

OSTEOPOROSIS IN PROSTHETIC PATIENTS - A QUANTITATIVE PATHOHISTOLOGICAL ANALYSIS

Zorica Ajduković¹, Dragutin Stanković¹, Dragan Mihailović², Aleksandar Dimić³

¹Clinic of Stomatology, ²Institute of Pathology, and ³Institute for Prevention, Treatment and Rehabilitation of Rheumatic and Cardiovascular Diseases "Niška Banja", University of Niš

Summary. *The objective of this study was to define a relation between the histological structure of the alveolar bone and periodontal disease, on the one hand, and osteoporosis of different etiopathogenesis on the other, as well as to propose an adequate stomato-prosthetic therapy.*

The female patients, divided into age groups, underwent a procedure aimed at determining the level of interdependence between the degree of osteoporosis and the corresponding form of periodontopathy, which was done on the basis of anamneses, data from the case history, clinical check-ups and secondary diagnostic methods.

During the extraction of the teeth according to the plan of therapy, the samples of the alveolar bone were taken and decalcified, colored by the routine HE method and analyzed by image analyzer. The following changes have been detected: poorly calcified parts of the cortical bone, thinned bone lamellae and widened Haversian system which indicates poor bone activity, i.e. a greater activity of osteoclasts as compared to osteoblasts.

Six months after the defined internist's therapy (alpha-calcidol, etidronate, plus compensatory hormonal therapy) and a corresponding stomato-prosthetic therapy with PMD (partial mobile dentures), the samples of the alveolar bone were taken again and prepared in the same way. It was microscopically found that the Haversian system was not widened and the cement lines were noticeable, which indicated bone tissue recovery and prevalence of anabolic processes.

In conclusion, it is emphasized that cumulative effects of internist's and stomato-prosthetic therapies improve the osteoblastic activity enabling prevalence of anabolic processes which improves the quality of the said tissues and provides grounds for a more successful prosthetic therapy.

Key words: Osteoporosis, dentistry, mandible, image analysis

Introduction

Osteoporosis is the most common metabolic disease and presents a major public health problem among the elderly.

Osteoporosis is characterized by reduction of the bone tissue per anatomic bone volume unit, which leads to decreased mechanical bone strength and to a greater possibility of fractures, even by slightest trauma (1,2,3,4,5).

The aim of the study was to establish a relation between the histological structure of the alveolar bone and the periodontal disease, on the one hand, and osteoporosis of various etiopathogenesis, on the other, as well as to propose an adequate stomato-prosthetic therapy.

Material and methods

Samples of the mandibular tissue of 16 postmenopausal women, aged 45-64 years, have been analyzed. Osteoporosis was diagnosed in 11 women, while the remaining 5 represented a control group. In the experimental group, primary osteoporosis was detected in 4

woman, and secondary osteoporosis was detected in 7 woman (3 after hysterectomy, and 4 after corticosteroid therapy). The patients came to the Clinic of Stomatology, University of Niš, with osteoporosis diagnosed at the Institute for Prevention, Treatment and Rehabilitation of Rheumatic and Cardiovascular Diseases "Niška Banja".

The patients, divided into two groups, underwent a procedure aimed at determining the level of interdependence between the degree of osteoporosis and the corresponding form of periodontal disease as classified by the Community Periodontal Index of Treatment Needs (CPITN). This was done on the basis of anamneses, data from the case history, clinical check-ups and secondary diagnostic methods. The index of tooth looseness (below or higher than 3 mm) was established before tooth extraction.

During the extraction of the patients' periodontopathic teeth according to the plan of therapy, the samples of the mandibular alveolar bone (interdenticle septum) were taken, and fixed in 10% formaline, decalcified in the 15% solution of HNO₃, stained by hematoxylin-eosin (HE) and analyzed histomorphometrically using Lucia M

3.51AB (Nikon) image analyzer with the objective $\times 10$ (NA=0.25) of the FXA microscope (Nikon, Tokyo, Japan) (Fig. 1) This system has a Sony CCD camera, which enables picture digitalization with 512×512 pixels, in 256 gray levels. After the initial determination of the picture threshold and digitalization, a binary picture was edited manually. Upon defining a test field area fraction, integrated density and circumference of the bone were determined.

Six months after the administration of a prescribed internist's therapy, according to the etiology, (calcitonin (Calcimar 100 u SC daily), alpha-calcidol 0.25 mg twice daily and biphosphonates (Fosamax 10 mg once daily, Didronel 400 mg daily for first two weeks of every third month) for primary postmenopausal osteoporosis; fluorites and alpha-calcidol for primary senile osteoporosis; appropriate compensatory hormonal therapy - estradiol 1 mg daily) combined with a appropriate stomato-prosthetic therapy - PMDP (partial mobile dental prosthesis with selective disembrasement), the samples of the mandibular alveolar bone were taken again, prepared in the same way, and analyzed histomorphometrically.

Student t-test was used for the statistical analysis of the results. Values are shown as average values with standard deviation (SD).

Results

In osteoporotic patients, a histological analysis revealed the following changes: poorly calcified parts of the cortical bone, thinned bone lamellae, and widened Haversian system (Fig. 1).

A histomorphological analysis carried out six months after the defined internist's and adequate stomato-prosthetic therapy revealed the following: the Haversian system is not widened and the cement lines become visible (Fig. 2). Table 1 shows the interdependence between osteoporosis of different etiopathogenesis and the corresponding state of the periodontium. The examination of our group of patients revealed a significant interdependence between the degree of osteoporosis and periodontopathy.

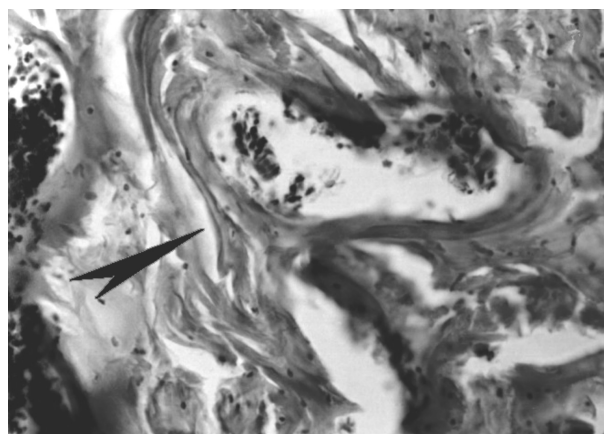


Fig. 1. Pathohistological changes in osteoporosis: poorly calcified parts of cortical bone (arrow), and widened Haversian system (HE, obj. $\times 20$).

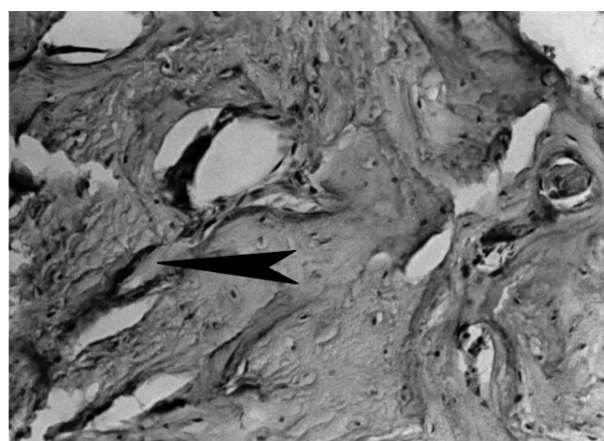


Fig. 2. Pathohistological analysis of mandible after therapy: in a cortical bone the cement lines are clearly visible (arrow) (HE, obj. $\times 10$).

Statistically, area fraction, integrated density and circumference of the bone have been found to be significantly lower in the group of patients with osteoporosis before treatment in comparison with the control group (Table 2). Differences between primary and secondary osteoporosis, and bones after treatment and control group were not statistically significant.

Table 1. Primary and secondary osteoporosis relation to the state of the periodontium and looseness of teeth.

	Number of patients	Periodontal status	
		Index of periodontium state estimate-CPITN	Index of teeth looseness
Control group	5	2	0
Primary osteoporosis	4	3	2
Secondary osteoporosis			
Induced by hysterectomy	3	3	1
Induced by corticosteroids	4	4	1

Table 2. Area fraction, integrated density, and size of the mandible bone

	Group		t-test
	osteoporosis	control group	
Number of patients	11	5	
Area fraction (%)	35.32 ± 8.72*	61.89 ± 7.36	p<0.001
Integrated density	2.99 ± 1.05	4.58 ± 1.08	p<0.01
Circumference (µm)	21.83 ± 4.21	30.26 ± 6.11	p<0.001

Discussion

Osteoporosis is a pathological loss of the bone mass which induces a disturbed micro-architecture of the bone and contributes to fracture diathesis (2,3,5).

Osteoporosis is a consequence of a disturbed osseous exchange with a misbalance between stronger bone resorption and normal (or insufficient) creation of the new bone.¹

In osteoporosis, bone mass reduction is characteristically greater in the trabecular than in the cortical bone; that is why it is usually said that osteoporosis is a state in which there is "less bone". The bone, which has remained, is chemically unchanged (1,6,7,8).

The examination of our group of patients revealed a significant interdependence between the degree of osteoporosis and the corresponding phase of periodontopathy with the following clinical manifestations: inflammation of the free and the annexed gingiva, naked teeth cervices (frontal teeth), deep periodontal fobs, presence of tartar and subgingival concretions (as shown by the CPITN index) and teeth looseness of various degrees. Persistence of such a pathological process, leads not only to the inflammation of the periodontium and the alveolar bone, but also to the destruction of the compact bone. On the X - ray film, it can be seen first as thinning and than as interruption of the lamina dura. The apex of the interdental bone septum is destroyed.

Osteoporosis of the alveolar processes (or parts) of the jaw can lead to loosening, migration and falling of teeth.

This study involved biopsies of the mandible and a television system Lucia M, with automatic processing of the digitized picture. The time for one biopsy was approximately 5 min, which is acceptable for routine pathohistological diagnostic work. Decalcification method using HNO₃ is also acceptable for routine work. The changes revealed by a histomorphological analysis - poorly calcified parts of the cortical bone, thinning of the bone lamellae, and widened Haversian system - indicate poor bone activity, i.e. prevalent osteoclastic activity. (5,9,10,11)

The changes revealed by a histomorphological analysis carried out six months after the defined internist's and adequate stomato-prosthetic therapy (PMDP) - the Haversian system is not widened and cement lines become visible - indicate bone reparation, which means that the processes of anabolism have prevailed.

In our study, circumference of the bone and their integral density are variables on the basis of which osteoporosis can be diagnosed.

Conclusion

In the conclusion it is emphasized that cumulative effects of adequate internist's and stomato-prosthetic therapy improve the osteoblastic activity. The process also occurs in the bone tissue, which is a support of the dentures with the prevalence of anabolic processes, which improves the quality of these tissues providing grounds for the creation of a successful prosthetic therapy.

References

1. Riis BJ. Biochemical markers and bone turnover in diagnosis and assessment of therapy. *Ann J Med* 1991; 91 (Suppl): 64-68.
2. Suda T, Miyaura C. Pathogenesis of bone loss due to estrogen deficiency. *Osteoporosis Int* 1997; 7 (Suppl 3): 43-46.
3. Kribbs P. Comparison of mandibular bone in normal and osteoporotic women. *J Prosthet Dent* 1990; 63 (2): 218-222.
4. Dawson HB, Karll EA, Harris S. Risk factors for bone loss in healthy postmenopausal women. *Osteoporosis Int* 1993; 3 (Suppl 1): 27-31.
5. Kekow J. Bone mineral density (BMD) of the hand and disease activity in a patients with rheumatoid arthritis. *Bone* 1998; 22(3): 1-43.
6. Elovic-RP. Maxillary molar extraction causes increased bone loss in the mandible of ovariectomized rats. *J Bone Miner Res* 1995; 10(7): 108-93.
7. Kocijančić A. Osteoporozoza. Posebne edicije Fenix, Ljubljana, 1989. (In Slov)
8. Fujita T. Osteoporosis: past, present and future. *Osteoporosis Int* 1997; 7(3): 6-9.
9. Miyake M. A case of osteoporosis with bilateral defects in the mandibular process. *J Nihon Univ Sch Dent* 1995; 37(2): 108-14.
10. Chappard D, Legrand E, Basle MF, Andran M. Altered trabecular architecture induced by corticosteroids: a bone histomorphometric study. *J Bone Miner Res* 1996; 11: 676-685.
11. Fogelman I, Ryan P. Measurement of bone mass. *Bone* 1991; 12: 429-437.

OSTEOPOROZA KOD PROTETIČKIH PACIJENATA - PATOHISTOLOŠKI NALAZI (PRELIMINARNA STUDIJA)

Zorica Ajduković¹, Dragutin Stanković¹, Dragan Mihailović², Aleksandar Dimić³

¹Stomatološka klinika, ²Institut za patologiju i ³Institut za prevenciju, lečenje i rehabilitaciju srčanih i reumatskih oboljenja "Niška Banja" Medicinskog fakulteta Univerziteta u Nišu

Kratak sadržaj: Cilj ovog istraživanja je utvrđivanje odnosa histološke građe alveolarne kosti i oboljenja periodoncijuma, s jedne strane, i osteoporoze različite etiopatogeneze, s druge strane, kao i predlog adekvatne stomatološko-protetičke terapije.

Kod bolesnica su definisane uzrastne grupe na osnovu anamneze, podataka iz istorije bolesti, kliničkog pregleda i pomoćnih dijagnostičkih metoda; utvrđena je međuzavistnost između stepena osteoporoze i odgovarajućeg oblika parodontopatije.

U toku terapijski predviđene ekstrakcije zuba uzimani su uzorci alveolarne kosti mandibule, i zatim dekalcfikovani, bojeni hematoksilin-eozin (HE) metodom i analizirani pod svetlosnim mikroskopom uz pomoć sistema za analizu slike.

Zapažene su sledeće promene: slabo kalcifikovani delovi kortikalne kosti, istanjenje koštanih lamela, proširen Havers-ov sistem. Sve ovo ukazuje da je kost slabo aktivna, tj. da je veća aktivnost osteoklasta u odnosu na osteoblaste.

Šest meseci posle definisane internističke terapije (alphacalcidol, etidronat, phosphamax, odgovarajuća supstituciona hormonska terapija) i odgovarajuće stomatološko-protetičke terapije parcijalnom mobilnom zubnom protezom (PMZP) ponovo su uzeti uzorci alveolarne kosti i obrađeni na prethodno opisani način. Histološki je uvrđeno da Havers-ov sistem nije proširen i zapažene su cementne linije, što govori u prilog nadoknade koštanog tkiva, odnosno proces anabolizma.

Usaglašenom internističkom i stomatološko-protetičkom terapijom poboljšava se aktivnost osteoblasta i pojačava anabolizam kosti, što podiže kvalitet koštanog tkiva i stvara preduslove za uspešniju protetičku terapiju.

Ključne reči: Osteoporoza, proteza, donja vilica, analiza slike