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Research Article

Study of Contralateral Hip in Patients with Hip Fracture

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Abstract

Background: This study was done to know whether patients with hip injury have pre-existing osteoporosis due to which, the patient sustained the fracture, subsequent fracture of the contralateral hip, any osteoarthritic changes of the contralateral hip at the time of index fracture, and ten-year probability of a major osteoporotic fracture by calculating fracture risk assessment percentage (FRAX%).
Methods: 34 patients were evaluated for age, gender, body mass index (BMI), fracture type, Singh index, bone mineral density (BMD), T-scores using dual-energy X-ray absorptiometry (DEXA) scan, and ten-year probability of fracture using FRAX%.
Results: Average age of the patients with hip fractures was 72.1 years. About 85% of patients were women. 67.6% of the patients were with BMI of 18.5-25 kg/m^2. The Singh index for osteoporosis fell in grades 2 and 3 in most patients. The mean interval between index fracture and contralateral hip injury was 4.25 years. Osteoarthritis of the contralateral hip was seen in 9%. The probability in ten years of hip fracture in 30 indexed patients using the FRAX% tool was 15%, and for 4 patients who were having bilateral hip fractures was 22.75%. There was a significant relationship between FRAX% with the Singh index and osteoarthritis of the contralateral hip. FRAX% was high in female patients.
Conclusion: Contralateral hip fracture in patients with osteoporosis was high in women and patients with low and high BMI. Fractures were also high in patients with low Singh index and T-scores. FRAX% increased with an increase in age and increased with a decrease in T-score.

Keywords: Osteoporosis; Hip Fractures; Osteoarthritis

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Background

It is a known fact that there is an increasing number of the elderly population besides the growing number of both unilateral and bilateral hip injuries which impose a significant burden both on the individual and the family, as well as on the health care system. Hip fractures most of the time will have an impact on a patient's life, with mortality rates of 18% to 32% compared to 15% of vertebral fractures in one year (1-4). Osteoporosis-related fractures have been identified as risk factors for sustaining subsequent fractures after the initial fracture particularly during the first two years (5, 6). The incidence of contralateral hip fracture varies from 2.38% to 13.80% (7, 8). The one-year risk was 2%, with a short interval between the two hip injuries (8).

The contralateral femur continues to weaken during the year following the fracture, potentially increasing the risk of a second fracture (9). During the first year after a hip fracture, there is a rapid loss of bone minerals from the lumbar spine and contralateral femoral neck (10). The Singh index is commonly used to assess osteoporosis and is based on the radiological appearance of the trabecular bone structure of the proximal femur on a plain anteroposterior radiograph (11). Osteoporosis using a bone mineral density (BMD) measurement that estimates the bone strength by dual-energy X-ray absorptiometry (DEXA) is the most widely used screening and diagnostic method and it is a mostly validated technique. The osteoporosis was defined by World Health Organization (WHO) as a BMD greater than 2.5 standard deviations (SDs) below the average. Fracture risk assessment percentage (FRAX%) is a computerized fracture risk algorithm with the use of clinical risk factors with or without femoral neck BMD. It calculates the ten-year probability of a major osteoporotic fracture in both men and women (12). These risk factors include age, sex, race, height, weight, body mass index (BMI), fragility fractures history, history of hip fractures in parents, glucocorticoid intake, inflammatory arthritis like rheumatoid, any secondary causes for osteoporosis, smoking, and intake of alcohol three or more units daily. Identifying high-risk groups is essential to elaborate effective prevention strategies for second hip fractures (8-12).

The study was done to know whether patients with hip fracture have pre-existing osteoporosis due to which, the patient sustained the fracture, any osteoarthritic changes of the contralateral hip at the time of index fracture, subsequent fracture of the other hip, and the probability of a major osteoporotic fracture in ten years by calculating FRAX%.

Methods

Out of 34 patients aged above 55 years, 30 patients who had the first incidence of fracture around the hip were observed and evaluated both clinically and radiologically to note the type of fracture, BMI, osteoporotic grading using Singh index of the other hip, and their FRAX% using the calculator tool. Eighteen patients falling under grade 1, 2, and 3 osteoporosis were sent for a DEXA scan to note their BMD and T-scores. Four patients with one-side old hip injury were attended with second-side hip injury and studied as above. Their Singh index and FRAX% were calculated based on their history and radiographs retrospectively. For all 34 patients, a history of on and off

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osteoporotic medication was also noted. The study was initiated after obtaining approval from the Institutional Ethics Committee and all patients signed informed consent.

Results

Most patients were between the ages of 71-80 years (47.1%), followed by 61-70 years (32.4%). The average age of the patients with hip fractures was 72.1 years (range: 59-90, SD: 8.1). About 85% of patients were women. Most patients (67.6%) had a BMI of 18.5 to 25 kg/m^2, and the mean BMI was 24.5 (range: 18-29, SD: 3.3). The intracapsular femur neck fracture was the most frequent type of fracture, i.e., 55%. The Singh index fell in grades 2 and 3 osteoporosis in most patients, i.e., 20.6% and 38.2%, respectively. The mean time interval between index fracture and contralateral hip injury was 4.25 years (range: 3-6, SD: 1.5). Osteoarthritis of the contralateral hip was seen in 9% of patients. The majority of the patients (56%) were not taking any medications for osteoporosis regularly. Most patients were osteopenic, followed by osteoporosis (T-score range: -2.6 to 1.0, mean ± SD: -1.7 ± 0.9) (Table 1).

The ten-year probability of hip fracture in 30 indexed patients using the FRAX% tool ranged from 5% to 41%, and the mean FRAX% score was 15%; for 4 patients with bilateral hip fractures, the score was 22.75% when retrospectively studied. Age and FRAX% were in significant correlation (r: 0.433) with a significant P-value (0.017). Mean FRAX% was high in the age group of 71-80 years (range: 5-41, mean ± SD: 18.20 ± 9.50). Women had a higher risk of contralateral hip fractures. Patients with low BMI had a high risk of fracture, followed by obese patients (mean FRAX% of 21 and 18.31, respectively). The patients with intracapsular neck of femur fracture had a high risk of fracture of the contralateral hip (mean and SD of FRAX%: 15.66 ± 8.61). Patients with the Singh index of 1, 2, and 3 had higher FRAX% of 12, 19.83, and 16.47, respectively. There was a significant relationship between FRAX% and associated osteoarthritis of the contralateral hip as the P-value was < 0.05. The mean FRAX% of patients with bilateral fracture (22.75%) was greater than that of unilateral hip fracture (15%). The mean T-score decreased with a decrease in Singh index grading with a P-value of 0.132 and an R-value of 0.368 (Table 2).

Discussion

Age shows a wide variety in the incidence of second hip fractures. There is a risk of subsequent hip fracture with increasing age. Yamanashi et al. demonstrated no significant difference in the incidence of second hip fracture in relation to age in the Japanese elderly (13). Angthong et al. reported that the risk of sustaining a second hip fracture was greater in patients over 85. In practical terms, the role of age is considered to be an influential factor (14). In our study, the risk of subsequent hip fracture increased with age. In this study, there were 85% of women, with a clear predominance of hip fractures over men.

Data from the study of osteoporotic fractures showed that total body weight, fat mass, body fat percentage, hip girth, and BMI were inversely associated with fracture risk before correction for BMD. When adjustment for BMD was performed, the relationship appeared to be U shaped, confirming that the effect of BMI on fracture risk is non-linear (15). BMI of less than 18.5 kg/m^2 and more than 25 kg/m^2 in older people had been widely linked to an increased fracture risk in this study, which is in correlation with the literature. The patients with intracapsular neck of femur fracture were at higher risk of fracturing the contralateral hip in comparison to trochanteric fracture in this study. The median interval between two hip fractures varies between 12 months to 5 years in the literature (15-18); in this study, it was 4.25 years. These times seem longer after a trochanteric fracture, a mean of 60 months after a neck fracture versus 68 months after a trochanteric fracture. This difference may be explained by the time required to regain autonomy, which is usually longer after conservative treatment than after hip replacement (19).

Table 1. Distribution of age, gender, type of fracture, Singh index, bone mineral density (BMD), and body mass index (BMI)

Distribution		n (%)	Range	Mean ± SD
Age (year)	< 60	4 (11.8)		
	61-70	11 (32.4)		
	71-80	16 (47.1)	59-90	72.10 ± 8.10
	81-90	3 (8.8)		
	Total	34 (100)		
Sex	Women	29 (85.3)		
	Men	5 (14.7)		
	Total	34 (100)		
BMI (kg/m^2)	< 18.5	3 (8.9)		
	18.5-25.0	23 (67.6)	18-29	24.50 ± 3.30
	> 25	8 (23.5)		
	Total	34 (100)		
Type of fracture	ICNF	21 (55.5)		
	IT	17 (44.5)		
	Total	38 (100)		
Singh index	Grade 1	2 (5.9)		
	Grade 2	7 (20.6)	Osteoporosis	
	Grade 3	13 (38.2)		
	Grade 4	5 (14.7)	Osteopenia	
	Grade 5	5 (14.7)		
	Grade 6	2 (5.9)	Normal	
	Total	34 (100)		
Osteoarthritis on the other hip	Present	3 (8.8)		
	Absent	31 (91.2)		
	Total	34 (100)		
Hip DEXA BMD and T-scores	BMD (G/cm^2)	18 (100)	0.684-1.134	0.77 ± 0.10
			T-score	
	> 0	1 (5.5)	Normal	
	-1 to -2.4	12 (66.7)	Osteopenia	
	> -2.5	5 (27.8)	Osteoporosis	
	Total	18 (100)	-2.60 to 1.00	

BMI: Body mass index; BMD: Bone mineral density; DEXA: Dual-energy X-ray absorptiometry; ICNF: Intracapsular neck of femur; IT: Intertrochanteric; SD: Standard deviation

Table 2. Fracture risk assessment percentage (FRAX%) in relation to age, body mass index (BMI), bone mineral density (BMD), and T-scores

Distribution		N	Minimum	Maximum	Mean ± SD	P-value	R-value
Age (year)	< 60	4	5.2	20.0	9.70 ± 6.98	0.017	-0.433
	61-70	9	9.0	18.0	12.56 ± 3.47		
	71-80	15	5.0	41.0	18.20 ± 9.50		
	81-90	2	12.0	15.0	13.50 ± 2.12		
	Total	30	5.0	41.0	15.06 ± 7.96		
Gender	Women	25	5.2	41.0	15.83 ± 8.25		
	Men	5	5.0	18.0	11.20 ± 5.26		
	Total	30	5.0	41.0	15.06 ± 7.96		
BMI (kg/m2)	< 18.5	2	12.0	30.0	21.00 ± 12.73	0.958	-0.010
	18.5-25.0	21	5.0	29.0	13.41 ± 5.95		
	> 25	7	5.2	41.0	18.31 ± 11.27		
	Total	30	5.0	41.0	15.06 ± 7.96		
Type of fracture	ICNF	17	5.2	41.0	15.66 ± 8.61		
	IT	13	5.0	29.0	14.28 ± 7.28		
	Total	30	5.0	41.0	15.06 ± 7.96		
Singh index	Grade 1	2	12.0	12.0	12.00 ± 0.00		
	Grade 2	7	10.0	30.0	19.83 ± 8.04		
	Grade 3	13	5.0	41.0	16.47 ± 10.27		
	Grade 4	5	5.6	16.0	11.12 ± 4.03		
	Grade 5	5	9.0	18.0	12.20 ± 3.77		
	Grade 6	2	8.0	15.0	11.50 ± 4.95		
	Total	34	5.0	41.0	15.06 ± 7.96		
Osteoarthritis	Present	3	18.0	30.0	24.67 ± 6.11	0.030	
	Absent	27	5.0	41.0	13.09 ± 7.48		
	Total	30	5.0	41.0	15.06 ± 7.96		
Fracture	Unilateral	30	5.0	41.0	15.06 ± 7.96	0.090	
	Bilateral	4	14.0	41.0	22.75 ± 12.07		
Singh index	Grade 1	1	-2.5	-2.5	-2.50 ± 0.00	0.132	-0.368
	Grade 2	6	-2.6	-1.0	-2.18 ± 0.64		
	Grade 3	11	-2.0	1.0	-1.54 ± 0.86		
	Total	18	-2.6	1.0	-1.70 ± 0.90		

BMI: Body mass index; ICNF: Intracapsular neck of femur; IT: Intertrochanteric; SD: Standard deviation

In 1994, the WHO defined a T-score equal to or less than -2.5 as osteoporosis and the same T-score with a history of fractures as severe osteoporosis. The important factors for knowing osteoporosis by screening appear to be T-score and age. For women of postmenopausal age with normal BMD or mild osteopenia at baseline, to repeat screening clinicians can wait up to 15 years; postmenopausal women with moderate osteopenia at baseline can be screened every five years, and those with advanced osteopenia should be screened yearly (20).

In this study, majority of patients with hip fracture had their Singh index grade of the contralateral hip with grades 1, 2, and 3, i.e., osteoporosis, followed by grades 4 and 5, i.e., osteopenia. FRAX% increases with low grades of Singh index of the contralateral hip, predisposing to fractures. FRAX% increased with a decrease in T-score, i.e., FRAX was inversely related to T-score and BMD. According to Angthong et al. (14), the Singh index of grade ≤3 showed the highest associations with second hip fractures in both univariate [odds ratio (OR): 18.9, 95% confidence interval (CI): 5.8-65.9, P < 0.001] and multivariate (OR: 30.0, 95% CI: 7.9-112.9, P < 0.001) analyses (21, 22).

Female patients had higher FRAX% in comparison with male patients in this study, and an increase in age increases the mean FRAX% and further increases in patients with low BMI and low BMD. Many of the patients with both hip fractures and hip osteoarthritis had a hip fracture due to secondary osteoporosis. The prevalence of hip osteoarthritis radiographically in the contralateral hip of patients with hip fracture was nearly 12% which was in correlation with our study of about 10% (21, 22). Osteoarthritis of the other hip seems to be a significant risk factor for subsequent other hip fractures, which is not included in the FRAX% calculation. Our study suggests that osteoarthritis of the other hip should be included as a risk factor in the FRAX% calculator tool.

Most of the patients in this study did not use regular medications to lower the fracture risk. The National Osteoporosis Foundation recommends that women of postmenopausal age and 50-year-old men and older should be considered for treatment if they have a fragility fracture, hip or vertebral fracture. Those with a T-score less than -2.5 at the femoral neck or spine and a 10-year risk score FRAX% of at least 3% for hip fracture or at least 20% for major other osteoporotic fracture are also considered for treatment (21, 22). Bisphosphonates, selective estrogen-receptor modulators, calcitonin, estrogen, human recombinant parathyroid hormone teriparatide, and denosumab are a few treatment options for osteoporosis. This study requires a large population and long duration, as the changes in the contralateral hip are late and require a number of follow-ups; DEXA also has limitations in studying BMD.

Conclusion

The majority of the patients were aged 71-80 years. Contralateral hip fracture risk, as assessed by FRAX%, increased with an increase in age. Women were at higher risk of contralateral hip fracture. Patients with low BMI were at higher risk of sustaining a subsequent contralateral hip fracture, followed by patients with high BMI, that is, obese patients. Most patients with Singh index grades 1, 2, and 3 who come under osteoporosis have higher FRAX% indicating a high risk of contralateral hip fracture. FRAX% increased with a decrease in T-score, indicating that osteoporosis and osteopenia are risk factors for subsequent contralateral hip fracture. Four patients presented with bilateral hip fractures with a mean interval of 4.25 years. Osteoarthritis changes in the contralateral hip were found in 9% of patients. Osteoarthritis of the contralateral hip carries a high risk of hip fracture with a mean FRAX% of 24.67%. Most patients (55.9%) did not take any medication for osteoporosis prevention, and thereby developed a hip fracture.

Conflict of Interest

The authors declare no conflict of interest in this study.

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