed a progressive decrease in number with increasing age, but displaced fractures were consistently more numerous than undisplaced fractures. In addition, the incidence of displaced group II fractures showed a progressive decrease with advancing age (Table III).

In patients aged 61 to 80 years (Table IV), the prevalence of group I fractures was similar to that observed in patients aged 41 to 60 years, but group II fractures showed a higher incidence. Before age 61 years, only 2 subjects sustained a displaced fracture of the medial third, whereas this type of fracture represented 9% of all fractures in elderly persons. However, with the data available, no significant difference could be detected between the 2 age groups.

Overall, the prevalence of clavicle fractures was found to decrease with increasing age, except for male patients during childhood and adolescence (Figure 2). In only 2 cases did the data in the clinical charts clearly indicate that the fracture was open. No other complication appeared to be associated with clavicle fractures.

Fractures were due to a traffic accident, an accidental fall, a sport-related injury, and a work-related injury in 47.5%, 33.0%, 7.3%, and 0.9% of cases, respectively (Table V). The cause could not be clearly identified from the clinical charts in 11.3% of cases. Group I fractures prevailed in each cause-related group of patients ($P < .001$). The main cause of fractures was a traffic accident in adolescents and young adults and an accidental fall in children and elderly persons. Only 3 young adults sustained a fracture due to a work-related injury.

In the 11-year period under study, the incidence of fractures showed no significant change over time (Figure 3). The incidence in male patients was consistently higher than that in female patients; however, there was no evidence of increasing risk for male patients as compared with female patients over time (χ^2 for linear trend, 1990-2001, $P = .35$). The incidence of fractures was similar in the various seasons: 22% in winter, 24% in autumn, and 27% in either spring or summer.

DISCUSSION

In previous reports providing epidemiologic data on clavicle fractures, no mention is made of whether the fractures scrutinized were isolated or associated with other fractures in the shoulder girdle. We limited our study to isolated fractures because they represent, from the etiopathogenetic and anatomic viewpoint, a homogeneous group of injuries.

In several studies,[7,9,11,15] which scrutinized a lim-

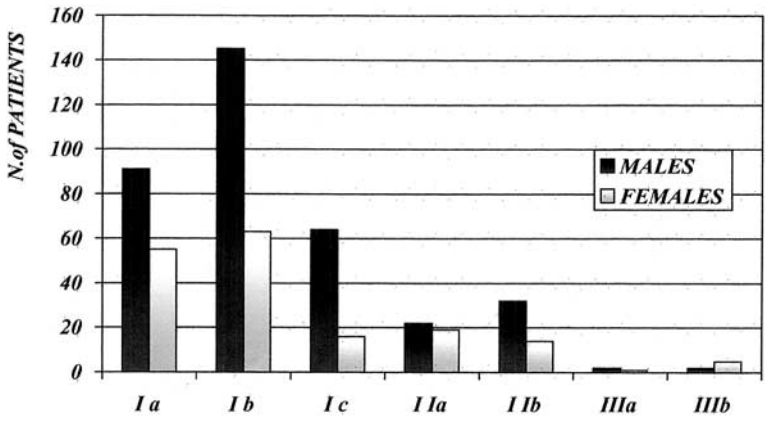

Figure 1 Gender-specific prevalence of clavicle fractures.

Table II Distribution of fractures in the Allman groups and subgroups in children and adolescents

	Group							
Age	**Ia**	**Ib**	**Ic**	**IIa**	**IIb**	**IIIa**	**IIIb**	**Total**
0–10	50 (49%)	39 (38%)	1 (1%)	10 (10%)	2 (2%)	0	0	102 (100%)
11–17	18 (25%)	45 (63%)	3 (4%)	3 (4%)	3 (4%)	0	0	72 (100%)

Table III Distribution of fractures in the Allman groups and subgroups in young and middle-aged adults

	Group							
Age	**Ia**	**Ib**	**Ic**	**IIa**	**IIb**	**IIIa**	**IIIb**	**Total**
18–30	36 (25%)	53 (37%)	24 (17%)	8 (6%)	18 (13%)	1 (1%)	1 (1%)	139 (100%)
31–40	10 (14%)	30 (43%)	18 (26%)	5 (8%)	6 (9%)	0	0	66 (100%)
41–50	9 (19%)	12 (24%)	22 (45%)	3 (7%)	2 (4%)	1 (2%)	0	46 (100%)
51–60	7 (21%)	13 (40%)	4 (12%)	6 (15%)	2 (6%)	1 (3%)	1 (3%)	30 (100%)

Table IV Distribution of fractures in the Allman groups and subgroups in elderly people

	Group							
Age	**Ia**	**Ib**	**Ic**	**IIa**	**IIb**	**IIIa**	**IIIb**	**Total**
61–70	5 (16%)	8 (26%)	5 (16%)	3 (10%)	7 (22%)	0	3 (10%)	30 (100%)
71–80	6 (20%)	9 (30%)	3 (10%)	3 (10%)	6 (20%)	0	3 (10%)	29 (100%)
81–90	2 (50%)	0	2 (50%)	0	0	0	0	4 (100%)
>90	1 (33%)	0	0	2 (67%)	0	0	0	3 (100%)

ited number of clavicle fractures, they represented 5% to 15% of all fractures. The incidence was only 2.6% in our study, whereas it was 4% in the Swedish study of clavicle fractures by Nordqvist and Petersson,[10] the largest series reported thus far. The discrepancy between our study and theirs may result from the different historical periods to which the 2 studies refer, the different lifestyles of patients, the size and climate of the town in which patients lived, and the differences in the type of city transportation commonly used. The latter factors may account for the fact that in Nordqvist and Petersson's study, clavicle fractures were found to be more common in summer, whereas we found no season-related changes in prevalence.

Most of our patients (81.3%) had a group I fracture. This finding is consistent with findings in previous studies.[1,9-11] The same is true for sex (prevalence in men)[3,6,8,10,14] and side (prevalence of left side).[6,8,10]

Nordqvist and Petersson[10] found the overall incidence of displaced fractures to be 42%, ranging from

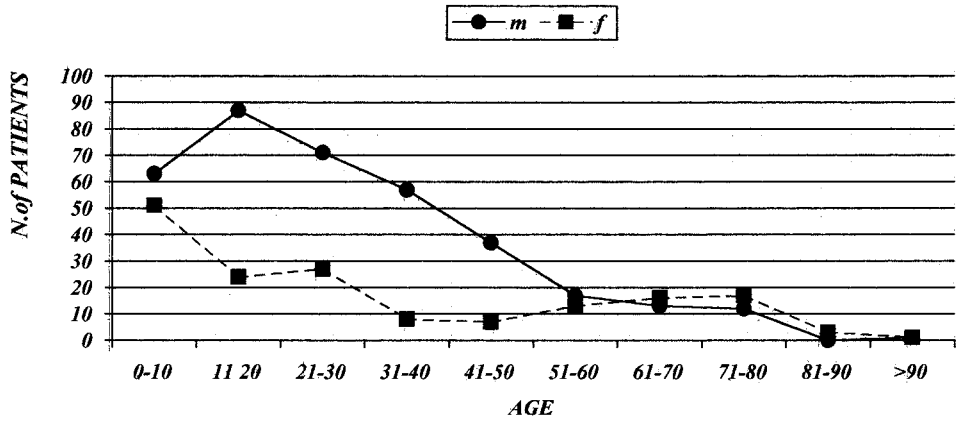

Figure 2 Age- and gender-specific prevalence of the 528 clavicle fractures. *m*, male patients; *f*, female patients.

Table V Age distribution of clavicular fractures according to cause of injury

	Age (y)										
	0–10	**11–20**	**21–30**	**31–40**	**41–50**	**51–60**	**61–70**	**71–80**	**81–90**	**>90**	**%**
Traffic accident	6	64	65	47	28	18	13	10	1	1	47.5
Fall	87	22	15	9	10	8	11	16	2	1	33.0
Sport-related injury	5	17	9	6	2	0	0	0	0	0	7.3
Work-related injury	0	1	3	0	1	0	0	0	0	0	0.9
Unknown	17	10	11	3	6	4	6	3	0	1	11.3

Data are presented as numbers of patients.

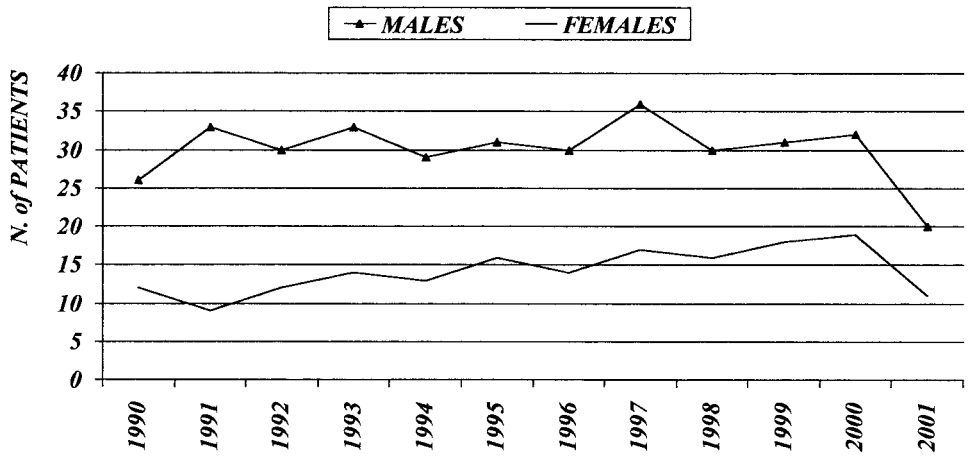

Figure 3 Gender incidence of clavicle fractures in the period studied.

47% in group I to 20% in group III. However, they did not define when a fracture should be classified as displaced. Eskola et al,[8] who considered fractures with a displacement of 1 mm to be displaced, found 66% of their 118 patients to have a displaced fracture. We identified the interfragmentary distance of 3 mm as the boundary between undisplaced and displaced fractures. On the basis of this criterion, 64.7% of all fractures were classified as displaced, groups I and III comprising the highest proportions of this injury subgroup (66.8% and 70%, respectively).

Our data suggest that a close relationship exists among age, Allman group allocation, and displacement of fracture fragments. Almost all children in the

first decade of life (88.2%) had a group I fracture, but only 41.2% of all fractures (in the 3 Allman groups) were displaced. By contrast, in adults, group I fractures decreased progressively with increasing age, whereas the overall incidence of displaced fractures was higher. These findings may be related to the progressive decrease in elasticity of the clavicle with increasing age and to the violence of the trauma that caused the fracture. High elasticity of the bone, which is present at younger ages, makes the clavicle more prone to fracture in the middle third; in the first decade of life and in elderly persons, the mechanism of injury is usually a fall (low-energy trauma), whereas most fractures in adults occur as a result of a traffic accident. On the other hand, the increase in incidence of group II and III fractures in elderly persons may be related to the fact that senile osteopenia makes the trabecular bone of both ends of the clavicle more prone to fracture than the cortical bone of the middle third.

A previous study[10] referring to fractures occurring in the 1950s to the 1980s found a progressive increase in incidence over time. The present study has shown that, in the last decade, the incidence of clavicle fractures in a metropolitan area presented no significant change over time.

Clavicle fractures may be associated with several types of injuries and acute complications. These can be divided into skeletal injuries and injuries to the lung, pleura, nearby vessels, and brachial plexus.[4] These injuries usually occur in severely displaced fractures and/or in patients with multiple injuries. In our series we found only 2 complications, both consisting of exposure of the clavicle fracture. The low rate of complications in the current series is probably related to the fact that our retrospective analysis was limited to patients with an isolated clavicle fracture.

In conclusion, this survey indicates that almost half of patients with a fracture in the shoulder girdle have a clavicle fracture that, in the majority of cases, involves the middle third of the bone and is displaced to a varying extent. Fractures of the medial third, taken as a whole, are exceedingly rare; however, these injuries, which may easily go unrecognized,[4] are not uncommon in elderly patients, in whom they should be suspected in the presence of post-traumatic pain in the sternoclavicular region. Acute complications are very rarely associated with isolated fractures of the clavicle.

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