Evaluation of the Correlation between Antegonial and Mental Indices with Age, Gender, and Dental Status

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Abstract: There is evidence that the panoramic indices can be utilized as tools in the detection of low mineral bone density. This study was designed to evaluate the correlation of mental and antegonial indices with age, gender, and dental status. This historical cohort study was conducted from March 2005 to December 2006 in the School of Dental Medicine (Shaheed-Beheshty University of Medical Sciences in Tehran, Iran). The sample included people in the age range of 40-79 years who were referred for evaluation by panoramic radiography for dental treatment purposes. The correlation of mental and antegonial indices with age, gender, and dental status was evaluated. A total of 212 people participated in the study, consisting of 118 females (55.7%) and 94 males (44.3%). Antegonial index (AI) showed a statistically significant decrease with age in females ($P < 0.05$). However, in males, AI increased until age 60 years, after which there was a statistically significant decrease ($P < 0.05$). Mental index was statistically lower in females who were age 60 and older compared with males ($P < 0.05$). In males, this index increased until age 60 and decreased thereafter, just as was observed for AI. Dentate persons had statistically higher AI means compared with partially dentate and edentulous persons in all age groups ($P < 0.05$).There was no relationship between mental indices(MI) and dental status ($P > 0.05$). The results of this study indicated that the antegonial index is influenced by dental status. Therefore, this index is not sufficient for determining bone loss. Future studies for determining the relationship between MI and bone marrow densitometry are recommended.
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1. Introduction

Osteoporosis is a disease in which progressive bone demineralization occurs, and it affects a significant number of people every year. The adverse economic effects and mortalities associated with the disease have made osteoporosis a public health problem (Mohajery and Brooks 1992). Currently, because of increased life expectancy, a larger number of osteoporotic patients may visit dentists for oral care or treatment. Therefore, detecting those individuals who have low bone densities will help decrease the mortality and morbidity associated with osteoporosis.

Several methods have been reported for diagnosing the osteoporosis, including dual photon absorptiometry, quantitative computed tomography, dual energy X-ray absorptiometry, radiographic absorptiometry, intraoral radiographs, single photon absorptiometry, and panoramic radiographs (Dervis 2005). Some studies have demonstrated significant correlations between bone mineral density and the thickness of the inferior mandibular cortex (Brand, Lowe et al. 2008; Gulsahi, Yuzugullu et al. 2008; Taguchi, Ohtsuka et al. 2008). Therefore, the involvement of the mandible, as well as other bones, led scientists to develop an easy, inexpensive, and non-invasive technique for identifying individuals with low bone mass (Ledgerton, Horner et al. 1997).

The use of panoramic radiographs to prepare indices, such as mental and antegonial indices, is one of the methods that is used to measure mandibular bone mass. Hence, using these measurements as a reference, a person may be categorized further as having a high risk for developing osteoporosis and referred for assessment by a higher investigative modality. However, there are contradictory results for various indices in detecting osteoporosis. Several variables, such as race, gender, geographical location, and age, may influence the values of the indices. So, this study was designed to evaluate the differences

between mental and antegonial indices in dentate, partially-dentate, and edentulous persons of both genders and different age groups.

2. Material and Methods

This historical cohort study was conducted from March 2005 to December 2006 in the School of Dental Medicine (Shaeed-Beheshty University of Medical Sciences in Tehran, Iran). The sample included persons in the age range of 40-79 years who were referred for evaluation by panoramic radiography for dental treatment purposes in 2005 to 2006. Only those who agreed to participate were enrolled in the study, and the exclusion criteria included unknown precise medical history, tobacco or alcohol use, metabolic bone diseases, cancer with bone metastasis, diabetes, major renal impairment, the use of medications that affect bone metabolism (other than estrogen), bone destructive lesions in the jaw bones (such as malignant tumors or osteomyelitis), and vertebral or non-vertebral osteoporotic fractures. The study was approved by the Ethics Committee of Shaeed-Beheshty University of Medical Sciences, and all participants signed an informed consent form for a dental panoramic examination for oral care.

Two hundred and twelve panoramic radiographs were obtained using Digora PCT Sorodex equipment and a PM 2002 CC proline panoramic X-ray unit (Planmeca, Helsinki, Finland) with the same exposure parameters (Kvp = 68 and mA = 9).The position of the participants' heads was standardized as much as possible. The graphies were scanned with a Microtek 9600 XL scanner, and Vixwin 2000 software was used to assess the mental and antegonial indices.

For mental index (MI) (Figure 1), the thickness of the mandibular cortex was measured on the line perpendicular to the inferior border of the mandible at the middle of the mental foramen. For antegonial index (AI) (Figure 2) (Ledgerton, Horner et al. 1999), the thickness of the mandibular cortex was measured on the line perpendicular to the inferior border of the mandibular cortex at the intersection with the tangent line to the anterior border of the ramus.

The indices were determined for the following four age groups: 40-49, 50-59, 60-69, and 70-79. The relationship between dental status and MI and AI were assessed for dentate persons, persons with mandibular molars, partially-dentate persons, persons with other teeth without mandibular molars, edentulous persons, and persons with no teeth. Assessment of the reliability of replicate measurements of angles and distances was conducted using graphs to determine the concordance correlation coefficient (CCC) (Lin 1989; Liao and Lewis 2000). One person served as the main observer, and intra-observer reliability was estimated between measures performed one week apart. Another person who had the most experience served as the reference observer, and inter-observer reliability was assessed. To estimate intra-observer reliability, 40 subjects were selected randomly and distance measurements were repeated; to estimate inter-observer reliability, the measurements of all subjects were repeated. All statistical analyses were done using SPSS v.16 software. The simple t-test and analysis of variance (ANOVA) were used to compare the means of the indices between age groups, by gender, and dental status. Alpha was set at 0.05 for the statistical significance level.

3. Results

A total of 212 people participated in the study, consisting of 118 females (55.7%) and 94 males (44.3%). There were 75 persons (35%) with dentate status, 70 persons (33%) with partially-dentate status, and 67 persons (32%) with edentulous status. The means of the indices are shown in Table 1. The results indicated that there was a statistically significant decrease in AI with age in females ($P < 0.05$). However, in males, AI increased until age 60, after which it showed a statistically significant decrease ($P < 0.05$).

Table1. Relationship of panoramic indices with age groups and dental statuses*

Variables	N	Mental Index (mm)		Antegonial Index (mm)	
		Female	Male	Female	Male
Age group (Year)					
40-49	56 (26.5%)	3.01	3.01	2.27	2.11
50-59	57(27%)	2.89	3.25	2.07	2.34
60-69	47(22%)	2.36	3.08	2.01	2.12
70-79	52(24.5%)	2.16	3	1.81	1.81

*Data was presented as number and mean ± SD.

Dentate persons had statistically higher AI means compared with partially-dentate and edentulous persons in all age groups ($P < 0.05$). There were no statistical differences between partially-dentate persons and edentulous persons in all age groups ($P > 0.05$). The mean of AI on the right side was 2.1 ± 0.06 mm, and it was 2.5 ± 0.07 mm on the left side. According to t-test analysis, there was statistically difference between the left and right sides ($P = 0.04$).

Mental index was statistically lower in females who were age 60 and older compared with males ($P < 0.05$). This index increased with age until age 60 in males and then decreased, just as was observed for AI. There was no relationship between MI and dental status ($P > 0.05$). The mean of MI on the right side was 2.3 ± 0.04 mm and 3.0 ± 0.06 mm on the left side. According to t-test analysis, there was a statistically significant difference between the left and right sides ($P < 0.05$). The intra-observer agreement ranged from 0.78 to 0.90 for the indices. The inter-observer agreement ranged between 0.74 and 0.96

4. Discussions

There is evidence that the panoramic indices can be utilized as tools in the detection of low mineral bone density but not for diagnostic purposes. This study of cortical bone width in the antegonial and mental indices showed that the change in cortical width is inversely proportional to age in females; however, in males, the values increase until age 60, after which they decrease. The values are higher in dentate individuals than in partially-dentate and edentulous individuals. The means of AI and MI were statistically different between the left and right sides. Therefore, future studies are recommended to determine whether such differences could be due to increased function on the preferred chewing side or random asymmetry of the facial skeleton.

This study shows discrepant results for indices concerning age in females and males. Our findings support the hypothesis that only females experience increasing bone loss as age increases. This result is not consistent with the results of some other studies (Knezovic Zlataric, Celebic et al. 2002). The reasons for this inconsistency may be due to the fact that none of these studies is a longitudinal study, so we could not determine exactly the effects of age on bone loss by gender. In addition, many factors, such as food regimen, lifestyle, the time that a person has had no teeth, and environmental stress can influence the results and bias the findings. The values are higher in dentate individuals than in partially-dentate and edentulous individuals, but we only found a statistically significant relationship between dental status and AI. This may be due to the loss of molars, which would decrease AI values.

In our study, all measurements were adjusted by 20% due to the magnification of the panoramic machines used in the study. This compensation was used to obtain absolute measurements, which would better simulate the clinical situation. The intra-observer agreement was very high for all indices, ranging from 0.78 to 0.90 for the indices. The inter-observer agreement was also high for all measurements, ranging between 0.74 and 0.96. These excellent results probably are due to the previous experience of both researchers in measuring anatomical structures using dental radiographs.

In sum, this study indicated that the antegonial index is influenced by dental status. Therefore, this index is not sufficient for determining bone loss. It is recommended that future studies be conducted to determine the relationship between MI and bone densitometry.

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