Resorption Level of Edentulous Alveolar Bone in Normal, Osteopenia and Osteoporosis Postmenopausal Women

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Introduction: Estrogen hormone deficiency in postmenopausal women results in a reduction of bone density. In this condition, estrogen hormone level decreases and bone density is less than normal, known as osteopenia and osteoporosis. Decreasing bone density becomes a risk factor of alveolar bone resorption in edentulous ridge.

Objective: The aim of this study was to provide a description of alveolar bone resorption level in normal, osteopenia and osteoporosis postmenopausal women. This study provided information about bone density and postmenopausal condition in order to lower the failure of denture treatment.

Methods: Data was collected cross-sectionally on June 2009, in East Bekasi, West Java, Indonesia, on 312 postmenopausal women age 41-82 years old. Bone density was measured by Ultrasound Densitometer. Alveolar bone height in edentulous ridge was measured by mouth mirror size 3 on buccal side of the edentulous ridge.

Results: The result of this study showed that the resorption level of edentulous alveolar bone in women with normal bone density was lower than those of women with osteopenia and osteoporosis.

Conclusion: Postmenopausal osteoporosis women had higher level of alveolar bone resorption compared to normal density and osteopenia.

Keywords: postmenopausal women, bone density, osteopenia, osteoporosis, alveolar bone resorption

Introduction

In their life, women will having menopause and postmenopause period. Menopause is a condition when women has no longer menstruation permanently. In this condition, estrogen hormone level decreasing and bone density less than a normal, which known as osteopenia and osteoporosis. The decreasing of bone density become a risk factor of alveolar bone resorption. Estrogen hormon takes a huge role on bone development, including bone remodelling process which kept the balance of osteoblast (bone formation) and osteoclast (bone resorption) activity. Estrogen hormone deficiency affected bone development process (1). Payne stated, estrogen deficiency and osteoporosis are the risk factors of the decrease of alveolar bone density (2).

Interference of bone development process due to estrogen deficiency decreased of bone density, also known as osteoporosis (3). Osteoporosis defined as bone density reduction and bone microstructure damage to the fracture limit (4). Bone density reduction level between normal and osteoporosis defined as osteopenia (5). Osteopenia become one of the risk factor of osteoporosis, however not every osteopenia diagnosed, someone will suffer osteoporosis (6,7).

In dentistry, osteoporosis is a very important issue because it is one of the causes of removable denture failure. Denture is loose and unstable due to excessive resorption of the alveolar bone.
Bone density reduction occurs on entire bone system of human body. Intraorally, this reduction could be observed by the height of alveolar bone on maxilla and mandible. Several studies showed that there were correlations between mandible bone density to other bone, such as alveolar bone resorption, decrease of mandible cortex thickness and tooth loss (8,9).

The aim of this study was to provide a description of alveolar bone resorption level in normal, osteopenia and osteoporosis postmenopausal women, whether osteopenia condition will also affect alveolar bone resorption level need to be analyzed in this study. This study provided information about bone density and postmenopausal condition in order to lower failure of denture treatment.

Material and Methods

Data was collected cross sectionally on June 2009, in East Bekasi, West Java, Indonesia. The group of test subjects was 312 postmenopausal women, age 41-82 years old.

At first, the subject were informed about this study and interviewed by two dental students using socio-demographic and questionnaire. They had to satisfy the following requirements: 45 year or older, had menopauses for at least 1 year, had 1 or more tooth loss. All subjects were willing to participate in this study and agree to fill in the informed consent. Secondly three experienced and calibrated dentists clinically examined the subjects. From the initial group of 312 postmenopausal women, only 278 women were included in the criteria, another 34 women were excluded in this study because they had complete dentition.

Bone density was measured on the right of Os.calcaneus (Figure 1) by Ultrasound Densitometer (Furuno CM-100 Nishinomiya, Japan). Bone density was categorized into 3 groups. Group 0: normal density, with T-score ≥ -1 and density value = 1SD. Group 1: osteopenia (loss of bone), T-score -2.5 to -1, and density value = 1-2 SD. Group 2: osteoporosis, T-score ≤ -2,5 and density value < 2,5 SD.

Alveolar bone height in edentulous ridge was measured by stainless steel mouth mirror sized 3 (diameter 20 mm), on the buccal side of edentulous ridge mandible or maxilla. When there were more than 1 edentulous site, the measurement were done on the site with the most severe alveolar bone resorption.

Alveolar bone height was categorized in 3 levels. High level classified as alveolar bone height that higher than diameter of mouth mirror (Figure 2A). Moderate level were those at the same or half the height of mouth mirror (Figure 2B), and lower than half diameter, categorized as lowest level (Figure 2C).

The resorption level of edentulous alveolar ridge was determined as alveolar bone height in edentulous site. The high resorption level meant alveolar bone height was low. The moderate resorption level meant alveolar bone height was moderate. And the low resorption level meant alveolar bone height was

Figure 1. Location of Os.calcaneus (A) and bone density measured by ultrasound densitometer (B).

Figure 2. Alveolar bone height on the edentulous ridge. High level (A), moderate level (B), and low level (C).
high.

Univariate methods were used to analyze all data to provide description of alveolar bone resorption level in normal, osteopenia and osteoporosis postmenopausal subject. Bivariate analyzes using Chi-square test to analyzed association between alveolar bone resorption and bone density.

Results

Description of study groups, distribution and frequency of age, duration of menopause, number of tooth loss and bone density from total population target were shown on Table 1. Most of subjects had: age range from 51-60 year (51.9%), duration of menopause range from 1-5 year (51.3%), number of tooth loss range from 1-5 (35.6%) and osteopenia on 138 women (44.2%).

The age of subjects ranged from 41-82 years, and the mean age was 57.53 year. Duration of menopause ranged from 1-35 years, and the mean was 8.41 years. The mean number of tooth loss were 8.13 with the maximum were 32 teeth loss (Table 2).

<table>
<thead>
<tr>
<th>Variable</th>
<th>Group</th>
<th>Frequency</th>
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</tr>
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<tbody>
<tr>
<td>Age (year)</td>
<td>40-50</td>
<td>57</td>
<td>18.3%</td>
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<td></td>
<td>51-60</td>
<td>162</td>
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</tr>
<tr>
<td></td>
<td>&gt; 60</td>
<td>93</td>
<td>29.8%</td>
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<tr>
<td>Total</td>
<td></td>
<td>312</td>
<td>100%</td>
</tr>
<tr>
<td>Duration of menopause (year)</td>
<td>1-5</td>
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<td>51.3%</td>
</tr>
<tr>
<td></td>
<td>6-10</td>
<td>62</td>
<td>19.9%</td>
</tr>
<tr>
<td></td>
<td>&gt; 11</td>
<td>90</td>
<td>28.8%</td>
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<tr>
<td>Total</td>
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<td>312</td>
<td>100%</td>
</tr>
<tr>
<td>Number of tooth loss</td>
<td>0</td>
<td>34</td>
<td>10.9%</td>
</tr>
<tr>
<td></td>
<td>1-5</td>
<td>111</td>
<td>35.6%</td>
</tr>
<tr>
<td></td>
<td>6-10</td>
<td>82</td>
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<tr>
<td></td>
<td>&gt; 10</td>
<td>85</td>
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<tr>
<td>Total</td>
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<tr>
<td>Bone density</td>
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<tr>
<td></td>
<td>Osteopenia</td>
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<tr>
<td></td>
<td>Osteoporosis</td>
<td>116</td>
<td>37.2%</td>
</tr>
<tr>
<td>Total</td>
<td></td>
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Table 2. Description of age, duration of menopause and number of tooth loss

<table>
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<th>Variable</th>
<th>Range</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (year)</td>
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<td>41</td>
<td>82</td>
</tr>
<tr>
<td>Duration of menopause (year)</td>
<td>8,41</td>
<td>1</td>
<td>35</td>
</tr>
<tr>
<td>Number of tooth loss</td>
<td>8,13</td>
<td>0</td>
<td>32</td>
</tr>
</tbody>
</table>

The subjects of postmenopausal women were classified, based on their bone density, as normal, osteopenia and osteoporosis.

Most of subjects were osteopenia (44%) and osteoporosis (37%). Only 19% postmenopausal women had normal bone density (Figure 3).

From the initial group of 312 postmenopausal women, only 278 women were included in the criteria, another 34 women were excluded in this study because they had complete dentition. Resorption level of edentulous alveolar bone of 278 subject were classified into the low, moderate and high level (Figure 4).

The most frequent found was high level of resorption on edentulous alveolar bone, followed by moderate and normal. Frequency and distribution of bone resorption level in normal, osteopenia and osteoporosis postmenopausal women were
The moderate resorption level was the most frequently found in normal and osteopenia postmenopausal women, while the highest frequency in osteoporosis postmenopausal women was the high resorption level.

Bivariate analyzes using Chi-square test showed significance association between alveolar bone resorption level and bone density \( (p=0.001) \)

**Discussion**

The purpose of this study was to provide a description of alveolar bone resorption level on edentulous area on normal bone density, osteopenia and osteoporosis postmenopausal women, not related to other factors that affect alveolar bone resorption level. This study provided information about bone density and postmenopausal condition in order to lower failure of denture treatment.

The amount of alveolar bone resorption level on edentulous area in this study refers to alveolar bone density that observed through the alveolar bone height clinically. Low alveolar bone height might indicate a high alveolar bone resorption level or low bone density. Otherwise, high level of alveolar bone height might indicate a low resorption level or a compact bone density.

This study showed that women with normal bone density tend to have lower alveolar bone resorption level than osteopenia. Osteopenia postmenopausal women tend to have moderate to high alveolar bone resorption level. The moderate alveolar bone resorption level commonly found on women with osteopenia. This indicates that osteopenia condition might affected alveolar bone resorption level on edentulous area.

Osteopenia had been related to mandibular bone loss. This explains about the relation of TBC, radius bone mineral content, and mandibular bone density on osteoporosis postmenopausal women (10). Women who had severed alveolar bone resorption also have low radius bone density (8,10).

Aging process and estrogen hormone deficiency cause osteopenia (10-12). In this study, they were related to postmenopausal condition. Some other study related the occurrence of osteopenia because of estrogen hormone deficiency on postmenopausal condition, and the alveolar bone resorption caused by decreased of bone density (10,13). Bone characteristic change on osteopenia postmenopausal women could be observed by bone density condition, alveolar bone resorption level and the tooth loss.

Ideally, alveolar bone resorption level on postmenopausal women with normal density showed the greatest number on low resorption level and least number on high resorption level. Otherwise, ideal distribution and frequency on osteoporosis postmenopausal women assumed showed the greatest number on high resorption level and least number on low resorption level. This study showed similar result.

According to some research, these facts caused by low bone mass thus cause decreased of bone quantity, bone density or both (10,14). This indicates that low bone density caused a high alveolar bone resorption level and vice versa.

Other factors that affect alveolar bone resorption level were not included in this study, hence might cause differences with other research result. The site of tooth loss also determined alveolar bone resorption level. Posterior tooth loss will cause greater alveolar bone resorption level, compared to anterior tooth loss, as a result of the difference of chewing force (15).

Denture wearing duration and denture design also affect alveolar bone resorption level. The more frequent of the denture in the mouth, especially for complete denture, the greater alveolar bone resorption level on edentulous area, also the greater pressure produced, and vice versa (16,17).

A difference between the level of maxillary alveolar resorption and resorption of mandibular process has been reported. Several study had proven, the level of mandibular loss of its alveolar portion is 3 or 4 times higher than alveolar resorption in maxilla, which is due to a smaller denture-bearing area in the mandible and thus a greater load per square cm (18). Alveolar bone resorption level was also determined by denture quality. Other studies state that alveolar bone resorption level was determined by systemic factor, otherwise in mandibula determined by local factor (19).

Osteoprotic postmenopausal women tend to had a high level of alveolar bone resorption due to the fact that higher alveolar bone resorption level are commonly found on osteoporotic than osteopenia. This indicates the change a high level alveolar bone resorption occurs increased as the bone density decreased. This might caused by estrogen hormone deficiency that occurred on
postmenopausal women. Estrogen hormone can highly alter bone development. On postmenopausal periode, decrease of estrogen quantity occurs, hence disturbing bone development process and bone remodeling (1). The bone development disturbance and bone remodeling causes bone density decrease (osteopenia and osteoporosis) (3,6,7). Bone density occur equally on every bone in human body, including jaw bones (maxilla and mandible). Several study reported there is correlation between bone density, jaw bone density, alveolar crest height, and alveolar bone resorption on edentulous area (8,9,20). Payne stated that osteoporosis are one of the factor that caused alveolar bone density decrease (2).

This study also similar with others studies. Kribbs et al. (1989) (8) and Taguchi (1995) (9) stated that there are correlation on mandibula bone density and other bones density. The more normal a bone density, the less alveolar bone resorption level that occurs, and vice versa. Hirai et al. (1993) (20), in study on 44 edentulous men and women with average age of 81.1 year, stated that osteoporosis highly determine alveolar bone density decrease (on edentulous area). On the other hand Birkenfeld et al. (1999) (21) stated that there is positive correlation between bone mass and systemic osteoporosis with bone resorption in oral cavity.

Reddy et al. (2008) (11) stated there is significant decrease of mandibula bone thickness on osteoporotic women compared to women with normal bone density. Latest study that similar, are from Poštić (2009) (22) in Serbia that stated that there are significant decrease of alveolar bone height on edentulous area of osteoporotic postmenopausal women. This study also conclude that the bone density on upper and lower jaw are reduced in osteoporotic patient.

However this study is different from Von Wowern and Kollerup (1992) which stated that, tooth loss on osteoporotic women, severe resorption occurs on maxilla, but no significant amount of resorption on mandibula, if compared to normal women. Klemetti et al. (1993) in a study to determine correlation between bone loss in oral cavity and osteoporosis, measured the height of alveolar bone and bone mineral density (BMD) of mandibular trabekula bone. Then compares it with femur and lumbar bone density. They found that there is no significant correlation between mandibular bone density and alveolar bone height with lumbar and femur bone density (20).

Conclusion

It can be generally concluded that there is association between alveolar bone resorption level and bone density. Bone density affecting alveolar bone resorption level, the lower bone density on postmenopausal women the higher alveolar bone resorption level. Alveolar bone resorption level on women with normal bone density tends to be lower, compared to osteopenia.

Postmenopausal women who experiencing decrease of bone density (osteopenia or osteoporosis) will suffer jaw bone osteopenia or osteoporosis which cause alveolar bone resorption. This study found a tendency, that women with normal bone density suffer low alveolar bone resorption, osteopenic women suffer moderate alveolar bone resorption and osteoporotic women suffer high alveolar bone resorption.

Within limitation of this study, its only 1 risk factor of alveolar bone resorption involved, that is reduction of bone density (osteopenia and osteoporosis), not related to other factors that affect alveolar bone resorption level. The other factors that affect alveolar bone resorption e.g. anatomical, mechanical, functional and biological factor and the use of denture also.

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References