http://dx.doi.org/10.35630/2199-885X/2021/11/1.23

ORAL HOMEOSTASIS STATUS IN MILD CHRONIC GENERALIZED PERIODONTITIS AND MILD DENTAL PERI-IMPLANTITIS

Received 23 January 2021;
Received in revised form 22 February 2021;
Accepted 25 February 2021

Vladimir Tlustenko ✉, ***Valentina Tlustenko***, ***Oksana Gusyakova***, ***Dmitry Trunin***, ***Vladimir Potapov***

Samara State Medical University, Samara, Russia

✉ *vlastt@yandex.ru*

ABSTRACT — The paper is focused on evaluating the oral cavity homeostasis in patients with mild chronic generalized periodontitis (CGP) (Group 1, 35 persons) and mild peri-implantitis (Group 2, 30 persons). The control group included healthy individuals (20 persons) with neither dental nor somatic issues. The material used for the study was oral fluid. The general metabolic processes in the periodontal and peri-implant area tissues were described based on analysis of the protein and mineral metabolism indicators, as well as on the hygiene and periodontal status indices. The paper presents the results of a comparative assessment involving Groups I and II with the control group and between Groups I and II. Our findings show changes in ion balance in both groups. Significant disturbances in the protein and mineral metabolism have been identified in the main groups, which contributes to the development of inflammation and reduced detoxification in periodontal and peri-implant tissues. A rise in Calcium and Magnesium indicates destructive processes in bone tissues. In case of mild CGP, these changes are more prominent. The oral hygiene and periodontal status indices in Group I proved to be significantly worse. Therefore, while performing implantation on the background of chronic generalized periodontitis, it is important to take into account its metabolic imbalance and implement preventive measures.

KEYWORDS — dental peri-implantitis, chronic generalized periodontitis, oral fluid, oral cavity homeostasis.

INTRODUCTION

Of all dental issues affecting different population groups, the recent years have witnessed an increase in various periodontal diseases [1, 2, 5, 7, 14]. Their overall prevalence remains high with no decrease trend to be observed practically anywhere in the world [3, 4]. The data available in the literature in Russia shows that 95% -100% of patients among different age groups have signs of inflammatory periodontal diseases [12, 15]. A special place here belongs to chronic generalized periodontitis (CGP), which is a serious social, economic and medical issue [6]. Periodontal diseases feature pathogenic microflora in the oral cavity. Accumulating bacterial plaque facilitates inflammation, which often results in removed teeth. Once lost, the teeth can be restored through various methods, including implants. In modern conditions, the indications for implantation in patients with periodontal diseases are expanding.

However, failure to follow oral hygiene requirements and periodontitis belong to the risk factors for peri-implantitis [8–11, 13]. The hypothesis here is that pathogenic microorganisms detected on periodontal teeth can develop colonies, so implants, similarly to cross-infection, develop a complication known as dental peri-implantitis. Despite the undeniable progressive value of implantation, dental peri-implantitis complicates osseointegration. Typical is the fact that inflammatory and destructive complications can be observed even in cases where the bone-to-implant connection is optimal and are to be regarded as osseointegration. In this regard, improving implants osseointegration and maintaining the area of the implant and the surrounding bone tissue, which is discussed in the literature, stands out as an urgent issue faced by implantology.

Currently, there is a need for newer data that would reveal the role and the nature of the effect that CGP has in modeling molecular processes responsible for physiological and reparative osteogenesis, search for individual criteria, and identification of predictors behind the development of inflammatory and destructive complications in dental implantation. Oral fluid (OF), in this context, is a universal medium that can be obtained noninvasively and it is widely available when it comes to studying various processes. To determine the most specific character of metabolic changes in dental peri-implantitis, as we see it, can be done through a comparative study of oral fluid in inflammatory diseases of periodontium and the peri-implant area tissues.

Aim of study:
to evaluate the oral homeostasis status in patients with mild chronic generalized periodontitis and mild dental peri-implantitis, in order to predict the development of inflammatory and destructive complications of dental implants.

MATERIALS AND METHODS

To evaluate oral homeostasis, 85 patients were examined, including 35 (41.2%) of them featuring mild chronic generalized periodontitis (Group 1) and another 30 (35.3%) with mild dental peri-implantitis (Group 2). In order to compare the OF studied indicators, 20 more persons (23.5%), comparable in gender and age, healthy in term of dental and somatic health, and referred to as the control group, were examined. The oral homeostasis status was evaluated through studying a number of indicators reflecting the destruction process, the mineralization and demineralization of the bone tissue. For this purpose, the biochemical composition of the unstimulated mixed oral fluid and the hygiene status of the oral cavity were studied. The study relevance relies on the need to establish pathological changes at the metabolic level, thus aiming to develop further treatment tactics. All the patients had their OF content of mineral components (Calcium, Magnesium, Ammonium Cation, Nitrate Anion), protein metabolism indicators (total protein, total albumin concentration, effective albumin concentration, albumin binding reserve and toxicity index) evaluated.

The dental status was evaluated through the following indexes: the Green-Vermillion index in the Cowell modification, the Russel index, the Loe & Silness index, and the Muhlemann index. Statistical data analysis was performed within the SPSS 25 package. Descriptive statistics were represented via the mean and standard deviation (M±SD). Group comparison implied single-factor analysis of variance (one-way ANOVA) followed with inter-group comparisons involving the Bonferroni criterion. The differences were considered statistically significant at $p<0.05$.

RESULTS AND DISCUSSION

Table 1 shows the results of protein metabolism.

The total protein concentrations in the oral fluid of all the three groups featured comparable values and did not differ statistically. There was no difference between the total albumin concentration in the control groups and in patients with chronic generalized periodontitis, yet it was lower in patients with dental peri-implantitis ($p<0.001$ compared to the control group and Group 1). Significantly lower values of effective albumin concentration, albumin-binding capacity and toxicity index were observed in both groups of patients, if compared to the control group ($p<0.001$). The effective albumin concentration and the toxicity index in Groups I and II, though, revealed no statistically significant difference, whereas the albumin-binding capacity was the lowest in patients with mild dental peri-implantitis ($p=0.003$ compared to patients with mild CGP).

Table 2 shows the results of mineral exchange.

Statistically significantly higher concentrations of oral fluid mineral components (Calcium, Magnesium, Ammonium Cation and Nitrate Anion) were identified in patients with mild chronic generalized periodontitis and mild dental peri-implantitis, if compared to the control group ($p<0.001$). When comparing the groups among themselves, higher concentrations of Calcium and Ammonium Cations were to be observed in Group 1 compared to Group 2 ($p<0.001$), while the Nitrate Anions level was higher ($p=0.007$). The Magnesium concentrations in the oral fluid obtained from patients with mild CGP and mild dental peri-implantitis did not differ statistically.

The Ammonium Cation and the Nitrate Anion contents were evaluated in order to detect the degree of microbial invasion as the ions in question are mainly products of microorganisms' metabolism. Their increase in Groups I and II, if matched against the control group, inspired the idea of identifying the reason behind microbial contamination. From this stance, of interest is studying the indices of oral hygiene, the periodontal tissues status, and the peri-implant area. The results are to be seen from Table 3.

Analysis of the data in the table shows that the hygiene indices, as well as the periodontal index and

Table 1. *Oral fluid protein metabolism indicators in Groups I and II compared with the control group*

Indicator	Control group M±SD n=20	Patients with mild chronic generalized periodontitis (Group I) M±SD n=35	Patients with mild dental peri-implantitis (Group II) M±SD n=30	p, Control group – Group I	p, Control group – Group II	p, Group I – Group II
Total protein, g/l	3.40±0.47	3.50±0.36	3.45±0.35	1.000	1.000	1.000
Total albumin concentration, g/l	0.33±0.01	0.33±0.04	0.29±0.03	1.000	<0.001	<0.001
Effective albumin concentration, g/l	0.26±0.05	0.13±0.05	0.10±0.06	<0.001	<0.001	0.095
Albumin-binding capacity	78.8±10.5	42.7±9.6	34.4±9.4	<0.001	<0.001	0.003
Toxicity index	0.27±0.15	2.01±0.82	1.91±0.95	<0.001	<0.001	1.000

Table 2. *Mineral components content in the oral fluid, Groups I and II vs. the control group*

Indicator	Control group M±SD n=20	Patients with mild chronic generalized periodontitis (Group I) M±SD n=35	Patients with mild dental peri-implantitis (Group II) M±SD n=30	p, Control group – Group I	p, Control group – Group II	p, Group I – Group II
Calcium (mmol/l)	0.55±0.07	1.13±0.21	0.92±0.20	<0.001	<0.001	<0.001
Magnesium (mmol/l)	0.29±0.08	1.23±0.24	1.10±0.65	<0.001	<0.001	0.826
Ammonium Cation (mmol/l)	3.10±0.29	7.12±0.76	6.22±0.72	<0.001	<0.001	<0.001
Nitrate Anion (mmol/l)	2.74±0.38	7.21±0.89	6.51±0.87	<0.001	<0.001	0.007

Table 3. *Indicators of index assessment of the state of periodontal and peri-implant zone tissues of Groups I and II*

Group	Green-Vermillion index	Russel index	Muhlemann index
Group I	3.24±0.23	2.53±0.21	1.96±0.21
Group II	2.57±0.22	1.51±0.13	1.75±0.15
Control group	1.3±0.01	1.2±0.09	1.1±0.10

the gum bleeding index are significantly higher in Groups I and II if compared to the control one. Comparing Groups I and II, we can see that the values are higher in Group I, which suggests that the increase in the Ammonium Cation and Nitrate Anion in the OF is due to poor oral hygiene.

The oral homeostasis evaluation in patients with mild CGP and mild dental peri-implantitis revealed an ionic imbalance with a certain correlation dependence. A decrease in the albumin effective concentration reflects a decrease in its free binding centers. Their number helped identify the protein protection status. The effective concentration of this transport protein serves to describe its ability to be involved in detoxification processes. The albumin-binding capacity decreased significantly in Groups I and II, which can be viewed as a pathogenetically important link within inflammation development in peri-implant and periodontal tissues. The decrease in the Calcium and Magnesium levels observed in Groups I and II demonstrates a unidirectional process of bone resorption in the dentoalveolar zone.

CONCLUSION

Thus, the analysis of oral fluid protein metabolism indicators showed a decrease in protein protection in Groups I and II if compared with the control group, which is evidence to the development of inflammation and a decrease in detoxification processes in periodontal and peri-implant tissues. In case of mild CGP, these changes are more pronounced. The evaluation of mineral metabolism showed a significant increase in the Calcium and Magnesium levels in the OF collected among patients of Groups I and II, compared with the control, which points at bone resorption, especially in Group I. Low levels of oral hygiene as well as the periodontal and peri-implant tissue condition indices correlate both with the control group, and among the groups. Mild CGP, though, features more significant disturbances in protein and mineral metabolism, if compared with mild dental peri-implantitis. Lack of periodontal ligaments in implants attached to them may cause peri-implantitis on the background of chronic generalized periodontitis, even in mild cases. This factor should be taken into account when carrying out dental implantation.

REFERENCES

1. **Avanisyan V., Al-Harazi G., Kondratyeva T., Harutyunyan Yu.** Morphology of facial skeleton in children with undifferentiated connective tissue dysplasia. Archiv EuroMedica. 2020. Vol. 10; 3: 130–141. https://dx.doi.org/10.35630/2199-885X/2020/10/3.32
2. **Basov A.A., Ivchenko L.G., Nuzhnaya C.V.** The role of oxidative stress in the pathogenesis of vascular complications in children with insulinable sugar diabetes // Archiv EuroMedica. 2019. Vol. 9; 1: 136–145. https://doi.org/10.35630/2199-885X/2019/9/1/136
3. **Costa F.O.** Epidemiology of Periodontal Disease / F.O. Costa // Int. j Dent. – 2012 /. T. 2012 –P. 1–2. https://doi.org/10.1155/2012/848641
4. **Do, T**/ Oral biofilms: molecular analysis, challenges, and future prospects in dental diagnostics / T. Do, D. Devine, P.D. Marsh // Clin. Cosmet. Investing. Dent. – 2013 – Vol. 5. – P. 11-19. DOI: 10.2147/CCIDE.S31005
5. **Domenyuk D.A., Samedov F., Dmitrienko S.V.** Matrix metalloproteinases and their tissue inhibitors in the pathogenesis of periodontal diseases in type 1 diabetes mellitus // Archiv EuroMedica. 2019. Vol. 9. № 3. P. 81–90. https://doi.org/10.35630/2199-885X/2019/9/9/3.25
6. Evaluation of oral cavity condition with regard to decay in 18-year old from urban and rural areas in Podkarpackie Province, Poland / M. Mielnik-Blaszczak,

Rudnicka-Siwer, M. Warsz [etal.] // Przegl. Epidemiol. – 2016. – Vol. 70 No. 1. – P. 53–58.

7. **Harutyunyan Yu.** Undifferentiated connective tissue dysplasia as a key factor in pathogenesis of maxillofacial disorders in children and adolescents // Archiv EuroMedica. 2020. Vol. 10; 2: 83–94. https://dx.doi.org/10.35630/2199-885X/2020/10/2.24
8. **Karpyuk V.B., Perova M.D., Gilevich I.V., Sevostyanov I.A.** Cell-potentiated regenerative technologies for restoring jaw bone tissues in case of odontogenic inflammatory & destructive process // Archiv EuroMedica. 2019. Vol. 9. № 2. P. 140–146. https://doi.org/10.35630/2199-885X/2019/9/2/140
9. **Karpyuk V.B., Perova M.D.** Innovation-based approach in reconstruction of reduced jaw alveolar ridge bone using cell regeneration technologies // Archiv EuroMedica. 2019. Vol. 9. No. 2. P. 147–155. https://doi.org/10.35630/2199-885X/2019/9/2/147
10. **Kupryakhin S.V., Lepilin A.V., Kupryakhin V.A.** Optimization of dental implantation combined with closed sinus lift in patients with low maxillary sinus floor // Archiv EuroMedica. 2019. Vol. 9; 2: 117–121. https://doi.org/10.35630/2199-885X/2019/9/2/117
11. **Kupryakhin S.V., Lepilin A.V., Kupryakhin V.A., Postnikov M.A.** Potential introduction of cell technologies to improve dental implant surface preparing // Archiv EuroMedica. 2019. Vol. 9; 2: 122–129. https://doi.org/10.35630/2199-885X/2019/9/2/122
12. **Kuzmina, E.M.** Preventive dentistry: Textbook / E.M. Kuzmina, O.O. Yanushevich. - M .: Practical medicine. – 2016. – 544 p.
13. **Olesov, E.E.** Assessment of the responsibility of patients with implants for the observance of oral hygiene and dispensary observation / E.Yu. Khavkina, N.I. Shaimiev, V.I. Kononenko, R.U. Bersanov, S.S. Khubaev // Russian dental journal. – 2013. – No. 2. P. 50–52.
14. **Subanova, A.A.** Peculiarities of the epidemiology and pathogenesis of periodontal diseases (literature review) / A.A. Subanova // Bulletin of the KRSU. – 2015. – T. 15. No. 7 – P. 152–155.
15. **Vasilieva, N.A.** Dental status of patients with periodontal disease / N.A. Vasilyeva. A.I. Bulgakova, E.S. Soldatova // Medical Bulletin of Bashkortostan. – 2016. – T. 11, No. 6 (66). – P. 31–35.