

Description of alveolar bone resorption in partially edentulous mandible of a female patient in panoramic radiograph



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Abstract

Objective: The purpose of this research was to determine alveolar bone resorption by measuring alveolar bone height in the mandible of partially edentulous female patients through panoramic radiograph
Methods: The method of this study was descriptive using 34 panoramic radiographs of partially edentulous mandible in female patients aged 20-45 years in Dental Radiology Installation of Unpad Dental Hospital from 2016 to 2017. Alveolar bone height was measured using Proximal RABL (Radiographic Alveolar Bone Loss) method with the help of Ez-

Pax Plus software.

Results: The highest average alveolar bone height was 3.5 mm and 12.96% of them occurred in 30-35 years age group. The lowest height was 3 mm with 10.98% occurred in 20-29 years age group.

Conclusion: Alveolar bone height in partially edentulous mandible of female patients underwent resorption of mild classification according to proximal RABL method.

Keywords: Alveolar bone resorption, Edentulous, Panoramic radiograph
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Introduction

Alveolar bone is a part of the maxilla and mandible which shapes and supports the tooth socket (alveoli).¹ Alveolar bone is the result of bone formation and resorption process that occurs in lifetime and its existence depends on the existence of the tooth it supports. Alveolar bone develops together with the development of eruption of teeth in the oral cavity and gradually resorbs when a tooth is missing.²

When a tooth is missing, several phases occur. The first phase is blood clotting, which is a process of bleeding in the cavity caused by disrupted blood vessels. Proteins derived from blood vessel and damaged cells will create fibrin networks, which in turn will interact with platelets to produce blood clot (coagulum) to repair broken blood vessel and stop the bleeding.

Neutrophils and macrophages migrate to the wound area which consists of involving bacteria and damaged tissue to clean the area before new tissue formed. Furthermore, macrophage will release growth factors and cytokines. After the debris are cleaned and the wound is sterile, neutrophils will undergo apoptosis because of macrophage's action.

A blood clot will create granulated tissue. During the formation of this tissue, osteoblasts act in new bone formation known as woven bone.² Bone modeling and remodeling consist of two different phases, i.e. resorption and apposition. Bone resorption is a complex morphological process

related with erosion on bone surface and multinucleated giant cells (osteoclast).¹

In normal state, the height of alveolar bone crest is 1-2 mm apical of cemento-enamel junction. However, when bone loss occurs, alveolar crest height is more than 2 mm apical to cemento-enamel junction.³ Alveolar bone resorption is a common problem in edentulous patients, both on maxilla and mandible. Alveolar bone undergo resorption when there is inadequate support from remaining tissue, and this condition is aggravated by previous bone loss, excessive occlusal force during mastication and bruxism. These conditions may flatten alveolar ridge and disturbing patient comfort, both psychologically and physiologically.⁴

A study regarding alveolar bone resorption level is needed because alveolar bone resorption affects masticatory function and treatment given to patient, including prosthesis. Alveolar bone resorption may cause inadequate support and stability of prosthesis.⁵ For studies regarding bone quality, most authors used the mandible. This was due to mandible has higher compactness than the maxilla.⁶ Therefore, this study also used the mandible of partially edentulous female patients.

According to the study conducted in Panchbhai, India in 2013, there was a significant difference of alveolar ridge resorption between patients with dentition and edentulous patients. Compared to dentate patients, alveolar ridge resorption in edentulous patient reached 29-39% in mandible and

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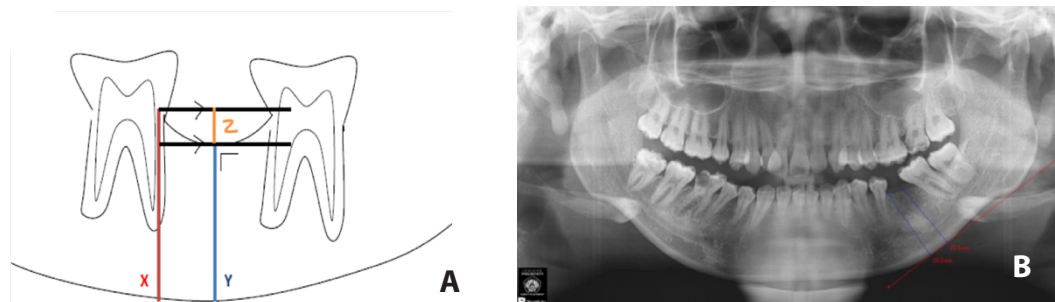


Figure 1. A. Overview of alveolar bone resorption in edentulous patient. B. Panoramic radiograph sample using the EzPaX-plus (VCT) program using the EzPaX-plus (VCT) program

Table 1. Distribution of alveolar bone resorption according to age

Age (Years)	N	Alveolar Bone Resorption			Resorption (%)	Classification
		X control (mm)	Y post-extraction (mm)	X-Y(mm)		
20-29	26	27.3	24.3	3.0	10.98	Mild
30-35	8	27.0	23.5	3.5	12.96	Mild

\bar{X} :average height of control alveolar bone
 \bar{Y} :average height of alveolar bone post-extraction
 $\bar{X} - \bar{Y}$:average alveolar bone resorption

alveolar bone resorption was higher in females than males, both in dentate and edentulous group.⁷ Other than that, according to previous study in 2010, mandibular alveolar ridge resorption was higher compared to maxilla in edentulous jaws according to radiograph.⁸ Panoramic radiography is an extraoral radiographic technique often used to obtain baseline data before any procedure is taken. In this study, panoramic radiograph can describe the extent of alveolar bone resorption.⁸

Material and Methods

This study used secondary panoramic radiograph data using descriptive method, which was conducted from December 2017 to January 2018. The population in this study was all panoramic radiograph archives available in Dental Radiology Installation, Unpad Dental Hospital from 2016 to 2017. Samples obtained were panoramic radiographs of partially edentulous females aged 20-45 years with a total sample of 30 radiographs. Sampling technique used was purposive sampling.

Sample criteria were as follows: Inclusion criteria; Medical records of partially edentulous female patients for more than 6 months; Panoramic radiograph of partially edentulous female patients with missing mandibular first molar; Good quality of panoramic radiograph.

Exclusion criteria; Superimposed radiograph which obstructed measurement area; Patients wearing prosthesis; Patients with systemic disease;

Patients with periodontal disease; Panoramic image containing calculus.

After obtaining permission from ethical committee of Faculty of Dentistry Dental Hospital Padjadjaran University, the author measured alveolar bone height using EzPax-Plus program (VCT). Measurement was performed by using proximal RABL (reabsorption of alveolar bone loss) technique. The unit used was millimeter (mm).

The first step was measuring base alveolar bone height by projecting alveolar bone height from adjacent tooth. Measured from the CEJ to mandibular inferior margin, reduced by 2 mm. The average height was recorded and marked with X. The second step was measuring available remaining alveolar bone height by measuring height from the highest point of alveolar ridge to mandibular inferior margin, and marked with Y. Afterwards, the height of bone resorption was measured by subtracting X and Y, and marked with Z figure 1A and figure 1B. The results of measurement were recorded, and percentage of alveolar bone resorption was measured using proximal RABL method formula⁸, which is:

$$\%RABL = \frac{Z}{X} \times 100\%$$

Determining resorption degree by:

- First degree: 0-30% (mild)
- Second degree: 30-60% (moderate)
- Third degree: 60-100% (severe)

Table 2. Distribution of alveolar bone resorption according to location

Region	N	Alveolar Bone Resorption			Resorption (%)	Classification
		X control (mm)	Y post-extraction (mm)	X-Y(mm)		
36	19	27.5	24.5	3.0	10.90	Mild
46	15	26.9	23.6	3.3	12.26	Mild

\bar{x} :average height of control alveolar bone
 \bar{y} :average height of alveolar bone post-extraction
 $\bar{x}-\bar{y}$:average alveolar bone resorption

Table 3. Distribution of alveolar bone resorption according to duration of edentulous

Duration	N	Alveolar Bone Resorption			Resorption (%)	Classification
		X control (mm)	Y post-extraction (mm)	X-Y(mm)		
≤ 1 year	6	26.8	24.08	2.7	10.1	Mild
> 1 year	28	27.3	24.13	3.2	11.7	Mild

\bar{x} :average height of control alveolar bone
 \bar{y} :average height of alveolar bone post-extraction
 $\bar{x}-\bar{y}$:average alveolar bone resorption

Results

The study regarding alveolar bone resorption in partially edentulous mandible female patients in panoramic radiograph was conducted in Unpad Faculty of Dentistry Dental Hospital Bandung for the last two years obtained 34 samples with characteristics according to age, location of edentulous area, and duration of edentulous.

According to [table 1](#), it can be concluded that the highest average of alveolar bone loss (measured from the difference between control alveolar bone and available bone) occurred in 30-35 years age group was 3.5 mm, and the lowest average alveolar bone loss occurred in 20-29 years age group was 3.0 mm.

According to [table 2](#), it can be concluded that the average control alveolar bone height (measured from the highest point of alveolar bone to mandibular inferior margin) of tooth 36 was 0.6 mm higher compared to tooth 46. Meanwhile, average alveolar bone loss (measured from the difference between control alveolar bone and available alveolar bone) of tooth 46 was 0.3 mm higher compared to tooth 36.

[table 2](#) showed that in tooth 36, control alveolar bone height was 27.5 mm with 3 mm bone loss, therefore bone loss percentage according to proximal RABL method was 10.90%. In tooth 46, control alveolar bone height was 26.9 mm with 3.3 mm bone loss, thus bone loss percentage of tooth 46 was 12.26%.

According to [table 3](#), it can be concluded that the average control alveolar bone height (measured

from the highest point of alveolar bone to mandibular inferior margin) on teeth missing for more than 3 years was 0.5 mm higher compared to teeth missing less than 1 year. Meanwhile, the average alveolar bone loss (measured from subtraction of control alveolar bone and remaining alveolar bone) on teeth missing for more than 1 year was 0.5 mm higher compared to teeth missing less than 1 year.

According to [table 3](#), in teeth missing less than 1 year, control alveolar bone height was 26.8 mm with 2.7 mm bone loss, thus the percentage of bone loss according to proximal RABL method was 10.1%. Meanwhile, control alveolar bone height in teeth missing for more than 1 year was 27.3 mm with 3.2 mm bone loss, thus the percentage of bone loss was 11.7%. According to percentage measurement of bone loss according to proximal RABL method, alveolar bone resorption was higher in patients with teeth missing for more than 1 year compared to patients with teeth missing for less than 1 year.

Discussion

Alveolar bone resorption may occur after tooth extraction, especially during the first year. When a tooth is extracted, a structure called residual alveolar ridge (RRR) will remain. This term includes all changes accompanying bone resorption after tooth extraction. Local and systemic factors have huge influence on RRR.¹¹ Insufficient mechanical stress, the use of prosthesis, duration of prosthesis use, and muscle shape are parts of functional factor. According to Kingsmill, local functional factors are very important and more significant compared to systemic factors, because functional factors are

more easily controlled compared to systemic factors.¹⁰ The force produced during mastication and excessive occlusal contact can also cause continuous resorption of alveolar bone in edentulous patient.²

Measurement results of alveolar bone resorption according to age in Table 1 showed that the highest average bone resorption was found in 30-35 years age group at 3.5 mm and percentage of 12.95%. Meanwhile, the lowest was found in 20-29 years age group with percentage of 10.98%. Previous study showed that age affects mineralization process of the mandible. Along with age, calcium absorption process in the body will decrease. Cortical porous and quantity of mandible will also decrease. This process occurred in the beginning of adulthood and will keep increasing with age.

Measurement results of alveolar bone resorption according to location in Table 2 showed that the average alveolar bone resorption of tooth 36 (3 mm) occurred with percentage of 10.90%, while tooth 46 (3.3 mm) occurred with percentage of 12.26%. The results were supported by previous study which stated that alveolar bone loss was higher on the right side compared to the left side.¹²

Measurement results of alveolar bone resorption according to duration of edentulous in Table 3 showed that the highest average alveolar bone resorption was found in partially edentulous patient with teeth missing for more than 1 year with 3.2 mm and percentage of 11.7%. Meanwhile, in partially edentulous patients with teeth missing for less than 1 year, the average alveolar bone resorption occurred at 2.7 mm with percentage of 10.1%. After extraction of tooth, bone remodeling will occur which resulted in decreased jaw height, especially during the first year after extraction. Bone deposition in the socket will occur for a few months.¹¹ The height of bone will be lower than coronal bone height of the adjacent tooth because trabecular bone formation only occurred until the edge of extraction socket, while bone resorption by osteoclasts occurs after 8 months on the surface of the remaining ridge. Several researchers stated that resorption process occurs during the first year after extraction. However, bone remodeling will continue for lifetime to maintain total volume of bone and anatomical structure. Therefore, bone resorption related to factors affecting bone resorption may occur.¹³

Percentage of alveolar bone loss in Table 1, 2, and 3 was measured using proximal RABL method. Bone loss between 0-30% was classified into first degree bone loss or mild loss. Bone loss between 30-60% was classified into second degree bone loss

or moderate loss. Meanwhile, bone loss between 60-100% was classified into third degree bone loss or severe loss.¹⁴ This study showed that alveolar bone resorption occurred between 0-30%, which means that alveolar bone resorption in partially edentulous patients was classified into mild alveolar bone resorption.

This study has several limitations because of local factors that may affect alveolar bone resorption such as trauma of occlusion and bad habit of patients.

Conclusion

According to the study, it can be concluded that mandibular alveolar bone in partially edentulous female patients underwent resorption with mild classification according to proximal RABL method.

Acknowledgment

None.

Conflict of Interest

The authors report no conflict of interest.

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