



# The comparison of Mandibular Cortical Index based on dental status in women using panoramic radiographs

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## ABSTRACT

**Objectives:** The aim of this study is to analyze the difference of the Mandibular Cortical Index (MCI) between dentate and edentulous regions in women using panoramic radiographs.

**Materials and Methods:** This is a comparative analytical observational research with a cross-sectional approach. The samples used were 250 female panoramic radiographs, which were divided into 125 dental region samples and 125 edentulous samples which were available at the Dental Radiology Installation, Dental and Oral Teaching Hospital (RSGM-P) Faculty of Dentistry, Trisakti University. MCI assessment uses i-Dixel software version 2.2.0.3. Morita Japan. The comparative test was carried out using the Mann-Whitney test to determine whether there was a significant

difference or not.

**Results:** There is a significant difference in MCI based on dental status with p-value = 0.000 ( $p < 0.05$ ). The percentage of category C1 was found higher (26%) in the dentate group than edentulous group (9,2%), whereas the percentage of category C3 was found higher in the edentulous group (16,3%) than dentate group (3,2%).

**Conclusion:** There is a significant difference in MCI based on dental status with p-value = 0.000 ( $p < 0.05$ ). The percentage of category C1 was found higher (26%) in the dentate group than edentulous group (9,2%), whereas the percentage of category C3 was found higher in the edentulous group (16,3%) than dentate group (3,2%).

**Keywords:** Bone density, mandibular cortical index, panoramic radiograph, women

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## INTRODUCTION

The bone functions as a means of supporting the body, protecting various organs in the body, forming body posture, a place where calcium and minerals are metabolized, and as a hemopoietic organ. Normal bone mass is a factor in maintaining bone density. A person will usually lose bone mass slowly when they are around 30 years old.<sup>1</sup> This loss of bone mass will result in a higher risk of bone health problems. A commonly found bone health disorder is osteoporosis. Osteoporosis is a disease that occurs due to low bone mass and damage to the micro-architecture of bone tissue.<sup>2</sup>

Osteoporosis is known as a silent disease because the disease is not felt or is accompanied by symptoms.<sup>3</sup> Osteoporosis commonly occurs in elderly people and most women in the post-menopausal stage, due to withdrawal of the hormone estrogen.<sup>4</sup> Osteoporosis can result in a decrease in jaw bone mass and changes in the structure of the mandible, especially in the inferior border or lower cortex of the mandible.<sup>2</sup> According to WHO, a tool for measuring bone mass reduction can be done using Dual-energy X-ray Absorptiometry (DXA), which has become the Gold

Standard because it has low radiation and high accuracy. However, DXA is quite expensive and has limitations in availability.<sup>3</sup>

There is another alternative to see a decrease in bone mass, namely a panoramic radiograph which covers a large area obtained in one receptor, the price is relatively cheaper, the radiation dose used is quite low and the availability of this tool is very wide. Panoramic radiography not only provides information on the condition of a tooth, but signs suggestive of systemic disease are also visible, for example, a decrease in the thickness of the mandibular cortex which is a sign of osteoporosis. Panoramic radiography is generally used as a routine examination in edentulous patients before complete denture construction.<sup>5</sup> The panoramic radiographic index used to assess bone quality, especially in the mandibular cortex area, is the Mandibular Cortical Index (MCI), where the MCI shows porosity.<sup>2</sup> According to Horner and Devlin, the Mandibular Cortical Index is closely related to the bone mineral density of the mandibular body.<sup>6</sup>

Several researchers have stated that MCI is used as an alternative method for assessing low

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Bone Mineral Density (BMD), especially in postmenopausal women.<sup>7</sup> The Mandibular Cortical Index (MCI) has categories based on the classification of Klemetti et al, namely C1 = the endosteal edge of the cortex and is sharp on both sides, C2 = the endosteal edge shows a semilunar defect (lacunar resorption) and appears to form an endosteal cortical residue on one or both sides, C3 = cortical layer forms a heavy endosteal cortical residue and is porous.<sup>8</sup> MCI is well known as a method used to see low bone mass in the mandibular cortex, but there are still few who state that there is a difference in MCI between the dentate and edentulous region. Therefore, this study was performed to determine whether there is a significant difference between MCI based on dental status using panoramic radiographs in women.

## MATERIALS AND METHODS

This comparative analytical study aims to analyze the difference in the Mandibular Cortical Index between the dentate and edentulous regions in women using panoramic radiographs.

This study was carried out from September 2023 to November 2023 and the data used in this research is secondary data in the Dental Radiology Installation, Dental and Oral Teaching Hospital (RSGM-P) Faculty of Dentistry, Trisakti University for the 2021/2022 period. In this study, we used an unpaired categorical comparative analytical sample size formula.

The number of samples used were 250 digital panoramic radiograph of women aged 30 years and above, divided into 125 samples with dentate regions and 125 samples with edentulous regions. All panoramic radiographs were made using digital panoramic machine (Morita VeraviewePocs 2D; J. Morita, Japan). This study has received ethical permission from KEPK-FKG Usakti with number 698/S1/KEPK/FKG/7/2023.

Data was recorded in Microsoft Excel software by writing the medical record number, dental

status, and MCI category assessment results. The data was analyzed using SPSS to test interobserver reliability, intraobserver reliability, and then the comparative test. A categorical comparative test was carried out using the Mann-Whitney to find if there is a significant difference in proportions or not. The interobserver and intraobserver reliability were tested prior to the comparative test. The interobserver assessment was performed by 2 observers consisted of the main observer and a Dentomaxillofacial Radiology Specialist. The interobserver assessed only 10% of a random sample of panoramic radiographs of dentate and edentulous areas. The MCI assessment of this study is based on MCI categories according to the Klemetti, et al. Classification<sup>8</sup> as shown in Figure 1.

## RESULTS

The interobserver and intraobserver reliability was tested in this study using Cohen's Kappa and the results was showed in Table 1.

Table 1 shows the kappa value in the interobserver test is 0.895 and in the intraobserver test is 0.954, which means the level of reliability is strong. The results of this test also show a p-value of 0.000, where the value is <0.05 so it can be concluded that the data is reliable.

Table 2 shows the frequency and percentage results of the MCI categories based on dental status. In the edentulous group, the C1 category represented 23 (9.2%) of the samples and respectively 60 (24%) and C3 42 (16.8%) for the C2 and C3 category. Whereas, the distribution of MCI category in the dentate group are C1 = 65 (26%), C2 = 52 (20.8%), and C3 = 8 (3.2%).

According to Table 3 above, the Mann-Whitney test was carried out and p-value of 0.000 was obtained, ( $p < 0.05$ ). Therefore, it showed that there was a significant difference in the Mandibular Cortical Index (MCI) between the dentate and edentulous regions in women through panoramic radiographs.



**Figure 1.** MCI assessment is based on MCI categories according to the Klemetti, et al. classification.<sup>8</sup> (A) C1, with clear boundaries and no erosion of the mandibular cortex; (B) C2, the boundaries are still clear but there is light erosion and a radiolucent image is visible; (C) C3, the border of the mandibular cortex is no longer visible and is badly eroded.

**Table 1.** Interobserver and Intraobserver Reliability Test

	N	Kappa value	p-value
Interobserver	25	0,895	.000
Intraobserver	25	0,954	.000

**Table 2.** Frequency Distribution of MCI based on Dental Status

Dental Status	n	MCI Category	Frequency	Percentage
Edentulous	125	C1	23	9,2
		C2	60	24,0
		C3	42	16,8
Dentate	125	C1	65	26,0
		C2	52	20,8
		C3	8	3,2

**Table 3.** Comparative Test of Categorical MCI by Dental Status

Dental Status	(p-value)
Dental Status	.000

## DISCUSSION

The results of this study came from 250 data samples consisting of 125 samples from the dentate region and 125 samples from the edentulous region. The subjects in this study used subjects aged over 30 years because this age is the peak bone mass where the bones have reached maximum density. This study used the female gender because women have more influence on reduced bone density. This is influenced by the female hormone estrogen which can decrease and increase the number of osteoclast activity. Women are more likely to experience bone density abnormalities than men.<sup>4</sup>

The results obtained in this MCI study were that there was a significant difference between the dentate and edentulous groups with p-value 0.000 ( $p < 0.05$ ) as shown in Table 3. The percentage of category C1 was found higher (26 %) in the dentate group than edentulous group (9,2%), in contrast to the edentulous group which the percentage of category C3 was found higher (16,3 %) than in the dentate group (3,2 %).

This study is in line with a study conducted by Gassama, et al. Who revealed that the C3 category was more frequent in edentulous subjects than dentate, with a statistically significant difference  $p < 0.05$ .<sup>9</sup> In addition, This study was also in line with Gulsahi, et al. which states that there is a significant relationship between MCI and dental status. The results of this study showed that C3 in edentulous cases was 27.30 times higher than in dentulous cases with a p-value  $< 0.001$ . Their research also demonstrated that the status of the teeth affects the quality of the mandibular bone. This can be seen in the condition of the tooth attachment which will affect bone density, as in the results of this study which show that a complete set of teeth will produce high bone density.<sup>10</sup> Tanaka et al. also showed that C2 and C3 categories are mostly found in women aged 50 years and above, C1 will decrease with increasing age.<sup>11</sup>

The higher frequency C3 category in the edentulous group may be influenced by residual ridge resorption. Imirzalioglu, et al. showed a significant difference in MCI between the dentate and edentulous group, regarding residual ridge

resorption, with C3 results being higher than C1 and C2 ( $P < 0.05$ ). In the edentulous group, residual ridge resorption occurred more often than in complete dentition cases ( $P < 0.001$ ). It may lead to the possibility that the mandibular bone density changes are caused by the resorption process in the alveolar bone.<sup>12</sup> The reduction in alveolar ridge dimensions is a physiological response to tooth loss.<sup>13</sup> Excessive bone resorption can also cause bone density abnormalities such as osteoporosis.<sup>14</sup>

According to the results obtained in this study, MCI alone should not be used as a gold standard for measuring Bone mineral density (BMD) or diagnosing osteoporosis. In addition, there was a limitation of this study since there are unobserved factors such as dental pathologies that related to edentulous condition. However, the MCI may be recommended as an alternative tool used for screening early bone density loss in women over 30 years.

## CONCLUSION

Through panoramic radiographs, we can determine the difference in MCI based on dental status in women since this study revealed a significant difference in MCI between the dentate and edentulous group. The loss of teeth in women may lead to any change in the MCI. However, low MCI values in edentulous regions in women cannot be directly interpreted as bone density abnormalities, since other factors still need to be observed.

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## FOOTNOTES

All authors have no potential conflict of interest to declare for this article. This research has received ethical approval from the Research Ethics Commission of the Faculty of Dentistry, Trisakti University with number 698/S1/KEPK/

FKG/7/2023. All procedures conducted were in accordance with the ethical standards.

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