



Prediction of Osteoporosis through Orthopantomogram: A Gender-Inclusive Study

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KEYWORDS

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ABSTRACT:

Introduction: Osteoporosis, a metabolic bone disorder, is characterized by reduced bone mineral density (BMD) and increased fracture risk. Traditionally considered a condition affecting women, osteoporosis also significantly impacts men. Due to the high cost and limited availability of the gold standard diagnostic tool, dual-energy X-ray absorptiometry (DEXA), alternative methods are necessary. This study explores the mandibular cortical index (MCI) derived from orthopantomogram (OPG) images as a non-invasive, cost-effective alternative for screening osteoporosis in both men and women.

Objectives: To investigate the role of OPG-based MCI as a predictive tool for osteoporosis, evaluating its effectiveness across genders and its potential as a screening tool in a cost-effective and inclusive manner.

Methods: A cohort of 120 participants (60 men and 60 women, aged 40 and above) was selected. OPG imaging was performed, and MCI scores were evaluated based on the inferior margin of the mandible near the mental foramen. MCI was scored as C1, C2, or C3 based on cortical bone appearance. Grouping was done based on presence of teeth as Group 1 (all teeth present) and Group 2 (more than 6 teeth missing). Descriptive (Mean & Standard deviation) and Inferential Statistical analysis was done for inter-group (Independent t-test) comparison based on gender and periodontal status.

Results: When comparison was done between Group 1 and 2, highly significant difference was observed for both males ($p = 0.001^{**}$) and females ($p = 0.000^{**}$). Gender-specific analysis revealed higher MCI scores in women compared to men with significant difference in both groups ($p < 0.01$)

Conclusions: The study highlights the potential of MCI as a reliable, non-invasive screening tool for osteoporosis in both genders. It suggests integrating MCI into routine dental care for early diagnosis and intervention, especially in resource-limited settings.

1. Introduction

Osteoporosis is a global health concern, particularly among aging populations. It is defined by low bone mineral density (BMD), microstructural deterioration, and increased fragility fractures. Though commonly associated with women, particularly postmenopausal

women, osteoporosis also significantly affects men, yet it remains underdiagnosed in this population. Traditional diagnostic methods like DEXA are costly and often inaccessible in resource-constrained settings (1,2).



Orthopantomogram (OPG) is commonly used in dental practice, and its potential as a tool for screening osteoporosis has been explored in prior studies (3, 4). This study aims to evaluate the role of MCI, derived from OPG images, in predicting osteoporosis in a gender-inclusive cohort.

2. Objectives

This study aims to investigate the role of OPG-based MCI as a predictive tool for osteoporosis, evaluating its effectiveness across genders and its potential as a screening tool in a cost-effective and inclusive manner.

3. Methods

Study Population

A total of 120 participants (60 men and 60 women) were randomly selected among patients reporting to the Department of Oral Medicine and Radiology of Yogita Dental College and Hospital, Khed, for the study. The pre-existing data OPG, Demographic details were collected from the Department of Oral Medicine and Radiology.

Inclusion Criteria:

- Participants aged 40 and above.
- No prior diagnosis of metabolic bone disorders other than osteoporosis.

Exclusion Criteria:

- History of malignancies or conditions affecting bone metabolism (e.g., Paget's disease).
- Recent use of medications that impact bone density (e.g., bisphosphonates, corticosteroids).
- Dental or mandibular abnormalities that interfere with clear MCI assessment on panoramic radiographs.

Grouping:

- Group 1: Determination of mandibular cortical thickness analysis on OPG in patients with all teeth for reliability of mandibular cortical thickness as an indicator of osteoporosis
- Group 2: Determination of mandibular cortical thickness analysis for OPG in patients with more than 6 missing teeth.

Visual analysis was performed by radiographic imaging of the inferior margin of the mandible near the mental foramen on panoramic radiographs based on the mandibular cortical index (MCI) (5,6). The mandibular cortical width of the cortex is measured at the mental foramen as a line parallel to the long axis of the mandible and tangential to the inferior border of the mandible. All measurements were taken in mm [Figure 1]. MCI of the mandibular inferior margin on panoramic radiographs was essentially a 3-point index (C1, C2, C3) and was scored using the following criteria:

- **C1:** The endosteal margin of the cortex was even and sharp on both sides.
- **C2:** The endosteal margin showed semilunar defects (lacunar resorption) or seemed to form endosteal cortical residues (one to three layers) on one or both sides.
- **C3:** The cortical layer formed heavy endosteal cortical residues and was clearly porous (7,8)

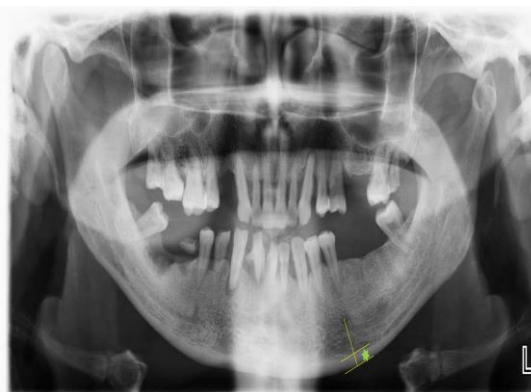


Figure 1: Measuring mandibular cortical width at the mental foramen as a line parallel to the long axis of the mandible and tangential to the inferior border of the mandible

Statistical Analysis:

Data was entered and coded in Microsoft Excel sheet. Statistical analysis was performed using Statistical Package for the Social Sciences (SPSS), version 26 IBM, for Windows (SPSS Inc, Chicago, IL). Confidence interval was set at 95% and probability of alpha error (level of significance) was set at 5%. Power of the study was set at 80%.

Descriptive statistics (Mean and Standard Deviation) and Inferential statistics - Independent t test (Intergroup comparison) was done for comparison based on gender and periodontal status. (9,10)



4. Results

Descriptive Statistics:

Descriptive Statistics			
SEX	N	Mean	S.D.
MALES	60	1.68	.507
FEMALES	60	1.76	.591

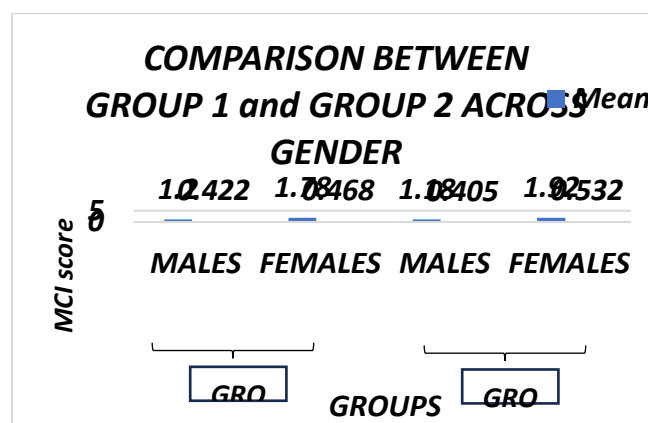
In the present study, the mean MCI value for males was 1.68 ± 0.507 and for females was 1.76 ± 0.591

Distribution according to MCI values across gender					
			SEX		Total
			MALES	FEMALES	
MCI	C1	Count	19	16	35
		% of Total	19.00%	16.00%	35.00%
	C2	Count	40	40	60
		% of Total	30.00%	30.00%	60.00%
	C3	Count	1	4	5
		% of Total	1.00%	4.00%	5.00%
Total		Count	60	60	120
		% of Total	50.00%	50.00%	100.00%

Gender Differences in MCI:

Comparison between Group 1 and 2 using Independent t test					
SEX	GROUP	N	Mean	S.D.	P value
MALES	1	33	1.20	.422	.001**
	2	27	1.78	.468	

FEMALES	1	31	1.18	.405	.000**
	2	29	1.92	.532	



When comparison was done between Group 1 and 2, highly significant difference was observed for both males ($p = 0.001$ **) and females ($p = 0.000$ **).

Comparison between the males and females using Independent t test					
GROUP	SEX	N	Mean	S.D.	P value
1	MALE	33	1.20	.422	.048*
	FEMALE	31	1.18	.405	
2	MALE	27	1.78	.468	.039*
	FEMALE	29	1.92	.532	

Gender-specific analysis revealed higher MCI scores in women compared to men with significant difference in both groups ($p < 0.01$)

Discussion

Osteoporosis presents a significant health risk, especially in the elderly, and early diagnosis is critical.



Mandibular bone changes are often seen in individuals with low BMD, with similar risk factors contributing to both conditions (5,11). This study demonstrates that MCI, assessed via OPG, is a reliable predictor of osteoporosis, with stronger correlations observed in women, likely due to postmenopausal bone loss.

The findings of this study align with previous research indicating that the mandibular cortex can be a useful indicator of systemic bone health. For example, studies by Devlin and Horner (2002) and Gulsahi et al. (2008) also found significant correlations between MCI and BMD in both genders (11,12). The ability to predict osteoporosis using OPG-based MCI is particularly important in resource-limited settings where DEXA may not be readily available (3,10).

However, the diagnostic accuracy of MCI varies across populations. While a study by Benson et al. have demonstrated high sensitivity and specificity, other studies by Horner et al., 2002; Jowitt et al., 2005 reported lower predictive values, particularly in populations with diverse ethnic backgrounds or varying degrees of oral health (4,7,13). Additionally, the differences in MCI correlations between genders observed in this study are consistent with prior findings of Kribbs et al., 1989 that women, especially postmenopausal women, tend to exhibit stronger correlations due to hormonal changes influencing bone mass (14).

Some studies have argued against using MCI as a standalone diagnostic tool. For instance, Horner et al. (2002) found that while MCI could serve as an initial screening tool, it had limited accuracy when used alone for osteoporosis diagnosis, advocating for its combination with other diagnostic methods. Furthermore, studies by Nakamoto et al. (2003) and Klemetti (1996) emphasize the importance of comprehensive clinical evaluation alongside radiographic analysis to improve diagnostic reliability. This highlights a potential limitation of MCI, as its predictive power may be influenced by factors such as the patient's dental status or age (4,11,15).

Moreover, the presence of few or missing teeth, which was included as a variable in our study, significantly affects MCI scores. A similar impact was reported by Gulsahi et al. (2008), where individuals with fewer teeth exhibited altered cortical bone patterns,

complicating the interpretation of MCI in elderly individuals with substantial tooth loss.

Despite these limitations, our findings support the utility of MCI in conjunction with other diagnostic tools, providing a non-invasive, cost-effective screening alternative for osteoporosis. The high diagnostic accuracy observed, especially in women, confirms the potential of OPG-based MCI in clinical practice, particularly in settings where advanced diagnostic equipment is unavailable.

Conclusion

This study demonstrates that MCI, derived from OPG, is an effective, non-invasive screening tool for osteoporosis in both men and women. The findings underscore the importance of incorporating MCI into routine dental evaluations, particularly in resource-limited areas, to facilitate early osteoporosis detection and improve patient outcomes.

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