ORIGINAL ARTICLE

ASSESSMENT OF INTEROBSERVER RELIABILITY OF SINGH INDEX FOR GRADING OF OSTEOPOROSIS

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ABSTRACT

Objective: Assessment of the reliability of Singh's Index for measurement of osteoporosis between different observers.

Material & Methods: It was a cross-sectional validation study, conducted in the Orthopaedics and Radiology Departments, NorthWest General Hospital & Research Centre, Peshawar, Pakistan, involving 120 post-menopausal women from June 2015 to December 2015. X-ray Pelvis was undertaken in all patients.

Results: Mean age was 62.91 years ± 9.6 SD. Single measurement was 43%. Overall agreement among the observers was 69.5% with p value .000, which is significant. 95% Confidence interval was 0.587 to 0.779. The kappa value ranged from .171 to .261 with a slight to fair agreement.

Conclusion: Singh Index has 69.5% inter-observer reliability.

Key Words: Singh Index , Osteoporosis.

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INTRODUCTION

Osteoporosis is characterized by low bone mass, deterioration of bone tissue and disruption of bone architecture, compromised bone strength and an increase in the risk of fracture[1].

Osteoporosis is a silent disease until fracture occurs after minimal trauma. These fractures are common with a predilection for hip/wrist/vertebra and place an enormous medical and personal burden on aged population and a major economic toll on the national exchequer. In particular, hip fractures result in 10 to 20 percent excess mortality within one year[2]; additionally, hip fractures are associated with a 2.5 fold increased risk of future fractures. Approximately 20 percent of hip fracture patients require long-term nursing home care, and only 40 percent fully regain their pre-fracture level of independence[3].

Osteoporosis can be diagnosed before the catastrophic complication, i.e, fracture occurs. 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)[4].

Singh index is a diagnostic classification which has been subject of scrutiny for long regarding its reproducibility and reliability[5-7]. Proponents cite its cost-effectiveness for evaluation of osteoporosis, however after the introduction of new imaging modalities, its significance has waned. We have tried to establish its accuracy by assessing the interobserver reliability.

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. Written informed consent was taken for inclusion in the study. X-ray Pelvis was done in all patients. Singh index was calculated from plain X-rays (Figure 1 and 2). Radiographs were observed by an orthopaedic surgeon and two radiologists (3 observers). The data was analyzed with SPSS 16.0. Interclass Correlation Coefficient was measured. 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 BMI was 28.54 ± 6.62 SD with minimum of 16.80 and maximum of 59.80. Table 1 shows the grading of osteoporosis on plain X-rays by 3 different observers. Interobserver agreement was reached in 28/120 (23.33%) radiographs.

Single measurement was 43%. Overall agreement among the observers was 69.5% with p value .000, which is significant. 95% Confidence interval was 0.587 to 0.779. (Table 2). Cross-tabulation was done between observer 1 and 2. Kappa measurement was .186 with a p value of .000, which is significant (Table 3). Cross-tabulation was done between observer 1 and 3. Kappa measurement was .171 with a p value of .000, which is significant (Table 4). Cross-tabulation was done between observer 2 and 3. Kappa measurement was .261 with a p value of .000, which is significant (Table 5).

Table 1: Observers grading of X-rays

Singh Index Grading	Observer 1	Observer 2	Observer 3
1	1	0	3
2	10	10	16
3	64	28	27
4	42	47	38
5	3	23	20
6	0	12	16

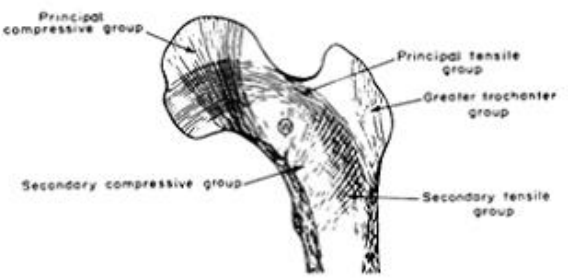

Fig 1

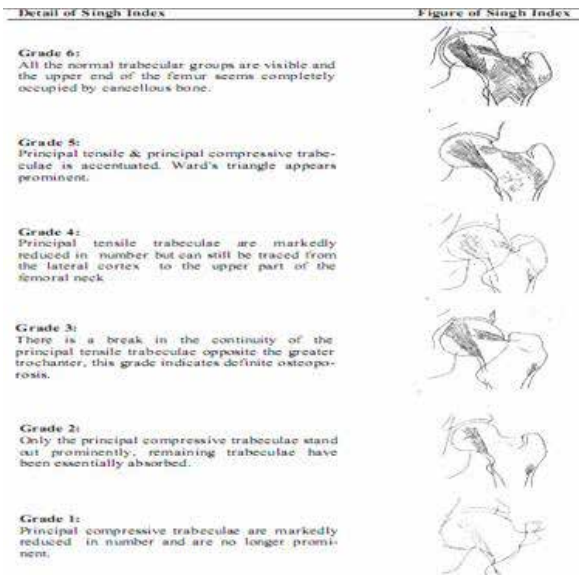

Fig 2

Table 2: Intraclass Correlation Coefficient

	Intraclass Correlation	95% Confidence Interval		F Test with True Value 0			
		Lower Bound	Upper Bound	Value	df1	df2	Sig
Single Measures	.432	.321	.540	3.279	119	238	.000
Average Measures	.695	.587	.779	3.279	119	238	.000

Table 3: Observer1 * observer2 Crosstabulation Symmetric Measures

	Value	Asymp. Std. Error	Approx. T	Approx. Sig.
Measure of Agreement	.186	.054	3.837	.000
N of Valid Cases	120			

Table 4: Observer1 * oberver3 Crosstabulation Symmetric Measures

	Value	Asymp. Std. Error	Approx. T	Approx. Sig.
Measure of Agreement	.171	.051	3.782	.000
N of Valid Cases	120			

Table 5: Observer2 * oberver3 Crosstabulation Symmetric Measures

	Value	Asymp. Std. Error	Approx. T	Approx. Sig.
Measure of Agreement	.261	.058	5.518	.000
N of Valid Cases	120			

DISCUSSION

Osteoporosis means “porous bone.” Viewed under a microscope, healthy bone looks like a honeycomb. When osteoporosis occurs, the holes and spaces in the honeycomb are much larger than in healthy bone. Osteoporotic bones have lost density or mass and contain abnormal tissue structure. Studies

suggest that approximately one in two women and up to one in four men age 50 and older will break a bone due to osteoporosis. By 2025, experts predict that osteoporosis will be responsible for approximately three million fractures and $25.3 billion in costs annually[2].

Measurement of bone mass can predict the fracture risk. Skeletal mass can be measured by different techniques; Singh index, radiogrammetry, radiographic absorptiometry, quantitative computed tomography, ultrasound, energy absorptiometry (dual/single energy X-ray absorptiometry) and single or dual photon absorptiometry[11].

The use of Singh's Index, described in 1970, in evaluating bone mineral density is fraught with controversies[8]. It's an observational tool and thus has an inherent drawback. Singh et al accepted the limitation in grading with occasional interobserver variability which, however, do not amount to more than one grade. There are several limitations of plain radiographs, e.g, soft tissue shadow in obese patient and poor radiographic technique[11,12].

Our study showed that there is 69.5% interobserver agreement. The kappa value ranged from 0.171 to 0.261 with a slight to fair agreement according to Landis and Koch criteria[14]. Koot et al[13] have argued that the results were disappointing for interobserver agreement (kappa values 0.01 to 0.54). Yoo MJ et al[15] showed that kappa values for interobserver agreement ranged from 0.325 to 0.423, which did not reach good reliability overall.

According to other studies[16-19] the inter-observer (and weighted) reliability k was 0.10 (95% CI: 0.00-0.20) and 0.26. Their conclusion was that inter-person reliability of the Singh index is poor; the index needs to be simplified to establish its reliability as a screening tool for osteoporosis. According to Supradeeptha Challa[16], there is poor to fair inter-observer reliability; interobserver agreement was 0.21±0.2 (kappa value).

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CONCLUSION

Interobserver reliability of singh index for grading of osteoporosis is very useful method for grading of osteoporosis.

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AUTHOR'S CONTRIBUTION

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

Bukhari SI: Formulation of Hypothesis ,grading of radiographs and writing research article

Qadir RI: Collection of data

Khan S: Grading of radiographs and review of the article

Khan A: Grading of radiographs

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.