CURRENT RESEARCH AND TRENDS IN DENTAL AND MEDICAL TECHNOLOGY

Edited by
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Indrayadi Gunardi and Anggraeny Putri Sekar Palupi

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Preface

It is with great pleasure that we present the proceedings of the **2nd International Conference in Dental Technology and Medical Sciences (ICDenTeMS)**, held on **November 21–22, 2024,** at the **Faculty of Dentistry, Trisakti University**, Jakarta, Indonesia.

With the theme **"Current Research and Trends in Dental and Medical Technology,"** this conference brought together a diverse group of researchers, academics, practitioners, and students to explore the latest innovations, challenges, and breakthroughs in the fields of dental and medical sciences. The hybrid format of this year's conference allowed for broader participation, both onsite and online, reinforcing our commitment to inclusivity and global collaboration.

The contributions compiled in this book reflect the depth and breadth of current research, showcasing original studies, case reports, and literature reviews that span a wide range of topics within dental and medical technology. Each manuscript has undergone a peer-review process, ensuring the quality and relevance of the work presented.

We would like to express our sincere appreciation to all authors, reviewers, speakers, and participants whose enthusiasm and dedication have made this event a success. Special thanks are also extended to the editorial and scientific committees for their tireless efforts in preparing these proceedings.

We hope that the insights shared in this volume will inspire further research and foster ongoing academic collaboration, contributing meaningfully to the advancement of dental and medical technology in Indonesia and beyond.

Jakarta, November 2024
Prof. drg. Rahmi Amtha, MDS, Sp.PM (K), Ph.D.
Chairperson, 2nd ICDenTeMS

Session 13: Oral biology and microbiology

Session 14: Dental public health

Does tooth loss have possibility to affect panoramic mandibular index in females?

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ABSTRACT: Objectives: to evaluate the possible effect of mandibular teeth loss to Panoramic Mandibular Index (PMI) value in females. Methods: This study used comparative analysis in female subjects aged 30 years and above. A sample size of 160 digital panoramic radiographs obtained from the Dental Radiology Installation, RSGM-P, Faculty of Dentistry Universitas Trisakti, divided into 80 samples of the edentulous region and 80 samples of the dentate region as control group. PMI assessment was conducted using i-Dixel software version 2.2.0.3. (Morita, Japan). Results: There was a significant difference between edentulous and dentate female patients regarding PMI (p value 0.000). The mean of edentulous PMI value (right side 0.22, SD 0.05 mm and left side 0.22, SD 0.048 mm) was smaller than dentate PMI value (right side 0.36, SD 0.05 mm and left side 0.37, SD 0.04 mm). Conclusion: The absence of teeth in females may result in alteration to the PMI.

Keywords: Bone Density, Females, Panoramic Mandibular Index, Tooth Loss

1 INTRODUCTION

Bone quality is influenced by several variables comprising of the bone metabolic process and edentulous jaw (Akay *et al.* 2019). Mandible is one the bones that undergoes remodeling and resorption process (Cooper and Ferrari 2019). Disturbed sequence of bone remodelling and resorption caused by imbalance that affecting bone quality abnormalities, resulted in metabolic bone diseases such as osteoporosis. The bone resorption will be more accelerated than the remodelling process with increasing age (Kristianti *et al.* 2021). The mandibular bone cortical thickness has a correlation with alveolar bone and other bones changes. The imbalance of bone remodelling and resorption can cause decreased mandibular cortical bone thickness (Talungchit *et al.* 2024). Hormones such as estrogen in females plays role in low bone density. The estrogen deficiency in elder females cause an increase in osteoclast activity (Sarianoferni and Wahjuningsih 2015). Decreased bone density can result in alveolar bone loss thus leads to tooth loss. Edentulous jaw may influence the mandibular bone cortical thickness. Taguchi *et al.* and Dutra *et al.* reported that low mandibular cortical bone thickness was founded in females with low bone density (Gulsahi 2015; Tounta 2017).

A dual-energy X-ray absorptiometry (DXA) examination is an accurate tool to predict bone density. In spite of that, there are several drawbacks of DXA technology in the aspect of cost and accessibility. Hence, the panoramic radiography became a alternative examination to predict bone quality abnormalities (Shah *et al.* 2012; Vlasiadis *et al.* 2007).

Panoramic radiography is widely used in dental practice, since its capability to visualize dental and surrounding structures in maxilla and mandible and also low-cost examination procedure (Tounta 2017). In addition, panoramic radiographs have the ability to predict bone

quality by radiomorphometric indices as anatomical landmarks measured at mandibular cortical thickness. The panoramic mandibular index (PMI) is among these radiomorphometric indices. It could be as a screening tool to assess mandibular cortical bone changes (Akay *et al.* 2019). Panoramic Mandibular Index (PMI) defined as a calculated ratio of mandibular cortical thickness towards the distance between the mental foramen and the inferior border of the mandible (Bajoria *et al.* 2015; Kathirvelu and Anburajan 2014; Talungchit *et al.* 2024). PMI is useful to predict bone density abnormalities because of the stable distance from the mental foramen towards the inferior border of the mandible, in spite of the alveolar bone resorption presence, that may lead to measurement error (Talungchit *et al.* 2024).

Certain researchers have deemed panoramic radiography as a dependable tool for osteoporosis screening. However, Gulsahi found no significant relationship between the radiomorphometric indices with osteoporosis, this is probably because only edentulous samples were assessed. This highlights the need of examining dentate regions and edentulous region followed by comparing these individuals (Gulsahi 2015). Previous studies have demonstrated the significant difference of PMI based on tooth loss in female subjects ($p<0.05$) (Bozdag and Sener 2015). However, other researchers stated that the loss of mandibular teeth did not make alteration of the PMI. They stated that the difference of PMI in edentulous and dentate group was not statistically significant ($p>0.05$) (Akay *et al.* 2019). This different results among previous studies makes the authors designed this study to resolve it by investigating the significant difference of PMI value based on tooth loss in females. This study compared the dentate and edentulous group to assess the potential impact of mandibular teeth loss on PMI values.

2 METHOD

This study uses comparative analysis in 160 panoramic radiograph samples of females who were at least 30 years old or above obtained at the Dental Radiology Installation, RSGM-P, Faculty of Dentistry Universitas Trisakti, with diagnostic acceptable quality of radiographs ensuring a good visualization of the mandibular inferior border area. Panoramic radiographs with poor quality and presence of pathological lesions at mandible were excluded. The samples were divided into edentulous and dentate region as control group, with each consists of 80 samples. Edentulous is considered as the absence of all mandibular posterior teeth. The present study was approved by the ethical committee Faculty of Dentistry Universitas Trisakti with number 596/S1/KEPK/FKG/8/2022.

The digital panoramic radiographs were obtained with Veraviewepocs 2D (Morita, Japan) with standard positioning according to the manufacturer's recommendation. PMI was measured bilaterally with the aid of software tool of i-Dixel software version 2.2.0.3. (Morita, Japan). First step to create PMI is drawing a line from the inferior border of the mental foramen perpendicular to the inferior border of the mandible. The next step is calculated the ratio of the mandibular cortical thickness against its distance from the inferior border of the mental foramen perpendicular to the line of contact with the inferior border of the mandible (Figure 1) (Talungchit *et al.* 2024).

Figure 1.   Panoramic Mandibular Index (PMI measurement). AB/AC is defined as PMI Value. (A) Dentate group (B) Edentulous group.

The statistical analysis of the data was conducted using the software IBM SPSS version 25. The normality test was performed using Kolmogrov Smirnov. An inter-rater reliability test which involved Dentomaxillofacial Radiologist was also carried out using the Technical Error Measurement (TEM) method. The independent t-test was carried out to identify the significant differences between edentulous and dentate group (Rajaah *et al.* 2010).

3 RESULT

Based on Table 1, the Technical Error Measurement (TEM) in the dentate group are 1.12% (right) and 1.04% (left); whereas in the edentulous group are 1.36% (right) and 1.41% (left). The ranges of percentage are below 2.0%. We concluded the inter-observer measurement error is acceptable.

The normality test results obtained from Kolmogorov-Smirnov normality test showed a p value = 0.200 ($p > 0.05$) in the dentate group, left edentulous group, and a p value = 0.082 ($p > 0.05$) in the right edentulous group. Based on normality test result, an independent t test was used to compare the two dental status groups in order to identify the significant differences.

The PMI was calculated as the ratio of the mandibular cortical thickness against its distance from the inferior border of the mental foramen perpendicular to the line of contact with the inferior border of the mandible (Figure 1). According to Table 2, the dentate group had a higher PMI value (right 0.3669 ± 0.05434 mm and left 0.3736 ± 0.04628 mm) than the edentulous group (right edentulous 0.2253 ± 0.05319 mm and left edentulous 0.2265 ± 0.04835 mm), with p value = 0.000 ($p < 0.05$). It demonstrated that there was a statistically significant difference of PMI between the dentate and edentulous group in females.

Table 1. TEM calculated value.

Region	Percentage
Right Dentate	0.76
Right Edentulous	1.01
Left Dentate	1.38
Left Edentulous	1.39

Table 2. The descriptive values and the independent t test results of PMI based on dental status.

Region	N	P value	Mean $\pm$ SD (mm)	Min (mm)	Max (mm)
Right Dentate	80	0.000	0.3669±0.05434	0.24	0.49
Right Edentulous	80	0.000	0.3736±0.04628	0.10	0.32
Left Dentate	80	0.000	0.2253±0.05319	0.26	0.49
Left Edentulous	80	0.000	0.2265±0.04835	0.09	0.32

4 DISCUSSION

The assessment of mandibular cortical thickness in panoramic radiographs has been proposed as a method for screening low bone density in patients, in spite of the fact that it is not a gold standard (Hastar, Yilmaz, Orhan, 2011). Panoramic radiographs commonly used in dental clinics and such a simple radiographic examination. The images can visualize the both

jaws including the inferior border of mandible and the mental foramen. PMI is the index used worldwide, since it was reproducible on digital panoramic images. The interpretation is quite simple since it depends on measurement of particular landmark. The rulers or distance features in the software program of digital panoramic radiographs may be used in the measurement (Akay et al. 2019). PMI is the ratio of the inferior mandibular cortex thickness to the distance between the inferior border of the mandible to the inferior border of the mental foramen. It is measured by i-Dixel software in this study (Figure 1).

As reported in the literatures, bones reached maximum density at the age around 30s. Hormones may influence the PMI values, so as a consideration of data homogeneity, we chose female subjects in this study (Akhiiarova et al. 2023; Azhari et al. 2019). Tanaka, et al. concluded that there was a high correlation between age and tooth loss in mandibular cortical thickness of females ($p < 0.01$), while no correlation found in males (Tanaka et al. 2020). We assumed that tooth loss as dental status may play a role in bone density abnormalities.

We used Technical Error Measurement (TEM) as reliability test and concluded the inter-observer measurement error is acceptable (Table 1). In the present study, The PMI of dentate group was significantly higher than edentulous group with $p < 0.05$ (Table 2). It could raise the notion that the resorption process in the alveolar bone is the variable that may cause variations in mandibular bone density. It was related to the fact that an imbalance in the remodeling and resorption processes alters the microstructure of bone, resulting in a reduction in bone density. When teeth are missing, the alveolar ridge's dimensions decrease physiologically (Imirzalioglu et al. 2012). Furthermore, the bone mass will be slowly decreased and resulted in thinner mandibular cortical bone. Osteoporosis and other irregularities in bone density can also be caused by excessive bone resorption (Usui et al. 2021).

Previous researches have investigated the relationship of dental status with radiomorphometric indices, including the PMI. The results of the present study is consistent with Bozdag G, et al. A study conducted by Bozdag G, et al. in female subjects aged 40 years above showed that PMI in dentate region (right 0.41 ± 0.08 mm and left 0.42 ± 0.09 mm) was significantly higher than edentulous region (right 0.34 ± 0.12 mm and left 0.35 ± 0.13 mm), with $p < 0.05$ (Bozdag and Sener 2015). Additionally, according to Hastar E et al. there was a significant difference in PMI values based on dental status. Patients with edentulous jaw had considerably lower PMI (Hastar et al. 2011).

Dentists can used panoramic radiographs as screening examination to predict abnormalities in bone density by evaluating the mandibular cortical thickness. However, a low PMI value of the edentulous region alone cannot be used as a primary indicator of bone density abnormalities. Other variables such as age, hormonal, may influence the value of PMI (Arnecia et al. 2023; Bozdag and Sener 2015; Hardanti and Azhari 2011). Therefore, it is suggested further research considering other factors that may influence the bone metabolism.

5 CONCLUSION

According to the present study, there is a significant difference in PMI value between the dentate and edentulous group in females. The absence of teeth in may result in alteration to the Panoramic Mandibular Index (PMI).

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