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Investigating of Differences in the Mandibular Inferior Cortical Thickness on Digital Panoramic Image in women at Different Age Groups

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Abstract

Panoramic images provide the dental clinician with a survey of anatomy of the jaws. 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. Changes in the thickness of mandibular inferior cortex can be attributed to many factors.

The most important aim was to correlate differences in the thickness of mandibular inferior cortex in women regarding , menopausal status and menopausal age, pregnancies, and history of backache using digital panoramic image.

A total sample of 199 apparently healthy Iraqi women attending the Dental Teaching Hospital in Al- Mosul city were considered. Each woman was subjected to dental panoramic image. Their ages ranged between (20 – 72) years. The total sample were collected during the period from November 2006 to April 2007 .The information from each woman was recorded in special case sheet. Calibration of the image was done by using known length stainless steel wire fixed in bite piece to be within the center of focal trough anteriorly. The digital dental panoramic image was taken and the thickness of mandibular inferior cortex in the right and left sides were measured and recorded using digital panoramic image measurement tools. All results were obtained under the run of the statistical software MINITAB release 11.12 32 Bit with R-square and t- test.

It has been found that age explains 38.4% of the total variability of the changes in mean thickness of mandibular inferior cortex. The results of the one-way analysis of variance test indicated that elder age groups have highly significantly lower mean thickness of mandibular inferior cortex than younger age groups, which emphasize the fact that this is an age related phenomenon (highly significant inverse relation), while pregnancies explains 10.2% of the total variability of the changes in mean thickness of mandibular inferior cortex (highly significant inverse relation). The results of the two-sample t-test indicated that women with history of backache are experience more changes in the mean thickness of mandibular inferior cortex than other women (highly significant relation). For the menopausal age our study show that 21.4% of the total variability of the changes in mean thickness of mandibular inferior cortex related to menopausal age (highly significant inverse relation). Postmenopausal women are found

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to have highly significantly lower mean thickness of mandibular inferior cortex than premenopausal women.

Because oral health is an integral part of general health, oral problems indigenous to the female population have to be addressed. Hormonal fluctuations affect more than a woman's reproductive system. Puberty, menses, pregnancy, and menopause all influence a woman's oral health and the way in which dental professionals should approach her dental treatment. Therefore, factors like menopausal status and age, number of pregnancies, history of backache together with age, were considered in this study which has direct effect on mean thickness of mandibular inferior cortex in women.

Introduction

The mandible is the largest and strongest bone of the face, serves for the reception of the lower teeth. It consists of a curved, horizontal portion, the body, and two perpendicular portions, the rami, which unite with the ends of the body nearly at right angles[1] . Different parts of the mandibular bone are exposed to changes by the means of many factors[2] .Changes of the mandibular cortical shape and thickness may be used as indications to many abnormalities, such as osteoporosis particularly in post menopausal women[3] . Panoramic images are most useful clinically for diagnostic problems requiring broad coverage of the jaws.

Aims of the Study

To correlate differences in the thickness of mandibular inferior cortex in women regarding , menopausal status and menopausal age, pregnancies , and history of backache using digital panoramic image.

Materials and method

Materials:

1- **Planmeca Proline CC panoramic x-ray TOC-3 unit**, (manufactured by Planmeca Oy, Helsinki, Finland)

2- **The sample:** During the period November 2006 to April 2007, a total of 231 healthy Iraqi women attending the Dental Teaching Hospital in Al- Mosul city, were evaluated . Their ages ranged between 20 and 72 years. The sample of this study was consisting of women referred for panoramic images from prosthodontic, surgery and orthodontics departments to experience panoramic X-ray for different reasons. Out of 231 women participated in this study, 32 (13.85%) were rejected; The total remaining was 199 women.

The criteria for selecting each woman in the sample:

1. Medical evaluation:

In this study we exclude women who had any metabolic bone diseases (hyperparathyroidism, hypoparathyroidism, paget's disease, osteomalacia, renal osteodystrophy, or osteogenesis imperfecta), cancer with bone metastasis, significant renal impairment, or taken any medications that affect bone metabolism,(such as estrogen). None have a history of any bone destructive lesions (e.g. malignant tumours or osteomylitis) in the mandible. Also none have a history of hysterectomy or oophorectomy[4&5] .

2. Radiographic evaluation:

In order to measure the thickness of mandibular inferior cortex on both sides of the mandible bone at mental foramen region, the image should give a clear representation for anatomy of the structures of interest.

methods:

1. Calibration tool of the image:

Known length stainless steel wires gauge 0.9 mm fixed in bite piece to be horizontally within the center of focal trough anteriorly and shaped according to the shape of anterior arch which selected from anterior arch selection key. The computer can then easily calculate the magnification of the image from the measured length of the wire and subsequently the real thickness of the mandibular inferior cortex[6&7] .

2. Examination technique:

We drew line (red line) parallel to long axis of mandible and tangential to lower border of mandibular cortex and constructed line (dotted line) perpendicular to this tangent intersecting inferior border of mental foramen, then we drew another line (black line) tangential to the upper border of mandibular cortex and parallel to the tangential lower line.(figure1). The distance between two parallel solid lines is cortical thickness (on screen two click measurement system). This procedure was made for each side of the mandible bone[3&8]. Two types of statistical procedures were performed on the data of this study, descriptive and inferential. Both of them were used in relevant situations.

Results

1. Descriptive Statistics:

The means and standard deviations of the thickness of mandibular inferior cortex for both sides of the mandible bone were calculated and showed on table (1).

A. Age of the sample:

It is of interest to know the frequency distribution of the age for the individuals (women) of the considered sample in this study. Ages of the considered sample ranged between 20 and 72 years, with mean age equals to 39.538 years and standard deviation of 13.247 years. Table (2) shows the distribution of the sampled women on age groups.

B. pregnancies:

The average number of pregnancies for the women was found to be 4.99 with standard deviation equals to 3.10. The number of pregnancies ranged between 0 to 13. Figure (2) shows the frequency distribution of the number of pregnancies.

C. History of backache:

Regarding history of backache, 83 (41.71%) of the women in this sample found to have history of backache, whereas 116 (58.29%) of them have no history of backache, table (3).

D. Menopausal status and menopausal age:

In this sample, the number of premenopausal women is found to be 118, which accounted for 59.30% of the total sample, whereas the number of postmenopausal women is found to be 81, which accounted for 40.70% of the total sample. the number of postmenopausal women was classified into two groups as in table (4).

2. Inferential Statistics:

According to the data of table (1), the two-sample t-test has been used to detect whether the mean thickness of right inferior cortex is significantly different from that of the left. The results of this test indicated that the right side mean thickness of inferior cortex is not significantly lower than that of the left side ($p>0.05$) table (5) .

the mean of both sides was used in all further statistical analysis.

A. Effect of age on mean thickness of mandibular inferior cortex MTMIC:

the simple linear regression equation of the mean thickness of mandibular inferior cortex (MTMIC) on age was considered, table (6).
The regression equation is:

MTMIC=4.7593-0.032257× Age

Table (6) showed the results of performing the regression on the variables of MTMIC and age. The coefficient of determination R^2 which equals to 38.4%, indicates that age explain 38.4% of the total variability of the changes in MTMIC. Regarding age groups, the one-way analysis of variance was used to compare means of MTMIC corresponding to age groups. The results of this test indicated that elder age groups have highly significantly lower MTMIC than younger age groups ($p< 0.001$), which emphasize the fact that this is an age related phenomenon (table 7).

B. Effect of pregnancies on MTMIC:

The simple linear regression was used to model the relationship between MTMIC and number of pregnancies, table (8). The regression equation is:

MTMIC=3.71409-0.06379× Number of pregnancies

Table (8) showed the results of performing the simple linear regression model. The coefficient of determination R^2 which equals to 10.2%, indicates that number of pregnancies explain 10.2% of the total variability of the changes in MTMIC. The number of pregnancies is highly significantly affecting MTMIC (HS inverse relationship, $p<0.001$).

C. Effect of history of backache on MTMIC:

Table (3) shows the result of using the two-sample t-test to compare means of MTMIC with respect to the groups of backache symptom. The results of this test indicated that women with history of backache are highly significant experience more changes in the MTMIC than other women ($p \leq 0.001$).

D. Effect of menopausal age and menopausal status on MTMIC:

the simple linear regression model in order to know the contribution of the menopausal age in the total variability of the MTMIC, table (9).
In our study the regression equation is:

MTMIC=3.66428-0.07768× Menopausal age

Table (9) showed the results of performing the simple linear regression model. The coefficient of determination R^2 which equals to 21.4%, indicates that menopausal age explain 21.4% of the total variability of the changes in MTMIC. Menopausal age is highly significantly affecting MTMIC (HS inverse relationship, $p<0.001$). Postmenopausal women are found to have highly significantly lower MTMIC than premenopausal women ($p<0.001$), table (10). Women with late postmenopause have a clearly lower MTMIC compared to women with early postmenopause and such difference was highly significant ($p<0.001$), table (11).

Discussion

Statistical analysis:

A. Age:

The results of statistical analysis for the data showed that MTMIC is highly significantly decreasing with increasing age ($p<0.001$), tables (6), and (7). This result indicates that MTMIC is an age related phenomenon. Also the study found that age explains 38.4% of the total variability in the

MTMIC. This percentage was emphasizing the fact that changes in MTMIC are age related. Similar finding of Newton-John and Morgan[9] and Albanese[10] who stated that bone loss is a closely age related phenomenon. This finding is in agreement with Benson et al[11] who found a considerable decrease in mandibular cortical thickness with an increase in age in black and South American Hispanic women but our study in disagreement with them when they study the same effect on white men may be because of changing in race and gender. The result of our study is in conformity with that of Meunier et al[12] who stated that women past the age of 55 year developed a sharp decline in bone volume.

B. Pregnancies:

In this study number of pregnancies was found to contribute by a percentage of 10.2 to the total variability in the MTMIC, there was statistically highly significant relationship between MTMIC and the number of pregnancies (HS inverse relation, $p<0.001$), table (8). This result was found to be in agreement with similar results of Ardakani and Niafar[2] , they showed a statistically highly significant inverse relation between the thickness of the mandibular cortex and number of pregnancies ($p<0.001$). After pregnancy, a woman's body absorbs calcium from the bones to maintain its need. This will result in a decrease in the mandibular cortical thickness after every pregnancy[13].

C. History of backache:

Regarding history of backache, 83 (41.71%) of the women in this sample found to have history of backache, whereas 116 (58.29%) of them have no history of backache. Accordingly, the result of the two-sample t-test indicated that women with history of backache have low MTMIC than other women, statistically highly significant relationship (p-value$\leq$0.001), table (3). Again these results are also in agreement with that found by Ardakani and Niafar[2] , they found statistically highly significant relationship between MTMIC and the history of backache ($p< 0.001$).

D. Menopausal age and menopausal status:

In menopause the production of sexual hormone (estrogen) ceases, and this has double effect on the reduction of the thickness of mandibular inferior cortex, because these hormones protects skeletal tissues against of the effect of bone reducing hormones like parathormon[14] . In this study we found highly significant inverse relation between menopausal age and mandibular inferior cortex (p-value< 0.001), tables (9) Postmenopausal women are found to have highly significantly lower MTMIC than premenopausal women (p-value< 0.001), table (10). The result of our study is in conformity with that of Riggs and Melton[15] , they mentioned that no significant bone loss before the menopause but larger losses thereafter. The result of our study is also in conformity with that of Haslett et al[16] , they stated that an accelerated phase of more rapid bone loss in women due to the effects of estrogen deficiency at the menopause. And Streckfus et al[17] in their study that menopause is associated with significant adverse changes in the orofacial complex.

Conclusions

1- There is no significant difference between left and right side of the mandible bone with regard to the MTMIC.
2- Age is found to contribute highly significant influence on the total variability of the MTMIC more than other factors (HS inverse relation).

Age is the first leading factor affecting MTMIC

3- Menopausal age is found to contribute highly significant influence on the total variability of the MTMIC (HS inverse relation). Menopausal age is the second leading factor affecting MTMIC. Menopausal status also has a highly significant influence on the MTMIC.

4- pregnancy is found to contribute highly significant influence on the total variability of the MTMIC and it is the third leading factor affecting MTMIC (HS inverse relation).

5- Women with history of backache have highly significant lower MTMIC than others.

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Table (1) Mean thickness (mm) and standard deviation of mandibular inferior cortex for the left, right and both sides of the mandible bone for the total sample.

Side of mandible bone	Mean	Sd
Left	3.552	0.708
Right	3.416	0.743
Mean of both sides	3.4839	0.6894

Table (2): Distribution of sampled women according to age groups.

Age groups	Number	Percentage
20-29	61	30.65
30-39	39	19.60
40-49	45	22.61
50+	54	27.14
Total	199	100.00

Table (3): Comparing MTMIC according to history of backache groups.

Backache symptom	No.	%	Mean ± Sd	t-test	p-value
Yes	83	41.71	3.295 ± 0.710	3.31	0.001
No	116	58.29	3.619 ± 0.644		

Table (4): Premenopause and early-late postmenopause distributed according to age groups.

Age groups	Total	Premenopausal		Postmenopausal			
				Early		Late	
		No.	%	No.	%	No.	%
20-29	61	61	100.00	0	0.00	0	0.00
30-39	39	38	97.44	1	2.56	0	0.00
40-49	45	18	40.00	27	60.00	0	0.00
50+	54	1	1.85	17	31.48	36	66.76
Total	199	118	59.30	45	22.61	36	18.09
Total	Premenopausal(118)59.30%			Postmenopausal (81) 40.70%			

Table (5) Results of the two-sample t-test used to compare right and left means thickness of mandibular inferior cortex.

Side of the mandible bone	Mean ± Sd	t-test	p-value
Left	3.552 ± 0.708	1.86	0.063
Right	3.416± 0.743		

Table (6): Evaluation of regression parameters of MTMIC on age.

Variable	Coefficient	Sd	t-test	p-value
Age	-0.032257	0.00291	-11.09	0.00001
Constant	4.7593	0.1213	39.24	0.00001

Table (7): Comparing MTMIC according to age groups.

Age group	No.	Mean ± Sd	F-test	p-value
20-29	61	3.9570 ± 0.6113	43.53	0.0001
30-39	39	3.7228 ± 0.5679		
40-49	45	3.3927 ± 0.3052		
50+	54	2.8531 ± 0.5760		

Table (8): Evaluation of regression parameters of MTMIC on number of pregnancies.

Variable	Coefficient	Sd	t-test	p-value
Number of pregnancies	-0.06379	0.01346	-4.74	0.00001
Constant	3.71409	0.06718	55.29	0.00001

Table (9): Evaluation of regression parameters of MTMIC on menopausal age.

Variable	Coefficient	Sd	t-test	p-value
Menopausal age	-0.07768	0.01060	-7.33	0.0001
Constant	3.66428	0.04992	73.40	0.0001

Table (10): Comparing MTMIC according to menopause groups.

Menopause	No.	%	Mean ± Sd	t-test	p-value
Postmenopause	81	40.70	3.021 ± 0.545	9.57	0.00001
Premenopause	118	59.30	3.802 ± 0.593		

Table (11): Comparing MTMIC according to early-late postmenopause groups.

Early-late postmenopause	No.	%	Mean ± Sd	t-test	p-value
Early	45	22.61	3.202 ± 0.447	3.48	0.00009
Late	36	18.09	2.795 ± 0.577		

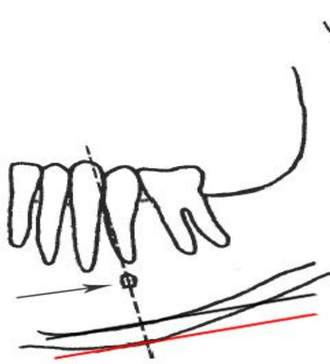
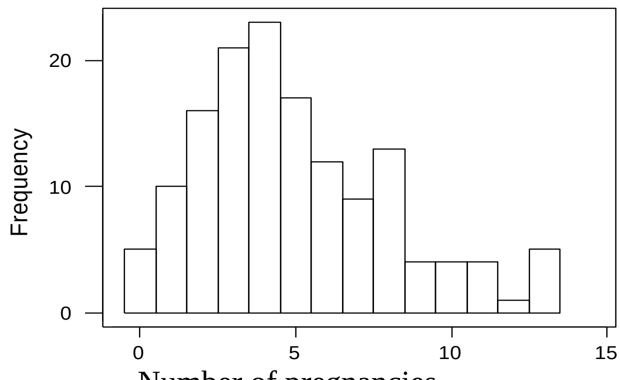


Figure (1) measurement of the mandibular inferior cortex on the panoramic image.



Number of pregnancies.

Figure (2). Histogram showing the frequency distribution of the number of pregnancies for married women