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Evaluation of dental health and thickness of mandibular inferior cortex among menopaused Iraqi cigarette smokers sample by the aid of using digital panoramic radiography

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Abstract

Smoking is linked to osteoporosis through its anti-estrogenic effect in women which results in premature menopause in smokers and increased bone resorption is correlated with estrogen loss in menopause women. The aim of this study is to evaluate the effects of smoking and hormonal changes on the thickness of mandibular inferior cortex and the dentition status in both maxilla and mandible (DMFT) in menopausal females and to estimate the value of panoramic radiographic findings in assessing the possibility of latent osteoporosis. Panoramic images for 80 healthy, median stature, smokers and non-smokers Iraqi female subjects aged (20-35) years premenopausal and (45-60) years menopause was done, then the thickness of mandibular inferior cortex and (DMFT) was evaluated. The results showed that panoramic radiographic measurements are considered as indicator of bone turnover and the dentist is able to identify smokers and non-smokers postmenopausal females with increase risk of osteopenia and osteoporosis by using dental panoramic radiography which is a simple valuable screening tool.

Keywords: Menopause, smoking, bone resorption, panoramic radiography

Introduction

Panoramic radiography is a curved plane tomography radiographic technique used to depict the body of the mandible, maxilla and the lower one half of the maxillary sinuses on a single image [(1)]. Digital radiography is considered to be a great enhancement to the diagnostic radiography due to its improved image properties, improved storage and transportability of the image and reduced equipments and time needed to produce a superior image [(2,3)]. Recent studies suggest that mandibular cortical thickness on panoramic images may be useful in identifying women with low bone mineral density. Panoramic radiographic measurements are considered as indicator of bone turnover [(4)]. Different parts of the mandibular bone are exposed to changes by the means of many factors [(5)]. Changes of the mandibular cortical shape and thickness may be used as indications to many abnormalities, such as osteoporosis particularly in

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postmenopausal women [6]. Smoking influence hormonal function as it increases estrogen loss in premenopausal or postmenopausal women and this can result in a loss of bone density and leads to osteoporosis [7]. Smoking is linked to osteoporosis through its anti-estrogenic effect in women resulting in premature menopause in smokers [8, 9, 10, 11]. Clinical and epidemiological observations indicate that the prevalence and the severity of oral diseases as well as progression rate of the diseases are increased in smokers [12, 13]. Tobacco smoking is very common, with cigarettes being main product smoked. Pindborg in 1947[14] was one of the first investigators to study the relationship between smoking and periodontal disease. Early studies showed that smokers had higher levels of periodontitis but they also had poorer levels of oral hygiene [15, 16]. Later studies which took account of oral hygiene status showed that smokers had more periodontal disease regardless of oral hygiene [17, 18, 19].

In a recent report derived from data of the united state third national health and nutrition examination survey estimated that more than one/half of the cases of periodontitis affecting adult may be due to cigarette smoking [20].

Long term cigarette smoking significantly worsens periodontal health [21]. The risk of more sever alveolar bone loss in smokers seems to depend on the number of the cigarettes smoked per day [22]. Individuals who smoked more than 20 cigarettes per day lost about 0.3mm more alveolar bone than did the non-smokers over 10 years [23]. The reduction of the periodontal bone height may occur irrespective of plaque infection [24].

This suggests that smoking exerts a systemic influence and not a local one and the combined effect from smoking and plaque infection is more destructive than either factor alone [25].

Menopause is defined as the absence of menses for one year. During this time, estrogen, progesterone and ovarian androgens are diminished due to adult-onset ovarian failure. Women usually experience menopause between (40-55) years old, with the median age being 51 years for the non-smokers. Smokers and women with chronic illnesses tend to experience menopause at an earlier age [26, 27].

An increase in bone resorption, which is associated with the increase in the number of osteoclasts, is correlated with the loss of estrogen. This increase in osteoclasts is caused by an increase in the cytokines that regulate the production of osteoclasts. It is believed that estrogen, either directly or indirectly, regulates the production of these cytokines [28].

However, such assessment using panoramic images of the oral health status in menopause female smokers and non-smokers is less studied, on this basis, this work was conducted.

Subjects and Methods

This study was conducted on 80 healthy, medium stature Iraqi female subjects aged (20-35) years for premenopause and (45-60) years for menopause attending the Diagnosis Department /College of Dentistry /Baghdad University. Informations from each subject were recorded in a special case sheet and each subject was subjected to digital panoramic radiograph and they were divided into four study groups: premenopausal non-smokers (N=20) with mean age (26.8) years, postmenopausal non-smokers (N=20) with mean age (52.9) years, postmenopausal mild smokers (N=20) with mean age (53.0) years and postmenopausal heavy smokers

(N=20) with mean age (53.6) years and the classification of smoking habit to mild or heavy was based on special pack year equation (David et al, 2003)

Pack Year = (No. of cigarette smokes per day X No. of years person smokes)/20.

In each dental panoramic radiograph, the thickness of mandibular inferior cortex was measured on both right and left sides at the mental foramen region by using digital panoramic image measurement tools. A Line parallel to the long axis of the mandible was drown and tangential to the lower border of mandibular cortex and a constructed line (dotted line) perpendicular to this tangent intersecting the inferior border of the mental foramen and then another line tangential to the upper border of mandibular cortex and parallel to the tangential lower line was drawn. The distance between the two parallel solid lines was the cortical thickness [6], as shown in fig. (1) (On screen two click measurement system). (Fig 1).

Clinical examination and digital panoramic images were used to evaluate dental health status (DMFT) in both maxilla and mandible. The collected data were possessed and analyzed by using SPSS package program (version 13).

Results

The mean differences between right and left sides of the mandible with regard to the MTMIC were very extremely small and not significant statistically, (Table 1)

1. Effect of menopausal status on MTMIC and DMFT index:

The MTMIC was significantly lower (3.7mm) among postmenopausal non-smokers when compared to premenopausal study group (4.8mm) and there was a statistically highly significant inverse relation between menopausal status and MTMIC with (p-value < 0.001) as illustrated in table (3).

Being a menopausal woman would significantly decrease the MTMIC by a mean of (1.14mm) compared to premenopausal after adjusting for smoking habit as illustrated in table (2-A)

For each year increased in age, the MTMIC was significantly reduced by a mean of (0.05mm) after adjusting for smoking habit as illustrated in table (2-B)

It was found that the mean Dt was significantly lower among postmenopausal non-smokers (4.8) and higher among premenopausal non-smokers (6.4) and there was significant inverse relation between Dt and menopausal status with (p-value = 0.034) and the lower mean Dt among postmenopausal women may be due to that fact that postmenopausal women were complaining of increasing tooth loss compared to premenopausal women and this was obvious as the mean Mt was significantly higher among postmenopausal women (5.4) compared to premenopausal women (0.8) and there was highly significant relation between Mt and menopausal status with (p-value < 0.001). The mean Ft was higher among postmenopausal women (6.0) compared to premenopausal women (3.8) and it was statistically non-significant with (p-value = 0.05), while the mean DMFT was significantly higher among postmenopausal women (16.2) and lower among premenopausal women (11.0) and there was statistically highly significant relation between DMFT and menopausal status with (p-value < 0.001) as illustrated in table (3).

2. Effect of smoking on MTMIC and DMFT index:

MTMIC was highest among non-smokers (3.7mm) and was lowest among those with heavy smokers (3.0mm), while those with mild smokers had the MTMIC in between (3.3mm). The MTMIC showed a statistically significant moderately strong negative linear correlation with smoking habit magnitude with (p-value = 0.001). The MTMIC in both smoking groups was significantly lower than non-smokers and this may reveal that smoking has a deleterious effect on the bones, while no significant differences were observed in MTMIC between heavy and mild smokers as illustrated in table (4).

Being a mild smoker would significantly reduce the MTMIC by a mean of (0.31mm) compared to non-smoker. Increasing the smoking habit to heavy would significantly reduce the MTMIC by a further (0.31mm) after adjusting for the menopausal status in the model. The model was stated significant and able to explain (72%) of variation in MTMIC observed as illustrated in table (2-A).

Being a mild smoker would significantly reduce the MTMIC by a mean of (0.25mm) compared to non-smoker. Increasing the smoking habit to heavy would significantly reduce the MTMIC by a further (0.25mm) after adjusting for the age included in the model. The model was stated significant and able to explain (89%) of variation in MTMIC observed as illustrated in table (2-B).

The mean Dt was lowest among non-smokers (4.8), followed by heavy smokers (7.3) and was highest among mild smokers (7.7). There was a statistically significant moderately strong positive linear correlation between Dt and smoking magnitude with (p-value = 0.002), the mean Dt in both smoking groups was significantly higher than non-smokers, while no significant differences were observed in mean Dt between heavy and mild smokers. The mean Mt was lowest among non-smokers (5.4), followed by mild smokers (5.9) and was highest among heavy smokers (11.3). There was a statistically significant moderately strong positive linear correlation between Mt and smoking magnitude with (p-value < 0.001); the mean Mt was significantly higher among heavy smokers compared to both mild smokers and non-smokers. The mean Ft was lowest among heavy smokers (4.1), followed by mild smokers (5.5) and was highest among non-smokers (6.0) and this may be explained as smokers are less likely than non-smokers to visit a dentist [(29)], also smoking patients were generally less aware of oral health effects of smoking than non-smokers [(30)]. The mean Ft observed were statistically non-significant with (p-value = 0.24) and no obvious or statistically significant Ft trend with smoking was observed. The mean DMFT was lowest among non-smokers (16.2), followed by mild smokers (19) and highest among heavy smokers (22.6) and the differences observed were statistically significant. There was statistically significant moderately strong positive linear correlation between DMFT and smoking magnitude with (p-value = 0.001) as illustrated in table (4).

Discussion

The MTMIC was significantly lower among postmenopausal non-smokers when compared to premenopausal study group and this result indicates that the elderly age group (postmenopausal non-smokers)

had significantly lower MTMIC when compared to the younger age group (premenopausal non-smokers) which emphasized the fact that it was an age-related phenomenon as illustrated in table (3).

Aging is associated with increased risk of oral and systemic bone resorption and both osteoporosis and osteopenia are characterized by resorption of bone [31, 32].

The disease affects the women because estrogen receptors on the bone-resorbing osteoclasts recognize the paucity of estrogen and respond by increasing their activity level [33].

This finding is in agreement with that found by Ardakani and Niafar in 2004[5], they found highly significant inverse relation between the thickness of the mandibular cortex and the menopausal status with (p-value < 0.001), also they found a statistically highly significant inverse relation between the thickness of the mandibular cortex and the menopausal age with (p-value< 0.001). Also, this finding is in agreement with Mohammed in 2008 [34], as he found that both menopausal status and age had a highly significant influence on MTMIC.

Kaye in 2007[35] found that patients with osteoporosis tend to have fewer teeth and advanced systemic bone loss which is in agreement with our findings. Otogoto and Ota in 2003[36] demonstrated that periodontal disease was correlated with osteoporosis and the mandibular cortical thickness could be useful in detecting of osteoporosis in postmenopausal women with periodontal disease. Geurs et al, in 2003[37] stated that despite several decades of research, there was no consensus about whether people with osteoporosis and osteopenia had greater risk of alveolar bone loss and tooth loss which is in disagreement with our findings.

The MTMIC was highest among non-smokers and was lower among those with mild smokers, while those with heavy smokers had the lowest MTMIC.

Templeton in 2005[38] mentioned that smoking resulted in a diminution of bone formation presumably a result of inhibitory effect of nicotine on the osteoblasts function and this effect appeared to be related to both the amount and duration of smoking which is in agreement with our findings. Smoking is linked to osteoporosis through its anti-estrogenic effect in women resulting in premature menopause in smokers [39]. Also increases estrogen loss in premenopausal or postmenopausal women this can result in a loss of bone density and leads to osteoporosis [7].

McGuire and Nunn in 1999[40] found that there were 2-3 folds increase the loss of teeth in smokers compared to non-smokers which is in agreement with our findings. Haffajee and Socranski in 2001[41] found that smokers had increased tooth loss which is in agreement with our findings.

Heng et al. in 2006[42] found that tobacco smokers as measured by the number of pack years smoked was significantly correlated with higher DMFT index with (p-value < 0.0001) and the mean DMFT for current smokers was higher (12.1) while it was lower for the non-smokers (10.1) and this result is in conformity with our finding.

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Table (1): Differences in MTMIC between right side and left side

Mean cortical thickness (mm)-(N=80)	**Right side**	**Left side**	**Difference between right and left sides**
Range	(1.7 – 5.19)	(1.74 – 5.11)	(-0.09 to 0.08)
Mean+/-SE	3.7+/-0.09	3.7+/-0.09	0.0004+/-0.004
P (Paired t-test) = 0.94[NS]			
Coefficient of variation = 1.1%			

Table (2): Multiple linear regression models with MTMIC as the dependent (response variable) and selected explanatory variables. Model (A): contains menopausal status as one of the explanatory variables, Model (B): contains age as one of the explanatory variables.

Model (A)

	Unstandardized partial regression Coefficient	**P**	**Standardized partial regression Coefficient**
(Constant)	4.364	<0.001	
Postmenopause compared to premenopause	-1.14	<0.001	-0.602
Smoking habit and amount		<0.001	-0.308
Heavy smoker compared to mild smoker	-0.31		
Mild smoker compared to non smoker	-0.31		

P (Model) < 0.001

R^2 =0.72

Model (B)

	Unstandardized partial regression Coefficient	P	Standardized partial regression Coefficient
(Constant)	6.047	<0.001	
Smoking habit and amount		<0.001	-0.257
Heavy smoker compared to mild smoker	-0.25		
Mild smoker compared to non smoker	-0.25		
Age in years	-0.05	<0.001	-0.765

P (Model) < 0.001

R^2 =0.89

Table (3): Mean of selective variables by menopausal status among non-smokers

	Menopausal status among non-smokers		
	Premenopause (N =20)	**Postmenopause (N =20)**	**P (t-test)**
Age in years			<0.001
Range	(20 - 35)	(45 - 60)	
Mean+/-SE	26.8+/-1.1	52.9+/-1.08	
Dt			0.034
Range	(2 – 10)	(1 - 9)	
Mean+/-SE	6.4+/-0.49	4.8+/-0.51	
Mt			<0.001
Range	(0 – 4)	(1 - 14)	
Mean+/-SE	0.8+/-0.3	5.4+/-0.76	
Ft			0.05[NS]
Range	(0 – 10)	(1 - 12)	
Mean+/-SE	3.8+/-0.75	6+/-0.81	
DMFT			<0.001
Range	(7 – 16)	(8 - 24)	
Mean+/-SE	11+/-0.56	16.2+/-1.02	
MTMIC (mm)-average			<0.001
Range	(4.5 - 5.15)	(3.01 - 4.19)	
Mean+/-SE	4.8+/-0.04	3.7+/-0.08	

Table (4): Mean of selective variables by amount of smoking among postmenopausal women

	Smoking among postmenopausal women			
	Non-smoker (N=20)	**Mild smoker (N=20)**	**Heavy smoker (N=20)**	**P (ANOVA)**
Age in years				**0.88[NS]**
Range	(45 - 60)	(45 - 60)	(45 – 60)	
Mean+/-SE	52.9+/-1.08	53+/-1.1	53.6+/-1.03	
r=0.061 P=0.64[NS]				
Dt				**0.002**
Range	(1 - 9)	(3 – 14)	(3 – 12)	
Mean+/-SE	4.8+/-0.51	7.7+/-0.67	7.3+/-0.62	
P (LSD) for difference in mean between:				
Non-smoker x Mild smoker=0.001				
Non-smoker x Heavy smoker=0.005				
Mild smoker x Heavy smoker=0.64[NS]				
r=0.349 P=0.006				
Mt				**<0.001**
Range	(1 - 14)	(1 – 16)	(2 - 22)	
Mean+/-SE	5.4+/-0.76	5.9+/-0.87	11.3+/-1.48	
P (LSD) for difference in mean between:				
Non-smoker x Mild smoker=0.75[NS]				
Non-smoker x Heavy smoker=<0.001				
Mild smoker x Heavy smoker=0.001				
r=0.444 P<0.001				
Ft				**0.24[NS]**
Range	(1 - 12)	(0 – 13)	(0 - 11)	
Mean+/-SE	6+/-0.81	5.5+/-0.84	4.1+/-0.83	
r=-0.216 P=0.1[NS]				
DMFT				**<0.001**
Range	(8 - 24)	(13 - 25)	(18 - 28)	
Mean+/-SE	16.2+/-1.02	19+/-0.76	22.6+/-0.75	
P (LSD) for difference in mean between:				
Non-smoker x Mild smoker=0.022				
Non-smoker x Heavy smoker=<0.001				
Mild smoker x Heavy smoker=0.004				
r=0.577 P<0.001				
MTMIC (mm)-average				**0.001**
Range	(3.01 – 4.19)	(2.45 – 3.96)	(1.72 – 3.84)	
Mean+/-SE	3.7+/-0.08	3.3+/-0.11	3+/-0.15	
P (LSD) for difference in mean between:				
Non-smoker x Mild smoker=0.013				
Non-smoker x Heavy smoker=<0.001				
Mild smoker x Heavy smoker=0.13[NS]				
r=-0.476 P<0.001				

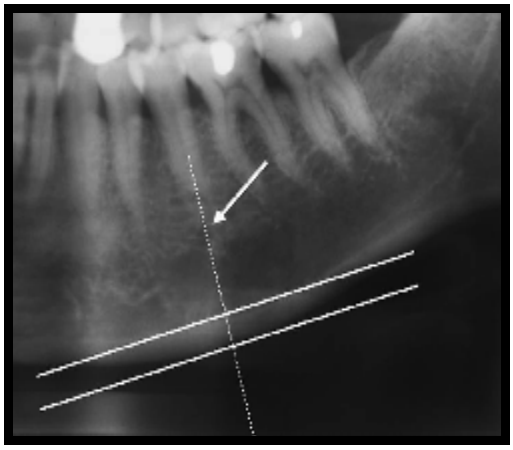

Figure (1): Procedure of the measurement of thickness of mandibular inferior cortex (Taguchi et al., 2004)