Open Access Journal
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THOMSON REUTERS
International Journal of Medical Research and Pharmaceutical Sciences
Volume 6 (Issue 1): January 2019 ISSN: 2394-9414
DOI- 10.5281/zenodo.2545407 Impact Factor- 4.174

DIAGNOSTIC RELIABILITY OF THE RATE OF ALVEOLAR CREST RESORPTION, ANTEGONIAL INDEX AND MENTAL INDEX FROM DIGITAL PANORAMIC RADIOMORPHOMETRIC ANALYSIS IN OSTEOPOROSIS DIAGNOSIS AND THEIR COMPARISON TO THE DEXA

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Keywords: *Antogonial Index, Dual-energy X-ray absorptiometry (DEXA), Osteoporosis, Digital panoramic radiographs*

Abstract

Introduction

The aim of the study is to compare the effects of alveolar crest resorption amount, antegonial index and mental index from digital panoramic radiomorphometric analyses with the dual-energy X-ray absorptiometry (DEXA) values between the control group and patients with osteopenia and osteoporosis.

Materials and methods

A total of 100 postmenopausal women aged between 45-72 years were included in the study, their bone mineral density values were measured with DEXA and grouped into osteoporosis, osteopenia and normal. The digital panoramic radiographs were received from all individuals. The rate of alveolar crest resorption, antegonial and mental index values were measured in normal, osteoporotic and osteopenicindividuals through panoramic radiographs and compared to the bone mineral density values measured in DEXA.

Results

There was no statistically significant difference between the control and patients with osteopenia for the rate of alveolar boneresorption. There was a statistically significant difference between the groups in terms of the antegonial and mental index values.($P<0.001$)

Conclusion

Antegonial and mental index measurements can be used to distinguish between normal individuals and patients with osteopenia and osteoporosis. However, alveolar crest resorption measurement is not appropriate to distinguish between normal individuals and patients.

Introduction

Osteoporosis is a metabolic bone disease that occurs because of the decrease in bone mineral density, easily diagnosed by bone fractures due to even minor traumas, in which the morbidity and even mortality are high, and the treatment is quite expensive (1).

The volume of paranasal sinuses increases in maxillary osteoporosis. After extracting the upper molars, the risk of fracture the tuber maxilla increases. Mandibular bone loss causes fractures by spontaneous or minor traumas (2.3). The success of implant in the presence of osteoporosis depends on the presence of adequate amounts of bone tissue around the implant. This is related to the qualitative and quantitative structure of the bone (4).

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Changes in bone mineral density for the diagnosis of osteoporosis are evaluated with single photon absorptiometry, dual photon absorptiometry, dual-energy X-ray absorptiometry (DEXA), neutron activation analysis, and quantitative computed tomography. The most common method is the DEXA, which is considered the gold standard (5). In dentistry, bone mineral density can be assessed with densitometric and radiomorphometric measurements performed on panoramic radiograms (6-8).

Our aim in this study is to determine the diagnostic value of digital panoramic radiograms used routinely in dentistry, comparing the values of alveolar crest resorption, antegonial index, mental index values known asradiomorphometric analysis with dual-energy X-ray absorptiometry in patients with osteoporosis, osteopenia,and control group.

Materials and methods

The study was conducted on 100 postmenopausal women aged between 45-72 years who were admitted to our clinic for different reasons between September 2006 and May 2008, 30 of them were diagnosed with osteoporosis because of bone mineral density measurements taken from femur and vertebral bones, 40 of them were diagnosed with osteopenia, and 30 were in the control group.

All the patients were informed about the processes before they were included in the study and their permissions were obtained by signing the informed consent form indicating that they want to participate in the study voluntarily. The approval of the Ethics Committee was obtained from Atatürk University Institute of Health Sciences (2006 4.1/2-14).

We paid attention that patients who constitute the study and control group did not have any systemic diseases affecting bone metabolism (Paget's disease, osteogenesisimperfecta, osteomalacia, hypoparathyroidism, hyperparathyroidism, renal osteodystrophy etc.). In addition, the patients who had not bone metastases and did not use any medications that would disrupt bone metabolism were not included in the study. We noted that the DEXA results taken for the diagnosis of osteoporosis should have taken in the last month. The patients that meet these conditions were divided into 3 groups.

Group-1: Osteoporosis (30 individuals))
Group-2: Osteopenia (40 individuals)
Group-3: Control (30 individuals)

Bone mineral density measurements were performed using DEXA device (QDR 4500 Acclaim Series Elite Hologic) (Figure 1) and bone mineral density measurements obtained from L1, L2, L3, L4, L1-L4 left femoral Ward's Triangle, neck, inter, total trochanter regions in PA spin were used.

Figure 1: DEXA device

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Panoramic radiograms of all individuals in the control and trial group were taken in the Department of Oral Diagnosis and Radiology at Faculty of Dentistry, Atatürk University, with the Morita WerawievepOCS HS digital panoramic device.

Figure 2: Digital panoramic radiography device

We ensured full compliance with the reference points determined by the manufacturer on the device to ensure standardization in panoramic radiographs.

Radiomorphometric measurements

Radiomorphometric measurements were performed separately for the left and right sides by a single researcher on digital panoramic radiographs and their averages were obtained. Data were obtained using Mediadent Data and Mediadent Demo Patient software for radiomorphometric measurements. The measurements were repeated for a week intervals to check the accuracy of the data. On digital images;

The rate of alveolar bone resorption: It was measured according to the Wical technique (9). The ratio of the distance of the line passing through the middle point of the mental foramen to the lower edge of the mandible to the distance from the lower edge of the mandible to the alveolar crest peak was calculated separately on the right and left side and the averages were taken and written to the table. **(Figure. 3)**

Figure 3: Alveolar bone resorption

According to the Wical technique, the b/a ratio is 1/2.9 (9).
The rate of alveolar bone resorption was calculated according to the formula (2, 9x B)-a.

Antegonial index: The amount of cortical bone at the widest point of the antegonial depth of the line parallel to the Ramus mandible and perpendicular to the Corpus mandible from the junction point of the Ramus mandible was measured separately on the left and right side, and the averages were taken and written to the table. (Figure. 4)

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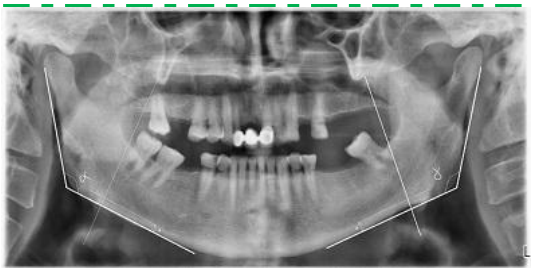

Figure 4:Gonial angle and Antegonial index.

Mental index: Cortical thickness at the point where the line passing through the middle point of the mental foramen tangent to the lower limit of the mandible was measured on the right and left side,after that, the averages were taken and written to the table (Figure. 5)

Figure 5: Mental index.

Statistical analyses

Parametric and nonparametric tests were used to compare the data obtained in the present study. Descriptive statistics, one-way variance analysis (ANOVA, Duncan), chi-square tests and Pearson correlation analysis were used in the evaluation of the data.

Results

A total of 100 female individuals between 45 and 72 years of age included in the present study were in postmenopausal period. The maximum, minimum, average, and standard deviation values of age of the participants were given in Table 1.

Table 1: Age descriptive statistics of all individuals

	N	Mean	Std. Deviation	Minimum	Maximum
Osteoporosis	30	60.13	6.016	48	72
Osteopeni	40	56.73	5.875	46	72
Control	30	55.50	5.812	45	68
Total	100	57.38	6.134	45	72

The average of the femoral neck and spinal T and Z scores of the individuals included in the study were given in Table 2.

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Table 2: T and Z scores of the spine and femoral neck regions of all individuals

	Spine (L1-L4) T score	Spine (L1-L4) Z score	Femoral Neck T score	Femoral Neck Z score
Osteoporosis	3.1717	1.6870	2.2043	0.2160
Osteopeni	1.7692	0.6390	1.3853	0.4678
Control	0.0157	1.0033	0.6880	0.9173

The spinal (L1-L4) T scores from the bone mineral density measurements of all individuals were shown in Table 3. There was a statistically significant difference between the groups in the spinal (L1-L4) T scores. (P< 0.001)

Table 3: Spine (L1-L4) T scores

	Mean**	Std. Deviation	F	P*
Osteoporosis	3.1717 [a]	0.5362	257.995	<0.001
Osteopeni	1.7692 [b]	0.3652		
Control	0.0157 [c]	0.7256		
Total	1.6545	1.3561		

*** One-Way Analysis of Variance (ANOVA)**
**** Duncan Test Results**

Femoral neck (Ward's) triangle T scores from bone mineral density measurements of all individuals included in the study were shown in table 4. There was a statistically significant difference between the groups in the femoral neck (Ward's) triangle T scores. (P < 0.001)

Table 4: Femoral neck (Ward's triangle) T scores

	Mean**	Std. Deviation	F	P*
Osteoporosis	2.2043 [a]	1.0580	15.189	<0.001
Osteopeni	1.3853 [b]	0.8716		
Control	0.6880 [c]	1.2907		
Total	1.4218	1.2101		

*** One-Way Analysis of Variance (ANOVA)**
**** Duncan Test Results**

The measurement results of the rate of alveolar bone resorption in patients with osteoporosis, osteopenia and in normal individuals are given in Table 5. There was no statistically significant difference between the control group and patients with osteopenia. There was a statistically significant difference between patients with osteoporosis and patients with osteopenia, as well as, between the control group and patients with osteoporosis.(P<0.01)

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Table 5: The rate of alveolar bone resorption values

	Mean**	Std.Deviation	Minimum	Maximum	F	P*
Osteoporoz	14.5623 [a]	6.0216	1.70	23.50	5.987	<0.01
Osteopeni	10.7343 [b]	5.0984	0.30	23.94		
Control	10.2167 [b]	5.1264	0.10	19.80		
Total	11.7274	5.6644	0.10	23.94		

*** One-Way Analysis of Variance (ANOVA)**
**** Duncan Test Results.**

Antegonial index values fromradiomorphometric measurements are shown in table 6. There was a significant difference between the control group and patients with osteopenia, between the control group and patients with osteoporosis and between the patients with osteoporosis and patients with osteopenia. (P < 0.001)

Table 6: Antegonial index values

	Mean**	Std.Deviation	Minimum	Maximum	F	P*
Osteoporosis	3.1667 [a]	0.7195	2.11	4.84	17.720	<0.001
Osteopeni	3.6670 [b]	0.6401	2.30	4.94		
Control	4.1593 [c]	0.5712	3.04	5.08		
Total	3.6646	0.7469	2.11	5.08		

*** One-Way Analysis of Variance (ANOVA)**
**** Duncan Test Results.**

The mental index values of patients with osteoporosis, osteopenia,and control group are shown in table 7. A statistically significant difference was found between all groups in the Mental index values.(P<0.001)

Table 7: Mental index values

	Mean**	Std.Deviation	Minimum	Maximum	F	P*
Osteoporosis	4.2400 [a]	0.9397	2.30	5.75	18.759	<0.001
Osteopeni	4.7563 [b]	0.7294	3.02	6.03		
Control	5.7397 [c]	1.2351	4.02	9.47		
Total	4.8964	1.1265	2.30	9.47		

*** One-Way Analysis of Variance (ANOVA)**
**** Duncan Test Results**

Discussion

The identification of osteoporosis symptoms in dental radiographs is important in the diagnosis and follow-up of this disease. In osteoporosis individuals, many researcheshas been conducted on the use of mineral densities and radiomorphometric analyses of the bones in different parts of the skeleton in the diagnosis of osteoporosis. (10-13). Cortical thickness and porosity rating performed on Dental Panoramic radiograms is a radiologically beneficial method for determining the risk of systemic osteoporotic individuals (14).

Dual-energy X-ray absorptiometryfrom bone mineral density measurement methods in the diagnosis of osteoporosis is regarded as the gold standard (5). For this reason, the comparison of mandibularradiomorphometricanalyses with the values of dual-energy X-ray absorptiometry was performed.
Examination of cortical bone thickness instead of trabecular bone is an accurate approach in the evaluation of bone in dentistry (15).

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Klemetti et al. (5) stated that the alveolar crest resorption was an undesirable condition following tooth extraction and they clinically compared the DEXA results of femur and vertebrae with the number of teeth, the time of the last tooth extraction in 355 post-menopausal women. Consequently, they reported that the alveolar crest resorption is influenced by many factors such as diet, tooth extraction history, hormonal status, and muscle function and menopause duration.

Kribbs et al. (16) compared the bone mineral density values of lumbar vertebrae measured by dual photon absorptiometry and quantitative computerized tomography in 85 postmenopausal women and total body calcium, mandibular bone mass, gonial cortical thickness,and alveolar crest. As a result of the study, there was a significant correlation between total body calcium and alveolar crest resorption, as well as, between mandibular bone mass and gonial cortical thickness and they suggested that the mandibular bone mass reflected the status of the whole skeleton better than the hip and vertebral bodies.

Klemetti et al (17) concluded that waters with flour reduced the resorption of the alveolar crest in postmenopausal women. They argued that the complications and healing cycles that could occur following the tooth extraction are factors to be considered in crest resorption. In the present study, there was no statistically significant difference between the control group and patients with osteopenia in terms of alveolar crest resorption. There was a statistically significant difference between patients with osteoporosis and patients with osteopenia, as well as, between the control group and patients with osteoporosis. This difference may be caused by the difference of toothless individual number in the osteoporotic group than the other groups.

Devlin and Horner (6) compared antegonial index values on the panoramic radiograms with the values of bone mineral density in healthy and patients with osteoporosis, and the antegonial thickness in osteoporosis and reported that antegonial thickness was decreased in osteoporoticindividuals, but they argued that these measurement methods must be evaluated in conjunction with familial story and clinical risk factors in the creation of the risk group rather than the diagnosis.Dutra et al. (7)grouped 52 total toothless female individuals according to dual-energy X-ray absorptiometry scores, so the antegonial index values measured on the panoramic radiograms decreased in the osteoporotic group and the antegonial region measurements were a useful method in determining the risk group of osteoporosis. They argue that mandibular inferior cortical bone is resorbed in mental and antagonistic regions with advancing age. In the present study, there was a statistically and mathematically difference between the individuals with osteopenia, osteoporosis,andcontrol in terms of antegonial index. These results are consistent with the studies on antegonial index.

Dutra et al. (8) evaluated the gonial cortical thickness, antegonial index and mental index while studying on the panoramic radiograms with 10 dry mandible, consequently, indicated that none of the measurement methods could be used alone in the diagnosis of osteopenia or osteoporosis. In the same study, they suggested that the mandibular cortical thickness in the mental region was a valid evaluation method and that the antegonial index and the gonial cortical thickness provided less information in the detection of osteoporosis risk. Dutra et al. (18) classified 312 individuals aged 40-79 with low mineral density in panoramic radiographs according to gender, age, and edentation status and compared the values of antegonial index and mental index. The results of the study suggest that antegonial bone thickness is significantly decreased in older women, but less resorbable in older men and that antegonial cortical thickness is decreased in toothless individuals compared to complete or partial toothed individuals. They argued that correlations between mental index and antegonial index values were lower in women aged 40-59 than in men, but that correlations between men and women over 60 years of age were moderate.The methodological problem is that the sensitivity and specificity of the antegonial index are not sufficient in the diagnosis of osteoporosis because the point at which the frontal edge of the Ramus begins to rise is relative. In the present research, morphological classification of the inferior cortex of the cortical bone in the distal of the mental foramina was performed. The classification of Klemetti et al. was taken into account. There was a statistically significant difference between all groups in mental index values.

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Conclusion

Antegonial index and mental index measurements from digital radiomorphometric analyses can be used to distinguish between normal individuals and patients with osteopenia and osteoporosis. However, to use the measurement of alveolar crest resorption from digital radiomorphometric analyses to distinguish between normal individuals and patient groups is not appropriate

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