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Comparison of Singh's Index Accuracy and Dual Energy X-Ray Absorptiometry in The Measurement of Bone Mineral Density for Evaluating Osteoporosis in Post Menopausal Women.

KEYWORDS: BMD, DEXA, Osteoporosis, Post Menopausal.

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ABSTRACT *Objective: To compare the prevalence of osteoporosis with DEXA scan and Singh's Index and try to establish any existing relation between them.*

Method: Females aged 45 yrs and above coming to OPD and IPD with pathological hip fractures or low energy fractures of hip suggestive of osteoporosis as primary pathology were selected for the study. Then a x-ray of hip joint and DEXA of hip was done after taking consent. The results of both were calculated and compared.

Results: Age wise distribution showed that majority were between the age of 50-69 years (56.67%). It was observed that using Singh's Index, osteoporosis was diagnosed in 26.67% women whereas by using DEXA it was found in 63.33%. Using kappa statics the agreement between the two was fair (k=0.348).

Conclusion: The Singh's Index cannot be used for evaluating and diagnosis of osteoporosis, because of its low reliability.

Introduction

Osteoporosis is an important health problem characterized by low Bone Mineral Density (BMD) and a reduction in bone strength[1]. The definition of osteoporosis by the WHO is a BMD that is 2.5 standard deviation (SD) or more below the mean of a age specific normal reference population.

Osteoporosis may not cause any symptom until a fracture occurs. Osteoporosis or low BMD is estimated to occur in about 55% of the population aged 50 and over[2]. If not treated, it can progress slowly and without any pain until a bone fracture. These fractures occur typically in the spine, hip and wrist. Spine and hip fractures may result in chronic pain, deformity, disability and death. About 50% of patients with hip fractures will never be able to walk without assistance and 25% will require long term care. Five years after a fracture of hip or vertebral fracture, the mortality rate is about 20% greater than expected, with mortality rates higher in men than women[3].

The Surgeon General[4] report on bone health and osteoporosis and National Osteoporosis Foundation[5] physician's guide to prevention and treatment of osteoporosis, identify osteoporosis as a major public health concern and emphasize the importance of using BMD as a clinical tool to diagnose patients at high risk of fracture before the first fracture occurs. Bone mass measurement is the single best predictor of fracture risk[6].

The Singh's Index, which describes trabecular patterns in the proximal femur is been used as a predictor for hip fractures and as an indicator of osteopaenia.Singh's suggested that the index could be used to separate patients with spinal osteoporosis from normal individuals, and also suggested that the index reflected the bone loss throughout the skeleton. Many studies have shown that the Singh's Index use in predicting skeletal bone mass has been overstated, and that the index is significantly inferior to photon absorptiometry methods [7,8]. The Singh's Index is an inexpensive simple method of assessing bone density at a site where fractures occur. The Singh's Index has been criticized for its low reliability due to the nature of its ill-defined grading for osteoporosis.[9]

Material and Methods:

Thirty women were selected for the study.

Inclusion Criteria: All females aged 45years and above coming to OPD and IPD with pathological fractures or low energy fractures around hip suggestive of osteoporosis as primary pathology.

Exclusion Criteria: Age less than 45years, Patients with any congenital hip pathology, Patients with avascular necrosis of femoral head, Patient who had taken any form of treatment for osteoporosis.

Methodology:

A detailed history of these patients with written informed consent was taken. Then x-ray of the hip joint and DEXA scan for BMD was done in all the study patients. The results of both the investigations were calculated and compared.

Singh's Index was calculated using trabecular pattern (Grade I To Grade VI).

Grade 6: All the normal trabecular groups are visible and the upper end of the femur seems completely occupied by cancellous bone.

Grade 5: Principal tensile & principal compressive trabeculae is accentuated. Ward's triangle appears prominent.

Grade 4: Principal tensile trabeculae are markedly reduced in number but can still be traced from the lateral cortex to the upper part of the femoral neck

Grade 3: There is a break in the continuity of the principal tensile trabeculae opposite the greater trochanter, this grade indicates definite osteoporosis.

Grade 2: Only the principal compressive trabeculae stand out prominently, remaining trabeculae have been essentially absorbed.

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Grade 1: Principal compressive trabeculae are markedly reduced in number and are no longer prominent.

For DEXA Report, T-score is used. It compares the individual's T-score with the average bone mineral density of a thirty year old of the same sex, race and culture. The peak age for bone density is estimated to be thirty years. A score of zero is similar or equal to that of a thirty years old bone mineral density. Scores of -1 or higher are normal, scores between -1 and -2.5 indicate thinning of bones and scores of less than -2.5 indicate osteoporosis.

The proportion of agreement between Singh's Index and DEXA was tested by calculating Kappa values. Landis and Koch criteria were used to assess the agreement level.

Landis And Koch Criteria For Kappa Statistic:

Kappa score	Level of agreement
0.00–0.20	Slight
0.21–0.40	Fair
0.41–0.60	Moderate
0.61–0.80	Substantial
0.81–1.00	Excellent

Results:

Age group	No.	Percentage
<50	3	10.00
50-59	8	26.67
60-69	9	30.00
70-79	5	16.67
80-89	5	16.67
Total	30	100

Table 1: Age Wise Distribution Of Study Women

In the above Table No.1, age wise distribution of the study women showed that majority were between the age of 50-69 years (56.67%) followed by age above 70 years (33.34%)

Table 2: Prevalence Of Osteoporosis Among Post Menopausal Women With Fracture

	No.	Percentage
Singh's Index	8	26.67
DEXA	19	63.33

In the above Table No.2, It was observed that using Singh's Index, osteoporosis was diagnosed in 26.67% post menopausal women with fractures whereas by using DEXA scan it was found in 63.33% women.

Table 3: Proportion Of Agreement Between Singh's Index And DEXA

Osteoporosis Present		DEXA Scan	
		Osteoporosis Absent	
Singh's Index	Osteoporosis Present	8	0
	Osteoporosis Absent	11	11

Number of observed agree

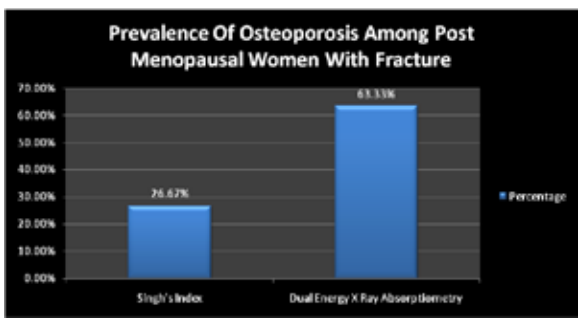
ments: 19 (63.33% of the observations) Number of agreements expected by chance: 13.1 (43.78% of the observations)

Kappa statics = 0.348

S.E. of Kappa = 0.119
95% confidence interval: From 0.115 to 0.580.

The strength of agreement is considered to be Fair.
When Kappa statics was applied to see the agreement between Singh's Index and DEXA, it was observed that strength of agreement was fair.

Chart 1: Prevalence Of Osteoporosis Among Post Menopausal Women With Fracture



Discussion:

The present study was conducted to study the comparison of Singh's Index and DEXA in the measurement of BMD for evaluating osteoporosis in post menopausal women.

It is now generally accepted that the main factor causing osteoporosis is low peak bone mass when reaching adult age. After the growth spurt, the bone density keeps on increasing gradually until about 30 years of age. It is during this time, that an additional 15% is added to the skeletal mass. A high peak bone mass in young adult life is thought to protect against fractures later in life, as obligatory loss ensues. The relationship between BMD and fracture risk is continuous. Fracture risk must be lowest when bone mineral density is highest, between ages 20 and 40 years in healthy individuals.[10]

It was observed that the majority of the women in the study were between the age of 50-69 years (56.67%) followed by age above 70 years (33.34%).

The prevalence of osteoporosis in post menopausal women with fracture using Singh's Index was 26.67% whereas by using DEXA scan it was 63.33%. Similar findings were also reported by Divesh Gulati et al[10] and Neelam Aggarwal et al[11].

To study the proportion of agreement between Singh's Index and DEXA, Kappa values were calculated. It was observed that Kappa value in this agreement was 0.348 and when Landis and Koch's criteria were used to assess the agreement level, it was observed that the strength of agreement was considered to be 'Fair'. This means that Singh's Index has fair reliability against DEXA in detecting osteoporosis in among post menopausal women with fracture.

In a study done by Soontrapa et al. in 2005 in Thailand[12], it was shown that the Singh's Index has had poor reliability and poor diagnostic value in screening of femoral neck osteoporosis.

In this study, after we analyzed the data, it was found that there was no significant correlation between the Singh's Index and Bone Densitometry and we cannot use this index for the evaluation and diagnosis of osteoporosis.

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Koot et al[9] studied the reliability of the Singh's classification of trabecular bone structure in the proximal femur as a measure of osteoporosis, using kappa statistics and they observed that the Singh's Index has no value in assessing the grade of osteoporosis.

Conventionally plain radiographs have been used for assessment of bone density. These may be inexpensive and easily available but have a very low sensitivity, as around 30% - 40% of demineralization must take place before changes appear on a plain radiograph[13]. DEXA scan is the gold standard for measurement of bone mineral density for clinical use and has been shown to have high short term and long term precision as well as low rate of error in reproducibility in measurement of BMD[14]. It can detect osteoporosis at a relatively early stage. Use of DEXA for mass screening of osteoporosis in low and middle income countries may not be feasible as it is expensive and not easily accessible. Hence, the relatively cheap and easily available methods to assess bone mass such as Singh's Index, Calcaneal Index, Radial Index and Metacarpal Index are in common use but these are relatively insensitive and detect osteoporotic changes at a relatively later stage.

The use of Singh's Index in evaluating bone mineral density has been controversial[8,9]. It relies on observation and thus has an inherent drawback. The limitations of plain radiographs include inability to see the trabeculae clearly due to soft tissue shadow in a fatty patient with bulky thighs and buttocks and poor quality of radiographs due to technical lag. Digital radiographs of the pelvis with both hip joints may improve the precision to determine trabecular pattern and are highly recommended. We found fair agreement between Singh's Index and DEXA for evaluating BMD in our patients. Therefore measurement of BMD by Singh's Index cannot substitute DEXA scan, which is the gold standard for diagnosis and quantification of osteoporosis.

Conclusion:

The Singh's Index cannot be used for evaluating and diagnosing osteoporosis, because of its low reliability and DEXA scan remains the gold standard for diagnosis and quantification of osteoporosis.

Abbreviations: DEXA - Dual Energy X-Ray Absorptiometry, BMD - Bone Mineral Density, WHO - World Health Organization

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