



Identification of Mandibular Cortical Index (MCI) in chronic periodontitis patients

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Abstract

Background: Chronic periodontitis is a disease of periodontal tissue involving periodontopathogenic bacteria and causes periodontal tissue damage. The tissue damage is caused by pathological bone resorption that indirectly affect the degree of cortical mandibular erosion bone. Resorption process that already reach hard tissue can be observed with dental radiograph, such as panoramic radiography. Assessing the degree of erosion on panoramic radiography, multiple qualitative and quantitative panoramic indices can be used. One of them use Mandibular Cortical Index (MCI).

Purpose: To identify MCI in chronic periodontitis patients as a beginning screening to predict the degree of cortical mandibular erosion bone.

Method: Observation was conducted on 49 sample that was diagnosed with chronic periodontitis, have no systemic disease, and did not have any bone lesions. Sample was classified into three categories, which was C1 type (normal cortex), C2 type (moderately eroded cortex), and C3 type (severely eroded cortex). Data were statistically analyzed with Friedman test in order to test the differences among the researchers.

Results: Based on the results of the study, the percentage of C1, C2, and C3 types obtained in patients with chronic periodontitis were; 34.7%, 59.2%, 6.1%. The MCI category in most chronic periodontitis patients was type C2 (moderate erosion cortex) then was followed by type C1 (normal cortex), and C3 (porous cortex).

Conclusion: The use of MCI become the consideration for dentists to predict the bone condition of chronic periodontitis patients as a beginning screening thus it can determine the treatment steps for the next periodontal.

Keywords: chronic periodontitis, Mandibular Cortical Index, panoramic radiography

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INTRODUCTION

Panoramic radiography technique is a technique for producing a broad, single image of the maxillofacial structure which includes the maxilla, mandible, and surrounding tissue in one film. Panoramic radiography is a form of tomography, which takes a picture of a particular body part. The panoramic technique uses an extra-oral radiation source and a film that is placed outside the patient's mouth in a cassette. One of the advantages of panoramic radiography is that it can produce a broad picture of the maxillofacial structure with a fairly low radiation dose. Therefore, panoramic radiography is often a screening tool and is effective for patient education media (Ghom, Ghom, 2016).

A number of measurement methods from panoramic radiography have been developed to assess jaw bone density. Several panoramic indices such as Gonial Index (GI), Antegonial Index (AI), Panoramic Mandibular Index (PMI), Mental Index (MI), and Mandibular Cortical Width (MCW) have been used to quantitatively measure

mandibular bone density. In addition, a qualitative assessment of mandibular bone density can be observed through the Mandibular Cortical Index (MCI) (Rosen, et al. 2013). Klemetti et al. elaborates that the MCI assessment on panoramic radiography is obtained through observation of the distal part of the mandible to the foramen mentale on both sides of the jaw and classifies the degree of erosion into three categories, namely the normal cortex, mild cortex, moderate erosion, and cortex with severe erosion (Klemetti, Kolmakow, Kroger, 1994). This assessment is based on a theory which states that the Havers canal will develop and extend in osteoporosis patients, thus the inferior cortex of the mandible will disappear (Taguchi, 2009; Barine, & Victor, 2016).

Although MCI is often used to see bone density in osteoporosis sufferers, MCI can also be used in patients

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with chronic periodontitis. In a study conducted by Moeintaghavi, Hosseinzarch & Tabassi, it was found that patients with chronic periodontitis who have mandibular cortex type C2 (mild to moderate erosion) of 48.1%. Chronic periodontitis which also has an impact on connective tissue loss is thought to be the reason for reduced bone mass in the cortical region of the mandible (Moeintaghavi, Hosseinzarch, & Tabassi, 2014). According to the same study, it was also stated that MCI was the most significant index in relation to chronic periodontitis when compared to MI and PMI.

Chronic periodontitis is a disease of periodontal tissue that involves the accumulation of plaque and calculus as the retention of periodontopathogenic bacteria. Chronic periodontitis can involve loss of tooth attachment and loss of bone mass in 30% of the total jaw area (localized chronic periodontitis) or it can involve loss of bone mass in more than 30% of the area of the total jaw (generalized chronic periodontitis) (Newman, Takei, Klokkevold, 2015). In a study conducted by Tonguc et al., it was reported that sufferers of chronic and moderate stage chronic periodontitis had significantly lower BMD values than people without periodontitis (Tonguc, et al. 2012).

As explained previously in a study conducted by Tonguc et al. a conclusion was found that there was a relationship between the panoramic index and bone density measured through BMD. Provisional estimates are changes in mandibular bone density in patients with chronic periodontitis that can be observed through MCI. Hence, the purpose of this study is to identify MCI in patients with chronic periodontitis as initial screening to estimate the degree of erosion of the mandibular bone.

MATERIALS AND METHODS

The type of this study was descriptive observational and conducted by 3 observers consisting of one researcher and two supervisors. The sample used was secondary data in the form of panoramic radiographs of patients who had been diagnosed with chronic periodontitis and originated from the Periodontics Poly and Oral Surgery Clinic of the Dental and Oral Hospital of Universitas Airlangga, Surabaya totalling 49 samples. Patients selected according to sample criteria included chronic periodontitis patients who did not have systemic disease and did not have bone-manifesting lesions.

The Mandibular Cortical Index (MCI) was observed in the panoramic radiographic results by observing the degree of erosion of the posterior mandibular cortex to the foramen mentale (Klemetti, Kolmakow, Kroger, 1994). Then the samples were grouped based on three MCI classifications as follows:

a. C1 (normal cortex): the endosteal margins of the mandibular cortex were the same and clearly visible on both sides.

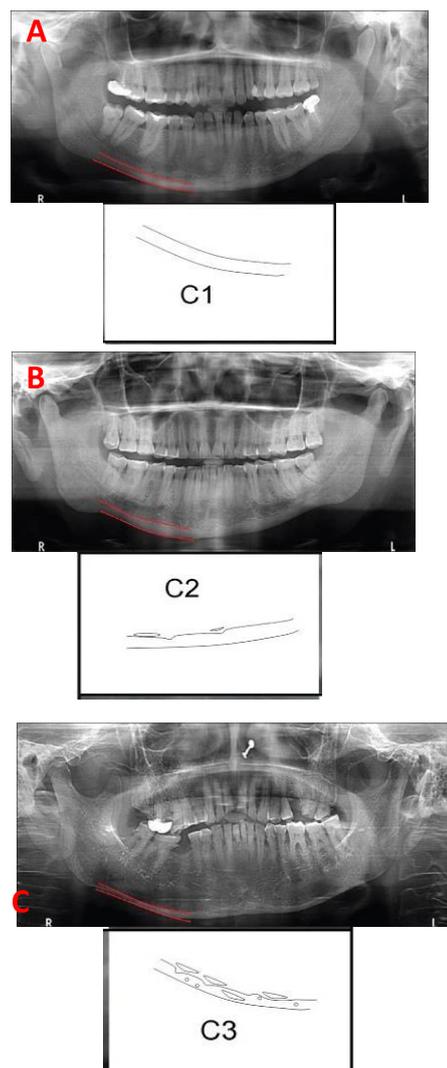


Fig. 1. Three types of mandibular inferior cortex which were classified as follows: (A) C1 / normal cortex; (B) C2 / mildly to moderately eroded cortex, (C) C3 / severely eroded cortex

b. C2 (mildly to moderately eroded cortex): The mandibular cortex whose endosteal margins have semilunar defects (lacuna resorption) or appear to form the rest of the endosteal cortex (one or three layers) on one or both sides of the mandible.

c. C3 (severely eroded cortex): cortex that formed endosteal remnants and was very porous.

Furthermore, data analysis was performed on the results of the study using descriptive analysis and statistical analysis. Descriptive analysis was conducted by presenting the results of study in the form of contingency diagrams. After that, a statistical analysis was performed using SPSS version 22 software in the form of Friedman test to find out the differences in the observations of the three researchers.

Table 1. Results of observations of MCI in patients with chronic periodontitis

Category of MCI	Frequency	Percentage (%)
C1 (Normal)	17	34.7
C2 (Mild)	29	59.2
C3 (Severe)	3	6.1
Total	49	100.0

RESULTS

Research has been conducted on 49 people who were selected according to the sample criteria. The following were observations of the mandibular inferior cortex in chronic periodontitis based on MCI.

Based on **Table 1**, it can be seen that the percentage of mandibular cortical radiographic images in patients with chronic periodontitis according to the Mandibular Cortex Index (MCI) showed that 34.7% of study subjects have normal mandibular cortex (type C1). 59.2% of the study subjects had a picture of the mandibular cortex with moderate erosion rate (type C2) while the remaining 6.1% had a picture of the mandibular cortex with severe erosion rate (type C3) or looked porous.

Based on these data, it can be seen that the picture of the mandibular inferior cortex in patients with chronic periodontitis was dominated by type C2 (cortex with moderate erosion), then followed by type C1 (normal cortex), and type C3 in the last sequence.

While the test results using Friedman analysis obtained a p-value of 0.097. At the 95% confidence level, it can be concluded that there were no differences in the results of observations of the mandibular inferior cortex based on the MCI of the three studies conducted by supervisors and students.

DISCUSSION

The use of radiography is used as a diagnostic investigation and a treatment evaluation medium. Radiographic assessment of the quality of the jawbone has a better value than the assessment of other bone types. One type of radiography that is often used as a routine examination and screening media as well as an overall evaluation of the patient's oral cavity is panoramic radiography. This is because panoramic radiography has a dose of exposure that is not too large but can produce an overall picture of the maxillofacial structure (Ghom, Ghom, 2016).

In certain abnormalities, it can also be observed that the local condition of the maxillofacial bone is resorbed through panoramic radiography. In assessing the state of bone resorption associated with this particular disease, various indexes have emerged in the form of densitometric indexes or morphometric or radiomorphometric indices (Malcic, et al. 2015). Among the many types of radiomorphometric indices that exist, the MCI (Mandibular Cortical Index) is the index that is

most easily observed and can be accepted by any observer (Ledgerton, et al. 1999). MCI is a radiomorphometric index that qualitatively assesses the degree of erosion in the mandibular cortical bone (Klemetti, Kolmakow, Kroger1994).

This study was conducted on patients with chronic periodontitis who did not have systemic disease. This is because in patients who have systemic diseases such as abnormalities in the endocrine system can cause abnormalities in bone metabolism. Besides that, osteoporosis sufferers also become one of the exclusion criteria due to the same theoretical basis.

Based on the results of the study, type C2 has the highest percentage of the two other types of MCI. These results are consistent with the results of study conducted by Moeintaghavi, Hosseinzarch & Tabassi (Moeintaghavi, Hosseinzarch, Tabassi, 2014). In that study, it was also found that the type of moderate erosional cortex was the type of MCI that most patients with chronic periodontitis had.

The results of this study are also in accordance with the theory which states that in the process of pathological bone resorption in chronic periodontitis there is an imbalance in the degree of resorption and bone formation (Hienz, Paliwal, Ivanovski, 2014). Chronic periodontitis involves loss of tooth attachment and loss of jaw bone mass (Newman, Takei, Klokkevold, 2015). An increase in the number of T cells, B cells, macrophages, and neutrophils in the gingival connective tissue as a form of body defense occurs in patients with chronic periodontitis. Excessive activation and production of T cells and B cells can increase the number of sRANKL (soluble receptor activator of nuclear factor-kappaB ligand) which directly increases the process of osteoclast cell formation (osteoclastogenesis), resulting in a more dominant resorption process compared to bone apposition process. In addition to the role of host immunity, the role of periodontopathogenic bacteria can also influence the formation of RANKL by osteoblast cells and fibroblasts in gingival tissue⁶. Therefore, the pathological resorption process in chronic periodontitis can affect the quality of the mandibular bone.

This study also obtained the results that the normal cortex type has a greater percentage than the porous cortex type. This is possible because the sample age, sex of the sample, and the severity of chronic periodontitis that are not differentiated in this study may have an effect on the progression of bone resorption thus it gives more normal cortex type results compared to porous cortex type (Tonguc, et al. 2012. Rajendran, Sivapathasundharam, 2012). This study also did not use BMD (bone mineral density) data from the sample to determine the status of the sample bone density systemically. According to a study conducted by Saran et al., the decrease in BMD can be related to the increase in type in MC (Newman, Takei, Klokkevold,

2015). Therefore, systemic bone status is predicted to influence the degree of erosion of the mandibular cortical bone. In addition, differences in the immune response factors of each individual host are also thought to cause different bone resorption processes, hence individuals with a good immune system will show a picture of the normal cortex (Barbato, et al. 2015).

Moreover, the results of the study only found three samples that have porous cortex type. In these patients, it is necessary to be suspected as a patient who is at high risk for osteoporosis, hence it is necessary to conduct further BMD examination for a definitive diagnosis of osteoporosis (Leite et al. 2011. Gulsahi et al. 2008).

Patients with chronic periodontitis can provide a picture on the radiograph that illustrates that the

progression of the disease has reached hard tissue. The use of panoramic radiography as a routine examination can be an opportunity for dentists to detect abnormalities that are clinically not directly observable.

CONCLUSION

MCI category in patients with chronic periodontitis is the most type of cortex with a moderate level of erosion which is then followed by the type of normal cortex and porous cortex. The use of MCI as an indicator to estimate bone condition in patients with chronic periodontitis can be a consideration for dentists to determine the periodontal treatment steps needed by patients.

REFERENCES

- Barbato, L., Francioni, E., Bianchi, M., Mascitelli, E., Brancato, L., Duvina M., Tonelli, P. 2015. Periodontitis and Bone Metabolism. *Clinical Cases in Mineral and Bone Metabolism*. 12(2). p. 174
- Barine, K. K. D., & Victor, N. (2016). The Particle Size and Thermal Properties of Flour from three Plantain (*Musa Paradisiaca*) Cultivars Grown in Nigeria. *Journal of Food Technology Research*, 3(1), 23-27.
- Daskalaki, A. 2010. *Informatics in Oral Medicine: Advanced Techniques in Clinical and Diagnostic Technologies*. Hershey:Medical Information Science Reference. p. 216.
- Ghom, G.A., Ghom, S.A. 2016. *Textbook of Oral Radiology*. 2nd edition. India: Elsevier. p. 357-9, 361.
- Gulsahi A, Yuzuqullu B, Mirzalioqlu P, Genc Y. 2008. Assessment of panoramic radiomorphometric indices in Turkish patients of different age groups, gender and dental status. *Dentomaxillofac Radiol*; 37 (5). Pp. 288-92.
- Hienz, S.A., Paliwal, S., Ivanovski, S. 2014. Mechanisms of Bone Resorption in Periodontitis. *Journal of Immunology Research*. Vol.2015. p. 5
- Klemetti, E., Kolmakow, S., Kroger, H. 1994. Pantomography in Assessment of the Osteoporosis Risk Group. *Scand J Dent Res*. 102: pp. 68-72
- Ledgerton, D., Horner, K., Devlin, H., Worthington, H. 1999. Radiomorphometric indices of the mandible in a British female Population. *Dentomaxillofac Radiol*. 28: pp. 173-81
- Leite AF, Figueiredo PT, Barra FR, De Melo NS, De Paula AP. 2011. Relationships between mandibular cortical indexes, bone mineral density, and osteoporotic fractures in Brazilian men over 60 years old. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod*; 112. Pp. 648-56
- Malcic, A.I., Matijevic, C., Vodanovic, M., Zlataric, D.K., Mehicic, G.P., Jukic, S. 2015. Radiomorphometric indices of Mandibular Bones in an 18th century Population. *Archives of Oral Biology*. p 60.
- Moeintaghavi, M., Hosseinzarch, H., Tabassi, S.M. 2014. The comparison of Mandibular Radiomorphometric Indices in Panoramic Radiography between patients with chronic periodontitis and healthy individuals. *The Journal of Contemporary Dental Practice* 15(4). p. 464-5
- Newman, M.G., Takei, H. H., Klokkevold, P.R. 2015. *Carranza's Clinical Periodontology*. 12th edition. Canada: Elsevier. pp. 55, 309
- Rajendran, A., Sivapathasundharam, B. 2012. *Shafer's Textbook of Oral Pathology*. 7th Edition. New Delhi: Elsevier. p. 404.
- Rosen, C.J., Bouillon, R., Compston, J.E., Rosen, V. 2013. *Primer on the Metabolic Bone Diseases and Disorders of Mineral Metabolism*. 8th edition. Willey-Blackwell.
- Saran, G., Misra, N., Umapathy, D., Channaiah, S.G., Singh, P., Srivatava, S. 2015. Evaluation of the relationship of mandibular cortical index and panoramic mandibular index with mineral bone density using panoramic radiography in postmenopausal women: A short study. p.543. *Journal of Indian Academy of Oral Medicine & Radiology*.

- Taguchi, A. (2009). Panoramic radiographs for identifying individuals with undetected osteoporosis. Japanese Dental Science Review. p. 111,115
- Tonguc, M.O., Buyukkaplan, U.S., Fentoglu, O., Gumus B.A., Cerci., S.S., Kirzioglu, F.Y. 2012. Comparison of bone mineral density in the jaws of patients with and without chronic periodontitis. Dentomaxillofacial Radiology 41. p. 514.

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