Diagnostic Efficacy of Mandibular Cortical Thickness on Panoramic Radiographs to Identify Postmenopausal Women with Low Bone Mineral Densities (Iraqi Population)

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Abstract: Background: The use of mandibular anatomic indicators on panoramic radiographs such as mandibular cortical thickness at mental region can be useful in the evaluation of bone resorption in different age of postmenopausal women to determine the presence of osteoporosis. The aims of the study were to assess the accuracy of mandibular cortical thickness in the panoramic radiographs of postmenopausal women with normal and low skeletal bone mineral densities diagnosed by using dual energy x-ray absorptiometry, and to correlate the effect of age in both two groups. **Materials and methods:** Forty digital panoramic radiographs obtained from postmenopausal women (20 normal and 20 osteoporotic) aged between (52.7-80.1 years). Bone mineral density has been assessed by a dual energy x- ray absorptiometry, at the lumbar spine and right femur at radiation center in medical city. The mean was calculated for mandibular cortical thickness values measured in the right and left mandibles. The measurements were analysed using the t- test and Pearson's correlation coefficients. **Results:** Difference was shown between the mandibular cortical thickness, measurements in the osteoporotic group and normal group which showed that mandibular cortical thickness was more thinner in osteoporotic group than normal group (t = 23.25, p value 0.01). Pearson's correlation coefficients of normal and osteoporotic by age and mandibular cortical thickness, were 0.976 and 0.973 respectively with (*p* value < 0.01). **Conclusion:** The pattern of decrease in mandibular cortical thickness with age was similar to that pattern of bone loss from the spine and femur, so panoramic radiography was a simple technique in osteoporosis screening of dental patients, giving the maximum benefit of being radiographed.

1. Introduction

Osteoporosis is a disease characterized by low bone mass and micro-architectural deterioration of bone tissue, leading to bone fragility and enhanced susceptibility to fractures. Osteoporosis is predominantly a condition of the elderly [Rizzoli et al 2009, Karasik 2008]. It affects mostly women, especially after menopause as a result of estrogen withdrawal ("menopausal" osteoporosis) (Karasik 2008) A major obstacle to combating osteoporosis is the failure to identify individuals who have osteoporosis until the clinical consequences of osteoporosis have occurred (i.e., fractures form with little trauma to the bones)[Karayianni et al 2007]. Most of the post- menopausal women have more opportunities to visit dental clinic for the treatment of dental caries and periodontal disease than to visit a medical office for diagnosis of osteoporosis prior to fracture [Ishii et al 2007 , Taguchi et al 2007].Hence the panoramic radiograph plays a vital role in identifying post menopausal women with undetected osteoporosis. The effect of osteoporosis on the jaw bones has been studied intensively. Cortical indices of the mandible on panoramic radiographs, such as cortical width and cortical shape, are significantly associated with BMD of the general skeleton [Leite et al 2010]. Dual energy x-ray absorptiometry (DXA) is considered to be the criterion standard assessment of bone strength and the best predictor for risk of fractures[Leite et al 2011].Thus, detection of osteoporosis, assessment of bone mass, and identification of fracture risk are important goals when evaluating patients for osteoporosis[Dutra et al 2005, Karayianni et al 2007]. Subjects with a self-reported history of osteoporotic fractures also tend to have increased resorption and thinning of the mandibular lower cortex[Bollen et al 2000]. Several investigators have stated that osteoporosis results in reduced jaw bone mass and altered mandibular structure, especially of the inferior border (mandibular lower cortex)[Hardanti 2011].Thin mandibular cortical width measurements in dental panoramic radiographs have been used as a predictive measure of systemic osteoporosis [Hekmatian et al].These radiographs are frequently used by dentists and may provide a useful opportunity to contribute to osteoporosis diagnosis, especially if the radiograph is taken for other reasons. In that situation, there is no additional radiation dose due to the osteoporosis investigation. Early detection by dentists would allow the necessary preventive treatment to be instituted [Roberts et al 2011].In a study of 112 healthy females and

females with osteoporosis,(Kribbs 1990) observed that the MI Mental index (MI): Mandibular cortical thickness measured on the line perpendicular to the bottom of the mandible at the center of the mental foramen (normal value≥3.1 mm)[Mudda et al 2010]. is smaller in the group with osteoporosis than in healthy individuals. Other studies measuring bone thickness in the mental region demonstrated that MI decreases with increasing age, is lower in white individuals than in black individuals, is lower in women than in men and is lower among female patients with osteoporosis compared with healthy female individuals[Arifin et al 2006 , Dagistan 2010 , Gulsahi et al 2008].

Aim of the study:
1. To assess the accuracy of mandibular cortical thickness in the panoramic radiographs of postmenopausal women with normal and low skeletal bone mineral densities (BMD) diagnosed by using dual energy x-ray absorptiometry (DXA).
2. To correlate the effect of age on MCT in both two groups.

2. **Materials and methods:**

Sample of this study was 40 postmenopausal women aged between (52.7-80.1), those ladies were already been assessed by dual energy x-ray absorptiometry (DXA) at the lumbar spine and right femur at radiation center in medical city.

According to the publication of the World Health Organization (WHO):-

- Bone mineral densities result not more than 1SD below the younger adult mean (T›-0.1) is considered normal.

- Bone mineral densities result more than 205SD below the younger adult mean (T<-2.5) is classified as osteoporosis.

According to the following classification, the sample of this study was (20 normal and 20 osteoporotic).

In Al-Karama specialized center digital panoramic radiographs were obtained for those 40 ladies who divided into:-

- Control group with normal skeletal BMD (n=20, mean age 61.4).

- Osteoporotic group with low skeletal BMD (n=20, mean age 70.4), fig (1).

Measurement of mandibular cortical thickness was made bilaterally on the radiographs at the site of a mental foramen [Taguchi et al 1996].A line parallel to the long axis of the mandible and tangential to the tangent, intersecting the inferior border of the mental foramen, was constructed, along which the mandibular cortical width was measured by a caliper. The mean was calculated for MCT values measured in the right and left mandibles as shown in fig (2).

3. **Results:**

In this study the means of age and MCT in both osteoporotic and normal were (70.4, 2.451) and (61.4, 4.515) respectively as illustrated in table (1). Figure (3) showed that MCT in osteoporotic group was smaller than in normal group obviously.

In table (2) the t-test between osteoporotic and normal group of MCT according to age showed high statistically significant with ($p<0.01$).

As shown in table (3) person correlation of osteoporotic and normal by age and MCT was a statistically significant very strong negative correlation with (r=-0.973, r=-0.976) respectively and ($p<0.01$).

In osteoporotic group MCT decreased more rapidly with age when compare with normal, figures (4, 5).
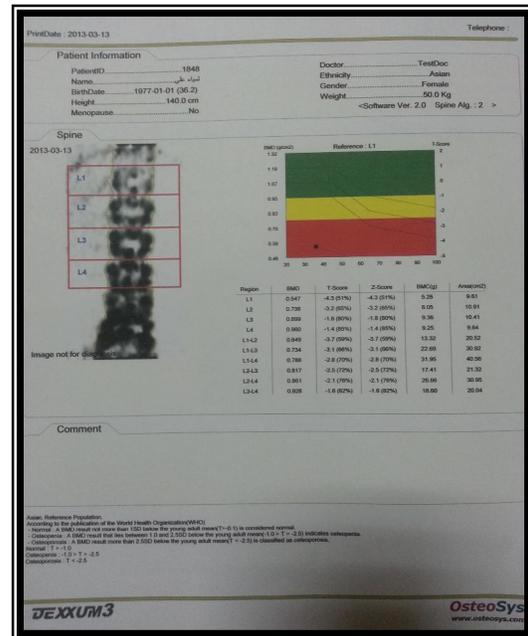

Fig (1): Report
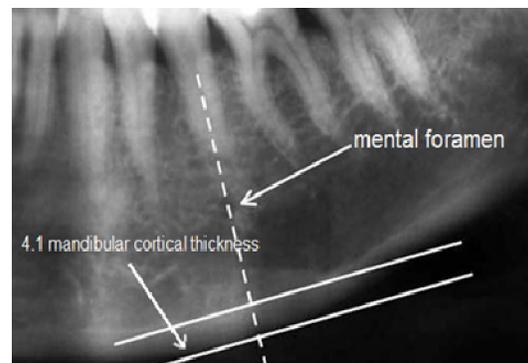
Fig 2: Measurement of mandibular cortical thickness

Table (1) Descriptive of osteoporotic and normal

	Osteoporotic		Normal	
	Age	MCT	Age	MCT
Mean	70.4	2.451	61.4	4.515
SD	5.215	0.267	4.418	0.33
SE	1.166	0.059	0.988	0.074
Min	62.3	1.96	52.7	4
Max	80.1	2.98	67.8	5.2
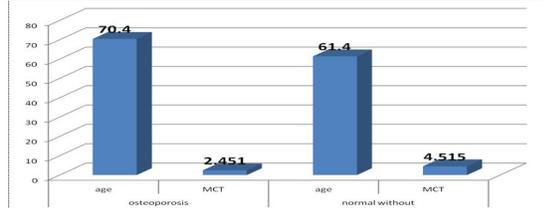
Fig 3: The means of age and MCT in osteoporosis and norma

Table 2: t-test between osteoporotic and normal of MCT by age

t-test	*P*-value	Sig
23.25	*P*<0.01	HS

Table 3: Person correlation of osteoporotic and normal by age and MC

	r	*P*-value
Osteoporotic	0.973-	*P*<0.01
normal	0.976-	*P*<0.01
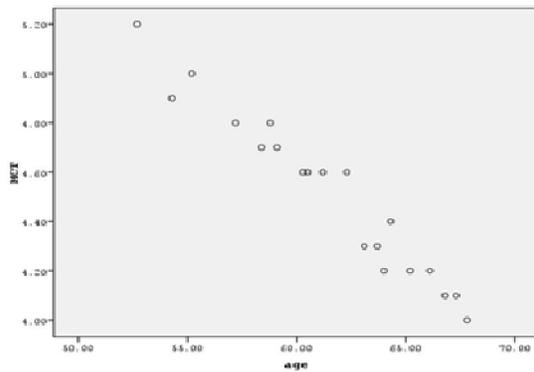
**Fig 4: dot diagram between age and MCT in normal group**
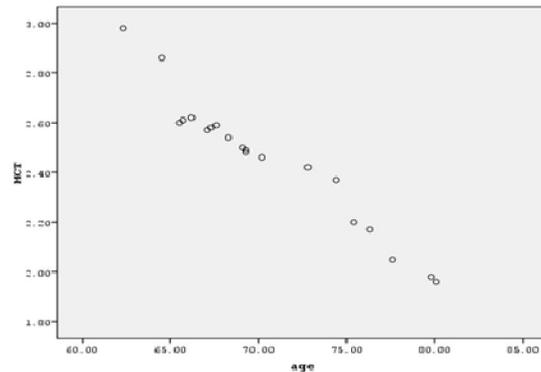
Fig 5: dot diagram between age and MCT in osteoporotic group.

4. Discussion

Osteoporosis may be occur in bone tissue as a result of ageing, after the age of thirty five the bone mineral density (BMD) of men and women gradually decreases with increasing age. Women tend to lose BMD especially after the menopause (Verheij et al 2009). Since the disease is preventable, diagnostic techniques are of major importance (Yashoda 2011). Hence, considerable effort has been expended in identifying methods of detecting individuals with osteoporosis at an early age (Yashoda 2011). Osteoporosis can reveal them as a specific image on panoramic radiograph. The characteristics of this disease are cortical thinning and more radiolucent trabecular areas (Devlin 2002). Cortical thinning on mandible happens as a result from Haversian canal widening (Hardanti 2011). Results of the studies suggested that the thickness of mandibular cortical bone is decreased in osteoporotic patients and inferior border of the mandible is more porous than the controls (Leite et al 2010) dental panoramic radiographs are frequently taken for the examination of teeth and jaws in general dental practice over the world, so dentists could play an important role in referring patients with suspected osteoporosis for further medical examination(Leite 2011).In this study we concluded that MCT decreased more rapidly in osteoporotic group when compared with normal group. Age also effect in both groups on MCT. Estrogen deficiency plays a very important role on menopause as a cause of bone mass decrease (Devlin 2002). Estrogen prevents osteoporosis by inhibiting the stimulation effect on specific cytokines in the osteoclast. Decreased level of estrogen will increase the sensitivity of osteoclast to parathyroid hormone. Moreover, estrogen deficiency affects the active vitamin D synthesis in renal tubules and lead to reduction of calcium absorption(Hardanti 2011).Our study is in agreement with the study of Hekmatian et al, which evaluated 51 post-menopausal that diagnosed by DEXA test from lumbar spine (L2-L4) divided into 3 groups normal; osteopenic and

osteoporotic. Mandibular cortical width (MCW) was measured at mental foramen area on the panoramic radiographs. The mean in the normal, osteopenic and osteoporotic groups were 4.8 mm, 3.8 mm and 2.7 mm, respectively MCW mean differences between normal, osteopenic and osteoporotic women were significant (p value < 0.001). MCW had a high correlation with BMD and T-Score (about 0.9). Based on the results of this study, dental practitioners might be the first person to suspect osteoporosis in post-menopausal women from panoramic radiographs and refer them to specialists. A study done by Hardanti et al in 2011, to obtain the description of the mandibular bone quality of male and female patients between 40-60 years old and their differences based on mandibular cortical bone thickness measured using Mental Index (MI).Forty digital panoramic radiographs, which consisted of twenty male and twenty female patients. Mandibular bone quality based on cortical bone thickness measurement using MI of male and female patients indicated a significant difference (p<0.05). In 2006,a study done by Taguchi et al. , to158 healthy Japanese postmenopausal women aged 46 years to 64 years for identifying women with low BMD or osteoporosis at either the lumbar spine or the femoral neck and concluded that cortical measurements detected on dental panoramic radiographs may be useful for identifying younger postmenopausal women with low BMD or osteoporosis so dentists should refer postmenopausal women with eroded cortex or thin cortical width (<3.0 mm) for bone densitometry which was in conformity with our study. The threshold of MCT to refer a patient for BMD testing was 3.0 mm, which was based on a previous study in British women population. Another study on Japanese population suggests a different threshold value of 2.8 mm or less to refer a patient for BMD testing (Devlin 2002, Taguchi et al 2007) which in conformity with our study results. Hastar et al., in 2011 was found there was statistically different mandibular cortical width in patients with osteoporosis and without osteoporosis (P<0.05) by panoramic radiographs of 487 elderly dental patients (age range 60-88 years) which is in agreement with our finding. A study done by Roberts et al. in 2011 to evaluate the mandibular cortical width of 4,949 dental panoramic tomograms, in patients aged 15–94 years and found that the pattern of decrease in mandibular cortical width with age was similar to the known pattern of bone loss from the hip, accelerating in women after the age of42.5 years. In 2006, Arifin et al. investigated panoramic radiographs of 100 postmenopausal women who had BMD assessments of the lumbar spine and the femoral neck were used in this study mandibular cortical width below the mental foramen was measured. Cortical width measured by computer-aided system was compared with BMD of the lumbar spine and the femoral neck. There were statistically significant correlation between cortical width measured by the computer-aided system and spinal BMD (r=0.50) and femoral neck BMD (r=0.54). These correlations were similar with those between cortical width by manual measurement and skeletal BMD.

Conclusion:

Dentists possess clinical and radiographic information sufficient to detect patients with osteoporosis so early detection by dentists would allow the necessary preventive treatment to be instituted.

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