



Validation OSTA Diagnosis of Osteoporosis in menopausal women by DXA

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Abstract: The Osteoporosis Self-Assessment Tool for Asians (OSTA) index has been developed to identify osteoporosis for menopausal Asian women. In this study, to validating OSTA, 267 menopausal women who underwent dual energy X-ray absorption method (DXA) examinations from January 2019 to October 2020 in the towns and urban areas of Zhengzhou city were recruited as the subjects. Via the DXA, the bone mineral density of lumbar vertebrae can be calculated through related formulas. The OSTA index can be validated via DXA in the diagnosis of osteoporosis in primary menopausal women. The T value and OSTA index of the <60-year-old group were greater than those of the 60-75-year-old group and the >75-year-old group (P<0.05); the T value and the OSTA index of the 60-75-year-old group were greater than those of the >75-year-old group (P<0.05). 267 cases of menopausal women showed 152 cases of osteoporosis by DXA, including 82 cases of lumbar osteoporosis and 70 cases of hip osteoporosis. The OSTA high-risk index in lumbar and hip osteoporosis was recognized 67.07% and 68.57%, respectively. The OSTA risk index was recognized 26.25% and 28.57%, and OSTA low-risk index was recognized 7.32%, 2.86% respectively. The sensitivity and specificity of OSTA for the diagnosis of osteoporosis in menopausal women were 83.55% and 79.13%, respectively. The validity of OSTA consistency with the diagnosis of DXA showed that the Kappa value was 0.626. The sensitivity of OSTA to the diagnosis of osteoporosis in menopausal women with lumbar spine osteoporosis and hip osteoporosis was 80.00% and 75.61%, and the specificity was 71.07% and 78.38%, respectively. The Kappa value was consistent with the diagnosis of DXA. They are 0.426 and 0.506 respectively. OSTA can thus be valued by DXA in the diagnosis of osteoporosis in primary menopausal women. The diagnostic efficiency of hip osteoporosis via the OSTA is better than that of lumbar osteoporosis. It is suggested that OSTA should be able to diagnose osteoporosis in primary menopausal women.

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Key words: Osteoporosis; Menopausal women; OSTA; Dual-energy X-ray absorptiometry

Introduction

Primary osteoporosis is a common but complex disease in orthopedics. Its main pathological changes are osteopenia and microstructural bone changes. Patients may be reported low back pain, spinal deformation symptoms, fractures, and respiratory system disorders. With high disability rate and the mortality rate, not only has a greater impact on personal health, but also brings an economic burden to the patient's family and society [1-3]. Menopausal women are the most effective patients suffering from osteoporosis. However, due to factors such as popularization of the disease and limited medical treatment, menopausal women have low awareness of osteoporosis, especially in primary menopausal women, leads to bone loss and has not been diagnosed and treated in time poorly [4]. Dual-energy X-ray absorptiometry (DXA) imaging is currently an

important method for clinical diagnosis of skeletal lesions. The cost of this diagnosis is high and there are strict requirements for the operator. In addition, the limited equipment resources make the county, township and some primary hospitals could not carry out this inspection. OSTA Screening Chart (OSTA) is an osteoporosis screening tool for Asians established by scholars such as Koh et al. [5]. It does not need to be tested by special equipment and is simple and fast [6]. However, despite this, there are varying degrees of difference in the effectiveness of OSTA screening in different Asian countries and regions and the evaluations are mixed. With the human research ethic commit approval, we recruited 267 menopausal women subjects, and explored the consistency validation test of OSTA and DXA in the diagnosis of

osteoporosis in primary menopausal women via the observation of screening for osteoporosis in primary menopausal women.

Method

267 menopausal women subjects, recruited from January 2019 to October 2020 in the towns and urban areas of Zhengzhou City with the inclusion criteria: (1) suffering pain of lower back and other bones and joints; (2) menopause; (3) normal communication skills, and be able to cooperate to complete the examination with the consent as well as exclusion criteria: (1) secondary osteoporosis; (2) combined with congenital or developmental diseases, such as spinal deformities; (3) bone metabolic diseases with non-primary osteoporosis; (4) secondary osteoarthritis or hypocalcemia caused by trauma; (5) abnormal thyroid function or malignant tumors such as myeloma; (6) comorbid with heart, liver and kidney dysfunction; (7) comorbid with circulatory system disease or self-immune diseases; (8) acute and chronic infectious diseases; (9) used drugs that affect bone metabolism, such as glucocorticoids; (10) mental illness, or lose consciousness and cannot communicate. The research design was granted by the ethics committee. The age of 267 menopausal women was 54-87 years old, with an average age of (67.75±8.02) years old.

OSTA Evaluation: All patients were measured for height and weight, OSTA index was evaluated via the criteria as, $OSTA = 0.2 \times (\text{body weight} - \text{age})$, OSTA index ≤ -4 was high risk, $-4 < \text{OSTA index} < -1$ was medium risk, and OSTA index ≥ -1 was low risk.

DXA Examination : The instrument was manufactured in USA company of Hologic Discovery Wi-Type DXA. The bone densities of the subject's positive lumbar vertebrae L1 to L4 were measured. Measurement percentage reduction in bone mass in subjects, $T = (\text{measured} - \text{bone peak}) / \text{normal adult bone density standard deviation}$, all the criteria were based on the Chinese Osteoporosis Diagnostic Standards Expert Consensus: $T \geq -1$ as normal bone mass, $-2.5 < T < -1$ as mass reduction, and $T \leq -2.5$ as osteoporosis.

Statistical Analysis

The data was analyzed and processed with the IBM SPSS 20. The results were expressed as the rate (%) with standard deviation ($\pm s$). The t-test and the F-test were calculated. We used receiver operating curve (ROC) to analyze the diagnostic values of OSTA for osteoporosis in primary menopausal women, Kappa test to analyze the consistency of OSTA and DXA in the diagnosis of osteoporosis, and $P < 0.05$ as statistical significance.

Results

There are significant differences of T values of bone density and OSTA index for different age groups ($P < 0.05$). Meanwhile, the T values and OSTA index of the < 60 years old group are greater than those of the 60 to 75 years old group and the > 75 years old group ($P < 0.05$). The T value and OSTA index of the 60-75-year-old group are greater than those of the > 75 -year-old group ($P < 0.05$). The results are listed in Table 1.

Table 1. The T-values and OSTA indices for different age groups

Group	Cases	T value		OSTA index
		lumbar vertebra	Hip Bone	
<60 year old	51	-0.38±1.50	-0.42±1.16	0.79±1.37
60~75	156	-1.85±1.21	-1.73±1.09	-2.55±1.84
>75	60	-2.72±1.34	-2.85±0.91	-4.17±2.26
F-test		45.547	71.555	101.352
P		<0.001	<0.001	<0.001

267 menopausal women showed 152 cases of osteoporosis through DXA screening, including 82 cases of lumbar spine osteoporosis and 70 cases of hip osteoporosis. The OSTA high-risk index demonstrated 153 cases and among them, 78 cases with high-risk fractures of the lumbar spine, and 75 cases with high-risk fractures of the hip. The detection rate of OSTA high risk index in lumbar vertebrae and hip

bone osteoporosis was 67.07% (55/82) and 68.57% (48/70), respectively. The OSTA risk index was in lumbar vertebrae and hipbone osteoporosis. The detection rates of OSTA were 26.25% (21/80) and 28.57% (20/70), respectively. The OSTA low-risk index in lumbar and hip osteoporosis was 7.32% (6/82) and 2.86% (2/70). The OSTA indexes are listed in Table 2.

Table 2. Lumbar Vertebrae OSTA validated by DXA

		Lumbar Vertebrae T values		
		Normal bone mass	Bone Reduction	Osteoporosis
OSTA	High risk	3	20	55
	Medium risk	20	54	21
	Low risk	56	32	6
Total		79	106	82

Table 3. Screening for hipbone osteoporosis OSTA validated by DXA

筛查方法		Hipbone Osteoporosis T values		
		Normal bone mass	Bone Reduction	Osteoporosis
OSTA	High risk	2	25	48
	Medium risk	28	52	20
	Low risk	64	26	2
Total		94	103	70

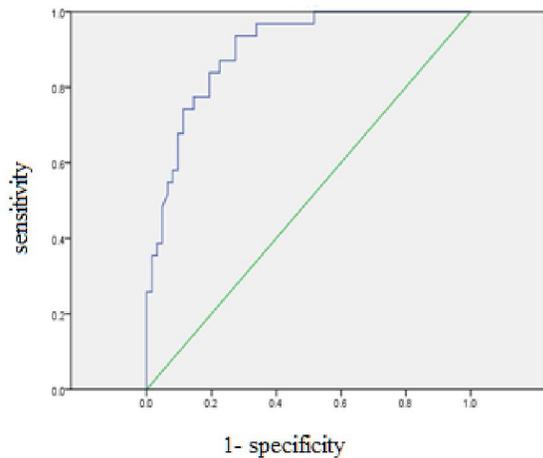


Figure 1: ROC curve for osteoporosis OSTA in menopausal women

OSTA's sensitivity and specificity to osteoporosis diagnosis in menopausal women were 83.55 percent and 79.13 percent, respectively. The result is shown in Figure 1.

OSTA's sensitivity to diagnosis of osteoporosis in menopausal women with lumbar osteoporosis and hip osteoporosis was 80.00%, 75.61%, 71.07% and 78.38%, respectively. The analysis results are shown in Table 3, table 4, Figure 2, Figure 3, and Figure 4.

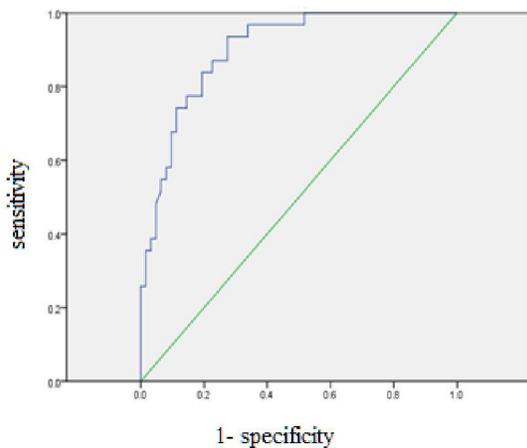


Figure 2: ROC curve for Lumbar vertebrae OSTA in menopausal women

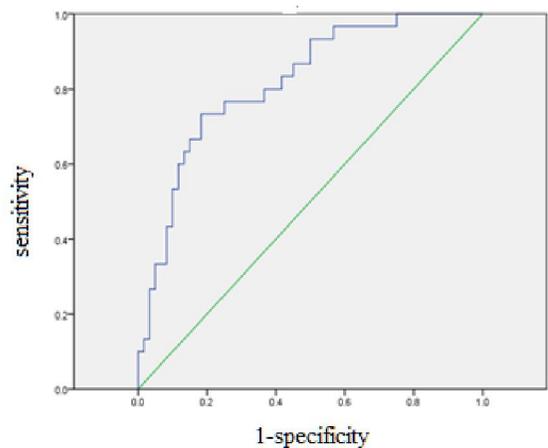


Figure 3: ROC curve for Hipbone OSTA in menopausal women

Table 4. OSTA diagnosis of osteoporosis in menopausal women

	AUC	Cut-off	sensitivity	specificity	consistency
Lumbar vertebra;	0.785	-2.64	80.00%	71.07%	0.426
Hip bone	0.817	-3.07	75.61%	78.38%	0.506

Discussion and Conclusion

Osteoporosis is a metabolic bone disease. The World Health Organization (WHO) has listed it among the top three diseases affecting the health of middle-aged and elderly people. Osteoporosis has become an important health issue of global concern [8]. Clinically, osteoporosis is generally divided into primary and secondary categories. Among them, primary osteoporosis is mainly affected by menopausal women and the elderly adults [9]. A number of studies have shown that the occurrence of primary osteoporosis is affected by age. The incidence of osteoporosis also shows an increasing trend [10,11]. This is because when the body reaches its peak bone mass, it will be slowly lost with age, especially for menopausal women, it loses the protective effect of estrogen, resulting in more rapid bone loss [12]. Compared with men of the same age, the incidence of osteoporosis in menopausal women is significantly higher. Previous studies have shown that the incidence of osteoporosis in men in the elderly population in China is about 23%, while that in women is 49% [13]. In this study, the lumbar vertebra and hip bone were used as the detection sites. The results show the T value of the <60 years old group was greater than that of the 60~75 years old group and the >75 years old group ($P<0.05$), and the 60~75 year old group is greater than the >75-year-old group ($P<0.05$), that is, as the age of menopausal women increases, their bone density shows a downward trend.

Osteoporosis is a high risk factor of fractures. Even mild pressure, including activities such as bending the waist may cause the bone fractures for the osteoporosis patients. Osteoporosis is also one of the important public health problems globally. Screening and intervening patients with osteoporosis to reduce the occurrence of fractures caused by osteoporosis is a major concern of national health care currently. Measuring bone mineral density by DXA and calculating T value is the main method for clinical diagnosis of osteoporosis. T value ≤ -2.5 in patients with osteoporosis is the basic criteria for evaluation as normal. If a fragility-fracture occurs under this condition, it is considered to be severe osteoporosis [14]. Clinical interventions can be carried out on osteoporosis patients who are with reduced bone mass based on the results of DXA testing. However, due to

the relatively expensive charge and limitations of supplies material and manpower, DXA in primary hospitals is limited as well, especially for bone mass detection. Usually, large-scale screening for porosity is difficult to be popularized. According to osteoporosis diagnosis and treatment guidelines, people who do not have the sufficient conditions to use DXA examinations, OSTA risk screening can be carried out. The OSTA index is an osteoporosis screening tool suitable for Asians. Its operation is simple, only needs to measure the height and weight of the examinee, and easily accepted by clinicians and examinees. Malaysia, Japan, Thailand and many other Asian countries have applied the OSTA index to their national population's osteoporosis screening, and the diagnostic sensitivity is 87%~97.5%, and the specificity is 54.6%~60.8% [15-17].

In this study, the OSTA index of the <60-year-old group was greater than that of the 60-75-year-old group and the >75-year-old group ($P<0.05$), and the OSTA index of the 60-75-year-old group was greater than that of the >75-year-old group ($P<0.05$), namely. As the age of menopausal women increases, the OSTA index also shows a downward trend, which is consistent with the change of trend of the T value, suggesting that the OSTA index may correlate with the T value. We analyzed the DXA diagnosis results of 267 menopausal women and showed that there were 152 cases of osteoporosis, including 82 cases of lumbar osteoporosis and 70 cases of hip osteoporosis. Osteoporosis was observed specifically in menopausal women. The incidence rate is relatively high, and the highest detection rate is at the site of lumbar vertebra. Previous study Liu Shuai et al. [18] also showed that the detection rate of DXA on lumbar vertebra and femoral neck osteoporosis was 28.5% and 25.2%, that is, lumbar vertebra osteoporosis was the most common, which was consistent with the results of this study. We evaluated osteoporosis through OSTA index and showed that the detection rates of OSTA was at high-risk, medium-risk, and low-risk indexes in lumbar osteoporosis of 67.07%, 7.32%, and 26.25%, respectively, in hipbone osteoporosis The detection rates of the disease were 68.57%, 28.57%, and 2.86%, respectively, suggesting that the OSTA high-risk index and DXA are more consistent in diagnosing osteoporosis in menopausal

women, and the OSTA risk index is more suitable for assessing osteopenia.

The ROC curve analysis of the diagnostic OSTA in menopausal women with osteoporosis shows that the sensitivity and specificity of OSTA in the diagnosis of menopausal women with osteoporosis are at 83.55% and 79.13%, respectively, which is consistent with the diagnosis of DXA. Kappa value equals to 0.626, indicating that the two inspection methods are more consistent in the diagnosis of osteoporosis in primary menopausal women, and OSTA can be better to screen the disease in menopausal women of osteoporosis. In this result, the sensitivity of OSTA to the diagnosis of osteoporosis in menopausal women is slightly higher than that of specificity, and the values are relatively close. The diagnosis of osteoporosis in menopausal women is more sensitive. This study also analyzed the diagnostic efficacy of OSTA in menopausal women with osteoporosis in different sites of the body of osteoporosis. The results showed that the sensitivity of OSTA to the diagnosis of lumbar osteoporosis and hip osteoporosis was 80.00%, respectively. 75.61%, the specificity was 71.07%, 78.38%, and DXA diagnosis consistency showed that the Kappa values were 0.426 and 0.506, respectively, suggesting that OSTA is more effective in diagnosing hip osteoporosis than lumbar osteoporosis. In summary, OSTA is simple and easy to operate, and is consistent with DXA in the diagnosis of osteoporosis in primary menopausal women. It can diagnose osteoporosis easier and accurately in menopausal women. OSTA can be validated for the diagnosis in treating primary menopause women.

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