

©Borgis

*Khrystyna Kovalyshyn, Mykola Rozhko

Features of the structural and functional state of bone tissue in patients with generalized periodontitis who live in different anthropogenically loaded areas

Cechy stanu strukturalnego i funkcjonalnego tkanki kostnej u pacjentów z uogólnionym zapaleniem przyzębia mieszkających w różnych obszarach obciążonych antropogenicznie

Department of Dentistry, Educational and Scientific Institute National Postgraduate Education Medical University of Ivano-Frankivsk, Ukraine

Keywords

generalized periodontitis, rheumatoid arthritis, ecologically unfavorable areas, bone tissue mineral density, deoxypyridinoline

Słowa kluczowe

uogólnione zapalenie przyzębia, reumatoidalne zapalenie stawów, obszary niekorzystne ekologicznie, gęstość mineralna tkanki kostnej, dezoksyperydynolina

Conflict of interest

Konflikt interesów

None

Brak konfliktu interesów

Address:

*Khrystyna Kovalyshyn
Department of Dentistry of the Institute of Postgraduate Education
Ivano-Frankivsk National Medical University
2 Halyska Str., Ivano-Frankivsk,
76018, Ukraine
tel.: +380991931860
endodoc89@gmail.com

Summary

Introduction. A research was conducted of the features of the structural and functional state of bone tissue in patients with generalized periodontitis with rheumatoid arthritis who live in different anthropogenically loaded areas.

Aim. The aim of the research is to assess the bone tissue mineral density according to the indicators of densitometric researches and the level of a marker of bone metabolism in generalized periodontitis of I and II degree of severity.

Material and methods. We examined 105 patients with GP of the I and II degree of severity, among whom were patients with rheumatoid arthritis who live in environmentally favorable and unfavorable areas. Peculiarities of the structural and functional state of bone tissue were assessed using an ultrasonic densitometer Sunlight Mini Omni TM and the level of a marker of bone tissue resorption of deoxypyridinoline in urine.

Results. Patients with generalized periodontitis with rheumatoid arthritis who live in environmentally unfavorable areas, found the largest number of people with signs of osteopenia, osteoporosis and elevated levels of deoxypyridinoline. In particular, in generalized periodontitis of the II degree of severity with osteopenia – 14 people (48.27%), with osteoporosis – 9 people (31%), the level of deoxypyridinoline determined in women was 12.03 ± 0.16 n/mol, which is 2.2 times significantly higher than the group of healthy ($p < 0.001$).

Conclusions. According to densitometric parameters and the level of deoxypyridinoline in the urine, the acceleration of bone tissue resorption in patients with generalized periodontitis of the II degree of severity with rheumatoid arthritis who live in environmentally unfavorable areas was established.

Streszczenie

Wstęp. Przeprowadzono badania nad cechami stanu strukturalnego i funkcjonalnego tkanki kostnej u pacjentów z uogólnionym zapaleniem przyzębia z reumatoidalnym zapaleniem stawów, mieszkających na różnych obszarach obciążonych antropogenicznie.

Cel pracy. Celem badania była ocena gęstości mineralnej tkanki kostnej na podstawie wskaźników badań densytometrycznych oraz poziomu markera metabolizmu kostnego w uogólnionym zapaleniu przyzębia I i II stopnia nasilenia.

Materiał i metody. Przebadano 105 pacjentów, wśród których byli chorzy na reumatoidalne zapalenie stawów, mieszkający na terenach korzystnych i niekorzystnych dla środowiska. Specyfikę stanu strukturalnego i funkcjonalnego tkanki kostnej oceniano za pomocą densytometru ultradźwiękowego Sunlight Mini Omni TM oraz poziomu markera resorpcji tkanki kostnej dezoksyperydynoliny w moczu.

Wyniki. Najwięcej osób z objawami osteopenii, osteoporozy i podwyższonym poziomem dezoksyperydynoliny stwierdzono wśród pacjentów z uogólnionym zapaleniem przyzębia z reumatoidalnym zapaleniem stawów, mieszkający na terenach niekorzystnych dla środowiska. W szczególności w uogólnionym zapaleniu przyzębia II stopnia z osteopenią – 14 osób (48,27%), z osteoporozą – 9 osób (31%), poziom deoksyperydynoliny ozna-

czony u kobiet wynosił $12,03 \pm 0,16$ n/mol – 2,2 raza więcej niż w grupie osób zdrowych ($p < 0,001$).

Wnioski. Na podstawie parametrów densytometrycznych i poziomu deoksyperydynoliny w moczu stwierdzono przyspieszenie resorpcji tkanki kostnej u pacjentów z uogólnionym zapaleniem przyzębia II stopnia z reumatoidalnym zapaleniem stawów, mieszkających na terenach niekorzystnych dla środowiska.

INTRODUCTION

One of the most pressing problems of modern dentistry is periodontal disease. Due to almost 100% prevalence and lesions of young people, generalized periodontitis (GP) is a problem of modern dentistry (1, 2). The mechanism of GP development still remains a debatable issue among modern researchers. A significant amount of scientific work is devoted to the study of changes in the bone tissue of the jaws in the pathogenesis of GP (3, 4). It has been studied that in rheumatoid arthritis (RA) there is a decrease in BTMD. However, to consider the processes that occur in the cellular process of the upper jaw and the cellular part of the lower jaw in isolation from other parts of the skeleton is not correct, given the unity of the functioning of the bone system (5, 6).

Bone metabolism is closely linked to the general somatic condition of the body and the influence of adverse environmental factors. Acceleration of bone remodeling processes, imbalance between the processes of bone tissue formation and resorption, increasing the rate of bone loss, and as a consequence the development of osteopenia and osteoporosis, occurs in RA (5, 7). However, the influence of adverse environmental factors on bone mineral density (BTMD) in patients with RA remains insufficiently studied.

In periodontology, there are the necessary methods for diagnosing GP in individuals with increased rate of bone tissue resorption. Statistical markers (X-rays, densitometric examination) help to diagnose osteopenia and osteoporosis by determining the amount of bone mass lost, but do not provide information on the rate of bone tissue resorption (8, 9). Biochemical methods have information about the condition of bone tissue. A highly sensitive and specific marker of bone tissue resorption is deoxypyridinoline (DPD) – a product of the destruction of type I collagen, which is contained only in bone collagen (10-12). High levels of DPD in the urine indicate increased bone tissue resorption. Therefore, the greatest amount of information about the condition of bone tissue can be obtained by the simultaneous use of densitometric and biochemical studies.

AIM

The aim of the research is to assess the bone tissue mineral density according to the indicators of densitometric researches and the level of a marker of bone metabolism in generalized periodontitis of I and II degree of severity.

MATERIAL AND METHODS

On the basis of the Department of Dentistry of Postgraduate Education of the Educational and Scientific Institute of Ivano-Frankivsk National Medical University, we examined 105 patients with GP, including 70 patients with RA. The diagnosis of RA was established by a rheumatologist on the basis of clinical, laboratory and radiological data according to the unified clinical protocol "Rheumatoid Arthritis", approved by the Order of the Ministry of Health of Ukraine 11.04.2014 №263. Treatment prescribed by a rheumatologist consisted of the use of basic antirheumatic drugs and nonsteroidal anti-inflammatory drugs.

Patients with RA were divided into two groups depending on environmental living conditions. Group I ($n = 35$) – live in environmentally unfavorable areas; Group II ($n = 35$) – live in environmentally favorable areas. Group III ($n = 35$) was formed by patients with GP without concomitant somatic pathology. Patients of all groups, depending on the degree of GP, were divided into two subgroups: A (I degree of GP), B (II degree of GP). The control group (K) consisted of 18 practically healthy individuals with intact periodontium and preserved dentition. The diagnosis of GP was established according to the classification of MF Danilevsky (1994).

Densitometric researches were performed using an ultrasonic densitometer Sunlight Mini Omni TM at Dr. Tsaruk Medical Center. Quantitative determination of DPD was performed using the DPD EIF KIT kit (USA) by the method of solid-phase enzyme-linked immunosorbent assay in the interdepartmental research laboratory of Ivano-Frankivsk National Medical University. Reference values are for women (25-44 years): 3.0-7.4 n/mol, for men (25-55 years): 2.3-5.4 n/mol. The obtained results were statistically processed using the computer program Statistica 7.

RESULTS

Figure 1 shows the result of examination of a patient with GP IIIB subgroup on an ultrasonic densitometer.

As can be seen from figure 1, in this patient BTMD is within normal limits. After analyzing the results obtained by us in all patients, we found changes in the structural and functional state of bone tissue in patients with generalized periodontitis of varying severity in percentage in each subgroup, which are presented in figure 2.

Patients with GP of the II degree of severity of osteopenia were most detected in the IB subgroup – 14 people (48.27%), and in the IIB subgroup – 12 people (46.15%). In subgroup IIIB, osteopenia was

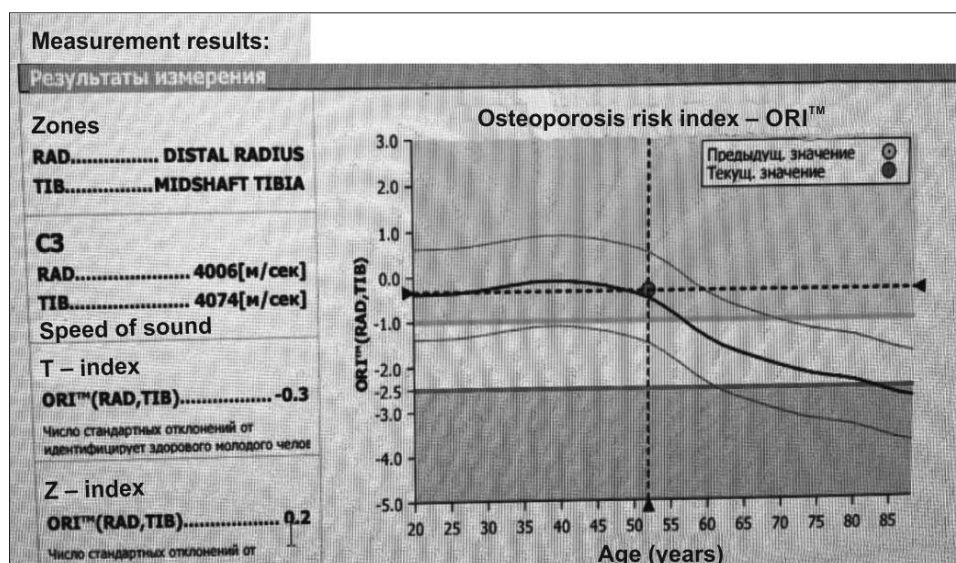


Fig. 1. The result of ultrasound examination of patient O, 52 years old
 T-index: from -1.0 to +1 – norm; from -1.0 to -2.5 – osteopenia; < -2.5 – osteoporosis

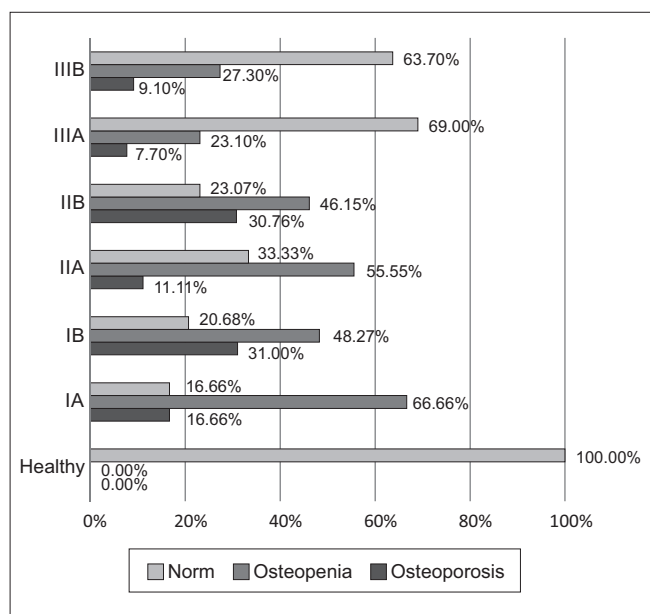


Fig. 2. Structural and functional state of bone tissue in patients with generalized periodontitis of varying severity

diagnosed in 6 subjects (27.3%). In patients with GP of the I degree patients with signs of osteopenia were significantly less, in particular in IA subgroup 4 people (66.66%), in IIA – 5 people (55.55%) and in IIIA – 3 people (23.10%).

As can be seen from figure 2, osteoporosis was also more often diagnosed in patients with GP of the II degree of severity almost equally in IB and IIB subgroups in 9 (31%) and 8 (30.76%) patients, respectively. In IIIB subgroup it was found only in 2 people (9.1%). On the other hand, in patients with GP of the I degree osteoporosis was manifested only by 1 patient (16.66%) – IA subgroup, (11.11%) – IIA subgroup, (7.70%) – IIIA subgroup. Only in subgroup IIIA were found the most patients who had BTMD within normal limits (69%).

Thus data from densitometric researches indicate that the presence of concomitant somatic pathology increases the frequency of structural and functional disorders of bone tissue.

Bone tissue resorption was assessed by the level of the marker of bone remodeling DPD in the urine of patients, and our results are presented in table 1.

According to our results, the level of DPD was much higher in women. The highest level of DPD was determined in women of IB subgroup – 12.03 ± 0.16 n/mol, which was 2.2 times significantly higher than this indicator in the control group (5.47 ± 0.05 n/mol, $p < 0.001$). In the IIB subgroup this indicator was slightly lower and was 11.05 ± 0.22 n/mol, IIB subgroup – 8.31 ± 0.16 n/mol, which significantly differed from the control group in 2.02 and 1.5 times respectively ($p < 0.001$). The lowest level of the researched indicator was

Tab. 1. The level of deoxypyridinoline (n/mol) in the urine of patients with GP (M ± m)

Gender of patients	Control group w (n = 8) m (n = 8)	I group		II group		III group	
		IA w (n = 6) m (n = 0)	IB w (n = 23) m (n = 6)	IIA w (n = 7) m (n = 2)	IIB w (n = 21) m (n = 5)	IIIA w (n = 11) m (n = 2)	IIIB w (n = 15) m (n = 7)
Women	5.47 ± 0.05	11.49 ± 0.52	12.03 ± 0.16	10.75 ± 0.47	11.05 ± 0.22	7.91 ± 0.13	8.31 ± 0.16
Men	4.16 ± 0.18	–	10.78 ± 0.52	8.78 ± 0.13	9.33 ± 0.57	5.95 ± 0.70	6.98 ± 0.42

found in patients of subgroup IIIA and was -7.91 ± 0.13 n/mol, which is 1.45 times significantly higher than that in the control group ($p < 0.001$).

Among men, the level of DPD was highest in IB subgroup 10.78 ± 0.52 n/mol and IIB subgroup 9.33 ± 0.57 n/mol, against 4.16 ± 0.18 n/mol in the control group, which was significantly higher by 2.6 and 2.24 times, respectively ($p < 0.001$). The lowest value of DPD level was also observed in IIIA subgroup 5.95 ± 0.70 n/mol.

Data of densitometric researches indicate that the presence of concomitant somatic pathology increases the frequency of structural and functional disorders of bone tissue. Adverse effects of ecology are insignificant on the researched indicators.

DISCUSSION

Summarizing the obtained results of the research on densitometric indicators and the level of a marker of bone tissue resorption – deoxypyridinoline, revealed a significant violation of the structural and functional state of bone tissue in patients with GP with RA who live in anthropogenically loaded areas. In particular, in patients with GP of the II degree of severity (IB subgroup) there is a significant acceleration of bone tissue remodeling, imbalance between the processes of bone formation and resorption and as a consequence the development of osteopenia and osteoporosis, as evidenced by a significant increase in deoxypyridinoline in urine both men and women. In patients with GP of the I degree (IA subgroup), more than half of the patients showed signs of osteopenia more often than osteoporosis, and the level of DPD was already slightly lower. However, in patients

with GP with RA, who live in environmentally favorable areas of the II group, the development of GP of I and II degree of severity also occurs against the background of reduced structural and functional state of bone tissue. The predominance of osteopenia over osteoporosis was revealed, which was more pronounced in patients with II degree (IIB) of severity, which is also confirmed by the increase in deoxypyridinoline in the urine.

In almost healthy individuals with intact periodontium who live in environmentally favorable areas, bone tissue remodeling processes are in a state of dynamic equilibrium.

Thus, the concomitant somatic pathology and the adverse effects of environmental factors lead to an imbalance of osteosynthesis and osteoresorption, which accelerates the progression of GP.

CONCLUSIONS

According to the level of deoxypyridinoline in urine, which is 2.19 times higher than the level of the researched indicator in examined healthy people, and the highest percentage of patients with osteopenia and osteoporosis, the acceleration of bone tissue resorption in patients with generalized periodontitis of the II degree of severity with rheumatoid arthritis who live in environmentally unfavorable areas.

PROSPECTS FOR FURTHER RESEARCH

Based on the results of our research of the level of DPD in urine and BTMD in patients with RA who live in environmentally unfavorable areas, a treatment and prevention complex will be developed.

BIBLIOGRAPHY

1. Borysenko AV: Biochemical substantiation of complex treatment of generalized periodontitis. Department of Therapeutic Dentistry named by Bohomolets O O.National Medical University. Dentistry From Science and Practice 2014; 1: 12-20.
2. Kulygina VN, Mokhammad AL, Mokhammad, Kozlova LL: The results of a research of the prevalence and structure of periodontal disease in young people. Ukrainian Dental Almanac 2013; 5: 29-31.
3. Mazur IP: Disorders of bone metabolism in patients with generalized periodontitis. Clinical and experimental study. Part 3. Implantology. Periodontology. Osteology 2012; 2(26): 70-74.
4. Mazur SP, Stupnytska OM: Age features of the structural and functional state of periodontal tissues and bone tissue in women. Women's Health 2012; 9(75): 143-150.
5. Banadyha NV: Osteoporosis or osteopenia. Child Health 2007; 6(2): 52-56.
6. Batih VM, Ostafiychuk MO, Prodanchuk AI: Periodontal tissue pathology in systemic osteoporosis. Bukovynian Medical Bulletin 2013; 3(67): 90-93.
7. Bilozetskyi II: Modern ideas about the relationship between generalized periodontitis, rheumatoid arthritis and osteoporosis. Problems of Osteology 2015; 2(8): 51-63.
8. Huk UM, Hayko OH, Zyma AM: X-ray densitometry in the assessment of the structural and functional state of bone tissue in patients with imperfect osteogenesis. Pain. Joints. The spine 2014; 1: 99-104.
9. Yarmoshuk IR, Rozhko MM, Pelekhan LI: Changes in densitometric indicator in the complex treatment of generalized periodontitis in patients with osteopenia. Archive of Clinical Medicine 2016; 2(22): 54-56.
10. Kuznyak NB, Boytsanyuk SI, Sukholovets IO: Use of biochemical markers of bone metabolism in dentistry. Clinical Dentistry 2015; 1: 13-14.
11. Prots HB: Diagnostic value of biochemical markers of bone remodeling in the complex treatment of patients with generalized periodontitis. Archive of Clinical Medicine 2013; 1(19): 76-79.
12. Prots HB, Pyuryk VP, Nychyporchuk HP, Solodzhuk YUI: Evaluation of markers of bone remodeling in the complex treatment of generalized periodontitis. Prykarpattya Bulletin of NTSh. Pulse 2016; 4(36): 41-50.