Relation of Gonial Angle Index to osteoporosis and age using CBCT in female subjects

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ABSTRACT

background: osteoporosis is a metabolic bone disease that affects women more than men, it is characterized by generalizes reduction of bone mineral density (BMD) leaving a fragile weak bone that is liable to fracture, gonial angle index (GAI) is one of the radio-morphometric indices, it has been controversial whether it is related to bone mineral density or ageing or none of them. The aim of study is to evaluate the role of cone beam computed tomography (CBCT) as a screening tool for diagnosis of osteoporosis and age effect in females using gonial angle index.

Material and method: 60 females were divided into 3 groups according to age and (BMD) status into: Group1 (non-osteoporosis 20-30 years), Group2 (non-osteoporosis 50years and above), and Group3 (osteoporosis 50years and above), each patient had a CBCT scan, and gonial angle index was measured compared among groups.

Results: Gonial angle index showed a significant difference between Group1 and Group2 at $p < 0.05$, while it showed no significant difference between Group2 and Group3 at $p > 0.05$.

Conclusion: Gonial angle index is significantly affected by age factor while it was not affected by osteoporosis, so it cannot be used as a parameter that can predict bone mineral density status patients

Key words: osteoporosis, CBCT, GAI. **(J Bagh Coll Dentistry 2018; 30(2): 41-46)**

INTRODUCTION

Osteoporosis is a systemic skeletal disease characterized by low bone mass and micro architectural deterioration, with a consequent increase in bone fragility with susceptibility to fracture.[1] It causes fragility fractures on minimal injury where otherwise normally a micro-fracture will not occur. The vertebral column, hip, and wrist being the most common sites of such fractures.[2] For a person, over 50 years living in a developing country, the lifetime risk of sustaining a fracture has been estimated at 50% for females and 20% for men.[3] Dual energy X-ray absorptiometry (DEXA) is the most reliable technique to determine BMD. [4] Osteoporosis is defined as a BMD T-score of -2.5 or less at either the lumbar spine or the femoral neck, in accordance with the World Health Organization classification. [5]

On the other hand, gonial angle, or the angle of mandible, is formed by the line tangent to the lower border of the mandible and the line tangent to the distal border of the ascending ramus and condyle. [6] Fish indicated that age and loss of teeth may effect change of gonial angle, but other factors are also influential. [7]

Xie *et al*., stated that the gonial angle size was widened in edentulous older women and also showed a significant negative correlation with cortical thickness at gonial angle, indicating a possible systemic effect such as osteoporosis or metabolic bone loss on the size of gonial angle.[8] CBCT has been widely accepted in dentistry since its introduction in 1998. [9,10] it provides two dimensional (2D) and three dimensional (3D) images with obvious details with cheaper cost and much lower radiation than medical computed tomography (CT). Also Manufacturers of CBCT devices offer viewer software to study the images. This software has the necessary tools for basic and simple analyses, such as multi-planar reconstruction, dimensional measurements, and radiographic density (RD) measurements. [11] And this is beneficial in studying GAI.

Since early detection of osteoporosis can allow therapeutic intervention, but the condition is often undiagnosed. There has been recent interest among dental researchers in identifying those at risk of reduced bone mineral density from dental radiographs. [12,13]

The purpose of this study was to establish an association between changes in the angle of mandible on CBCT in relation to DEXA scan T-score of lumber vertebrae to see whether or not the CBCT can be employed for early detection of osteoporosis.

MATERIALS AND METHODS:

The study sample was 60 Iraqi females who attended AL-Sadir Specialized Dental Center referred for CBCT scan. All patients were

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informed well about the aim and the method of the study and told them that they are free to withdraw at any time, they signed for their agreement of participation on a special consent form. Each patient was asked to have a bone mineral density evaluation by DEXA scan at AL-Wasity Medical Hospital at the DEXA unit so both scans were made on the same day, the sample was divided into three groups according to their age and osteoporotic status: Group1 composed 20 females with(20-30) years old as control group (non-osteoporotic), Group2 composed of 20 postmenopausal non osteoporotic females with 50 years old and above, and Group3 composed of 20 postmenopausal osteoporotic females with 50 years old and above.

Exclusion criteria were previously diagnosed patients with any other metabolic bone disease, diabetics, Smokers and alcoholics, Pregnancy, ,cancers with bone metastasis or renal impairment, patients with any medication that affects bone metabolism, and Acute traumatic injury to TMJ, mandible.

Measurements of T-score in lumber spine was done by DEXA scanner (Stratos) machine, origin (France), DEXA machine uses a pencil beam scanning method with micro-emission of x-ray with scan time of 90 second, and bear weight of 150 Kg, a computer system used for image manipulation and viewing the image on the computer LCD monitor (LG), origin (Korea).

BMD was evaluated according to World Health Organization (WHO), normal (T-score ≥ -1.0), osteopenia (T- score between -1.0 and -2.5), and osteoporosis (T- score ≤ -2.5).[14]

CBCT machine used in the study was Kodak 9500 cone beam 3D system manufactured by Care Stream, origin France, year 2012, with was Large field of view mode (18height × 20.6 cm diameter) (full skull) parameters was 10 ma, 90 kv, and exposure time of 10.08 seconds with voxel size 300, the viewer software (care stream 3D imaging developed by the same CBCT manufacturer) with LG computer unit with windows XP to view and manipulate images.

After the exposure the image presented on the screen as secondary reconstructed images in three orthogonal planes (axial, sagittal, and coronal), with the three dimensional image, then the curved slicing option was selected, then the coronal view was selected and manually created an arch (arch reconstruction) then it was selected and an arch line was drawn to reconstruct the OPG lay out view and by scrolling the mouse, a picture with obvious mandibular cortex was used for measurements, and For determining the location of gonial angle, a vertical line was drawn tangential to the posterior border of the ramus with two points contact to prevent rotation of the line. The angle was made by meeting this line with another line tangent to the lower border of the mandible that was also made by two points contact to prevent rotation of the line , the angle value for a patient was determined by calculating the mean of right and left side scores. [15] (Figure. 1)

Statistical analysis: Inter-examiner and intra-examiner calibration was assessed by interclass correlation, Statistical analysis were computer assisted using SPSS version (21) (statistical package for social sciences), GAI, and T-score of DEXA scan were normally distributed, whereas Age was not normally distributed. GAI was analyzed using one way ANOVA test to assess the mean, standard deviation (SD) and effect

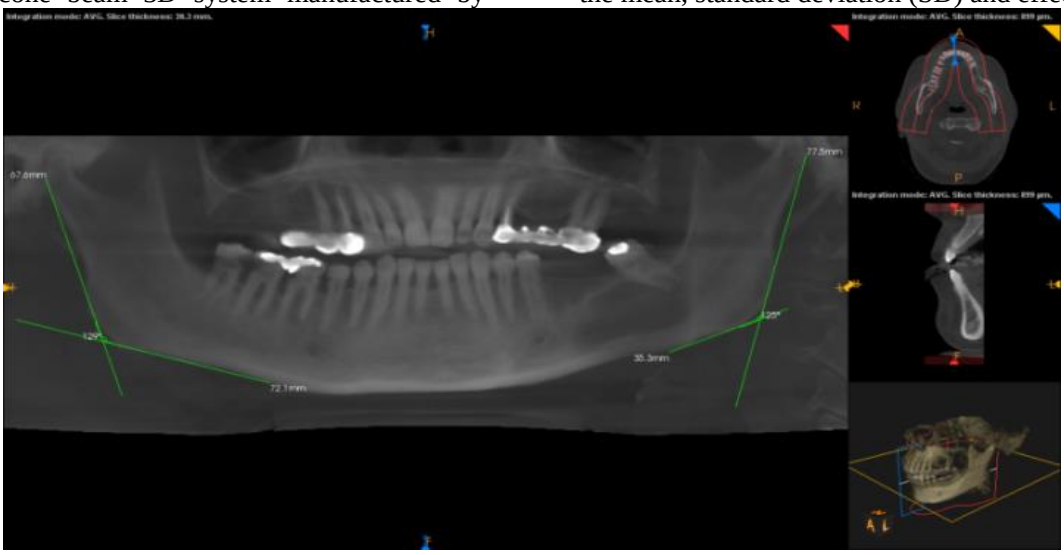

Figure 1.Gonial Angle Index measurements

size(eta^2) described as 0.01(Small), 0.06 (Medium), (0.14) Large, then Further exploration of statistical significance of means among the 3 groups was assessed by Dunnett test with control which is a multiple comparison test of groups with control (2-sided)

The statistical significance, direction and strength of linear correlation between normally distributed variables were done by Pearson correlation coefficient, and for variables with not normal distribution were done by Spearman correlation coefficient. For all tests, Statistical significance level was set at P<0.05

RESULTS:

According to DEXA values and age, the study sample was divided into 3 groups to determine whether the variable is affected by age or by osteoporosis or both**.**

Descriptive data and statistical test for GAI among study groups showed no statistical significant difference among groups P>0.05, with (p =0.061) and medium size effect (0.094) that is shown in table (1) it was decided to further explore the results using Dunnett test with control to see the cause of that medium effect, Multiple comparison of GAI among study groups showed a significant difference between Group1 and Group2 p<0.05, and a non-significant difference between Group2 and Group3 p>0.05 which illustrated in table (2). Correlation coefficient showed a negative correlation between GAI and Age (r=-0.338) and the correlation is statistically significant (p=0.033), whereas it showed weak negative correlation between GAI and T-score (r=-0.053) and the correlation is not statistically significant (p=0.689) as shown in table (3).

DISCUSSION:

In this study GAI showed statistical significant difference according to age as the mean of (GAI) for 20-30 years old non osteoporosis group was significantly higher than the mean (GAI) for non-osteoporotic 50 years old and above, and this is agreed by Pecora *et al*.,2008 longitudinal cephalometric study.[16]

Upadhyay *et al*.[17] stated that the angle of mandible differ according to age but not with significant amount, Xie and Ainamo[18] studies conducted in old females who had no teeth, found that angle was to be increased, whereas Dutra *et al*.[19] confirmed that mandibular gonial angle is not correlated with age.

This disagreements with others could be due to that to that the group sample in present study were mixed dentate and partially edentulous while most samples of old females of other studies were edentulous, and it is well known that gonial angle is affected by dental status. Another explanation may be the difference in age between Group 1 and 2 was about 20 years and more caused the age effect to be stronger. Other cause may be that the second

Table 1. Descriptive data and statistical test for GAI among study groups

Statistics	Groups			ANOVA	
	Non-Osteoporosis 20-30	Non-Osteoporosis 50+	Osteoporosis 50+	P-value	Eta ^{2}
Minimum	118.500	113.000	116.000	0.061 NS	0.094 Medium
Maximum	140.500	137.500	142.000		
Mean	128.175	123.050	126.350		
±SD	6.103	6.741	7.413		

P >0.05,NS

Table 2. Multiple comparison of GAI among study groups using Dunnett test

Groups	Groups	MD	SE	P-value
Non-osteoporosis (20-30)	Non-Osteoporosis 50+	**5.125***	**2.142**	**0.037 Sig.**
Osteoporosis 50+	Non-Osteoporosis 50+	-3.300	2.142	0.222 NS

P<0.05,Sig ; p>0.05, NS

Table 3. correlation of GAI with age and T-score

	GAI	
	R	P
AGE	-0.338	0.033
T-score	-0.053	0.689

Sig, p<0.05

group were all post-menopausal females which suggest a hormonal deficiency effect which affect the bone quality.

Speaking of Osteoporosis, the results of this study showed that it has no effect on Gonial Angle as the difference in means of GAI between non-osteoporotic 50 years and above group and osteoporotic 50 years and above group was not significant.

This is confirmative to studies of Dutra *et al.*[19], and Guduba *et al.* [20]

Also agrees with Sindhu *et al.* [21] who found that there was no significant difference of the gonial angle in relation to osteoporosis.

On the other hand Rehman *et al.* [22] concluded an opposite result as he suggested that Gonial Angle can definitely be used for prediction of bone mineral density condition.

This study showed a negative correlation between GAI and age and the relation was significant. Taleb and Beshlawy [23] found a negative correlation but it was not significant, Bathla *et al.* [24] found a significant but positive correlation between gonial angle and age , whereas Nemati, *et al.*[25] showed that there was no correlation between gonial angle and age which disagree with our results

Different results in correlation between age and gonial angle noticed among diverse researches could resulted of differing ages and differing dental conditions among study samples.

Regarding DEXA results, there was no correlation between GAI and T-score of lumber vertebra. And this was agreed by study of Sindhu, *et al.*,[21] and Leite *et al.*[26]

It has been found that genetics and ethnicity do play a strong role in describing the characteristics of angle of mandible.[27] also dental status, bone mass, and muscle activity at mandibular angle affect the size of GAI

In conclusion GAI showed a decreasing tendency on ageing, also GAI showed no significant difference between normal and osteoporotic patients, so it cannot be used as a reliable parameter to predict the presence of osteoporosis.

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الخلاصه

نبذة مختصرة : ان مرض هشاشة العظام هو مرض يصيب العظام بشكل عام ويؤثر على النساء اكثر من الرجال ،يتصف بنقصان عام في كثافة المعادن في عظام الجسم مما يؤدي الى ضعف هذة العظام وزيادة اكمكانية تعرضها للكسور. ان قياس زاوية الفك الأسفل هي واحدة من المؤشرات الراديومورفولوجيه والتي غالبا ماكانت موضع جدل فيما اذا كان لها علاقة بنقصان الكثافة العظميه او التقدم في السن او كليهما. هذة الدراسة تهدف الى تقييم دور اشعة cbct في الكشف المبكر عن مرض هشاشة العظام كذلك تهدف الى دراسة تأثير هشاشة العظام على زاوية الفك الأسفل في النساء وتمييزها عن تأثير التقدم في السن.

طرق البحث والمواد المستخدمة: تم تقسيم 60 امرأة الى ثلاثة مجموعات حسب العمر وقياس كثافة المعادن في العظم ، المجموعة الأولى 20 امرأة بعمر (20-30) سنه غير مصابة بمرض هشاشة العظام ، المجموعة الثانية 20 امرأة بعمر 50 سنة فما فوق غير مصابة بمرض هشاشة العظام ، والمجموعة الثالثة 20 امرأة بعمر 50 سنه فما فوق مصابة بمرض هشاشة العظام .

وتم اخذ اشعة CBCT لكل واحدة من هؤلاء النساء وتم قياس المتوسط لقياس كل من زاويتي الفك الأسفل لكل مريضة.

النتائج : لوحظ وجود فرق معنوي صحيح بين مؤشر زاوية الفك الأسفل مابين المجموعة الأولى والمجموعة الثانية ($p<0.05$) ، بينما لوحظ عدم وجود فرق معنوي صحيح مابين المجموعة الثانية والمجموعة الثالثة ($p>0.05$).

الأستنتاجات : مؤشر زاوية الفك الأسفل يتأثر بشكل واضح بعامل التقدم في السن الأ انه لايتأثر بنقصان كثافة العظام لذلك لايمكن الأعتماد على هذا المؤشر في الكشف المبكر عن مرض هشاشة العظام.