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An age- and sex-controlled matched pair analysis of T scores in ethnic Indians with hip fractures

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ABSTRACT

Objective. The first study to predict peritrochanteric fractures by the use of T scores amongst the Indian population was performed. This study aimed to assess the risk of fracture around the hip in peri-menopausal and postmenopausal women, and in men over the age of 35 years using dual energy X-ray absorptiometry, and to analyse whether the result, i.e. the T score, can predict an impending hip fracture.
Methods. T scores of the unaffected hip in 30 patients with peritrochanteric fractures were determined, and matched pair analysis was done using a control group without fracture. All patients were from a single centre and were evaluated using the same scanner.
Results. The mean T score of the 30 patients in the fracture group was -3.34 (range, -1.2 to -5.1; standard deviation [SD], 1.032), compared with the mean T score of the 30 control subjects which was -2.41 (range, 0.6 to -5.0; SD, 1.378). T scores of patients from the fracture group were significantly lower than those in the control group.
Conclusion. We infer that T scores are the best predictors for fracture risk. A score of -2.5 or lower effectively defines patients at risk and is useful for predicting fracture risk in the Indian population. In patients with osteoporosis, whether a fall precedes the fracture or the fracture precedes a fall may not be an issue of debate, but can serve as a basis for prevention of additional fractures by instituting appropriate measures in patients at risk.

Key words: *femur neck, intertrochanteric; osteoporosis; risk; T score*

INTRODUCTION

Osteoporosis is a major health and economic problem. It is a silent disease and its first clinical sign may be a fracture, usually of the spine, hip, or lower end of the radius. It is estimated that by the year 2020, a world population of more than 1000 million people will be aged 60 years or above, with more than 700 million of them living in developing countries.[1] More than 142 million of this group will be in India. Today there are approximately 580 million elderly people in the world, with 355 million in developing countries. By the year 2020, it is projected that 75% of all deaths in developing

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countries would be age related. One in 4 women and one in 8 men older than 50 years are believed to have osteoporosis.[2,3]

Osteoporosis is characterised by low bone mass and microarchitectural deterioration of bone tissue, leading to increased bone fragility and risk of fracture. The condition is difficult to be defined accurately. It is an abnormal reduction of bone tissue mass per unit volume of anatomic bone, i.e. the total quantity of bone is diminished but the bone that is present is qualitatively normal.[4]

Because the absolute values of bone mineral density (BMD) measurement vary with different densitometers, BMD is expressed as a T score. T score is the standard deviation (SD) of BMD or bone mineral content (BMC) from the expected BMD for a young normal adult of the same sex.

WHO definitions of osteoporosis, osteopenia, and normal bone mass

The WHO defines normal bone mass, osteopenia, and osteoporosis as below[3]:

Normal: Value for BMD or BMC measurement within 1 SD of the young adult mean. T score is -1.0 or above.
Osteopenia (low bone mass): Value for BMD or BMC of more than one SD but less than 2.5 SD below the young adult mean. T score is between -1.0 and -2.5.
Osteoporosis: Value for BMD or BMC of 2.5 SD or more below the young adult mean. T score is -2.5 or lower.
Severe osteoporosis (established osteoporosis): Value for BMD or BMC of more than 2.5 SD below the young adult mean in the presence of one or more fragility fractures. T score is -2.5 or lower, or with fragility fracture(s).

These definitions are currently applicable only to postmenopausal white women.[5] There has been no previous study specifically of ethnic Indians.

MATERIALS AND METHODS

A prospective analysis of 30 patients with peritrochanteric fractures, as well as 30 age- and sex-matched control subjects was performed by using dual energy X-ray absorptiometry (DEXA) from June 2000 to December 2001. Patients with hip fractures were selected on a random basis. Detailed clinical evaluation and serological examination was performed to exclude patients with secondary osteoporosis. Patient selection was based on WHO criteria for establishment of reference date for BMD. Exclusion criteria of patients are shown in Table 1. The controls were recruited on random basis as age- and sex-matched pairs with respect to the fracture group. Activity level and diet were not used as the basis for inclusion.[6]

Age and sex distribution of patients are shown in Table 2. 17 (56.7%) subjects were male and 13 (43.3%) were female. The mean age of patients was 63.0 years (range, 35–78 years); the mean age of the male patients was 63.2 years (range, 36–75 years) and that of the females was 62.6 years (range, 35–78 years). 12 (40.0%) patients had sustained intertrochanteric fractures and 18 (60.0%) had transcervical fractures. 13 (43.3%) had right-side fracture, while 17 (56.7%) had left-side fracture (Table 3).

There is no population control database of T scores for ethnic Indians; however, in the absence of any quantitative database of an ethnic population, a database of the Caucasian population was used for comparison in this study.[5]

Table 1

Patient exclusion criteria

Subjects with a history of renal disease, hyperparathyroidism or hypoparathyroidism, thyroid disease, adrenal disorders, malignancy, chronic gastrointestinal disease, liver disease, diabetes, Paget's disease, early oopherectomy, hypogonadism, osteomalacia, vitamin D deficiency, rheumatoid arthritis, or renal lithiasis.
Subjects who regularly use or have used any of the following medications: glucocorticoids, oestrogen (replacement therapy), anticonvulsants, sodium fluoride, heparin, thyroxin, or vitamin D metabolites.
Subjects with a history of hip, spine, or wrist fracture or evidence of vertebral compression fracture on thoracolumbar spine X-rays. One or 2 fractures are common in the normal elderly and are not grounds for exclusion.
Subjects with a current history of alcohol or drug abuse.
Subjects with prolonged hospitalisation or other extended immobilisation.
Postmenopausal status should be ascertained.

Table 2

Patient population with regard to age and sex

Age (years)	Number of patients		Percentage (%)
	Male	Female	
31–40	1	1	6.67
41–50	2	1	10.00
51–60	2	1	10.00
61–70	7	8	50.00
71–80	5	2	23.33

Table 3

Patient information—fracture group

Patient No.	Sex	Age (years)	T score	Menopausal status	Fracture type
1	M	70	-3.9	N/A*	Rt TC†
2	M	70	-2.5	N/A	Lt TC
3	F	78	-4.2	Postmenopausal	Rt TC
4	M	72	-4.7	N/A	Lt IT‡
5	F	67	-2.9	Postmenopausal	Rt TC
6	M	65	-4.0	N/A	Rt TC
7	F	62	-2.4	Postmenopausal	Rt TC
8	M	61	-4.5	N/A	Lt IT
9	M	71	-3.6	N/A	Lt IT
10	M	70	-2.2	N/A	Lt IT
11	M	56	-1.2	N/A	Rt TC
12	M	75	-3.2	N/A	Lt TC
13	F	65	-5.1	Postmenopausal	Lt IT
14	M	50	-4.4	N/A	Rt TC
15	F	78	-3.7	Postmenopausal	Lt TC
16	F	65	-4.7	Postmenopausal	Lt TC
17	F	61	-3.6	Postmenopausal	Rt IT
18	M	47	-4.0	N/A	Lt TC
19	M	36	-2.2	N/A	Rt IT
20	M	59	-3.1	N/A	Lt TC
21	M	66	-2.5	N/A	Rt TC
22	F	66	-2.5	Postmenopausal	Lt TC
23	F	71	-3.5	Postmenopausal	Rt IT
24	M	66	-2.2	N/A	Lt IT
25	F	56	-4.8	Postmenopausal	Lt TC
26	F	64	-3.6	Postmenopausal	Lt TC
27	M	66	-2.6	N/A	Rt IT
28	F	46	-3.9	Postmenopausal	Rt IT
29	M	75	-3.4	N/A	Lt TC
30	F	35	-1.2	Premenopausal	Lt IT

* N/A not applicable
† TC transcervical
‡ IT intertrochanteric

Table 4

Comparison of T scores

T score	Fracture group No. (%)	Control group No. (%)
<-2.5	21 (70%)	9 (30%)
-1 to -2.5	9 (30%)	18 (60%)
>-1	0 (0%)	3 (100%)

Table 5

Patient information—control group

Patient No.	Sex	Age (years)	T score	Menopausal status
1	M	70	-2.2	N/A*
2	M	70	-2.4	N/A
3	F	78	-3.2	Postmenopausal
4	M	72	-3.0	N/A
5	F	67	-4.9	Postmenopausal
6	M	65	-1.3	N/A
7	F	62	-1.7	Postmenopausal
8	M	61	-0.4	N/A
9	M	71	-1.8	N/A
10	M	70	-1.6	N/A
11	M	56	-1.9	N/A
12	M	75	-2.4	N/A
13	F	65	-1.9	Postmenopausal
14	M	50	-4.8	N/A
15	M	78	-1.4	N/A
16	F	65	-4.6	Postmenopausal
17	F	61	-5.0	Postmenopausal
18	M	47	0.6	N/A
19	M	36	-2.2	N/A
20	M	59	-0.8	N/A
21	M	66	-2.6	N/A
22	F	66	-1.4	Postmenopausal
23	F	71	-2.4	Postmenopausal
24	F	66	-3.6	Postmenopausal
25	F	56	-1.3	Postmenopausal
26	F	64	-2.4	Postmenopausal
27	M	66	-5.0	N/A
28	F	46	-2.2	Postmenopausal
29	M	75	-2.1	N/A
30	F	35	-2.5	Premenopausal

*N/A not applicable

The scan was performed at a single centre. The screenings of all patients with fractures were performed within one week following their diagnosis of fracture to prevent changes due to disuse osteoporosis. For each subject, the whole body as well as the unaffected hip was assayed using a DEXA scanner (Lunar DPX® series; GE Medical Systems, Wisconsin, United States). All precautions as per the instruction manual of the manufacturer were followed during the scan. The unaffected hip was chosen for study in the patients with fractures because T scores can be variable in a fractured hip.

RESULTS

30 patients of both fracture and control groups with T scores determined using DEXA were available at the end of the study. In the fracture group, T scores ranged from -1.2 to -5.1 (mean, -3.34; SD, 1.032), and in control group the scores ranged from 0.6 to -5.0 (mean, -2.41; SD, 1.378) (Tables 3, 4, and 5).

There was a significant difference (X_2^2 =10.8, $p<0.01$) in the distributions of T score values between the fracture and control groups, i.e. the percentage of patients with T scores lower than -2.5 was significantly higher (70%) in the fracture group as compared to the control group (30%).

DISCUSSION

Fractures around the hip are associated with considerable morbidity and mortality, and place an additional burden on health economics. They are the second highest cause of nursing home admissions in the United States. Only one-third of patients regain their pre-fracture level of independence.[7] In light of the above, fracture risk assessment and prevention is imperative mortality.[8]

There are 3 modalities of fracture risk prediction: BMD assessment, biochemical markers of bone turnover, and assessment of risk factors.[9–11] Risk factor assessment predicts neither bone density nor fracture risk with any degree of certainty.[3,12] Biochemical markers of bone turnover assessment present in urine and blood—including total alkaline phosphatase, skeletal alkaline phosphatase, osteocalcin,[3] procollagen type I extension peptides, alpha 2 HS-glycoprotein, other non-collagenous bone proteins, tartarate resistant acid phosphatase, free gamma carboxyglutamic acid, fragments of non-collagenous protein, total and dialysable hydroxyproline, hydroxylysine and its glycosides, pyridinoline and deoxypyridinoline (collagen crosslinks), and proline immunopeptidase—can be used as an adjunct to screening by BMD. There are no data on the role of biochemical markers in fracture prediction, and they do not represent the true density of bone but are an indication of turnover of bone in vivo.

There is evidence that a single bone density measurement provides the best measure of fracture risk prediction.[13–17] Furthermore, only bone mass can be manipulated in mid-life in the hope of preventing fractures in later life. Of the modalities available for assessment of BMD—including conventional radiography, single photon absorptiometry, dual photon absorptiometry, DEXA, quantitative computer tomography, and ultrasound—DEXA is reported to have the high short-term and long-term precision in vivo, and its error in reproducibility is 0.4% in vitro.[3]

In a meta-analysis of the predictive value of BMD, hip BMD was the strongest predictor of hip fracture. Spine, radius, and calcaneus BMD were much less predictive of hip fracture.[18] This has been further strengthened by the Osteoporosis Epidemiology Study of Australia and the Study of Osteoporotic Fractures Research Group.[19]

Africans have the lowest incidence of hip fracture, while Caucasians have the highest.[20] In between these ends of the spectrum are people of Asian origin.[21–23] There are data on diminished BMD and fracture risk prediction in Caucasian patients.[24] Studies done by Wasnich et al.,[25] Seeley et al.,[26] and the Study of Osteoporosis Fractures Research Group[27] attribute high fracture risk to decreased BMD in their prospective or cohort studies.

To the best of our knowledge, there are no previous data for peritrochanteric fractures in the Indian population. This is the first study in which pairs have been matched with respect to age and sex in 2 groups; a fracture group, in which the opposite normal side was studied, and a non-fracture control group, with a single modality of T score.

Furthermore, T scores were considered instead of BMD because T scores are standardised. As the T scores are expressed as a SD in comparison with peak bone mass of young adults, reproducibility is increased.

There was a statistically significant difference between T scores in the fracture and control (non-fracture) groups, suggesting that T score values can be useful for assessing fracture risk.

CONCLUSION

T scores appear to be good predictors for fracture

risk. T scores are equally helpful in postmenopausal patients and those with senile osteoporosis. The definition of osteoporosis as established by WHO (a score of 2.5 SD below the mean) effectively defines patients at risk and predicts fracture risk in an Indian population. However, this study investigated a small group of patients, and a larger study will be required to ascertain whether osteoporosis is present in a younger age-group, whether osteoporosis is common in males, and whether peritrochanteric fracture occurs in a younger age-group, as compared to the western population.

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