One fracture is enough!

Experience with a prospective and consecutive osteoporosis screening program with 239 fracture patients

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Background **Fracture and low bone mineral density both have strong predictive value for future fractures. The risk of future fractures can be reduced by medical treatment if patients with osteoporosis are identified, for example by screening fracture patients for low bone mineral density. We suggest that these screening routines be organized at orthopedics departments and we report our experience with such a screening system.**

Patients and methods **We screened all patients between 50–75 years of age with a wrist, vertebral, proximal humerus, or hip fracture visiting our orthopedics department by measuring bone mineral density (BMD) using DEXA scans. After diagnosis, the patients were referred to their primary care physician for treatment.**

Results **Between November 1, 2002, and October 31, 2003, 239 patients were investigated and only 13% had normal BMD values. 45% of the patients were diagnosed with osteopenia and 42% with osteoporosis.**

Interpretation **Screening of fracture patients who visit an orthopedics department appears to be an effective way of identifying individuals with low bone mineral density. The screening routines can be organized as an osteoporosis team consisting of a doctor, a nurse and a secretary at each department. Today, these patients are largely undetected and untreated—at least in our region. In our series, only 13 patients had been DEXA-scanned and were treated by antiresorptive drugs at the time of fracture.**

Osteoporosis leads to an increasing incidence of fragility fractures with age. Scandinavia has the highest incidence of hip fractures in the world (Johnell et al. 1992, Kanis et al. 2002), and the lifetime risk of sustaining a fragility fracture in Sweden is 50% for women and 25% for men (Obrant et al. 1989). Worldwide, the annual number of hip fractures is expected to rise from 1.7 million in 1995 to 6.3 million by 2050 (Cooper et al. 1992).

Orthopedic surgeons tend to treat only the current fracture. However, medical treatment of a patient with a fragility fracture can reduce the risk of a future fracture by up to 90% (Lindsay et al. 2004). The results seem to be most beneficial in patients with low BMD (Black et al. 1996, Russel et al. 1999) but low BMD is only one of the risk factors, and not an indicator of the disease itself; it has limited predictive value as an isolated risk factor (Kanis et al. 2004). Thus, it is not cost-effective or feasible to screen an entire population using DEXA scans (SBU report 2003). In individuals for whom additional risk factors such as a fracture are present, BMD measurements have a stronger predictive value of future fractures—which justifies screening of fracture patients (Mallmin et al. 1993, Klotzbucher et al. 2000, SBU report 2003). Such screening for osteoporosis is not common (Dreinhöfer et al. 2004). It seems practical that the orthopedics departments should develop routines to screen fracture patients for osteoporosis, even though the treatment might be administered elsewhere. Our hypothesis was that fracture patients

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have lower BMD than the population in general, and we also wanted to test whether a screening routine can be managed with limited resources. At our hospital, a team consisting of a doctor, a nurse, and a secretary perform the screening on a part-time basis for the entire orthopedics department with a total of 40 surgeons. We present the first-year results.

Methods

The Orthopedics Department at Lund University Hospital serves a population of approximately 280,000 inhabitants. All patients between 50–75 years of age presenting at our department with a low-energy distal radius-, vertebra- or hip fracture between November 1, 2002 and October 31, 2003 were included in the screening. Low-energy fractures were defined as falls in the same plane. The upper age limit was chosen to avoid overloading of the screening routine. We also prioritized finding patients in the early stages of osteoporosis, where preventive treatment might be of value. From May 2003, proximal humeral fractures in the same age group were also included. One nurse identified the fracture patients using three methods: 1) to determine the cause of admission in the computerized entry log of the emergency room, 2) to identify fractures in the preliminary statements from the radiology department on radiographs ordered by the doctors in the emergency rooms, and 3) to study the ICD-code of diagnosis from the computerized records of the orthopedics department. This triple means of identifying patients was adopted for convenience and to minimize the risk of dropouts due to malregistration or lack of registration. Patients occurring in any of these registers were included. The patients were visited at the orthopedics ward and interviewed. If being treated as outpatients, the patients were interviewed by telephone or received a questionnaire concerning risk factors for osteoporosis by post. The assessed risk factors included smoking, previous falls and fractures, steroid treatment, loss of height or weight, heredity, and early menopause. Height and weight were measured to calculate the BMI. The questionnaire was deliberately kept short—one page only—to assure high compliance and minimize administrative work.

Table 1. Stratification protocol for admitting patients to Endocrinologist

Men	< 65 years	DEXA > –2.5 SD
Women	< 60 years	DEXA > –2.5 SD
	60–65 years	DEXA > –3.5 SD

If the patients were able to and agreed to participate, and had not been examined previously, they were admitted for a DEXA-scan (Lunar Expert XL; GE Lunar, Madison, WI). At the Department of Physiology in Lund, 6 doctors were involved in the interpretation of the DEXA results, using a standard definition of BMD-based diagnose with < 1 SD below reference values as normal, < 2.5 SD as osteopenia and below 2.5 SD as osteoporosis (Kanis 1994). The results of the scans were evaluated and a diagnosis of "normal", "osteopenia" or "osteoporosis" was established. The questionnaires and the DEXA results were recorded in a database, and the patients received a copy of their questionnaire, the result of the DEXA scan and two preprinted standard letters based on the diagnosis. Of these, one was addressed to the patient, recommending a contact with their primary care physician or other doctor of their own choice. The patients were encouraged to ask for a discussion regarding osteoporosis and treatment options with their chosen doctor. To minimize the risk of documents being lost and to facilitate administrative work, the patients were asked to bring the above-mentioned documents to the visit themselves. The second preprinted standard letter sent to the patient was for their chosen doctor, with advice concerning laboratory tests and treatment. Comparatively young patients with a diagnosis of osteoporosis were referred to an endocrinologist for evaluation according to a stratification protocol, based on age and BMD values and designed in collaboration with the colleagues at the endocrinology department (Table 1).

338 patients (84 males) were contacted according to the criteria above. Of these, 196 had distal radius fractures (36 males), 87 had hip fractures (38 males), 27 had vertebral fractures (5 males) and 28 had proximal humerus fractures (5 males). 1 of the hip fracture patients sustained a simultaneous fracture of proximal humerus but was only

Table 2. Fracture types and gender

	Wrist	Hip	Vertebral	Proximal humerus
Women	122	34	14	18
Men	16	29	3	3
Total	138	63	17	21

registered as a hip fracture patient once in the database. 99 patients were excluded: 33 were considered to have had high-energy fractures, 8 could not participate due to illness (1 patient), dementia (4), poor language skills (2) or living far away (1). 28 did not want to participate or did not respond to the questionnaire. Only 13 patients had been examined already and were under treatment for osteoporosis. Another 4 patients with known result of a DEXA scan, but untreated, were included in the screening program on the basis of their previous scans. Thus, 256 patients were referred for a DEXA scan (54 males). 16 patients did not show up for the DEXA scan (3 males) and 1 woman died before undergoing the scan. After the DEXA scan, comparisons were made with DEXA reference data concerning the age groups 50–59 and 60–69 years of age (DPX-series Operator Manual).

Statistics

From the database, statistical analysis of the different risk factors in the questionnaires and their relation to the diagnosis of "osteoporosis" was performed (SPSS software). Logistic regression analysis was done, and as dependent variables, the diagnoses "normal" and "ostopenia" were set to "0" and "osteoporosis" to "1". A forward stepwise likelihood ratio test was performed as an omnibus test of model coefficients.

Results

239 patients (51 males) underwent DEXA scans. Of these, 13% had a normal bone mineral density (< –1 SD), 45% had osteopenia (< -1–2.5 SD) and 42% had osteoporosis (< –2.5 SD).

Of the risk factors, age ($p = 0.01$) and BMI ($p = 0.04$) were associated with the "osteoporosis" diagnosis. No association with the diagnoses "normal", "osteopenia" and "osteoporosis" was found for any of the following parameters: gender, previous fractures, previous falls, previous cortisone treatment, weight loss, height loss, mother had hip fracture or menopause before 45.

The mean age of the patients undergoing DEXA scans was 64 (SD 7) and there were almost four times as many women (188) than men (51). The number of females and males in each fracture-type group corresponded roughly to this ratio, except hip fractures, where there were almost as many males with hip fractures as females (Table 2). The age distribution within the different fracture types was roughly similar regarding wrist fractures in females and males, and regarding male hip fractures. The hip fractures in women showed a higher relative incidence above 65 years of age (Table 3). Proximal humerus fractures were only registered for the last 6 months of the test period, so the number was small (21), as was the registered number of vertebral fractures (17). Among the fracture types, hip fractures and vertebral fractures were more often associated with the diagnosis "osteoporosis", both among men and women (Table 4). The screened fracture patients in the 50–69 age range had a BMD that was more than 1.5 SD lower on average than the reference populations (Table 5).

Table 3. Fractures divided into fracture types and age groups

	50–54 years		55–59 years		60–64 years		65–69 years		70–75 years	
	Women	Men	Women	Men	Women	Men	Women	Men	Women	Men
Wrist fracture	22	4	26	2	20	3	28	4	26	3
Hip fracture	1	3	3	6	4	7	11	4	15	9
Vertebral fracture	2	0	2	1	1	2	4	0	5	0
Proximal humerus fracture	2	0	4	1	2	2	1	0	9	0

Table 4. Distribution of diagnoses according to fracture type

	Wrist		Hip		Vertebral		Proximal humeral	
	Women	Men	Women	Men	Women	Men	Women	Men
Normal	19	4	2	1	1	0	3	1
Osteopenia	62	8	13	9	4	11	0	1
Osteoporosis	41	4	19	19	9	2	5	1

Table 5. BMD values of fracture patients in comparison with reference population (DPX-series Operator's Manual)

			Fracture group			Reference group			Difference in BMD [b]
Site	Sex	Age	BMD [a]	SD	n	BMD [a]	SD	n	SD
Lumbar spine	Female	50–59	0.92	0.17	62	1.10	0.12	2,472	–1.50
		60–69	0.82	0.16	70	1.02	0.12	1,942	–1.66
	Male	50–59	0.93	0.12	17	1.14	0.12	250	–1.79
		60–69	0.96	0.21	22	1.16	0.12	400	–1.72
Cervical neck	Female	50–59	0.76	0.13	62	0.88	0.12	1,799	–1.03
		60–69	0.64	0.14	70	0.82	0.12	1,433	–1.53
	Male	50–59	0.68	0.15	17	0.96	0.13	319	–2.13
		60–69	0.61	0.21	22	0.91	0.13	428	–2.29

[a] BMD in g/cm^2.
[b] Fracture group versus reference group.

Discussion

Identification of patients with osteoporosis is a challenge, since in its early stages the condition is often asymptomatic and difficult to detect. Screening of an entire population for osteoporosis using DEXA scans has been shown to be less feasible (SBU report 2003), but a recent review has proposed DEXA scans of all women over 65 years of age, and of younger women and men who have had a fragility fracture (Raisz 2005). However, it is debatable whether age or an event such as a fracture should be used to justify a DEXA scan, at least regarding middle-aged patients. Individuals below 65 years of age are perhaps even more important to consider regarding osteoporosis screening, since treatment at an earlier stage is more likely to prevent fractures.

The DEXA scan is a two-dimensional measurement of mineral content, and does not measure the three-dimensional architecture of the bone. Methods of analysis of bone architecture, for example micro-CT, exist but their availability is severely limited at present for practical reasons—high radiation and various other considerations. Regarding skeletal metabolism, there is an evolutionary advantage in achieving high strength while maintaining low weight, and optimal trabecular orientation can compensate to some extent for low bone mineral content. Consequently, the DEXA scan cannot fully distinguish between an optimized and a degraded bone. A fracture can, however, be regarded as an indicator of suboptimal bone architecture since the bone has failed.

The first fracture is therefore an opportunity to find individuals in a population with a low BMD, suggestive of low bone strength and perhaps low bone quality (Homminga et al. 2002) with a fourfold risk of future fracture (Robinson et al. 2002). Our study has confirmed that among fracture patients, the proportion of patients with osteoporosis or osteopenia is high, and 87% of the patients had BMD at least 1 SD below the mean for young healthy subjects. It therefore appears that a fracture is a relevant selection criterion to merit the deployment of a DEXA scan, especially if it leads to appropriate treatment.

With our data, one might argue that we should start to treat all fracture patients for osteoporosis without the DEXA measurement, since most frac-

ture patients have a low BMD anyway. We do not agree with this, for a number of reasons. Firstly, a set of laboratory tests must be considered in osteopenic or osteoporotic patients to check for secondary osteoporosis, such as parathyroid or kidney-related disease. Secondly, a DEXA scan is valuable for assessment of the degree of osteopenia or osteoporosis, in order to determine what type of treatment is appropriate for the individual patient. Thirdly, an initial DEXA measurement allows monitoring of the therapy by a later scan, which can confirm improvement or suggest a change of therapy. Furthermore, the fragility fractures most commonly associated with increased mortality and morbidity are hip and vertebral fractures (Keene et al. 1993, Hasserius et al. 2003). To predict the future risk of such a fracture, optimal measurement must be done at the site of risk. The DEXA scan is currently the only method which allows that (SBU report 2003). It is therefore superior to methods measuring only one site, for example calcaneal scans.

Where DEXA scanners are not available, risk factors are often considered as an alternative to identify which patients need preventive treatment against osteoporosis. In our study, the risk factor fracture was present, and only high age and low BMI were associated with a further increase in the rate of the diagnosis "osteoporosis". Another interesting observation from our data is that male patients with fractures of the femoral neck had an even more pronounced reduction in BMD compared to the reference group. However, we feel that our material is too small to draw definite conclusions concerning the merits or limitations of risk factors and how well they can predict the diagnosis of osteoporosis among fracture patients, and this can also be true considering our observation regarding male femoral neck fractures.

Fragility fracture patients appear at orthopedics departments, and the orthopedic surgeon has an opportunity not only to treat the fractures but also to identify patients at risk of future fractures and to prepare for, or initiate, preventive treatment. If the patient is in hospital care for the first time, that opportunity might in itself improve the chances of reaching the patient with information, and help to motivate, educate and start the patient on treatment. Hypothetically, one can look upon the chronic and progressive disease of osteoporosis as a sequence of fractures. The distal radius fracture often occurs as the index fracture as much as 20 years before the other fragility fractures (Robinson et al. 2002). The fracture sequence can end in a final hip fracture, which is the most demanding to treat and which sends 25% of such patients to nursing homes (Cree et al. 2000). However, if patients with low BMD are identified already after their first fracture of the distal radius, we can apply effective treatment to prevent or at least postpone subsequent fragility fractures (Black et al. 1996, Lindsay et al. 2004).

Osteoporosis screening for fracture patients has been suggested by several authors (Tosi and Lane 1998, Stephen and Wallace 2001). However, screening routines must be organized in orthopedic departments where the patients are seen. We have shown how they can be organized as a small team; a doctor, a nurse, and a secretary. In our experience, the identification of patients to be screened works best if handled by only a few personnel and if separated from normal emergency room procedures, where treatment of the fracture usually takes precedence. Apart from the nurse identifying the patients, the workload required for the screening reported here is limited. We chose to outsource the treatment and let the patient himself/herself take responsibility for the contact with the house physician, but this can be organized differently depending on what is most practical according to local tradition or routines.

Our study has a number of limitations. We had a low number of vertebral fractures, probably because it is not uncommon for patients presenting with low back pain to be diagnosed with lumbago without undergoing a spinal radiograph, or perhaps the patient never comes to a doctor at all. The overall number of patients is relatively small, which must be considered when discussing the association between risk factors and diagnosis. We chose not to instigate treatment at the orthopedics department, and as a result we do not yet know how many of the patients really received treatment for osteoporosis. Our screening routine is continuing, and feedback from colleagues in general practice and planned questionnaires to our patients will hopefully give us answers to how many patients receive treatment. This will possibly allow prediction of how many fractures this screening routine can prevent.

Author contributions

JÅ study concept and design, acquisition of the data, drafting of the manuscript. JÅ and MT analysis and interpretation of the data. MT statistical expertise. MT and KGT critical revision of the manuscript for important intellectual content. KG obtained funding, administrative, technical, or material support.

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