Risk of hip fracture after osteoporosis fractures

451 women with fracture of lumbar spine, olecranon, knee or ankle

Jes Bruun Lauritzen[1] and Bjarne Lund[2]

In a follow-up study during 1976–1984, the risk of a subsequent hip fracture was investigated in women aged 60–99 years, hospitalized for the following fractures: lumbar spine (n 70), olecranon (n 52), knee (n 129) and ankle (n 200). Follow-up ranged from 0 to 9 years. Observation time of the 4 different fractures were 241, 180, 469, and 779, person-years, respectively. In women aged 60–79 years with one of the following fractures the relative risk of a subsequent hip fracture was increased by 4.8 (lumbar spine), 4.1 (olecranon), 3.5 (knee) and 1.5 (ankle). The relative risk of hip fracture showed a tendency to level off 3 years after the primary fracture.

University of Copenhagen, Departments of Orthopedics, [1]Hvidovre Hospital and [2]Rigshospitalet, Copenhagen, Denmark
Tel +45–35 452360. Fax –35 366733
Correspondence: Dr. Jes Bruun Lauritzen, Department of Orthopedics U 2161, Rigshospitalet, Blegdamsvej 9, DK-2100 Copenhagen Ø, Denmark
Submitted 92-10-11. Accepted 92-12-27

Early detection of women with a high risk of a later hip fracture is desirable in relation to prevention of hip fracture. Fractures of the distal radius and the proximal humerus are the most common fractures in postmenopausal women, and these fractures have been found to be associated with an increased risk of a subsequent hip fracture (Gay 1974, Owen et al. 1982). In a retrospective study, the prevalence of previous unspecified fractures was found to be increased in women with a hip fracture, but only in women younger than 70 years of age (Finsen and Benum 1986). We performed a follow-up study in 451 women with fractures related to osteoporosis and studied their risk of a subsequent hip fracture. Mortality was also calculated.

Patients and methods

During 1976–1984 all 451 female in-patients aged 59 years or older with a fracture of the lumbar spine (n 70), the olecranon (n 52), the knee (n 129) and the ankle (n 200) admitted to Hvidovre Hospital in Copenhagen were registered (Table 1). The hospital covers an area with 110,000 inhabitants. No information about previous fractures was available. Lumbar spine fractures included both vertebral crush and wedge fractures. Knee fractures included women with fractures of the tibial or the femoral condyles. Ankle fractures included women with fractures of the medial and/or the lateral malleolus. All fractures were confirmed by radiography. The following parameters were registered for each woman: Name, address, municipality, personal identity number, age, type of fracture. Demographic background data were obtained from the Danish Statistical Municipal Bureau of Hvidovre. The registration included deaths and persons leaving the municipality, which was accounted for in the analysis.

During the same period 1976–1984 all hip fractures (readmissions excluded) in women older than 59 years of age were registered according to the International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM, 820.00 and 820.01), which distinguishes between cervical (including basocervical) and trochanteric fractures. All hip fractures in patients in the study population sustained outside the municipality were also registered as they were reported to a central register in Denmark.

A control of 100 operated hip fractures showed that all fractures were recorded in the ICD system, but 3 records of hip fractures were incorrect regarding type of hip fracture. This misclassification did not interfere with the results. The expected number of hip fractures was calculated from the age-specific incidence of hip fracture in the background population of the same area and during the same observation period. The indirect method of standardization was used, which means that age was not a confounding factor. The observed number of hip fractures was compared to the expected number and the relative risk (RR) was calculated (Foldspang et al. 1986).

The change in RR of hip fracture related to time after the initial fracture was tested with a Chi-square contingency test. Life tables showing expected mean

Table 1. The distribution of various types of fractures in women 60–99 years of age

Fracture	n	Observation time (yr)	Follow-up (yr)	
			Median	25th–75th
Lumbar spine	70	241	2.9	1.5–5.0
Olecranon	52	180	2.8	1.2–4.0
Knee	129	469	3.2	1.4–5.1
Ankle	200	779	3.6	1.5–5.7
Total	451	1669		

Table 2. The relative risk (RR) of a subsequent hip fracture and 95% confidence limits (CL) following 1 of the 4 fracture types in 451 women

Age	n	Obs	Exp	RR	95% CL	Power
Lumbar spine						
60–79	47	6	1.2	4.8	1.3–9.4	0.70
80–99	23	4	1.4	2.8	1.1–8.2	0.40
All	70	10	2.6	3.8	1.8–7.1	0.85
Olecranon						
60–79	38	5	1.2	4.1	1.4–9.7	0.61
80–99	14	0	0.7	–	0–5.3	0.23
All	52	5	1.9	2.6	0.9–6.1	0.44
Knee						
60–79	89	9	2.6	3.5	1.6–6.6	0.81
80–99	40	5	3.3	1.5	0.5–3.5	0.17
All	129	14	5.9	2.4	1.3–4.0	0.82
Ankle						
60–79	182	7	4.6	1.5	0.6–3.1	0.18
80–99	18	1	1.4	0.7	0.02–4.0	0.07
All	200	8	6.0	1.3	0.6–2.7	0.12

Obs observed , Exp expected number of hip fractures.

Table 3. The relative risk (RR) of a subsequent hip fracture and the 95% confidence limits (CL) within the first 9 years in 451 women with fractures listed in Table 1

Years after fracture	n	Obs	Exp	RR	95% CL
1	451	19	3.6	5.3	3.2–8.3
3	305	27	9.6	2.8	1.9–4.1
5	182	33	14	2.4	1.6–3.3
7	91	37	16	2.3	1.6–3.2
9	7	37	16	2.3	1.6–3.2

Obs observed, Exp expected number of hip fractures, Chi-square contingency table, P 0.02, d.f. 8

Table 4. The age-adjusted standardized mortality rate (SMR) and 95% confidence limits (CL) in 451 women

Age	n	Obs	Exp	SMR	95% CL	Power
Lumbar spine	70	28	9.3	3.0	1.9–4.4	0.99
Olecranon	52	17	6.4	2.7	1.5–4.3	0.95
Knee	129	45	20	2.2	1.6–2.9	0.99
Ankle	200	50	20	2.5	1.8–3.3	0.99

Obs observed, Exp expected number of deaths.

additional life-time were obtained from the Statistical Yearbook of Denmark 1976–1985. The standardized mortality rate (SMR) was calculated for the various fractures by use of the indirect method of standardization.

The RR and the SMR of the women with the various fractures was evaluated by the Cox proportional hazard model, using age and type of fracture as independent variables. The test accounted for differences in observation time (Cox 1972). The 95 percent confidence limits of the RR and SMR were calculated by regarding the observed number of hip fractures or deaths as a Poisson variable (Breslow and Day 1987). In addition, the power of the data was calculated (Altman 1991).

Results

The relative risk (RR) of a subsequent hip fracture compared to the female background population was 3.8 after a fracture of the lumbar spine, and after a fracture of the olecranon, knee and ankle respectively 2.6, 2.4, and 1.3, respectively (Table 2). The increase in RR was most pronounced for women in the age group 60–79 years, where the RR ranged from 3.5–4.8 for women with fracture of the knee, olecranon and the lumbar spine. When the risk of hip fracture following the various fractures was tested by the Cox proportional hazard model, the relative risk of hip fracture following a fracture of the lumbar spine was 3.9 (t 2.71) compared to women with a fracture of the ankle. The RR after a fracture of the olecranon was 2.7 (t 1.7) and 2.5 (t 1.99) for women with fracture of the knee, compared to women with ankle fractures. Age influenced the risk of hip fracture marginally (t 1.76, beta 0.04). The RR was highest within the first 3 years after the index fractures (P 0.05; Table 4) and then seemed to level off. The SMR was increased 2–3 times in women with one of the 4 fractures (Table 4). The mortality between women with the various fractures did not differ when tested by the proportional hazard model.

Discussion

The bone density in women with vertebral fractures is generally lower compared to age-matched controls (Riggs et al. 1982). The occurrence of a vertebral crush fracture combined with osteopenia has been defined as clinical osteoporosis (Albright et al. 1941), which may explain the increased risk of hip fractures in women with fractures of the lumbar spine. In the present study, spine fractures were only in-patients, thus with the most severe problems, and out-patients were not included in the risk estimates. Fractures of the spine are often spontaneous, while fractures of the knee and the olecranon are related to a trauma. The relation between fractures of the ankles and later hip fracture was not unequivocal, as the power of the ankle data was low, and therefore no conclusion can be drawn, even though the confidence intervals of these data were also compatible with a doubling of the relative risk. Fractures of the ankle may be more often related to activities such as sport (Sylvest et al. 1991) in otherwise healthy women.

Whether women with fractures related to osteoporosis are more accident-prone for a limited period of time or more osteoporotic than the background population is difficult to elucidate. The tendency to fall is increased in elderly women (Lucht 1971, Cook et al. 1982), and minor traumas are more likely to produce fractures. Wild et al. (1981) found that 3/125 falls in the home among people aged 65 and over lead to a fracture of the femur. Increased postural sway (Crilly et al. 1987) and decreased bone mineral content (Eastell et al. 1987) have been found in patients with Colles' fracture. These patients have also an increased risk of hip fracture (Gay 1974, Owen et al. 1982).

Earlier investigations have demonstrated subgroups of patients with various fractures who had an increased risk of other fractures but no association to osteoporosis was evident (Johnell and Nilsson 1985). Another study has indicated postfracture osteopenia to be of relevance for the subsequent risk of certain fractures (Finsen et al. 1989).

We found that the risk of a later hip fracture in patients who sustained a limb or spine fracture was highest within the first years following the primary fractures, and this may indicate that the increased risk may be due to imbalance and a greater propensity to fall rather than to osteoporosis.

The relative risk may not seem increased dramatically, but a 2-fold increased relative risk for a common disease is obviously important. The increased relative risk among the younger women in the study may not be of major clinical relevance compared to the same increased risk of hip fracture among the elderly women. Among postmenopausal women with fracture, the increased mortality compared to the background population may be related either to the actual trauma and the following complications or to the general state of health.

Even though the present population with fractures had an increased mortality, we suggest that these postmenopausal women with an increased risk of later hip fracture should be evaluated with the purpose of preventing later hip fractures. An interventional action may be aimed at the life style, home environment, medications which interfere with balance and postural capability, medication against osteoporosis and trauma-reducing arrangements, such as hip cushions.

Acknowledgement

This study was supported by grants from the Danish Hospital Foundation for Medical Research, Region of Copenhagen, The Faroe Islands and Greenland and by grants from Novo, and the Danish Medical Council.

References

Albright F, Smith P H, Richardson A M. Postmenopausal osteoporosis. Its clinical features. JAMA 1941; 116: 2465–74.

Altman D G. Practical statistics for medical research. Chapman and Hall, London 1991; 456.

Breslow N E, Day N E. Statistical methods in cancer research. Volume II The design and analysis of cohort studies. IARC Sci Publ 1987 (82): 1–406.

Cook P J, Exton Smith A N, Brocklehurst J C, Lempert Barber S M. Fractured femurs, falls and bone disorders. J R Coll Physicians Lond 1982; 16 (1): 45–9.

Cox D R. Regression models and life-tables. J Royal Statist Soc B 1972; 34: 187–202.

Crilly R G, Delaquerriere Richardson L, Roth J H, Vandervoort A A, Hayes K C, Mackenzie R A. Postural stability and Colles' fracture. Age Ageing 1987; 16 (3): 133–8.

Eastell R, Wahner H W, O Fallon W M, Amadio P C, Melton L J, Riggs B L. Osteoporosis and the risk of Colles' fractures. In: Osteoporosis 1987. (Eds. Christiansen C, Johansen J S, Riis B J) Osteopress Aps, Copenhagen 1987; 1: 424–5.

Finsen V, Benum P. Past fractures indicate increased risk of hip fracture. Acta Orthop Scand 1986; 57 (4): 337–9.

Finsen V, Haave Ø, Benum P. Fracture interaction in the extremities, The possible relevance of posttraumatic osteopenia. Clin Orthop 1989; 240: 244–9.

Foldspang A, Juul S, Olsen J, Sabroe S. Epidemiologi. Sygdom og befolkning. Munksgaard, Copenhagen 1986: 102.

Gay J D. Radial fracture as an indicator of osteoporosis: a 10 year follow-up study. Can Med Assoc J 1974; 111 (2): 156–7.

Johnell O, Nilsson B E. Hip fracture and accident disposition. Acta Orthop Scand 1985; 56 (4): 302–4.

Lucht U. A prospective study of accidental falls and resulting injuries in the home among elderly people. Acta Sociomed Scand 1971; 3 (2): 105–20.

Owen R A, Melton L J, Ilstrup D M, Johnson K A, Riggs B L. Colles' fracture and subsequent hip fracture risk. Clin Orthop 1982; 171: 37–43.

Riggs B L, Wahner H W, Seeman E, Offord K P, Dunn W L, Mazess R B, Johnson K A, Melton L J. Changes in bone mineral density of the proximal femur and spine with aging. Differences between the postmenopausal and senile osteoporosis syndromes. J Clin Invest 1982; 70 (4): 716–23.

Sylvest A, Lund N A, Lauritzen J B, Hegnhøj J. Skiing injuries among Danes in Austria. Scand J Med Sci Sports 1991; 1: 225–7.

Wild D, Nayak U S, Isaacs B. How dangerous are falls in old people at home?. Br Med J (Clin Res Ed) 1981; 282 (6260): 266–8.