The Effect of Low Bone Mineral Density in Stomatognatic System

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Abstract

Osteoporosis is a systemic bone disease that characterized by low bone mineral density. The study was aimed to determine the relationship between bone mineral density status with the severity of periodontal disease and tooth loss.

The study was conducted on patients who come to RSUP.DR.Wahidin Sudiro Husodo with the sample size is 33 people. After completing dental records, each oral cavity of the sampleswas examine of by using a panoramic dental x-ray to see the level of alveolar bone resorption. A complete blood laboratory test was performed to value calcium serum. Examination of bone mineral density conducted at the lumbal spine and the femoral head by using DXA.

The results show that low levels of BMD to periodontal status showed a significant result (p = 0.005). The level of bone resorption occured greater in mandible than in maxilla. However, calcium serum levels showed no significant results in the low BMD (p> 0.005). In addition, there were no statistically significant results between low bone mineral density with tooth loss (p> 0.005).

In general, low bone mineral density had a significant relationship with the severity of periodontal status, while generally low bone mineral density was not significantly associated with tooth loss.

Introduction

According to the World Health Organization (WHO), osteoporosis is defined as a systemic bone disease that characterized by low bone mineral density, and micro-architectural changes followed by fragility as well as fractures of bone tissue.[1] Osteoporosis also known as "a silent disease" or a disease that may not show any signs and symptoms until bone fractures occured. Commonly fractures experienced by patients with osteoporosis are fractures of the spine, hip and wrist.[2] There are four categories for diagnosing bone mass (bone mineral density)[3,4] based on T-score using dual energy x-ray absorptiometry (DXA) are as follow: (a) Normal: T-score greater than or equal to -1 SD; (b) Osteopenia (Early osteoporosis): T-score between -1 SD to -2.5 SD; (c) Osteoporosis: T-score below -2.5 SD. (d) Advanced osteoporosis: T-score below -2.5 SD in the presence of one or more fractures or osteoporosis.

Osteoporosis and periodontitis have systemic effects in bone. Along with the change of long bones in the body, alveolar bone would also experience bone turnover. Someone who has low bone mineral density will also has low bone mineral density in the jaws.[1,5] Periodontitis is an inflammation of the tissues supporting the teeth. It cause by specific microorganisms and it could lead to damage of periodontal ligament and alveolar bone, followed by pocket formation, recession or both.[6] Losing teeth can be use indirectly as an indicator of periodontal status of a person. In addition to tooth loss, the level of alveolar bone and the presence of edentulous, the greater the chances of developing osteoporosis.[7] When someone has experience a tooth loss, the condition will affect this person's quality of life. The impact is related to oral health. Diet, nutrition, social interaction, sleep, self-esteem, and speech are also affected by the loss of teeth. Moreover, it can cause a decrease in self-confidence and self-image change.[8,9]

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Materials and methods

The study was an observational study with cross-sectional method. Total number of samples was 33 subjects based on inclusion and exclusion criteria. Inclusion criteria: (a) Patients (men and women) who checked up their bones; (b) Patients were diagnosed as normal, osteopenia, and osteoporosis in the examination of spine and hip bones. (c) Did not suffer from diabetes and gout. (d) Experienced loss of teeth, including its of the root. Exclusion criteria: (a) Patients value of T-scores were <-1 for osteopenia and <-2.5 for patients with osteoporosis on the one site inspection; (b) Presented bone abnormalities and third molar; (c) Had other systemic diseases; (d) Non-smokers and alcohol drinkers.

The clinical examination with panoramic dental X-ray was conducted in the oral cavity to obtain dental records of each sample. Blood test were also conducted beside panoramic examination. Evaluation of bone mineral density on the lumbar vertebrate and femoral head was using DXA at the DR. Wahidin Soudero Husodo Public Hospital.

Bone evaluation was conducted on the lumbar spine vertebrae and femoral head with T-Score. Index to measure the severity of periodontitis should also be able to measure the loss of tooth supporting tissues. The index used in this study was the Community Periodontal Index (CPI) according to the World Health Organization (WHO). Periodontal examinationswere performed on all the remaining teeth except for tooth residual roots and the third molars.[10] Assessment of alveolar bone resorption was conducted by using *a panoramic dental x-ray*. An *auto power-off digital calipe*r (0.01mm accuracy) was utilized to measure it.The size of alveolar bone resorption on the each tooth was valued by measuring the distance between the *cement enamel junction* (CEJ) and the *alveolar bone crest* (ABC), and between ABC and *Root Length* (RL). The formula[11] used to determine bone resorption was:

$$\frac{(CEJ - ABC) - 2mm}{(CEJ - RL) - 2mm} \, x \, 100 = \text{Results}$$

Reduction of the distance CEJ to the ABC and the CEJ to PA by 2mm was adopted from on the formula that has been used in reasearch by Cassia TF et.al. It based on the histological study of healthy periodontal tissue that has dentogingival junction depth of 2mm. Therefore, the formula must be reduced by 2 mm because the gingival tissue would not be appeared in the X-ray results.[11] When osteoclast bone resorption occurred, it would degrade the extracellular matrix and provoke collagen to release various products. The products would enter the kidney and liver organs through cellular mechanism. Collagen degradable products can be measured by analysing urine and blood serum concentrates.[12] Routine blood laboratory tests also be conducted. The results of these were assessed by following the standard of blood test scores: urea 10-50 mg / dL, keratinin 0.6-1.2 mg / dL, and serum calcium from 8.1 to 10.4 mg / dL.

This study on tooth loss is to figure out clinical condition of the oral cavity. Assessment criteria was based on theWHO dental-oral health targets that population with age between 35- to 44 years should have at least 20 teeth. The results is managed by using*Microsoft Office Excel 2007*software and analyzed by*SPSS 19.0* programme.

Results

The number of teeth, alveolar bone resorption, serum calcium, periodontal indices, and bone mineral density of the lumbar vertebrae were used as statistical parameters. General characteristics of the samples were shown in Table 1.

The results showed low levels of HR against periodontal status significantly (p = 0.005). The level of bone resorption on mandibular was greater than in maxilla. However, serum calcium levels showed no significant results on the the low BMD (p = 0.930). In addition, there were no statistically significant results between low bone mineral density and tooth loss (p> 0.005).

Caracteristic	Min	Max	Mean±SD
Age (yr)	14	71	56,1 ± 10,9
lumbar	-4.3	0.6	-1,84± 1,22
BMI (kg / m 2)	16,8	34,2	24,3 ± 4,28
number of Teeth	3	28	18,0 ± 6,51
Serum Calcium (mg/dL)	7,6	9,8	8,37 ± 0,53
periodontal Index	0,2	4	2,19 ± 1,03

Table 1. The characteristics of subjects.

Discussion

Low bone mineral density found in osteopenia or osteoporosis was associated with periodontitis. Osteoporosis and periodontitis are diseases could influenced the bone turnover of the whole long bones in the body, including alveolar bone. For this reason, it could be assumed that someone who had low bone mineral density would also had a low bone mineral density in the jaws.[1,5] The study result in Table 3 showed a significant association between the low levels of BMD and periodontal status (p = 0.005). It was linier with other studies conducted by Snophia S, et.al to observed the relationship between BMD and periodonsitis in women pre and post-menopause. The sample were 20 people (10 controls and 10 cases). Variables associated with BMD on lumbar spine and femur were age,body mass index, number of teeth, plaque index, pocket depth, attachment loss support networks, and alveolar bone resorption. Based on the chi-square statistic test, it could be seen that low BMD on lumbar spine and femur had significant correlation with plaque index, pocket depth, tooth supporting structures loss, and alveolar bone resorption.[4]

Alveolar bone resorption caused by periodontal disease occurs in all tooth surfaces and it could be observed on radiographic examination. Normally, the alveolar bone crest was 1-2 mm towards the apical portion of cemento-enamel junction. In the present of bone loss, the alveolar bone crest could shift more than 2 mm apical towards the cemento-enamel junction.[10] The radiographic result (Table 2) of the alveolar bone tissue measurements from samples showed that alveolar bone resorption mostly found in the anterior mandibular teeth group, followed by the maxillary anterior teeth group. The lowest bone resorption was demonstrated by the right and left posterior maxillary teeth.

Osteoporosis primarily affected bone trabecular and cortical bone. Alveolar bone structure and morphology were different in each person. At the anterior aspect of mandible, the alveolar bone was very thin and parallel to the external cortical bone and the maxilla consist of more cortical bone. Therefore, mandible was more prone to experienced low bone mineral density.[13] Osteoclast could decrease the volume of bone extracellullar matrix and collagen and might provoke the release of products that could enter kidney and liver organs. Collagen consentrate could be detected in urine and serum.[12] The result in Table 3 showed that there was no significant association between the low bone mineral density and the level of calcium serum (p = 0.930).

Statistical analysis by chi-square test shown in Table 3 obtains P value = 0.120, greater than the value of α = 0.005. It means that there was no significant relationship between tooth loss and low bone mineral density. Tooth loss could be used indirectly to determine periodontal status of a person.

Periodontal Index	Bone Mineral Density		
	Normal (n = 6)	Osteo-penia (n= 15)	Osteoporosis (n=12)
Health (Normal) (n=0)	0 (0,0)	0 (0,0%)	0 (0,0%)
Gum Bleeding (n=14)	3 (21,4%)	8 (57,1%)	3 (21,4%)
Calculus Subgingiva (n=11)	0 (0,0%)	3 (27,3%)	8 (72,7%)
Shallow pockets (n=6)	1 (16,7%)	4 (66,7%)	1 (16,7 %)
Deep pockets (n=2)	2 (18,2%)	0 (0,0%)	0 (0,0%)

Table 3. Distribution of periodontal indices on bone mineral density.

Characteristics	frequency	Percentage
Normal	6	18, 2 %
Osteopenia	15	45,5 %
Osteoporosis	12	36,4 %
Total	33	100 %

Table 2. The characteristics of bone mineral density.

Dental Group	Mean (mm)	SD
Right posterior RA	9,78	9,34
anterior RA	14,98	8,86
Left posterior RA	9,70	9,06
Right posterior RB	11,64	11,8
anterior RB	15,48	11,3
Left posterior RB	10,67	8,35

Note: RA: Upper Jaw, RB: Lower Jaw

Table 4. Alveolar bone resorption based on dental group.

Total of Teeth	Bone Mineral Density		
	Normal (n= 6)	Osteopenia (n = 15)	Osteoporosis (n = 12)
Normal (n=16)	4 (66,7%)	9 (60 %)	3 (25 %)
Un-Normal (n= 17)	2 (33,3 %)	6 (40 %)	9 (51,5 %)

Table 5. Alveolar bone resorption percentages based on dental group.

Calsium Serum	Bone Mineral Density		
	Normal (n = 6)	Osteopenia (n = 15)	Osteoporosis (n = 12)
Normal (n=24)	4 (16,7%)	11 (45,8%)	9 (37,5%)
Un-Normal (n=9)	2 (22,2%)	4 (44,4%)	3 (33,3%)

Table 6. Distribution of serum calcium on bone mineral density

Variables	Mean±SD	P-values
Serum Calcium (mg / dL)	8,37 ± 0,53	0.930
periodontal Index	2,19 ± 1,03	0,005*
Number of remaining teeth	18,0 ± 6,51	0,120

*Significant

Table 7. Chi square test variable to the low DMT Lumbar vertebrae.

In addition, the level of alveolar bone resorption and the presence of edentulous showed a greater chance of developing osteoporosis. However, several other studies have shown that tooth loss had no significant correlation to the level of bone mineral density.[7,16,17] Osteoporosis and periodontitis were chronic multicaftorial diseases that might caused bone loss. Moreover, it could be exacerbated by local and systemic factors. Gender, genetic changes, less physical activity, calcium and D vitamin deficiencies, alcohol consumption, smoking, hormonal factors and drugs were also risk factors of osteoporosis and periodontitis.[7,17]

An evidence indicated that poor periodontal status and tooth loss was several factor that affected the level of osteoporosis. The main cause of tooth loss were caries and periodontitis. However, other factors, socio-economic, were also involved in the loss of teeth. Socio-economic conditions might influence patient consideration in choosing the best type of dental treatment. This could create the high prevalence and incidence of caries in children and adults. In addition, poor brushing skills and low number of visits to the dentist are also affects the tendency of tooth loss. These all are reasons why the results show no significant correlation between low bone mineral density and periodontal status as well as tooth loss.[9,14,15] Other studies conducted by Your S et.al explore the relationship between tooth loss and bone mineral density in menopause women who have used partial dentures. The result of 79 samples who agree to participate and examinedshows no significant relationship between age and the decreased bone mineral density (p = 0.215).[13] In addition, this study also shows that a statistical test is not significant to the difference of bone mineral density of the total number of teeth presented (p = 0.99), number of teeth on the maxilla (0.90) and the number of teeth on the mandible (p = 0.68). Results of statistical tests of coefficient correlation showed no assocciation between the number of remaining teeth in the oral cavity and the decreased bone mineral density.[13]

Comparing several other studies of osteoporosis by using periodontal status and tooth loss as indicators could be very difficult. Different types of studies and methods in diagnosing osteoporosis, periodontal status and tooth loss may caused the difficulties. Therefore, different results of this study may significantly influenced by the type and method of study used, particularly the number of samples.

Conclusions

In general, low bone mineral density has a significant relationship with the severity of periodontal status, while generally low bone mineral density was not significantly associated with tooth loss.

Declaration of Interest

All the authors have contributed to this research, so we could finish this study and achieved the results. We obtained Ethical Approval from our institution with administered number UH14070362. There is no conflict of interest and there was no source of funding from any institution.

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