Postmenopausal osteoporosis and tooth loss

Anda Slaidina, Una Soboleva, Ilze Daukste, Agnis Zvaigzne, Aivars Lejnieks

SUMMARY

Objective. The aim of this study was to determine relation between tooth loss and general body bone mineral density in postmenopausal female who were seeking for prosthetic treatment.

Material and methods. There were included 79 women in this study (age from 49-81 years, mean age 62.9 years) with partial tooth loss.

For all patients bone mineral density measurements for lumbar spine and both femoral necks by dual energy X-ray absorptiometry (Lunar DEXA DPX-NT, GE Medical Systems) were performed.

Based on DEXA results patients were divided into 3 groups: normal bone density (T-score $\geq$-1.0), osteopenia (T-score from -1.0 till -2.5) and osteoporosis (T-score $\leq$-2.5).

Dental investigation was performed to detect existing teeth.

ANOVA analysis of variance was used to determine relationship between different variables by group. To test correlation between different values Pearson correlation was used.

Results. The number of teeth in different bone mineral density groups is almost similar. There are no statistically significant differences between groups according the number of the all teeth present and according the number of teeth in maxilla and mandible. There is no significant correlation between the number of the teeth and DEXA readings, except there is weak correlation between the number of maxillary posterior teeth and bone mineral density in femoral neck.

Conclusion. There is no correlation between number of the teeth and general bone mineral density.

Key words: bone mineral density, menopause, osteoporosis, tooth loss.

INTRODUCTION

Osteoporosis is a systemic disease characterized by decreased bone mineral density, impaired microarchitecture leading to the loss of bone strength and consequent increase of bone fracture risk [1; 2]. It is very common disease among populations in moderate climate zone around the world, and it is directly connected with age. According to the data of the World Health Organisation osteoporosis is the second most common disorder following cardiovascular diseases [3], and fractures caused by it are observed in every third female and every fifth male older than 50 years [4]. Although this disease is

observed among females and males, the most common type in 90% of cases is postmenopausal osteoporosis [5]. Due to ageing of the European population number of patients with osteoporosis will double in the next 50 years [4]. Experts estimated that in Latvia 160 000 – 200 000 females 45-80 years of the age may have osteopenia or osteoporosis [6]. Osteoporosis involves jaw bones similarly as the rest of skeleton [7]. The effect of osteoporosis on jaw bones and related structure nowadays is widely studied [8-10]. There is an opinion that females with low bone mineral density have a higher rate of tooth loss. However, research findings are controversial [11-13]. Since the rate of tooth loss among Latvian population is higher than European average this issue becomes very important [14; 15].

The aim of the study was to determine relation between tooth loss and general body bone mineral density in postmenopausal female who were seeking for prosthetic treatment.

[1]Department of Prosthodontics, Riga Stradins University, Latvia
[2]Riga Second Hospital, Riga, Latvia
[3]Clinics of Internal Diseases, Paul Stradins Clinical University Hospital, Latvia
[4]Department of Internal Diseases, Riga Stradins University, Latvia
[5]Riga Austrumu Clinical University Hospital

Anda Slaidina[1] – D.D.S., PhD, instructor
Una Soboleva[1] – D.D.S., PhD, assoc. prof.
Ilze Daukste[2] – M.D.
Agnis Zvaigzne[3, 4] – M.D., PhD, assist. prof.
Aivars Lejnieks[3, 5] – M.D., PhD, prof.

Address correspondence to Dr. Anda Slaidina, Department of Prosthodontics, Institute of Stomatology, Riga Stradins university, 20 Dzirciema str., Riga LV-1007, Latvia.
E-mail address: anda.slaidina@inbox.lv

MATERIAL AND METHODS

The study population included 79 postmenopausal patients aged 49-81 (mean age 62.9 years) from the

Prosthetic Clinic of the Institute of Stomatology with partial adentia, who attended clinic during the time period September 2008 – December 2008 and agreed to participate. Study protocol was reviewed and permission was obtained from the Ethics Commission of Riga Stradins University.

The study was designed as cohort study. We asked to participate in the study all female who attended the Prosthetic clinic in particular time period. Overall 96 females were asked to take part in this study, and 12 of them refused to participate due to lack of time and other reasons. Five females were excluded from the study due to missing bone mineral density examination.

Patients with the history of thyroid disease, impaired calcium metabolism, hyperthyroidism, diabetes mellitus, long term use of glucocorticoids and other diseases affecting bone metabolism were excluded from the study. Smokers and patients with alcohol abuse were excluded from the study. Patients with aggressive periodontitis and those who didn't cooperate were exclude from study

Number of the existing teeth was determined during the clinical examination of the oral cavity.

As patients were in different treatment stages for periodontal and caries treatment, we couldn't control these variables, therefore we decide not to perform additional periodontal or caries examination.

All patients underwent dual energy X-ray absorptiometry (DEXA) (Lunar DEXA DPX-NT, GE Medical Systems – Riga Hospital No 2) to determine bone mineral density. This examination was performed for lumbar spine (L2-L4) and femoral neck. All examinations were performed by one experienced professional. The worst T-score reading (L2-L4 and femoral neck) was taken into consideration. Patients were divided into 3 groups according to the WHO criteria: normal bone mineral density (T-score – +2,5 to -1), osteopenia (T-score <-1,0 to -2,5), osteoporosis (T-score ≤ -2,5) [3].

Data was analyzed using descriptive and analytical statistical methods. Distribution of values by different groups was determined using 2×2 and r×c frequency tables. ANOVA analysis of variance was used to determine relationship between different variables by group. Pearson correlation was used to determine correlation between different variables.

RESULTS

The number of females included in this study was 96 and 79 of them (82.29%) agreed to participate and had all necessary examinations. According to the DEXA results all females were dividend into 3 groups: females with normal bone mineral density – 25 (mean age 61.56±9.8 years), females with osteopenia – 36 (mean age 62.17±8.54 years), and females with osteoporosis – 18 (mean age 66.22±9.47 years). The age differences between groups were not statistically significant (p=0.215).

The number of preserved teeth in different groups (normal bone mineral density, osteopenia and osteoporosis) was almost similar. There were no statistically significant differences between groups in respect to the total number of teeth (p=0.9926), and number of teeth in maxilla (p=0.9064) and mandible (p=0.6821) (Table 1).

No correlation between number of teeth and DEXA readings was found (Table 2). Weak correlation was observed between number of maxillary posterior teeth and bone mineral density in femoral neck (Table 3).

DISCUSSION

The prevalence of various age related diseases as well as research relating to these diseases increases due to ageing of population. Therefore, osteoporosis and its side effects also becomes very important topic nowadays. The research in dentistry is focused on effects of osteoporosis on various structures of oral cavity, including periodontal structures and alveolar bone. Although findings of studies are controversial several studies have found that females with osteoporosis more frequently have a periodontal disease with more severe symptoms [16-18]. It suggests that individuals with low bone mineral density have a higher rate of tooth loss which is supported also by studies [11; 13; 19]. Inagaki et al proposed theory that in the studies where relationship between osteoporosis and tooth loss was not found the age of patients was too low (females younger than 60

Table 1. The number of the teeth by different groups of bone mineral density

Osteoporotic status	Number of patients	Maxillary tooth count	Standard deviation	Mandibular tooth count	Standard deviation	Total number of teeth	Standard deviation
Normal bone mineral density	25	7.52	4.7	9.20	3.7	16.72	8.2
Osteopenia	36	7.19	5.2	9.69	3.8	16.89	8.5
Osteoporosis	18	7.83	5.3	8.78	3.6	16.61	8.1
p-value		0.906		0.682		0.993	

years of age), and it means that osteoporosis was present not long enough for negative effect to manifest in the jaw bones [16]. Yet, Taguchi et al observed positive relationship between osteoporosis and tooth loss also among relatively young females [11; 20] and May and Weyant et al didn't find such relationship among elderly females [21; 22]. The findings of the present study are similar. Although the mean age of females was 62.9 years, females with decreased bone mineral density had no higher rate of tooth loss which is in compliance with many other studies [12; 23; 24].

Though age is an important risk factor for development of osteoporosis, we didn't find any statistically significant difference between osteoporosis, osteopenia and normal bone mineral density by age groups. It may be explained by small study population. It suggests that we can exclude age of patients as a confounding factor which has a high correlation with the number of lost teeth [25].

It is difficult to compare various studies regarding the effect of osteoporosis on tooth loss because they all have different design and they all employ different methods for diagnosis of osteoporosis. In some studies history of osteoporotic fractures [26] and x-rays [27] are used for diagnosis of osteoporosis. It does not exclude cases when females without fractures do not have low bone mineral density. Qualitative ultrasound scan [19] and peripheral DEXA [16] are good methods for osteoporosis screening, which are not accurate enough for diagnosis of osteoporosis, are also used. DEXA examination, which is the main diagnostic method worldwide, was used for diagnosis of osteoporosis in our study. Main advantages are as follows: it is relatively cheap method, easy to use, with low radiation dose and good accuracy (error 0.9-5%) [28]. However, it does not provide information regarding dimensional bone structure and bone microarchitecture. Since it is difficult to compare results obtained with various DEXA devices [29], we used only one device and all measurements were made by one experienced professional in order to reduce inaccuracy of DEXA readings.

One of the study limitations is population chosen, which includes patients of the Prosthodontic clinic mainly attending clinic to replace lost teeth. The rate of tooth loss in these patients probably is higher than in general population. In order to diminish this effect we excluded from the study all edentulous females. Main reasons for the teeth loss are caries, periodontal diseases and complications. Some previous studies have shown that females with osteoporosis more frequently have a periodontal disease with more severe symptoms [16-18]. It could cause tooth loss, therefore reason for tooth loss becomes very important research question.

Unfortunately in present study it is impossible to control cause of tooth loss in long term and dental situation at present not always represent tooth loss reason in past, therefore we didn't take it into account.

The prevalence and incidence of caries among children and adults in Latvia is high [15]. The aetiology of caries is more related to the plaque and carbohydrate rich diet [30]. Due to socioeconomic reasons people often choose tooth extraction as a treatment method. This is the possible reason why we didn't find relationship between osteoporosis and tooth loss. Similar conclusion was made also by Klemmenti and Vainio, who observed similar problem in Finland where intensity of caries and loss of teeth was very high [31].

Osteoporosis primarily affects trabecular bone and later cortical bone [32]. Since maxilla contains more cortical bone os-

Table 2. Correlations and correlation coefficients between number of teeth and DEXA readings

DEXA	Maxillary tooth count	Mandibular tooth count	Total number of teeth
Lumbar spine (L2-L4)	-0.08 0.64% p=0.489	-0.049 0.24% p=0.668	-0.071 0.5% p=0.535
Femoral neck	-0.162 2.62% p=0.156	-0.082 0.67% p=0.478	-0.136 1.85% p=0.234
Worst reading from femoral neck and lumbar spine	-0.066 0.44% p=0.562	-0.023 0.05% p=0.843	-0.51 0.26% p=0.656

Table 3. Correlations and correlation coefficients between number of teeth in frontal and posterior region and DEXA readings

DEXA	Maxillary frontal tooth count	Maxillary posterior tooth count	Mandibular frontal tooth count	Mandibular posterior tooth count
Lumbar spine (L2-L4)	-0.107 (1.15%) p=0.353	-0.043 (0.18%) p=0.706	-0.067 (0.45%) p=0.561	-0.024 (0.06%) p=0.832
Femoral neck	-0.058 (0.37%) p=0.617	-0.228 (5.2%) p=0.045	0.079 (0.62%) p=0.494	-0.145 (2.1%) p=0.205
Worst from femoral neck and lumbar spine	-0.064 (0.41%) p=0.575	-0.058 (0.34%) p=0.612	0.026 (0.07%) p=0.819	-0.042 (0.18%) p=0.711

teoporosis affects maxilla at first especially posterior region where bone density is already anatomically lower [33]. However, we didn't find relationship between number of maxilla teeth and bone mineral density. During separate examination of frontal and posterior teeth we observed slight correlation between number of maxillary posterior teeth and hip bone mineral density. In the study performed in Japan, where mean age of females was 54 years, number of posterior teeth was associated with the 3rd lumbar vertebral bone mineral density [11], however they didn't evaluate hip bone mineral density. Since osteoporosis primary affects trabecular bone and first changes of bone mineral density are observed in vertebral column, and only later in hips, the findings of our study suggests, that there might be a lag time between decreased bone mineral density and tooth loss.

CONCLUSIONS

Postmenopausal females who were seeking for prosthetic treatment and had low bone mineral density does not have higher rate of tooth loss than postmenopausal females with normal bone mineral density.

REFERENCES

1. Peck WA, Burkhard P, Christensen C. Consensus development Conference: diagnosis, prophylaxis and treatment of osteoporosis. *Am J Med* 1993;94:645-50.
2. NIH Consensus Development Panel on Osteoporosis prevention, diagnosis and therapy. *JAMA* 2001;285:785-95.
3. WHO. Assessment of fracture risk and its application to screening for postmenopausal osteoporosis: Report of WHO Study Group. *World Health Organ Tech Rep Ser;843.*WHO; 1994.
4. Melton LJ, Chrischilles EA, Cooper C, Lane AW, Riggs BL. Perspective: How many women have osteoporosis*? J Bone Miner Res* 1992;7:1005-10.
5. Albright F, Smith PH, Richardson AM. Post-menopausal osteoporosis. Its clinical features. JAMA 1941;116:2465-74.
6. Lejnieks A. Osteoporozes diagnostika, profilakses un ārstēšanas vadlīnijas (Guidelines of osteoporosis diagnosis, prophylaxis and treatment). Riga, Latvia; 2005.
7. Von Wowern N. General and oral aspects of osteoporosis: a review. *Clin Oral Investig* 2001;5:71-82.
8. Miliuniene E, Alekna V, Peciuliene V, Tamulaitiene M, Maneliene R.Relationship between mandibular cortical bone height and bone mineral density of lumbar spine. *Stomatologija. Baltic Dent Maxillofac J* 2008;10:72-5.
9. Ozola B, Slaidina A, Laurina L, Soboleva U, Lejnieks A. The influence of bone mineral density and body mass index on resorption of edentulous jaws. *Stomatologija. Baltic Dent Maxillofac J* 2011;13:19-24.
10. Peciuliene V, Maneliene R, Balcikonyte E, Drukteinis S, Rutkunas V. Microorganisms in root canal infections: a review. *Stomatologija. Baltic Dent Maxillofac J* 2004;6:17-19.
11. Taguchi A, Suei Y, Ohtsuka M, Otani K, Tanimoto K, Hollender LG. Relationship between bone mineral density and tooth loss in elderly Japanese women. *Dentomaxillofac Radiol* 1999;28:219-23.
12. Earnshaw SA, Keatign N, Hosking DJ. Tooth counts do not predict bone mineral density in early postmenopausal Caucasian women. *Int J Epidemiol* 1998;27:479-83.
13. Meisel P, Reifenberger J, Haase R, Nauck M, Bandt C, Kocher T. Women are periodontally healthier than men, but why don't they have more teeth than men? *Menopause* 2008;15:270-75.
14. Soboleva U, Rogovska I, Pugaca J. Assessment of the received prosthetic treatment in the Latvian population. *Stomatologija. Baltic Dent Maxillofac J* 2006; Suppl 3: 39.
15. Care R, Arne G. Kariesa intensitāte Latvijā 2005. gadā pieaugušajiem iedzīvotājiem 35-44 un 65-74 gadu vecuma grupās (Caries intensity in age groups 35-44 and 56-74 years in Latvia). *RSU Zinātniskie raksti* 2007. p. 340-4.
16. Ingaki K, Kurosu Y, Yoshinari N, Noguchi T, Krall EA, Garcia RI. Efficacy of periodontal disease and tooth loss to screen for low bone mineral density in Japanese women. *Calcif Tissue Int* 2005;77: 9-14.
17. Persson RE, Hollender LG, Powell LV, MacEntee MI, Wyatt CC, Kiyak HA, et al. Assessment of periodontal conditions and systemic disease in older subjects. I. Focus on osteoporosis. *J Clin Periodontol* 2002;29:796-802.
18. Tezala M, Wactawski- Wende J, Grossi SG, Ho AW, Dunford R, Genco RJ. The relationship between bone mineral density and periodontitis in postmenopausal women. *J Periodontol* 2000;71:1492-8.
19. Bando K, Nitta H, Matsubara M, Ishikawa I. Bone mineral density in periodontally healthy and edentulous postmenopausal women. *Ann Periodontol* 1998;3:322-6.
20. Taguchi A, Tanimoto K, Suei Y, Otani K, Wada T. Oral signs as indicators of possible osteoporosis in elderly women. *Oral Surg Oral med Oral Pathol Oral Radiol Endod* 1995;80: 612-6.
21. May H, Reader R, Murphy S, Khaw KT. Self-reported tooth loss and bone mineral density in older men and women. *Age Ageing* 1995;24:217-21
22. Weyant RJ, Pearlstein ME, Churka AP, Forrest K, Famili P, Cauley JA. The association between osteopenia and periodontal attachment loss in older women. *J Periodontol* 1999;70:982-91.
23. Hildebolt CF, Pilgram TK, Dotson M, Yokoyama-Crothers N, Muckerman J, Hauser J, et al. Attachment loss with postmenopausal age and smoking. *J Periodontal Res* 1997;32:619-25.
24. Kribbs PJ, Chesnut CH, Ott SM, Kilcoyne RF. Relationship between mandibular and skeletal bone in a population of normal women. *J Prosth Dent* 1990;63:86-9.
25. Madlena M, Hermann P, Jahn M, Fejerdy P. Caries prevalence and tooth loss in Hungarian adult population: results of a national survey. *BMC Public Health* 2008;8:364.
26. Astrom J, Backstrom C, Thidevall G. Tooth loss and hip fractures in the eldery. *J Bone Joint Surg (Br)* 1990;72:324-5.
27. Yoshihara A, Seida Y, Hanada N, Nakashima K, Miyazaki H. The relationship between bone mineral density and the number of remaining teeth in community-dwelling older adults. *J Oral Rehabil* 2005;32:735-40.
28. Kanis JA, Melton LJ, Christiansen C. The diagnosis of osteoporosis. J *Bone Miner Res* 1994;9:1137-41.
29. Wilson CR, Fogelman I, Blake GM, Rodin A. The effect of positioning on dual energy X-ray bone densitometry of the proximal femur. *J Bone Mineral* 1991;13:69-76.
30. Moore WJ. The role of sugar in the aetiology of dental caries. 1. Sugar and the antiquity of dental caries. *J Dent* 1983;11:189-90.
31. Klemetti E, Vainio P. Effect of bone mineral density in skeleton and mandible on extraction of teeth and clinical alveolar height. *J Prosthet Dent* 1993;69: 21-5.
32. Stevenson JC, Banks LM, Spinks TJ, Freemantle C, MacIntyre I, Hesp R, et al. Regional and total skeletal measurements in the early postmenopause. *J Clin Invest* 1987;80:258-62.
33. August M, Chung K, Chang Y, Glowacki J. Influence of estrogen status on endosseous implant osseointegration. *J Oral Maxillofac Surg* 2001;59:1285-9.