

Osteoporosis Self Assessment Tool for Asian (OSTA) Index in Comparison to Quantitative Ultrasound of the Calcaneal in Predicting Low Bone Density.

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ABSTRACT

Introduction: Osteoporosis represent a worldwide public health problem, frequently resulting in fractures and leading to psychological problem, social consequences, functional limitation and poor quality of life. So it is important to identify those people who have high risk of osteoporosis, in order to reduce the incidence of osteoporotic fractures. The Osteoporosis Self-Assessment Tool for Asians (OSTA) index is a simple tool based on age and body weight. Calcaneal quantitative ultrasound (QUS) is another simple and low-cost instrument used to prescreen osteoporotic subjects. The aim of this study was to correlate between these two screening methods and to validate usefulness of Osteoporosis self assessment tool for Asian (OSTA) in comparison with QUS of the calcaneum for the prediction of low bone density in Nepalese women.

Methods: This was a two-year descriptive observational study comprising 100 subjects performed at TU Teaching Hospital, Kathmandu, Nepal, from 2007 January to 2009 January who completed semi structured questionnaire with subsequent measurement of Quantitative Ultrasound (QUS) of the calcaneum. The sensitivity, specificity, and diagnostic accuracy of OSTA index was validated with the QUS T-score.

Results: When the risk category was defined as OSTA index ≤ -1 , and low QUS value as t-score ≤ -2.5 , the sensitivity, specificity and diagnostic accuracy of the index were 93.3%, 56.5%, and 62% respectively, and the area under the curve was 0.7651. When the low QUS value was taken as t score ≤ -1.0 , the sensitivity, specificity and diagnostic accuracy was 85.2%, 89.1% and 87% respectively.

Conclusions: The OSTA index, a simple and free risk assessment tool, can be used to estimate the prevalence of low QUS values in Nepalese women and may help to increase awareness and prevention of low bone mineral density.

Keywords: Bone Mineral Density; Osteoporosis; OSTA index; Quantitative ultrasound of calcaneum; T score.

INTRODUCTION

Osteoporosis represent a worldwide public health problem, affecting 45% of women who are fifty years of age or older resulting in life time risk of 40% for the fractures of hip, vertebrae, and distal forearm¹. It is important to identify people who have high risk of osteoporosis, in order to reduce the incidence of osteoporotic fractures.

Dual Energy X-ray Absorptiometry (DEXA) is gold standard to Bone Mineral Density (BMD), however

it is not readily available in Nepal and also is a costly method for screening purpose. Osteoporosis Self assessment Tool for Asian (OSTA) is a clinical decisions making risk index originally developed for the use in post menopausal Asian population². It is an inexpensive, simple tool based on age and body weight. Purpose of OSTA index is not to diagnose osteoporosis or low BMD but to identify women who are more likely to have low BMD who could then undergo BMD

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measurement for a definitive assessment.

Calcaneal quantitative ultrasound (QUS) is another simple low cost, instrument use to screen osteoporotic subjects³.

The aim of this study was to correlate between these two screening methods and to validate usefulness of Osteoporosis self assessment tool for Asian (OSTA) in comparison with QUS of the calcaneus for the prediction of low bone density in Nepalese women.

METHODS

It was a descriptive observational study conducted at Department of Orthopedics, TUTH from 2007 January to 2009 January. Any women age 40 or above with no previous diagnosis of osteoporosis with at least 1 additive risk for osteoporosis were included in this study. Previous diagnosis of osteoporosis and secondary osteoporosis were excluded from the study. Ethical clearance was taken from the ethical clearance committee. Informed consent from all the eligible patients was taken after full explanation about the nature of the study.

Semi Structured Interview Schedule

All participants completed a structured questionnaire. Information on demographic profile, age, age of menarche, age of menopause were obtained. Risk factors were stratified into non modifiable and modifiable. Non modifiable risk factors were defined by; age ≥ 65 years, history of low energy fracture after the age of 40, history of Osteoporotic fracture in first degree relative and surgical menopause. Modifiable risk factors were defined by; smoking (current or past), weight of 127 lb or less, early menopause [age ≤ 45 yrs], prolonged premenopausal amenorrhea [≥ 1 yr]), Late menarche (age 15 years or more), low calcium intake (lifelong), excessive alcohol intake (≥ 2 drinks/day), Excessive caffeine intake (2 to 4 cups/day) and inadequate physical activity.^{4,5}

Sedentary lifestyle was defined as the occupation or activity that the subject engaged in most frequently in her life and accordingly subject was categorized as sedentary or heavy worker

Anthropometry measurement

Weight of the subject was measured in Kilogram with the standard measuring tool while subjects were standing, wearing light clothing and no shoes.

Bone mass assessment

Bone mass was assessed by broad band ultrasound attenuation using a QUS device. This device is small and portable, with a gel-coupled (dry) system that can measure BUA and speed of sound at the calcaneus. For all subjects, QUS was performed at the right calcaneus. The T-score for each subject was calculated by using the peak BUA value for a defined population of young adults (ASIAN)



Figure 1. QUS device and Measurement of bone density

OSTA INDEX CALCULATION

OSTA Index = (Weight in kg- Age) x 0.2

OSTA RESEARCH GROUP CLASSIFICATION

- A. High risk subgroup (index < -4)
- B. Intermediate risk subgroup (index -1 to -4)
- C. Low risk sub group (index > -1)

Statistical analysis

Here data are presented as percentage and as mean (standard deviation). *Sensitivity, specificity*, Diagnostic accuracy was calculated. Receiver operating curve analysis was performed and area under curve was calculated. To assess the internal validity of the index sensitivity was defined as the proportion of the subject with low T score correctly classified by the risk index

(true positive) and specificity was defined as the proportion with normal T score correctly identified by the risk index (true negative). ROC curve provided a graphical representation of the overall accuracy of a test by plotting sensitivity against (1- specificity) for all thresholds, while AUC quantified the accuracy of the test. All statistical analysis were performed by using SPSS software for Windows, version 11.5 (SPSS, Inc., Chicago, Illinois).

with the mean index of -0.860.

When the T- Score were calculated, 46 subjects were identified as Normal with mean T Score of 0.4089, 39 subjects were having Osteopenia with the mean T score of -1.7764 and 12 subjects were identified as Osteoporosis with the mean T- Score of -2.8792. Only 3 were identified as severe osteoporosis with the mean T score of -3.1067.

Table 1. Percentage of women identified with low bone density by QUS

OSTA Risk level	Total number of women	No of women identified as low QUS T score \leq -1.0	% of women out of each OSTA risk level with low QUS (T score \leq -1.0)
High	21	20	95%
Medium	30	26	86%
Low	49	8	16%

Table 2. OSTA index versus QUS when cut off T score is taken as \leq -2.5

OSTA INDEX	QUS T score	
	With osteoporosis (T score \leq -2.5)	With out osteoporosis (T score $>$ -2.5)
	N	N
OSTA index \leq -1	14	37
OSTA index $>$ -1	1	48
Total	15	85

Table 3. OSTA index versus QUS when cut off T score is taken as \leq -1.0

OSTA INDEX	QUS T score	
	Abnormal (T score \leq -1.0)	Normal(T score $>$ -1.0)
	N	N
OSTA index \leq -1	46	5
OSTA index $>$ -1	8	41
Total	54	46

RESULTS

Mean age of the subject was 58.14 years with minimum age of 40 to maximum age of 84 years. Similarly mean weight of the subject was 53.91 kg with minimum weight of 28 kg to maximum weight of 92 kg. Mean age of menopause was 46.60 years with the minimum age of 38 years to maximum age of 57 years.

The Osteoporosis Self Assessment Tool for the Asian was classified according to the original OSTA research group classification. A total of 21 subjects fell into OSTA class A with mean index of -5.590; 30 subject fell into OSTA class B with the mean index of -2.393 and 49 subject fell into OSTA class C (low risk subgroup)

When cut off point for the T score is taken as \leq -1.0, 95% of the subjects in High risk, 86% of the subjects in intermediate risk and 16% of the subjects in low risk group were identified as having low bone density (Table 1).

There were 14 true positive, 37 false positive, 1 false negative and 48 true negative cases. When the QUS T score cutoff value was taken as -2.5 the OSTA index has Sensitivity of 93.3%, Specificity 56.5% and Diagnostic accuracy was 62%(Table 2).

When QUS T score cutoff value was taken as ≤ -1.0 , there were 46 true positive, 5 false positive, 8 false negative and 41 true negative cases and their Sensitivity was 85.2%, Specificity was 89.1% and Diagnostic accuracy was 87% (Table 3).

to 1999 among 4035 post menopausal women and they had High risk group comprising 11%, intermediate risk group 47% and low risk group 42%.⁶ Our study is comparable to their results in respect to the OSTA research group classification of the subject included in our study.

Table 4. variation in sensitivity, specificity and diagnostic accuracy at different T score cutoff value

T score cutoff	Sensitivity	Specificity	Diagnostic accuracy
-2.5	93.3%	56.5%	62%
-1.0	85.2%	89.1%	87%

T score cutoff value of -1.0 has better specificity and diagnostic accuracy than cutoff value of -2.5 (Table 4).

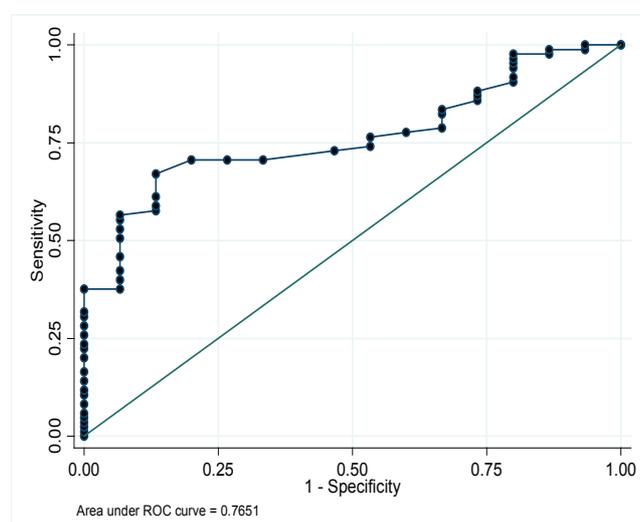


Figure 1. Receiver operating curve analysis

The sensitivity and specificity of the OSTA index in relation to T score obtained by QUS calcaneum were plotted as receiver-operating characteristic (ROC) curves. The areas under the curves (AUC) were calculated and the OSTA index provided AUC of 0.7651 (Figure 1). The results show that OSTA index is capable of selecting patients with low bone density as measured by QUS calcaneum.

DISCUSSION

Twenty one (21%) of the subject fall into OSTA class A i.e. high risk sub group with mean index of -5.590, a total of 30 (30%) of the subject fall into OSTA class B i.e. intermediate risk group with the mean index of -2.393 and 49 (49%) of the subject fall into OSTA class C i.e. low risk sub group with the mean index of -0.860.

F. Richey, et al performed a validation and comparative study of OST in Caucasian in Belgium between 1996

T-score quantifies the differences between the patients BMD and the mean value for young adults from the reference group.^{6,7,8} When the T-Score were calculated 46 (46%) of the subject were identified as a Normal group with mean T Score of 0.4089, 39 (39%) of the subjects were identified as having Osteopenia with the mean T score of -1.7764 and 12 (12%) of the subjects were identified as having Osteoporosis with the mean T-Score of -2.8792. Only 3 (3%) were identified as having severe osteoporosis with the mean T score of -3.1067. Anand et al from India in 2000 performed QUS calcaneum of 1713 subjects during a nine month period from sep 98 to may 99. Using the WHO standard guideline they found that 48.9% of the subject were found to have bone mineral density within normal limit, 39.9% were found to have osteopenia and 11% were found to have osteoporosis.⁹ Vu Thi Thu Hien, et al from Vietnam performed population based cross sectional survey at Hanoi city in 2003 and determined the crude prevalence of osteoporosis to be 15.4% when the QUS T-score cut off point was taken as < -1.8 .¹⁰ Our study has comparable results with other studies despite of relatively small sample size.

We validated the OSTA index with the two different cutoff T score value obtained by the QUS calcaneum. The abnormal value taken for OSTA index is ≤ -1 as classified by the OSTA research group. When the cutoff T score value obtained by the QUS calcaneum is taken as ≤ -2.5 as classified by WHO as a Osteoporosis, Sensitivity, Specificity and diagnostic accuracy of OSTA Index was 93.3%, 56.5%, and 62% respectively. Similarly when the cutoff T score value obtained by the QUS calcaneum is taken as ≤ -1.0 as classified by WHO as a osteopenia, Sensitivity, Specificity and diagnostic accuracy of OSTA Index was 85.2%, 89.1%, and 87% respectively.

The sensitivity and specificity of the OSTA index in relation to T score obtained by QUS calcaneum were plotted as receiver-operating characteristic (ROC) curves. The areas under the curves (AUC) was

calculated and the OSTA index provide AUC of 0.7651 and 0.8935 for T score of -2.5 and -1.0 respectively. In a study conducted by Nan Ping Yong, et al in Taiwan in 2004 When the risk category was defined as OSTA index ≤ -1 , and low QUS value as t-score ≤ -2.5 , the sensitivity and the specificity of the index were 84.0% and 61.0%, respectively, and the area under the curve was 0.81.⁸

Hoon Choi, Yong Joo Park, Chul Min Lee, Hong-Kyoon Lee from Korea showed that OSTA has 98.7% sensitivity and 73.4 % specificity.¹¹ F Richey et al in Belgium showed that OSTA has sensitivity of 97% to detect BMD < -2.5 with DEXA in a Hip.⁶

H.M. Park, W. Ben Sedrine, J.-Y. Reginster, Philip D. Ross from Korea validated OSTA index. In their study the OSTA had a high sensitivity (87%), and good specificity (67%) for identifying osteoporosis (DEXA BMD T-scores ≤ -2.5). The prevalence of osteoporosis ranged from 2% among women classified as low risk (OSTA > -1) to 64% among those classified as high risk (OSTA < -4).¹²

Siris et al, in 2001 validated in Caucasian women using original SCORE population with 1102 post menopausal women aged 45 or more with sensitivity of 88% and specificity of 52%.¹ In a population-based sample of postmenopausal Japanese women¹⁴, the OST had a sensitivity of 90% and specificity of 45%. This tool was similarly validated in Philippine¹⁵

Studies have reported ranges varying from 24-95% and 56-93% respectively for sensitivity and specificity depending upon the various cutoff.¹⁶ Our result is similar to the other validation studies to exclude persons with low risk for osteoporosis. However there is a difference in the percentage of women identified as Osteoporosis in OSTA high risk group, which is less in our study than others. Similarly significant proportion of women in intermediate risk group had osteoporosis. This may be due to the fact that we had enrolled women age 40 years or above irrespective of menstrual status where as these studies mostly included post menopausal or older age group.

OSTA index value of = or < -1 should be taken as a cutoff point to screen women so that maximum subjects with low bone density would be correctly identified and subjected to further evaluation. When cut off point for the T score is taken as = or < -1.0 , 95% of the subjects in High risk, 86% of the subjects in intermediate risk and 16% of the subjects in low risk group were identified as having low bone density.

Though the OSTA risk level classification had poor correlation with the classification with the WHO category based on T score, OSTA index cutoff value of -1.0 was equally good on identifying women with the low QUS value of -1.0.

CONCLUSION

OSTA index can be used as a first line screening tools in the clinic where detailed evaluation of osteoporosis is neither practical nor beneficial. OSTA cutoff value of = or < -1.0 is the most accurate index in our study.

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