

# VALIDATION OF DIAGNOSTIC EFFICIENCY OF DIGITAL PANORAMIC RADIOGRAPHS IN PREDICTING OSTEOPOROSIS BY FEMALE UNDERGRADUATE STUDENTS

Cristalle Soman<sup>1\*</sup>, Noura Aldakheel<sup>2</sup>, Layal Aldughishem<sup>2</sup>, Rahaf Alogaily<sup>2</sup>, Mashail Aljuhani<sup>2</sup>, Sara Aljumaiah<sup>2</sup>

<sup>1</sup> Faculty OMFS department, Riyadh Elm University, Riyadh, Saudi Arabia. [cristalle.soman@riyadh.edu.sa](mailto:cristalle.soman@riyadh.edu.sa)

<sup>2</sup> Dental Interns, Riyadh Elm University, Riyadh, Saudi Arabia.

<https://doi.org/10.51847/Vc2958C6e8>

## ABSTRACT

Decrease in bone density, severe pain, and often associated with an increased risk of fractures are factors that define osteoporosis as a disease. Studies worldwide have revealed that a high relationship between the development of osteoporosis and the density of the bone can be assessed using 2D radiographs that are used in dentistry from the mandibular bone analysis. Thus, in identifying patients at risk for the development of osteoporosis or detecting early osteoporosis, dental radiographs might be useful. The objective of the study is to therefore validate this diagnostic efficiency of digital panoramic radiographs in predicting osteoporosis using the mandibular cortical index (MCI), to identify the risk group of osteoporosis, and also to investigate the influence of age and gender in medically healthy patients. Statistically significant results are found between gender and the MCI indices. Males were shown to have a predilection than females to the risk of osteoporosis in our study. Whereas different age criteria analyzed did not show any statistical significance in the present study. In our study, males showed a statistically significant correlation to the risk of development of osteoporosis than the females unlike the majority of the studies. C2 was the prevalent MCI criteria among the Saudi subpopulation. Local environmental factors and a decrease in exposure to radiation can be the factors that have influenced the results. Also, larger samples will be evaluated as an extension of the study for further validation of gender influence on osteoporosis.

**Key words:** Digital OPG, Osteoporosis, dental students, diagnostic efficiency.

## Introduction

Osteoporosis is a silent bone disease characterized by defective bone remodeling due to increased bone resorption, decreased bone formation, or a combination of both [1, 2]. This leads to a resultant loss in bone mineral density, susceptibility to fractures impaired bone microarchitecture with resultant porous bone [3]. The effects of osteoporosis in the maxillofacial region are focused but not limited to the loss of teeth, resorption of alveolar bone resulting in a reduction in bone width and height levels, diminished cortical outlines of the maxillary sinus, inferior alveolar canals, thinning of the mandibular cortex and temporomandibular joint abnormalities which includes flattening of the condyles, osteophyte formation, cortical erosion and internal derangement of the TMJ [4].

Panoramic radiographs are used by dentists daily to screen the patient's dental status and concerns during their visit to the dentist. These radiographs can be utilized to screen patients at risk of osteoporosis. Consequently, the high-risk group can be confirmed with Dual-energy X-ray absorptiometry (DXA) and/or biochemical markers [3].

The assessment of radiomorphometric indices can be done using Mental index (MI), antegonial index (AI), mandibular

cortical index (MCI), and Panoramic mandibular index (PMI) [3-5].

## Materials and Methods

### Materials

After the study protocol was approved by the institutional ethical review board, a total random sample of 250 subjects with ages ranging between 18 to 68 years, who were advised to take an orthopantomography (OPG) for dental diagnostic and treatment purposes. Our research has specific criteria's that were followed:

**Table 1.** Inclusion and exclusion criteria

Exclusion criteria:	Inclusion criteria:
1. OPG with errors such as OPG positional errors, hyoid bone projected on the mandible compromising diagnostic efficiency	1. Age range between 18 to 68 years divided into 5 groups: Group A: 18-28 years of age; Group B: 28-38 years of age; Group C: 38-48 years of age; Group D: 48-58 years of age; Group E: 58-68 years of age.
2. Any history of bone pathology and dystrophies,	
3. Non-traumatic and traumatic fractures,	

4. A medically compromised condition such as diabetes mellitus,	2. Female: Male patients with age and gender-matched samples
5. Any surgical treatment to the mandible	3. Absence of conditions mentioned in exclusion criteria

*Methods*

Calculation of mandibular cortical width indices using an orthopantomography (OPG):

MCI is the classification of the morphological appearance of mandibular inferior cortex distal to the mental foramen as :

C1: The endosteal perimeter of the cortex is straight and sharp on both sides of the mandible.

C2: The endosteal margin has crescent-shaped shortcomings (resorption cavities) with cortical remains one to three layers deep on one or both sides.

C3: The endosteal margin comprises thick cortical deposits and is porous [6].

*Statistical Analysis*

For data analysis and results formulation, the Statistical package for social sciences (SPSS) version 22 was used.

Descriptive analysis and Chi-square test were conducted to determine any significant association of gender and age with different categories of mandibular cortex index.

**Results and Discussion**

Descriptive analysis can be observed in **Table 2**, which shows the male and female ratio, which is 50% each. Regarding the age groups, an equal distribution of 20% was maintained. As far as the MCI classification was concerned, 22% of the patients were in the category of C1, 69.2% in C2, and 8.8% in C3.

**Table 2.** Descriptive statistics of the study variables

Variables	Frequencies
Gender:	Males: n=125 (50%) Females: n=125 (50%)
Age Groups	18-28 years: n=50 (20%) 29-38 years: n=50 (20%) 39-48 years: n=50 (20%) 49-58 years: n=50 (20%) 59-68 years: n=50 (20%)
MCI Classification	C1: n=55 (22%) C2: n=173 (69.2%) C3: n=22 (8.8%)

A Chi-square test was conducted to determine any significant association of gender and age with different categories of mandibular cortex index. **Table 3** shows that

there is a statistically significant association between gender and MCI, with a p-value of .001. It was observed that C1 was more prevalent in females (32%), C2 in males (78%), and C3 in males (10%). However, **Table 4** reveals no statistical association between age and MCI as the p-value was .081.

**Table 3.** Association of gender with Mandibular Cortex Index

MCI Classification	Gender	P-value
C1	Male: 12% Female: 32%	
C2	Male: 78% Female: 61%	.001*
C3	Male: 10% Female: 7%	

\*Chi-square test resulting in statistically significant association

**Table 4.** Association of age with Mandibular Cortex Index

MCI Classification	Age groups	P-value
C1	18-28 years: 32% 29-38 years: 28% 39-48 years: 20% 49-58 years: 12% 59-68 years: 18%	
C2	18-28 years: 64% 29-38 years: 66% 39-48 years: 76% 49-58 years: 72% 59-68 years: 68%	.081
C3	18-28 years: 4% 29-38 years: 6% 39-48 years: 4% 49-58 years: 16% 59-68 years: 14%	

Osteoporosis is a general skeletal disorder portrayed by micro-architectural weakening and the low mass of bone tissue, which causes an increase in bone vulnerability and fracture probability. It is found in people of all types and ages [7]. The general diagnosis of osteoporosis involves examining the fractures that developed with little trauma in bones, which happened because of a decline in the density of a bone mineral. Similar to the rest of the bones in the body, medical treatment or a systemic disease can influence the jawbones, which cause total teeth loss. Osteoporosis affects one in three women and one in five men over the age of 50 and may not be detected until symptoms of fractures occur, Osteoporosis predominantly affects elderly women. The results of our study indicate that men are more prone to the risk of osteoporosis, unlike the previous studies which have a female predilection for osteoporosis [8].

To lessen the risk, it is necessary to quickly identify osteoporosis and to begin early on a cure. In dentistry,

Panoramic radiographs are utilized widely and permit the assessment and study of the maxillary as well as the structure of the mandibular bone, along with teeth. In dental panoramic radiographs, detecting signs of osteoporosis is vital in diagnosing the disease [6].

Previous researches stated that among the radiomorphometric examinations, the MCI has exceptional reliability and reproducibility. Some studies demonstrated incidences of MCI in a sample group of 80 (i.e. the intensity of cortical modification classes from C1 to C3) values of the patient were: C1, 14 (17.5%), C2, 53 (66.3%), C3, 13 (16.3%) in contrast to the outcomes of our study that showed C1, 55 (22%), C2, 173 (69.2%), C3, 22 (8.8%) which proves C2 is the most prevalent type to be seen among the populations assessed respectively [9, 10].

#### *Limitation of the study*

Due to time constraints, larger sample size was not assessed. However, the equal gender distribution following STROBE guidelines in conducting the study will help to attain more standardized results which will be extended to include larger samples in future studies.

#### **Conclusion**

In our study, males showed a statistically significant correlation to the risk of development of osteoporosis than the females unlike the majority of the studies. C2 was the prevalent MCI criteria among the Saudi subpopulation. Age did not depict any influence on the osteoporosis diagnosis using panoramic radiographs. Age as a confounding factor will be further analyzed with larger samples following STROBE guidelines of standardization, to be evaluated as an extension of the study for further validation of the results in the Saudi population.

**Acknowledgments:** Authors of this study would like to acknowledge the support and cooperation of the research center of Riyadh Elm University.

**Conflict of interest:** None

**Financial support:** None

**Ethics statement:** This study fulfilled all the ethical requirements including data collection and confidentiality of study participants.

#### **References**

- Ibrahim S, Ahmed SA, Ahmed SM, Ahmed SK. Osteoarthritis: The Effect of Specific Watsu Therapy on Peak Torque and Functional Parameters-An Analytical Study. *Pharmacophore*. 2020 Sep 1;11(5):46-50.
- Alanazi AM, Alotaibi HD, Alahmari SA, Almutairi AK, Babakr SA, Abdrabnabi HA, et al. Hip Bone Fracture Diagnosis and Management. *Arch Pharm Pract* 2019;10(4):29-32.
- Balto KA, Gomaa MM, Feteih RM, AlAmoudi NM, Elsamanoudy AZ, Hassanien MA, et al. Dental panoramic radiographic indices as a predictor of osteoporosis in postmenopausal Saudi women. *J Bone Metab*. 2018 Aug;25(3):165-73.
- Güngör E, Yildirim D, Çevik R. Evaluation of osteoporosis in jaw bones using cone beam CT and dual-energy X-ray absorptiometry. *J Oral Sci*. 2016;58(2):185-94.
- Alapati S, Reddy RS, Tatapudi R, Kotha R, Bodu NK, Chennoju S. Identifying risk groups for osteoporosis by digital panoramic radiography. *Contemp Clin Dent*. 2015 Sep;6(Suppl 1):253-7.
- Oglat AA. Acceptance experimentation and quality monitor of x-ray radiography units. *Radiat Phys Chem*. 2020 Jul 1;172:108810.
- Nguyen VH. Smoking Status on Bone Health and Osteoporosis Prevalence. *Osong Public Health Res Perspect*. 2018 Aug;9(4):213-4.
- Moradi M, Tofangchiha M, Soltanmohammadi E, Golshahi H, Mojtahedi N. The influence of age, gender and dental status on the mandibular radiomorphometric and morphological indices. *Ann Dent Spec*. 2017 Apr 1;5:63-7.
- Cakur B, Dagistan S, Sahin A, Harorli A, Yilmaz AB. Reliability of mandibular cortical index and mandibular bone mineral density in the detection of osteoporotic women. *Dentomaxillofac Radiol*. 2009 Jul;38(5):255-61.
- Ledgerton D, Horner K, Devlin H, Worthington H. Radiomorphometric indices of the mandible in a British female population. *Dentomaxillofac Radiol*. 1999 May 1;28(3):173-81.