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Validity of Clinical Attachment Loss for Diagnosis of Osteoporosis in Postmenopausal Women

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Abstract:
Background: *Osteoporosis is an important disease with significant fracture morbidity.*
Objective: *To assess validity of clinical attachment loss (CAL)for diagnose osteoporosis in post-menopausal women*
Patients and Methods: *This cross sectional study included 75 postmenopausal women. Osteoporosis was diagnosed by dual energy x-ray absorptiometry (DXA).CAL was calculated using the probing pocket depth and the level of the gingival margin*
Results: *Of 75 women involved in the study, 25 were healthy postmenopausal women, 25 had osteopenia, and 25 had osteoporosis. There was no statistical significant differences between age and body mass index in all groups ($p>0.05$).The effect of osteoporosis on increasing CAL was stronger (ROC area=0.92) than that of osteopenia (ROC area=0.68). Clinical attachment loss showed high statistically significant moderately strong ($r=0.55$) positive linear correlation with bone t- score. CALwas a valid parameter to predict osteoporosis in postmenopausal woman(ROC area=0.88, $p<0.001$).CAL at the optimum cut off value ≥3.34has highest accuracy (86.7%) to diagnose osteoporosis in postmenopausal women with sensitivity was 84%, specificity 88 %, positive predictive value (PPV) at pretest probability 50% was 87.5 % and PPV at pretest probability 90% was 98.4 % and negative predictive value (NPV) at pretest probability 10% was 98 %.*
Conclusions: *CAL was a simple, easy, and a valid clinical test to diagnose osteoporosis in postmenopausal women with high accuracy. This may indicate a hopeful measure for early diagnosis and treatment of osteoporosis.*
Keywords: *Clinical attachment loss, Menopause, osteoporosis, validity*

I. Introduction

Osteoporosis is a silent important systemic skeletal disease characterized by low bone mass and micro-architectural deterioration with a consequent increase in bone fragility and susceptibility to fracture [1] and has a major growing public health problem with impact that crosses medical, social, and economic lines [2]. Therefore; most relevant studies have been designed to develop new measures for early diagnosis and treatment to reduce the burden of this health problem [3].

Previous studies have shown positive association between osteoporosis and periodontitis [4, 5]. Some studies have shown that salivary diagnostic tests can be used for predicting osteoporosis [6, 7]. Periodontitis is an inflammatory disease characterized by resorption of the alveolar bone and loss of soft tissue attachment to the tooth [8]. Clinical attachment loss (CAL) is one of the clinical parameters used for determining the condition of periodontal tissues [9]. Because validity of CAL for predicting OP in postmenopausal women have not been studied. This study was designed to assess the validity of CAL for predicting OP.

II. Patients and Methods

Study design

This cross-sectional study was conducted in Institute of radiology, Baghdad Medical City from 23rd of September 2014 till 10th of February 2015.Informed consent and ethicalapproval had been obtained.

Participants

Eligible individuals included in the study were postmenopausal women who had experienced at least 12 consecutive months of amenorrhea. The postmenopausal stage was defined as beginning at the time of the woman final menstrual period [10].

Subjects were excluded from the study if they had: diabetes mellitus, thyroid and parathyroiddisease, autoimmune diseases, history of periodontal therapy within the last 3 months; current use of medications such as corticosteroids or any immune suppressive within the previous 3 months, chemotherapy, ovarictomy; smokers, alcohol users, fracture and neoplastic diseases.

Data collection and measurements

Age of the postmenopausal women, weight, height were recorded and body mass index (BMI) was measured according the equation BMI=weight / height ^{2}. The intra oral examination was performed under natural light with patient seated on an office chair.

William periodontal probe was used to assess clinical attachment loss(CAL):-

1. The measurement of probing pocket depths (PPD) is a clinical diagnostic test to assess the corono-apical extension or the depths of the periodontal pocket respectively. The probing pocket depth PPD was read out in relation to the gingival margin using the markings of the periodontal probe, in this examination a periodontal probe was inserted into the periodontal pocket with a simple pressure in apical direction parallel to the tooth axis between gingiva and tooth surface until probing pressure and tissue resistance are in balance [11].All four surfaces of the six Ramfjord teeth (3, 9,12,19,25 and28) index were examined, if an index tooth was missing the nearest distal tooth was substituted for examination and patient was at least 5 of 6 Ramfjord teeth present.
2. Gingival recession was assessed by measuring the distance from free gingival margin to the cement enamel junction (CEJ).

The result of these two measurements was used to calculate the clinical attachment loss: (a) the probing pocket depth and (b) the level of the gingival margin (distance from CEJ to gingival margin) [12].

The diagnosis of the osteoporotic patients was made by rheumatologist according to the results of BMD [13] using dual x-ray absorptiometry scan (DXA scan: central DXA type DEXXUM 3).All women were divided into three groups according to the results of BMD:Group one: twenty five post postmenopausal women with osteoporosis (T score ≤ -2.5), Group two: twenty five post postmenopausal women with osteopenia score between −1 and −2.5 standard deviations below the mean value of peak bone mass. Group three: 25 healthy postmenopausal women (T score ≥ -1.0).

III. Statistical analysis

Statistical software (SPSS version 22, IBM, USA) was used for data analysis. Kolmogorov-Semirnov test was done to assess the distribution of continuous variables.The statistical significance of differences in mean of a normally distributed variable between 2 groups was assessed by independent samples t-test. The statistical significance of differences in mean of a normally distributed variable between more than 2 groups was assessed by ANOVA test. When ANOVA model detects a statistically significant difference, further exploration for statistical significance of difference in mean between all possible paired combinations of study groups was performed using LSD (least significant difference).The statistical significance, direction and strength of linear correlation between 2 quantitative variables, one of which being non-normally distributed variable was measured by Spearman's Rho linear correlation coefficient. A receiver operating characteristic (ROC) curve analysis was used to assess validity parameters and set optimum cut-off values for CAL when used to predict a diagnosis of osteoporosis P value less than the 0.05 was considered statistically significant.

IV. Results

Of 75 postmenopausal women involved in the study, 25 were healthy controls, 25 osteopenic patients, and 25 were osteoporotic patients.There was no statistical significant difference between the mean age of the groups(55±5.1vs 56.1±4.2 vs 52.2±5.3 years, P= 0.07) respectively and no statistical significant difference between the meanof body mass index (BMI) in the study groups (33.8±4.9 vs 31.4±5.5 vs 30.8±5.7kg/m², p= 0.46) respectively.

Clinical attachment loss (CAL)

The mean CAL was highest in osteoporosis group (3.55) and lowest in control group (2.97).The difference in means between studied groups was statistically significant .The mean CAL was significantly higher in osteoporosis group (3.55) compared to control group (2.97).The mean CAL was significantly higher in osteopenia group (3.13) compared to control group (2.97) as shown in figure 1

The effect of osteoporosis on increasing CAL was stronger (ROC area=0.92) than that of osteopenia (ROC area=0.68). Clinical attachment loss showed high statistically significant moderately strong (r=0.55) positive linear correlation with bone t- score.

CALwas a valid parameter to predict osteoporosis in postmenopausal woman(ROC area=0.88, p<0.001) as in table 1.

CAL at cut off value ≥ 2.93 was associated with highest sensitivity (100%) in predicting osteoporosis .Testing negative at this cut-off value can exclude a possible diagnosis of osteoporosis among postmenopausal women

with 100% confidence at any pretest probability (any clinical context). Testing positive of CAL at highest specificity (100%)where cut-off value ≥ 3.79 will establish a diagnosis of osteoporosis with 100% confidence in any clinical context.

The best cut-off value providing the best separation between postmenopausal women with osteoporosis and those without osteoporosis is CAL ≥ 3.34 which is associated with a sensitivity of 84.0% and specificity of 88.0% and testing positive at this the optimum cut-off value will establish a diagnosis of osteoporosis with 87.5% confidence in clinical context where the pretest probability of having osteoporosis is 50%.whiletesting positive at the same cut-off value in clinical context where osteoporosis is of high probability based on clinical suspicion only (pretest probability =90%) will establish the diagnosis of osteoporosis with 98.4% confidence as shown in table 2

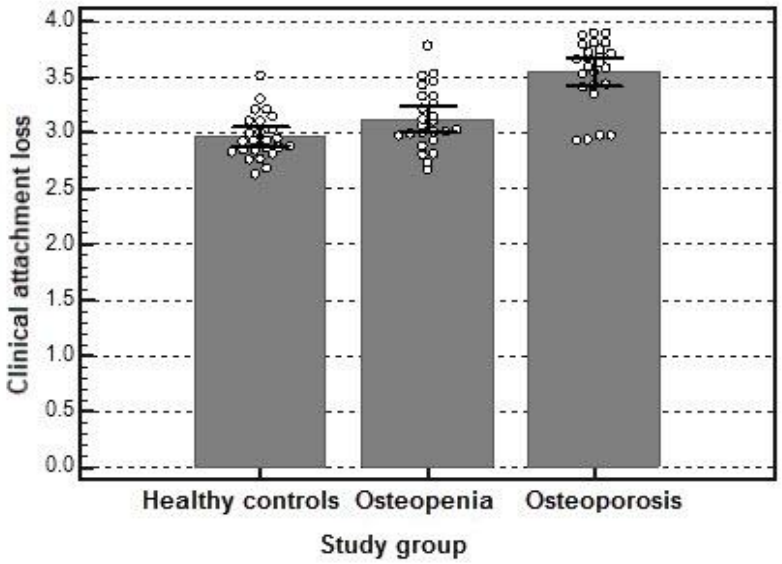

Figure 1: Distribution of samples according to clinical attachment loss

Table1: ROC area for clinical attachment loss when used as test to predict osteoporosis among postmenopausal women

Predicting Osteoporosis	ROC	P
Clinical attachment loss	0.88	<0.001

ROC, receiver operating characteristic

Table2:- Performance characteristics of clinical attachment loss in predicting osteoporosis.

Clinical attachment loss Positive if ≥ cut-off value	Sensitivity %	Specificity%	Accuracy %	PPV at pretest probability = 50%	PPV at pretest probability = 90%	NPV at pretest probability = 10%
2.93 (Highest sensitivity)	100	34	56	60.2	93.2	100
3.34 (Optimum cut-off)	84	88	86.7	87.5	98.4	98
3.79 (Highest specificity)	24	100	74.7	100	100	92.2

PPV, positive predictive value; NPV, negative predictive value

V. Discussion

Bone loss is a feature of both periodontitis and osteoporosis, and several studies have analyzed whether the periodontal destruction could have been influenced by systemic bone loss [14].Up to our knowledge, the current study is the first observational analytic cross sectional study that assessed validation of CAL for prediction and diagnosis of osteoporosis in postmenopausal women. It showed that CAL was a simple, noninvasive, and valid measure for predicting OP in postmenopausal women with high accuracy, sensitivity, specificity, PPV, and NPV.

Variable recent studies have reported significant association between osteoporosis and periodontitis, however none of them measured the validity of that association. Juluri [15] compared the severity of periodontal disease in postmenopausal osteoporotic women and postmenopausal women without OP and reported that postmenopausal OP had significantly greater CAL compared to non-osteoporotic group in addition to significant association with an increased incidence and severity of periodontal disease.Lin [5] investigated the association between periodontitis and osteoporosis by gender in A Nationwide Population-Based Cohort Study and showed after adjusting for age, sex, income, and geographical region, therewas a significant association between periodontitis and osteoporosisamong women.

In aStudy assessed and correlatedosteoporosis and periodontitis in selected population of Maharashtra, Lohana [16] concluded that there was a definite association between periodontitis and osteoporosis.Iwasaki [17] in a cross-sectional study evaluated the possible association between BMD and attachment loss with dental restoration information in Japanese community-dwelling postmenopausal females and concluded that that low systemic BMD was associated with severe attachment loss in Japanese community-dwelling postmenopausal females. Al-Habashneh [18] determined the relationship between periodontitis and osteoporosis among postmenopausal Jordanian women and found thatosteoporosis was significantly associated with severe alveolar crestal bone loss and the prevalence of periodontitis cases in postmenopausal Jordanian women.

The limitation of the present study is the small sample size however this may be solved by larger study sample size. Despite that, this is the first time to validate CLA as a simple measure to predict postmenopausal osteoporosis.

In conclusion, CAL was a simple, easy, and a valid clinical measure to predict and diagnose osteoporosis in postmenopausal women with high accuracy.This may indicate a hopeful measure for early diagnosis and treatment of osteoporosis.

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