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The mandibular angle in osteoporotic men

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Abstract
Objectives: Osteoporosis induces the reduction of bone mass and screening for low bone mineral density (BMD) by dual-energy x-ray absorptiometry (DXA) has been the current gold standard test to determine osteoporosis. Panoramic radiography is widely used in dentistry for routine examination of jaws. The objective of this study was to determine the relationship between the mandibular angle (MA) values and the vertebral bone mineral density (v-BMD) in 20 osteoporotic men.
Study design: In panoramic radiograms of osteoporotic men, the means were calculated for the mandibular angle values measured in the right and left mandible. v-BMD values were also calculated by manual analysis of DXA scans. The correlation between these variables was assessed.
Results: A negatively significant correlation was found between the MA and v-BMD.
Conclusions: The size of the mandibular angle decreases when osteoporosis increases. It is suggested that the mandibular angle may be useful in clinical dental practice to identify osteoporotic men with previously undetected low bone mineral density.

Key words: *Dual energy x-ray absorptiometry, men, mandibular angle, osteoporosis, panoramic radiography.*

Introduction
Osteoporosis induces the reduction of bone mass. Like other bones in the body the jaw bones can also be affected by systemic diseases such as osteoporosis (1). Bone mineral density (BMD), bone mineral content (BMC), or bone mass at various sites has been assessed using several BMD assessment technologies, such as single or dual energy X-ray absorptiometry (SXA- DXA), single or dual photon absorptiometry (SPA-DPA), quantitative computerized tomography (QCT), and quantitative ultrasound (QUS). The above mentioned methods are expensive to use and are often unavailable to ordinary practitioners (2). With a long use in dentistry to examine a current dentition, temporomandibular joint, jawbones, and related structures, dental panoramic radiographs (DPR) have been shown in recent clinical studies to play a critical role in the identification and evaluation of patients with low BMD or osteoporotic patients by

dentists (3). Thus, clinicians have started to focus on some mandibular panoramic indices such as mandibular cortical index (MCI) and panoramic mandibular index (PMI) for the identification of elderly individuals who should undergo BMD assessment (2). However, a few studies have focused on the mandibular angle. Publications related to MA have studied generally changes in angles and heights of the mandible in the ageing edentulous and dentate patients (4).

The main objective of this study was to determine whether or not the size of the mandibular angle on panoramic radiographs correlate with DXA values of the lumbar vertebrae in men with osteoporosis.

Materials and Methods

20 men with osteoporosis diagnosed in the Department of Nuclear Medicine, Faculty of Medicine, and Ataturk University were in included in this study. All of the patients were diagnosed with osteoporosis based on BMD values of the lumbar spine (L1 – L4) as measured using the WHO criteria (T-score ≤ -2.5 SD) (5). Their ages ranged from 30 years to 77 years (mean age 55.2 years ± 11.07 years). No fracture history was noted. Measurements of the v- BMD were made by a single technician using DXA on a Hologic QDR-4500 scanner (Hologic, Waltham, Mass., USA) at the Department of Nuclear Medicine, Faculty of Medicine, Atatürk University. The skeletal BMD was measured at the lumbar region (L1 – L4). BMD measurements were recorded in grams per square centimeter. All dental panoramic radiographs were obtained during the DXA scan using a PM 2002 CC Proline unit (Planmeca, Helsinki, Finland) by a single operator at the Department of Oral Diagnosis and Oral Radiology, Faculty of Dentistry at Atatürk University. Each patient underwent a panoramic radiographic examination using a cassette fitted with an aluminum step wedge as described by Horner and Devlin (6). On the dental panoramic radiographs, MA (Fig. 1) measurements were made separately on the right and left mandibular sides. The mandibular angle was measured by tracing a line on panoramic radiographs tangential to the most inferior points at the gonial angle and the lower border of the mandibular body and the other line tangential to the posterior borders of the ramus and the condyle (7). The intersection of these two lines formed the mandibular angle, which was measured on both the right and left sides of the mandible (Fig. 1). Their means were calculated and recorded. In order to determine the reliability of the mandibular measurements, the weighted kappa test was performed. The intra- and inter observer agreement was analyzed with the weighted kappa test. This study was approved by an ethical committee and informed consent was obtained from all patients.

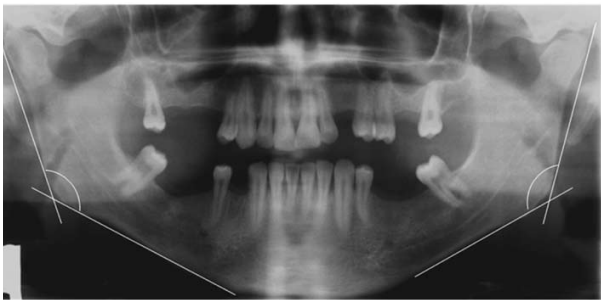

Fig. 1. The reference lines and points in measurement of the mandibular angle on the panoramic radiograms.

-Statistics

Descriptive statistics (means ± SD) and correlation were calculated using the SPSS® statistics program (SPSS® v11.0; SPSS Inc., Chicago, Ill., USA). Correlation between the measurements (MA and v-BMD) was established using the Pearson's correlation coefficient with the significance set at $p<0.05$.

Results

Table 1 shows the age- and bone-related characteristics, and table 2 shows the result of the correlation analyses. The negatively significant correlation between the MA and v-BMD was found. The weighted kappa values for intra-observer reliability were calculated as 0.87, 0.81, 0.93 for the first, second and third observer, respectively. The weighted kappa values for inter-observer reliability between the 1-2, 2-3 and 1-3 observers were calculated as 0.85, 0.82 and 0.87, respectively.

Table 1. Age, MA and v-BMD of the 20 patients.

	Min	Max	Mean	SD
Age	30	77	55.2	11.07
MA	115	140	125	6.67
v-BMD	0.65	0.81	0.75	0.05

MA: Mandibular Angle, v-BMD: Vertebral Bone Mineral Density

Table 2. Correlation between the MA and the v-BMD

	MA
v-BMD	r = -0.562 (p= 0.01)

MA: Mandibular Angle, v-BMD: Vertebral Bone Mineral Density

Discussion

In previous panoramic studies, the relationship between osteoporosis and jawbones have been evaluated by determining the area of the cortex, the visible trabeculae of the spongiosa, and heights of the mandible and then comparing these areas with the total area of the mandible on the images, especially in osteoporotic women due to higher peak bone mass in men when compared to women (8,9). However, the changes in the spine and femur with aging are similar in both sexes at advanced ages. But, male mortality rate due to hip fracture is two to three times higher than female mortality rate (10). Their results were variable and inconsistent. Earlier studies of the mandibular angle have often set edentulous groups against dentulous groups without osteoporosis and the mandibular angle has been compared with age, dental status in these groups (11-12). There are a few studies regarding to the relationship between osteoporosis and the mandibular angle (13). Therefore, in the present study, we investigated these relationships in men with osteoporosis. The result of the present research showed that a reduced skeletal BMD can alter the size of the MA. In a study, it was showed a widening of the mandibular angle in edentulous older women suggesting possible systemic effects, such as metabolic bone loss, on the size of the mandibular angle (14). But several other studies showed discrepant results (12,13,15). It was mentioned that males had significantly smaller antegonial angle values than females, irrespective of the dental status which might be due to gender hormonal differences affecting bone metabolism (4). In addition, it was also mentioned that muscle function tends to preserve bone at its point of insertion; therefore the structure of the gonial region will be maintained by the insertion of the medial pterygoid and masseter muscles and man have greater masticator force than do women (16). In a study in which morphologic changes of the mandible in osteopenic and osteoporotic edentulous women was evaluated, It was found that edentulous women with low bone mass have a deeper antegonial region (17). The gonial angle was not shown differences among the three categories of the skeletal bone status (normal, osteopenic, and osteoporotic). In another study, it was stated that the mandibular angle was not shown any change with gender, age, and dental status (4). In this study, panoramic radiographs were used to evaluate the mandibular angle. It is known that the nature of the panoramic radiograph affects the resulting images. It revealed that mandibular angular measurements in panoramic radiographs evaluated a high degree of accuracy when proper the position of the head was achieved (17). However, the difficulty of standardizing the position of the head leads to projection errors on the radiograph. Only structures located centrally within the panoramic image layer have equal vertical or horizontal magnification (2). In vertical or horizontal planes, shifts or tilts leads to difference of the mandibular angle size (17). However, many risk factors such as patient population, patient selection criteria, nature of the disease, nature of the bone, advanced age, race, genetics, physical and muscular activity may alter the measurements of the mandibular angle (2). Furthermore, it would be extremely difficult to find enough male patients with osteoporosis.

Conclusions

The size of the mandibular angle decreases when osteoporosis increases. It is suggested that the mandibular angle may be useful in clinical dental practice to identify osteoporotic men with previously undetected low bone mineral density.

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