Dentika Dental Journal
Journal homepage: https://talenta.usu.ac.id/dentika

The Use of the Panoramic Mandibular Index in Analyzing Cortical Mandibula Height in Batak Tribe Women With Perimenopause and Postmenopause Conditions

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ARTICLE INFO

Article history:
Received 13 January 2023
Revised 19 June 2023
Accepted 19 June 2023
Available online 25 July 2023

E-ISSN: 2615-854X

P-ISSN: 1693-671X

How to cite:
Cek Dara Manja, Gian Mubarani. The Use of the Panoramic Mandibular Index in Analyzing Cortical Mandibula Height in Batak Tribe Women With Perimenopause and Postmenopause Conditions Dentika Dental Journal 2023; 26(1): 48-52

ABSTRACT

Cancellous and cortical bone loss in postmenopausal women can be caused by a lack of estrogen, which plays an important role in growth and maturation. The panoramic mandibular index (PMI) also detects loss of bone mass and is a reference for individuals at high risk of developing osteoporosis. Therefore, this study aimed to determine the PMI value in Batak women with postmenopausal conditions using a descriptive survey correlation cross-sectional method. The samples were panoramic radiographs of Batak women with postmenopausal conditions aged >52 years and premenopausal as controls. Furthermore, the data was tested using an Unpaired T-test and the average PMI values in the premenopausal and postmenopausal Batak women groups were 0.327 ± 0.058 and 0.296 ± 0.063, respectively. Statistical analysis indicated a significant difference ($p < 0.05$, specifically 0.027) in PMI values between the premenopausal and postmenopausal Batak women. These findings showed that PMI served as a reliable indicator of bone loss and potentially aid in identifying individuals at a higher risk of developing osteoporosis.

Keywords: Panoramic Mandibular Index, Mandibular Cortical Height, Perimenopause, Postmenopause, Batak Tribe

ABSTRAK

Keropos tulang kanselus dan kortikal pada wanita menopause dapat disebabkan karena kekurangan estrogen, yang berperan penting dalam pertumbuhan dan pematangan. Indeks mandibula panoramik (PMI) dapat digunakan untuk mendeteksi kehilangan massa tulang dan sebagai acuan, bagi individu yang berisiko tinggi terkena osteoporosis. Tujuan penelitian untuk mengetahui nilai PMI pada wanita Suku Batak dengan kondisi postmenopause. Jenis penelitian ini adalah survei deskriptif korelasi cross sectional. Sampel penelitian adalah radiograf panoramik wanita Suku Batak dengan kondisi pascamenopause berusia >52 tahun dan radiograf panoramik wanita Suku Batak premenopause sebagai kontrol. Data diuji menggunakan Unpaired T-test. Nilai rata-rata PMI pada kelompok wanita Suku Batak premenopause adalah 0,327±0`,058 dan pada kelompok wanita Suku Batak postmenopause adalah 0,296±0,063. Berdasarkan hasil uji statistik parametrik diperoleh p<0,05 yaitu 0,027. Kesimpulan adalah terdapat perbedaan signifikan nilai PMI antara wanita Suku Batak dengan kondisi premenopause dan postmenopause.

Kata kunci: Panoramik Mandibular Indeks, Tinggi Kortikal Mandibula, Premenopause, Postmenopause, Suku Batak

http://doi.org/10.32734/dentika.v26i1.11088

1. Introduction

Decreased bone density and increased porosity are observed after the third decade of life.[1] However, women risk decreasing bone three times greater than men[2] due to menopause. During menopause, women experience a decrease in the production of estrogen, a hormone that plays a crucial role in bone growth and maturation[3] Consequently, this hormonal deficiency can lead to the loss of cancellous and cortical bone.[4]

Panoramic radiographic techniques are used to detect bone loss in the mandible. Meanwhile, mandibular bone mass measurements are related to other areas of the skeleton, such as the waist and lumbar spine. One of the widely used indexes for assessing mandibular bone mass through panoramic radiography is the Panoramic mandibular index (PMI).[5],[6] PMI is a simple, easy, and inexpensive method used to identify an individual with low bone mass. By utilizing these measurements, individuals can be classified based on their susceptibility to osteoporosis, and appropriate referrals for additional diagnostic assessments can be made.[5]

Batak is the third largest ethnic group in Indonesia, originating from North Sumatra. The ethnic groups are the Toba Batak, Karo Batak, Pakpak Batak, Simalungun Batak, Angkola Batak, and Mandailing Batak. Each category has a characteristic clan name, which functions as a sign of kinship. The Batak tribe strictly upholds the principle of patrilineal descent, where clan affiliation is determined through the lineage of the father. Therefore, multiple clans can form a specific category within this framework. To ascertain an individual's lineage and the corresponding position within a clan, the Batak people employ a system known as Torombo. According to Batak beliefs, Torombo facilitates the discovery of ancestral roots, ultimately leading to the recognition of status as Si Raja Batak.[7] This study endeavor is imperative as no previous studies have utilized panoramic radiograph samples obtained from indigenous Batak women spanning two or more generations. The primary objective of this investigation was to ascertain the PMI values in Batak women exhibiting premenopausal and postmenopausal conditions.

2. Materials and Methods

The study used a descriptive survey correlation cross-sectional method to obtain 39 women in the premenopausal group aged 20-29 years as the control group and another 39 in the postmenopausal group aged > 52 years. Samples were obtained by purposive sampling with the following inclusion criteria: 1) the original Batak tribe was of two generations and above, 2) not having a disease or developmental disorder related to bone metabolism, 3) not consuming medications that affected bone metabolism (glucocorticoids, anticonvulsants, thyroxine), 4) have no history of mandibular fractures. The sample exclusion criteria were uncooperative patients who did not agree to be sampled. The study obtained an ethics commission permit no: 38/TGL/KEPK FK USU-RSUP HAM/2018.

The samples that met the predetermined inclusion criteria were provided with a comprehensive explanation of the procedure and sought their consent through the signing of an informed consent form. For this particular study, panoramic radiography was employed, which was subjected to digital processing at the Dental Radiology Department of Rumah Sakit Gigi dan Mulut Universitas Sumatera Utara. The panoramic mandibular index was measured on the radiographs using computer technology and Clinic View version 10.1.2 software.

PMI is the ratio between the height of the mandibular cortex in the area of the mental foramen and the distance between the inferior border of the mandible and the inferior border of the mental foramen, measured bilaterally.[5],[6] Furthermore, the measurement was conducted using a digital caliper in millimeters. From Figure 1, points A, B, and C were the inferior border of the mental foramen, the superior border of the mandibular cortex, and the inferior border of the mandibular cortex, respectively. The results were analyzed using two different mean tests (Unpaired T-test) with a 95% confidence interval (CI), and an unpaired T-test was performed on normal data distribution.

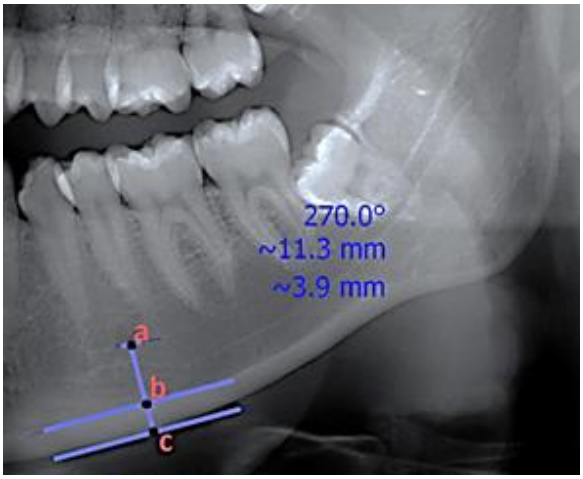

Figure 1. Panoramic mandibular index measurement

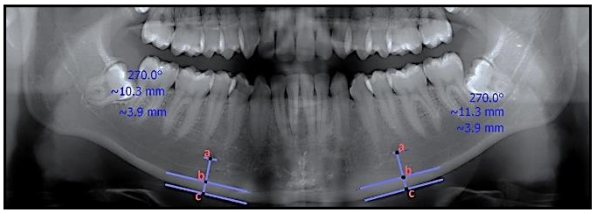

Figure 2. Results of measuring the height of the mandibular cortex using PMI in premenopausal women. On the right side, the values obtained are c=3.9 mm and ac=10.3 mm and on the left side, the values are bc=3.9 mm and ac=11.3 mm.

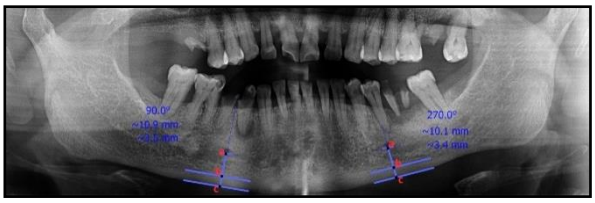

Figure 3. Results of measuring the height of the mandibular cortex using PMI in postmenopausal women. On the right side, the value of bc = 3.5 mm and the value of ac = 10.9 mm. On the left side, the value of bc=3.4 mm and the value of ac= 10.1 mm.

3. Results

Based on Table 1 in the control group, the average values of PMI on the right and left were 0.324 ± 0.069 and 0.328 ± 0.067. Based on Table 2, in the Batak women group with postmenopausal conditions, the average PMI values on the right and left were 0.307 ± 0.071 and 0.284 ± 0.065.

Table 1. The mean values of right and left PMI in premenopausal women as a control group

PMI	Mean (mm)	SD (mm)
Right	0.324	0.069
Left	0.328	0.067

Table 2. The mean values of right and left PMI in postmenopausal women

PMI	Mean (mm)	SD (mm)
Right	0.307	0.071
Left	0.284	0.065

Based on Table 3, the control group and Batak women's group with postmenopausal conditions were 0.327 ± 0.058 and 0.296 ± 0.063. After carrying out a significance test using an unpaired T-test, $p<0.05$ indicated that there was a significant difference in PMI values between premenopausal and postmenopausal women.

Table 3. The average PMI in premenopausal and postmenopausal women

PMI	Mean (mm)	SD (mm)	P
Premenopause	0.327	0.058	0.027
Postmenopause	0.296	0.063	

4. Discussions

The mandible is the largest and strongest facial bone, consisting of a body and a pair of ramus.[8],[9] The panoramic radiography technique has enlarged images of the originals. Distortion is unavoidable because of the object shadow in film, a projection-related structure that varies in some individuals.[10] Puberty and menopause are natural and unavoidable physiological processes. These distinct phases encompass the entirety of a woman's reproductive life and include premenopause, perimenopause, menopause, and postmenopause.[11],[12],[13] The overall mean PMI values in premenopausal and postmenopausal women were 0.327 ± 0.058 and 0.296 ± 0.063 with $p <0.05$ indicating significant differences. Decreased estrogen levels and increased alveolar bone resorption occur due to hormonal and mucosceletal changes. Women who have been through menopause longer, have a higher influence on a decrease in bone density which also causes a decrease in maxillary alveolar height.[14],[15],[16] Furthermore, the PMI is the ratio between the height of the mandibular cortex in the area of the mental foramen and the distance between the inferior border of the mandible and the inferior border of the mental foramen, measured bilaterally. Measurements are made using a digital caliper in millimeters, and PMI normal value is ≥ 0.3 mm.[17],[18],[19]

This is under the study of Chandak et al. (2017) who obtained the average PMI value for the premenopausal and postmenopausal groups by 0.34 ± 0.06 and 0.29 ± 0.07, respectively.[19] The results are also consistent with Mudda et al. (2017), where there was a significant difference in PMI values ($p <0.05$) between groups of premenopausal and postmenopausal women at 0.41 ± 0.04 and 0.36 ± 0.10. The pattern of decrease in mandibular cortical thickness with age was similar to the bone loss from the spine and femur. Therefore, panoramic radiography was a simple technique in osteoporosis screening of dental patients, giving the maximum benefit of being radiographed.[20] Taneja et al. (2018) also obtained the average PMI value for the premenopausal and postmenopausal groups at 0.36 and 0.30.[21] The results were also supported by Khojastehpour et al. (2009) who obtained PMI values of 0.38 ± 0.06 and 0.32 ± 0.05. Khojastehpour et al. state that with increasing age the average PMI value decreases.[22]

The results are different from Rao et al. (2014) who obtained the average PMI value in the premenopausal and postmenopausal of 0.28 ± 0.63 and 0.27 ± 0.35 with a p value> 0.05.[2] However, there was a gradual decrease in PMI values in women after the age of 50 years and the nonmenstruation group had a lower average PMI score.[2] The MCI, MI, and MPI radiomorphometric indices evaluated using DPR identified postmenopausal females with low bone densities and provided them with adequate medical

treatment.[23] The difference in values was due to the grouping of premenopausal and postmenopausal groups in different age ranges.[24]

Perimenopause marks the onset of the menopause phase, signifying the transitional period leading up to menopause. As women age, the quantity of bone resorbed by osteoclasts surpasses the amount replenished by bone stored in osteoblasts. This imbalance progressively results in a reduction of bone mass and strength.[12] Estrogen has an important role in maintaining the balance of bone remodeling by supporting osteoblasts, preventing resorption by suppressing osteoclast formation, stimulating osteoclast apoptosis, and counteracting oxidative stress.[10] Syulistyani et al (2016) showed that there is a statistically significant correlation between the mandibular cortical index and alveolar bone density. This can also be seen from linear regression where mandibular cortical index can be described by alveolar bone density with a value of 58.20%. Therefore, digital gear radiography has the potential for the detection of osteoporosis as on panoramic radiography.[25] After menopause, women are subjected to a period of accelerated bone loss within the initial 5-10 years due to diminished estrogen levels. Different studies have indicated that disparities in PMI values between premenopausal and postmenopausal women can be attributed to the reduction in estrogen levels. This decline is associated with decreased bone mass and an increase in cortical porosity.[26]

5. Conclusion

In conclusion, there was a significant difference in PMI values between Batak tribe women with premenopausal and postmenopausal conditions. In this study, the premenopausal group was determined to be 20-29 years old during the reproductive period. The postmenopausal group consisted of individuals older than 52 years, specifically during the 12 months after menopause.

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