SINGH'S INDEX ACCURACY WITH DEXA SCAN FOR EVALUATION OF OSTEOPOROSIS

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ABSTRACT

Objective: To compare Singh's index accuracy versus DEXA scan in diagnosing osteoporosis in post-menopausal women.

Material & Methods: This was a cross-sectional study, conducted in the Department of Orthopaedics, Northwest General Hospital & Research Centre, Peshawar, Pakistan, involving 120 post-menopausal women at Northwest General Hospital & Research Centre, Peshawar, from June 2015 to December 2015. All patients had X-ray Pelvis and DEXA scan was done.

Results: There was 'slight agreement' between DEXA scan and Singh Index on the basis of Kappa statistics (.088). Mean age was 62.91 ± 9.6 SD. Chi-square value was 1.106, p-value was 0.293 which was not significant.

Conclusion: Singh index assessment for osteoporosis is not reliable and can not be a valid substitute for DEXA scan.

Keywords: Singh index , DEXA scan , osteoporosis.

INTRODUCTION

Osteoporosis is characterized by low bone mass and micro architectural deterioration of bone tissue, with a consequent increase in bone fragility and susceptibility to fractures[1] .Osteoporosis has become epidemic. It causes approximately 8.9 million fractures per year worldwide. In Pakistan, this "silent disease" affects 6.7 million peoples and it will increase to more than 7.1 million by 2020. According to advocacy group, National Osteoporosis Foundation USA, 1/3 women over 50 will experience osteoporotic fractures, as will 1/5 men[2].

The early diagnosis of osteoporosis is crucial to mitigate the social and economic burden due to ensuing osteoporotic fractures[3]. Plain radiographs allow qualitative and semi-quantitative evaluation of osteoporosis, whereas other imaging techniques allow quantification of bone loss (e.g, dual-energy x-ray absorptiometry and quantitative computed tomography [CT]), assessment for the presence of fractures (morphometry), and the study of bone properties (ultrasonography). Measurement of bone mineral density (BMD) by DEXA scan is the cornerstone for management of osteoporosis[3]. DEXA scanners were introduced in 1987 and have entered common clinical practice with proven ability to predict fracture risk with high specificity.

The Singh's Index, which shows trabecular patterns in the proximal femur on plain radiographs has been used as a predictor of osteoporosis. Singh's suggested that the index could be used to differentiate patients with osteoporosis from normal individuals. However, the Singh's Index has been criticized for its low reliability due to high inter-observer and intra-observer variability in grading for osteoporosis[4]. We wanted to assess the accuracy of Singh index with respect to DEXA scan and whether Singh index can be a reliable substitute for DEXA scan in a primary care setting.

MATERIAL & METHODS

One hundred & twenty post-menopausal women with clinical risk factors (Age, Low body mass index, prior fracture after age 50, parental history of hip fracture, current smoking habit, current or past use of systemic steroids, alcohol intake > 2 units daily, Rheumatoid arthritis) for osteoporosis were included in the study. X-ray Pelvis and DEXA scan were done in all patients. Written informed consent was taken for inclusion in the study. Bone mineral content was assessed with DEXA scanner, Hologic Discovery QDR. T-score was used for reporting Table 1. Singh index was calculated from plain X-rays Figure 1 and 2. The data was analyzed with SPSS 16.0. Kappa statistic, chi-square test keeping p-value < 0.05 as significant were used. Mean and Standard deviation were used for quantitative variables.

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RESULTS

Mean age of the patients was 62.91± 9.6 SD with minimum age 43 and maximum age of 88, mean T-score Hip was 2.06 ± 1.188 SD, Table 1, mean BMI was 28.54 + 6.62 SD with minimum of 16.80 and maximum of 59.80, mean BMD was 0.64 ± .14 with minimum of .304 and maximum of 1.134.

Kappa statistics to assess the level of agreement between Singh Index and DEXA scan was 0.088, which suggests "Slight Agreement", as per Landis & Koch criteria[12] Table 1 and 2. Chi-square value was 1.106, and p-value was 0.293, which is not significant. Our data is normally distributed as per Kolmogorov-Smirnov (0.082) and Shapiro-Wilk test (0.170). Both are non-significant as shown in Table 3.

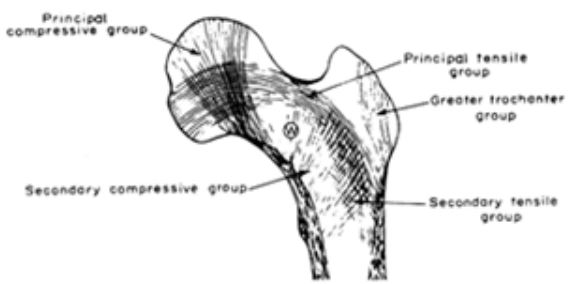

Figure 1

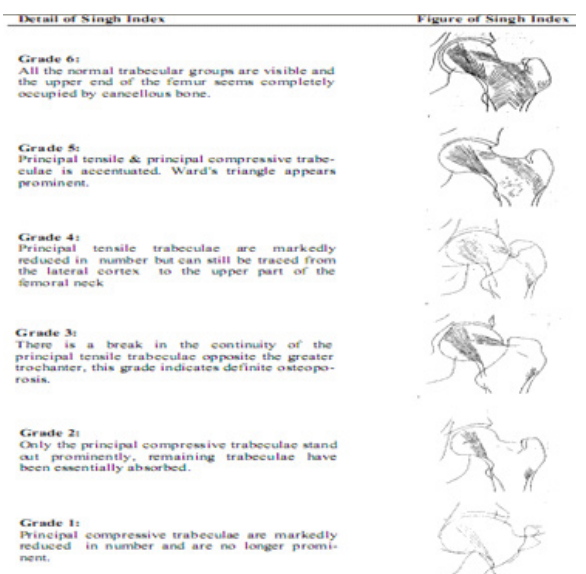

Figure 2

Table 1: T-score for Bone mineral density, WHO

Diagnosis	T-score
Normal	>-1
Osteopenia	<-1 to > -2.5
Osteoporosis	< -2.5
Severe osteoporosis	< -2.5 + fragility fracture

Table 2: 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

Table 3: Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
age	.082	120	.046	.984	120	.170

a. Lilliefors Significance Correction

DISCUSSION

Osteoporosis has become an epidemic and is considered to be an inevitable consequence of aging and a by-product of industrialization. Epidemiological studies lead by WHO have highlighted the high burden of the disease with significant morbidity, mortality and costs associated with its complications. The past few years have seen major improvements in diagnosis and management of osteoporosis and it is now possible to detect the disease before fractures occur[4,5].

In both men and women with different racial backgrounds, bone mass increases with age until approximately thirty years of age and then begins to decrease. It is widely accepted now that the main factor causing osteoporosis is low peak bone mass when reaching adult age. At menopause, estrogen levels drop which lead to a 1% to 3% drop per year in bone mineral density for as long as ten years, followed by a slower loss of bone density. Men start out with a higher peak bone mass than women, and lose bone at a slower rate than women do[6].

In 1970, Singh et al. showed in their landmark study how the trabecular patterns of the proximal femur thinned out in the course of osteoporosis. They described six trabecular patterns: grades 3 and lower showing increasing degrees of osteoporosis. The pattern of trabecular loss provided a semi quantitative estimate of osteoporosis, which they suggested would be a valuable and inexpensive tool in assessment of osteoporosis[7].

The use of Singh's Index in evaluating bone mineral density has been controversial. It relies on observation and thus has an inherent drawback. Singh et al. agreed that there may be sometimes difficulty in grading with occasional difference of opinion which, however, do not amount to more than one grade. The limitations of plain radiographs include inability to see the trabeculae clearly due to soft tissue shadow in an obese patient and poor quality of radiographs due to technical problem which can be poor positioning of the patient, poor image resolution, improper distance between patient and X-ray tube[8-11].

Plain radiographs 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[12]. 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 T6. Use of DEXA scan as a screening method in low 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[13,14].

Our study showed that there is "slight agreement" between DEXA scan and Singh Index, which means that Singh Index cannot be a reliable substitute for the gold standard DEXA scan. It is in agreement with the available literature. Salamat et a[l7] concluded that there was no any correlation between the Singh index and bone densitometry. Koot et al[18]. Demonstrated that Singh Index has no value in assessing the grade of osteoporosis. Similarly, Epanov VV & Lems WF[19,20]. demonstrated in 2005 that the Singh index has had poor reliability and poor diagnostic value in screening of femoral neck osteoporosis. The limitations of the study are small sample size and inter-observer differences in Singh index assessment have not been taken into account.

CONCLUSION

The Singh Index can not be used for evaluating and diagnosing osteoporosis because of its low reliability.

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REFERENCES

1. Kanis JA. Diagnosis of osteoporosis. Osteoporos Int 1997; 7:108-16.
2. F Cosman, SJ de Beur , MS LeBoff , EM Lewiecki, B Tanner, S Randall, R Lindsay. Clinician's guide to prevention and treatment of osteoporosis. Osteoporos Int 2014; 25:2359-81.
3. Cummings SR, Black DM, Nevitt MC, Browner W, Cauley J, Ensrud K, Genant HK, Palermo L, Scott J, Vogt TM. Bone density at various sites for the prediction of hip fractures. Lancet 1993; 341: 72-5.
4. Singh M, Nagrath AR, Maini PS. Changes in trabecular pattern of the upper end of the femur as an index of osteoporosis. J Bone Joint Surg 1970; 52: 457-67.
5. Vhora H, Patil S, Potdar P. 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. International journal of conference proceedings 2015: 85-90.
6. Center JR, Nguyen TV, Schneider D, Sambrook PN, Eisman JA . Mortality after all major types of osteoporotic fracture in men and women: an observational study. Lancet 1999; 353: 878-82.
7. Kanis JA. Diagnosis of osteoporosis and assessment of fracture risk. Lancet 2002; 359:1929-36.
8. Kranendonk DH, Jurist JM, Lee HG . Femoral trabecular patterns index and bone mineral content. J Bone Joint Surg 1972; 54: 1472-8.
9. Pogrund H, Rigal WM, Makin M, Robin G, Menczel J, Steinberg R. Determination of osteoporosis in patients with fractured femoral neck using the Singh index. Clin Orthop 1981; 156: 189-95.
10 Landis JR and Koch GG . The measurement of observer agreement for categorical data. Biometrics 1977; 33: 159-74.
11. Soontrapa S, Soontrapa S, Srinakarin J, Chowchuen P. Singh index screening for femoral neck osteoporosis. J Med Assoc Thai 2005; 88: S13-6.
12. Masud T, Jawed S, Doyle DV, Spector TD. A population study of the screening potential of assessment of trabecular pattern of the femoral neck (Singh index): the Chingford Study. The British journal of radiology. 1995; 68(808):389-93.
13. Sartoris DJ. Clinical value of bone densitometry. AJR. 1994; 163(1):133-5.
14. Mirsky EC,Einhorn TA. Bone densitometry in orthopaedic practice. J Bone Joint Surg Am 1998; 80: 1687-98.

15. Singh R, Gupta S, Awasthi A. Differential effect of predictors of bone mineral density and hip geometry in postmenopausal women: a cross-sectional study. Arch Osteoporos. 2015;10:39.

16. Klatte TO, Vettorazzi E, Beckmann J, Pueschel K, Amling M, Gebauer M.The Singh Index does not correlate with bone mineral density (BMD) measured with dual energy X-ray absorptiometry (DXA) or peripheral quantitative computed tomography (pQCT). Arch Orthop Trauma Surg. 2015;135:645-50.

17. Salamat MR, Rostampour N, Shanehsazzadeh S, Tavakoli MB, Siavash M, Almasi T . Assessment of bone mineral density with dual energy X-ray absorptiometry in pre- and post-menopausal women. Iran J Radiat Res 2008; 6: 103-7.

18. Koot VCM, Kesselaer SM, Clevers GJ, de Hooge P, Weits T, van der Werken C .Evaluation of the Singh index for measuring osteoporosis. J Bone Joint Surg Br 1996; 78: 831-4.

19. Epanov VV, Palshin GA, Epanova AA, Komissarov AN, Tomsky MI, Sedunov VF, Egorov PL. X-ray densitometry and FRAX model in predicting the risk of osteoporosis and low energy fractures in postmenopausal women. Wiad Lek. 2015; 68(4):526-8.

20. Lems WF. Fracture risk estimation may facilitate the treatment gap in osteoporosis. Ann Rheum Dis. 2015 Nov;74(11):1943-5.

CONFLICT OF INTEREST: Authors declare no conflict of interest

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AUTHOR'S CONTRIBUTION

Following authors have made substantial contributions to the manuscript as under:

Qadir RI: Formulation of hypothesis and collection of data.

Bukhari SI: Writing the research article.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.