

Influence of interdental hygiene products on periodontal pathogens according to indicators of hygienic indices

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ABSTRACT

Many articles describe in detail local accidents and complications in the treatment of dental implants. The comparison of the data provided is not always correct, because different criteria and indexes were used in different classifications. The problem of inflammatory complications of dental implantation is particularly acute, in the long term after prosthetics in patients who have facial mucositis and peri-implantitis. This observation gave rise to a hygienic hypothesis, which postulates that the reduction in the frequency of infections directly depends on the drug Phagodent. The prevalence of inflammation is limited in the gum around the implants – mucositis and accompanied by resorption of the underlying bone tissue - periimplantitis, according to various data, occurs at least 30%. This article compares three options for the volume of individual hygiene measures in patients with prosthetic implants. We found that the use of interdental hygiene products, irrigators, and Phagodent gel greatly improves the effectiveness of traditional hygiene using a toothbrush and paste. It should be noted that the high level of achieved indicators is based on quarterly professional hygiene.

Keywords: Interdental oral hygiene products, Oral hygiene, Prostheses on implants, Phagodent

Introduction

The extensive accumulated experience of using the dental implantation method in Russia and the world has revealed the main complication of implantation both at the stages of prosthetics and at different periods of operation of prostheses on implants – inflammation in peri-implant tissues [1-3]. The prevalence of inflammation is limited in the gum around the implants – mucositis and accompanied by resorption of the underlying bone tissue – periimplantitis, according to various data, occurs at least 30%, with 10% occurring in the three years

after the completion of prosthetics. In the absence of treatment, peri-implantitis ends with the disintegration of the implant; treatment of peri-implantitis is a complex problem associated, in addition to eliminating inflammation, with the need to restore lost bone tissue [4-7].

Analyzing the problem of inflammatory complications of dental implantation, some authors in the long term after prosthetics in their patients found mucositis in 28.0% of individuals and peri-implantitis in 7.4% (3% of implants removed in 10 years) [8-11]. According to Nikitin *et al.* (2017), there was an increase in complications in men, especially in older age, in the presence of somatic diseases and periodontitis, with poor oral hygiene and violation of medical examination [12]. The author interviewed many dentists and found that two-thirds of them have experience using antibiotics and antiseptics for inflammatory phenomena in the mouth (a quarter of doctors are dissatisfied with their effectiveness); only a fifth of the respondents conducted microbiological studies for their patients. Nikitin V.V. proposed to use the bacteriophage preparation "Phagodent" for the prevention of mucositis and peri-implantitis since the detection

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of periodontal pathogens around implants will decrease by half after treatment with "Phagodent" (before treatment with peri-implantitis, their content reached 66.5%). A higher sensitivity of the microflora to the "Phagodent" (80.0%) was found in comparison to the antiseptic chlorhexidine (53.3%) and antibiotics (60.0%). The lytic activity of "Phagodent" must be preserved with 0.05% chlorhexidine, "Listerine" and triclosan (which are included in hygiene products). "Phagodent" is significantly less cytotoxic compared to 0.05% chlorhexidine (10 times). According to the author's experience, the use of "Phagodent" at home reduces the appearance of mucositis and peri-implantitis by half, and with their treatment, the terms are 14.6% and 19.2% shorter, respectively (the recurrence rate is 62.6% and 62.3% less, respectively, compared with traditional treatment). This is also indicated by periodontal indices: with mucositis, hygienic and periodontal indices are better by 23.5%-50.0%, respectively, and with peri-implantitis by 13.0% and 33.3%.

In inflammatory periodontal diseases, the same drug Phagodent, including bacteriophages to 56 microorganisms of the oral cavity, was used by other authors, and their research extended to peri-implant tissues [13-17]. Just like Nikitin V.V., the authors did not see any (local and general) side effects of the drug. The phagodent was more effective compared to the preparation based on chlorhexidine and metronidazole Metrogyl Dent. This was manifested in a lower detectability of periodontopathogens according to PCR diagnostics (75% less detectability of periodontopathogens after Phagodent treatment and only 36.3% in the treatment of Metrogyl Dent; the detectability of normoflora increased by 17% respectively and only 9% in the treatment of Metrogyl Dent). When using Phagodent, it is 17% higher than before treatment (when using Metrogyl Dent, it is only 9% higher). With the use of a Phagodent, as a result of surgical treatment, the content of proinflammatory cytokines IL-1 β , IL-6, and TNF- α decrease in periodontal pockets, and IL-10 and TFR- β indicators increase per turnover.

In dentistry, several studies have shown the effectiveness of "Phagodent" in the treatment of periodontitis and peri-implantitis. Historically, interest in bacteriophages, which appeared as a science at the beginning of the last century, faded in the second half of the century due to the appearance of antibiotics and is increasing again due to the accumulation of cases of lack of effectiveness of antibiotics and the increase in "habituation" to them [18-22].

These principles underlie the phage preparations of the SPC "Microcosm" – "Phagoderm", "Phagogin", "Otophage", "Phagodent". The Russian Research and Production Center "Mikromir" develops antibacterial agents based on bacteriophages, which are used in some areas of medicine, including dentistry. According to the manufacturer's recommendation, the Phagodent gel is intended for dentistry, in particular, for use in hygienic complexes for the antibacterial protection of the gums and oral mucosa. The bacteriophage complex included in the "Phagodent" is specific to the suppression of anaerobic and aerobic flora.

The novelty of the study

1. For the first time, a comprehensive assessment of the state of the oral cavity was carried out depending on the volume of individual hygiene.
2. For the first time, a comparative assessment of the use of a gel-based on bacteriophages of periodontal pathogens "Phagodent" with three options for individual oral hygiene was carried out.

Purposes and objectives of the study

1. Compare periodontal indices in patients with implants depending on the volume of individual hygiene.
2. To study the effect of a combination of hygiene products, irrigators, and Phagodent gel on the effectiveness of traditional oral hygiene.

Materials and Methods

At the Department of Dentistry No. 3 of the North Ossetian State Medical Academy of the Ministry of Health of Russia (Vladikavkaz, Republic of North Ossetia-Alania, Russia), 60 patients with different volumes of individual hygiene measures were monitored for one year after the end of prosthetics on 162 implants.

Table 1. Characteristics of the clinical examination group

Specifications	The group under study		
Gender	male	female	
	38%	61%	
Age	20-40	40-60	
	43%	57%	
Oral hygiene	satisfactory	unsatisfactory	
	100%	0	
Medical examination	regularly	irregular	non
	100%	0	0
	1 year	2 years	3 years
Terms of operation	100%	0	0
	Defect of the dentition	complete absence of teeth	partial absence of teeth
15%		85%	
Periodontitis	Yes	No	
	28%	71%	
Bad habits	Smoking	No	
	10%	90%	
Prosthesis design	Removable	Fixed	
	8%	92%	

Dispensary control included clinical and index evaluation of periodontal and peri-implant tissues, professional oral hygiene, occlusive correction, and orthopantomography every six months [23-26]. In addition, the index examination of hygiene and periodontal was carried out in time: before the start of therapeutic measures (when contacting the clinic), after preimplantological sanitation of the mouth (including

periodontal treatment and professional hygiene, before the manufacture of permanent prostheses (at the end of the period of osseointegration and use of temporary prostheses). Equal in number subgroups differed according to the following criteria:

- traditional oral care twice a day using a standard toothbrush, toothpaste, and mouthwash (subgroup II_t – traditional hygiene);
- extended hygienic manipulations using a monopuckle toothbrush and interdental hygiene products (brushes and floss), dental irrigator (II_e – extended hygiene);
- additional use after extended hygiene of a gel based on bacteriophages of periodontal pathogens "Phagodent" in the form of applications (II_p – Phagodent).

Results and Discussion

As it turned out when comparing three variants of the volume of individual hygiene measures in patients with prosthetic implants in the second group (II_t – traditional hygiene, II_e – extended hygiene, II_p – Phagodent), the hygiene content is important for the indicators of the oral cavity (**Table 2**).

Table 2. The state of hygiene and periodontal in patients with implants depending on the volume of individual oral hygiene (after 12 months)

Subgroup Indicator	II _t	II _e	II _p
Green J.C. Oral Hygiene Index, Vermillion J.R (OHI-S)	2,0	1,5	1,2
Supraconstruction Hygiene Index	1,6	1,4	0,8
Gingivitis index Loe H., Silness J. (GI)	1,5	1,2	0,8
Muhlemann index in Cowell modification	1,3	0,7	0,5
The PMA index in the Parma modification	40,2%	32,0%	23,3%
Organoleptic index	3,7	1,9	1,2
Galimeter Index (ppb)	221,0	163,0	133,0
Detection of periodontal pathogens	45,0%	25,0%	10,0%

There is an unambiguous trend of improvement of indicators in the II_p subgroup in comparison with II_e and, in turn, II_e in comparison with II_t.

Thus, the index of oral hygiene Green J.C., Vermillion J.R. (OHI-S) in the subgroup with traditional hygiene (II_t) at the stage of final control for twelve months was 2.0 ± 0.3 , in the group with the inclusion of interdental hygiene products (II_e) – 1.5 ± 0.2 , in the group with the use of Phagodent gel (II_p) 1.2 ± 0.1 . In these subgroups of II_t, II_e, II_p, the hygiene index of supraconstruction was 1.6 ± 0.3 , 1.2 ± 0.3 , and 0.8 ± 0.1 , respectively. The index of gingivitis Loe H., Silness J. (GI) in the subgroups II_t, II_e, II_p was 1.5 ± 0.3 ; 1.2 ± 0.2 , and 0.8 ± 0.2 . The Muhlemann index in the Cowell modification decreased from 1.3 ± 0.3 with traditional hygiene, to 0.7 ± 0.1 with extended hygiene, and 0.5 ± 0.1 when Phagodent was included in hygienic care. Similarly, the $40.2 \pm 5.5\%$ PMA index in the Parma modification in the II_t subgroup decreased to $32.0 \pm 3.7\%$ in the II_e subgroup and, especially, in the II_p subgroup to $23.3 \pm 4.4\%$.

The organoleptic index and the Halimeter index (respectively 3.7 ± 0.5 and 221 ± 26.2 ppb) with traditional hygiene became 1.9 ± 0.3 and 153 ± 17.8 ppb with the expansion of hygiene due to interdental means and respectively 1.2 ± 0.1 and 133 ± 15.4 ppb in the subgroup when using a Phagodent.

Thus, the combination of interdental hygiene products, irrigators, and Phagodent gel greatly improves the effectiveness of traditional hygiene using a toothbrush and paste. The inclusion of interdental means and irrigators significantly improves traditional hygiene, and the use of a Phagodent further improves the effectiveness of mechanical hygiene products (toothbrushes, interdental brushes, irrigators). It should be noted that the high level of achieved indicators is based on quarterly professional hygiene.

Using the example of the second group, the study compared the effectiveness of not only professional oral hygiene but also three options for individual oral hygiene. One group of patients used traditional methods of oral care (II_t), the second additionally used methods of interdental hygiene and dental irrigator (II_e), and the third differed from the II_e group by using a gel based on bacteriophages of periodontal pathogens "Phagodent" at the end of hygienic measures.

The choice of "Phagodent" gel as a prophylactic drug of topical application is due to the originality of its action, harmlessness, and greater effectiveness without addiction in comparison, for example, to the gel "Metrogil-Denta". Data on the effectiveness of "Phagodent" are taken from many scientific studies [27-29].

Observation for a year of three groups of equivalent in number and characteristics with a different set of hygienic manipulations confirmed the expediency of prescribing, in addition to the traditional oral care scheme (toothbrush, paste, rinse aid), interdental hygiene products, and an irrigator. As a result of this approach, a number of indicators are significantly improved (hygiene index OHI-S, Muhlemann index, etc.). An even better effect is achieved when the Phagodent gel is prescribed – in this case, all hygienic and periodontal indicators are improved in comparison with the traditional volume of hygienic measures. Thus, when using Phagodent, the OHI-S oral hygiene index, the super construction hygiene index, the gingivitis index GI, the Muhlemann index, the PMA index, the organoleptic index, the Halimeter index, and the detectability of periodontal pathogens against the background of occupational oral hygiene during control after 12 months (**Figure 1**) were 1.2; 0.8; 0.8; 0.5; 23.3%; 1.2; 133.0 ppb; 10.0%, and the same indicators in people with traditional oral care methods were significantly worse. If the role of interdental agents and dental irrigators in maintaining the level of hygiene in the presence of implants has been shown in previous studies, then the role of "Phagodent" is not sufficiently illuminated and the data obtained allow it to be included in the algorithm of standard oral care for patients with implants.

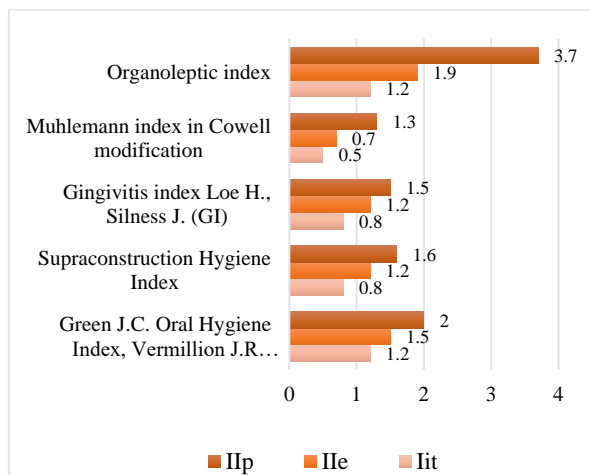


Figure 1. Comparison of the index and periodontal indices in patients with implants depending on the quality of individual oral hygiene (after 12 months).

Table 3. Reliability of differences in the influence of the quality of individual oral hygiene on hygienic and periodontal parameters in patients with prosthetic implants (+ p < 0.05).

Subgroups	Indicator							
	OHI-S	GSK	GI	Muhlemann	Organoleptic index	PMA index	Halimeter	Periodontopathogens
IIt – IIe	+	-	-	+	+	+	+	+
IIe – IIp	-	+	-	-	+	+	+	+
IIt – IIp	+	+	+	+	+	+	+	+

The addition of interdental agents and irrigators to hygiene measures improves, in comparison with traditional hygiene, such indicators as OHI-S, Muhlemann index, organoleptic index and Halimeter indicators, PMA index, and detection of periodontal pathogens. The advantages of using Phagodent in comparison with the use of irrigators were revealed relative to the following indicators: hygiene index of supraconstruction, organoleptic index, and Halimeter indicators, PMA, and detection of periodontal pathogens (Table 3). A clinical example of an adequate level of hygiene and condition of peri-implant tissues in a patient a year after the completion of prosthetics on implants is shown in Figure 2.



a)



b)



c)

Figure 2. Clinical example of an adequate level of hygiene and condition of peri-implant tissues in a patient one year after the completion of prosthetics on implants

Conclusion

Statistical analysis of the reliability of differences in hygienic and periodontal indicators when using a different list of measures for oral care showed significant differences in IIt – IIp subgroups: the use of Phagodent significantly improves all indicators in comparison with traditional hygiene. The use of interdental hygiene products, irrigators, and Phagodent gel greatly improves the effectiveness of traditional hygiene using a toothbrush and paste. It should be noted that the high level of achieved indicators is based on quarterly professional hygiene.

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Conflict of interest: None

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Ethics statement: The human study was conducted in accordance with the standards of the Helsinki Declaration of the World Association "Ethical Principles of Scientific Medical Research with human participation" and "Rules of Clinical Practice in the Russian Federation" (2003). All patients gave their voluntary consent to participate in the study.

References

1. Remizova AA, Bitarov PA, Epkhiev AA, Remizov NO. Reparative-regenerative features of bone tissue in experimental animals treated with titanium implants. J

- Adv Pharm Educ Res. 2022;12(2):110-6. doi:10.51847/Sprxb1DKyv
2. Xie Y, Li S, Zhang T, Wang C, Cai X. Titanium mesh for bone augmentation in oral implantology: current application and progress. *Int J Oral Sci.* 2020;12(1):37. doi:10.1038/s41368-020-00107-z
 3. Li X, Xu H, Zhao B, Jiang S. Accelerated and enhanced osteointegration of MAO-treated implants: histological and histomorphometric evaluation in a rabbit model. *Int J Oral Sci.* 2018;10(2):11. doi:10.1038/s41368-018-0008-z
 4. Greenstein G, Cavallaro J, Tarnow D. Dental Implantology: Numbers Clinicians Need to Know. *Compend Contin Educ Dent.* 2019;40(5):e1-e26.
 5. Guillaume B. Dental implants: A review. *Morphologie.* 2016;100(331):189-98. doi:10.1016/j.morpho.2016.02.002
 6. Nagdalian AA, Rzhepakovsky IV, Siddiqui SA, Piskov SI, Oboturova NP, Timchenko LD, et al. Analysis of the Content of Mechanically Separated Poultry Meat in Sausage Using Computing Microtomography. *J Food Compost Anal.* 2021;100:103918. doi:10.1016/j.jfca.2021.103918
 7. Gvozdenko AA, Blinov AV, Slyadneva KS, Blinova AA, Golik AB, Maglakelidze DG. X-Ray Contrast Magnetic Diagnostic Tool Based on a Three-Component Nanosystem. *Russ J Gen Chem.* 2022;92(6):1153-60. doi:10.1134/S1070363222060305
 8. Pashkova GS, Nikitin VV, Isadzhanyan KE, Apkhadze AR, Zhilenkov EL. Bacteriological monitoring of patients with periimplantitis (preliminary study). *Stomatologiya.* 2014;93(4):45-7.
 9. Chowdhary R, Hosadettu SR, Chandrakar N. A survey on the use of techniques, 23materials in dental implantology practice. *Indian J Dent Res.* 2012;23(2):297. doi:10.4103/0970-9290.100465
 10. Zhao M, Qiu F, Song J, Zhang C, Liu T, Wu M. The effects of Twinlight laser treatment on the titanium surface proliferation and osteogenic differentiation of mesenchymal stem cells. *BMC Oral Health.* 2022;22(1):409. doi:10.1186/s12903-022-02448-z
 11. Zhang H, Huang J, Fan X, Miao R, Wang Y. HSP90AA1 promotes the inflammation in human gingival fibroblasts induced by Porphyromonas gingivalis lipopolysaccharide via regulating of autophagy. *BMC Oral Health.* 2022;22:366. doi:10.1186/s12903-022-02304-0
 12. Nikitin VV, Muraviev SI, Shevchenko SS, Pashkova GS, Isagzhanyan KE, Andreeva SA. Minimally Invasive Professional Dental Hygiene Procedure in Implant Patients: Indications, Steps, Methods and Tools. *Dent Forum.* 2017;12:13-22.
 13. Schlegel D. Dental implantology-a review of the literature. *Dtsch Zahnarztl Z.* 1974;29(2):176-86.
 14. Davidowitz G, Kotick PG. The use of CAD/CAM in dentistry. *Dent Clin North Am.* 2011;55(3):559-70. doi:10.1016/j.cden.2011.02.011
 15. Kunrath MF, Muradás TC, Penha N, Campos MM. Innovative surfaces and alloys for dental implants: What about biointerface-safety concerns? *Dent Mater.* 2021;37(10):1447-62. doi:10.1016/j.dental.2021.08.008
 16. Derks J, Schaller D, Håkansson J, Wennström JL, Tomasi C, Berglundh T. Effectiveness of Implant Therapy Analyzed in a Swedish Population: Prevalence of Peri-implantitis. *J Dent Res.* 2016;95(1):43-9. doi:10.1177/0022034515608832
 17. Wang M, Zhang S, Chen L, Zou H, Wang Y, Xia H. Early soft tissue response to zirconium oxide and titanium healing abutments in vivo: a study in dogs. *BMC Oral Health.* 2021;21(1):416. doi:10.1186/s12903-021-01748-0
 18. Barootchi S, Wang HL. Peri-implant diseases: Current understanding and management. *Int J Oral Implantol (Berl).* 2021;14(3):263-82.
 19. Siddiqui SA, Snoeck ER, Tello A, Alles MC, Fernando I, Saraswati YR, et al. Manipulation of the black soldier fly larvae (*Hermetia illucens*; Diptera: Stratiomyidae) fatty acid profile through the substrate. *J Insects Food Feed.* 2022;8(8):837-55.
 20. Persson GR, Renvert S. Cluster of bacteria associated with peri-implantitis. *Clin Implant Dent Relat Res.* 2014;16(6):783-93. doi:10.1111/cid.12052
 21. Rzhepakovsky IV, Areshidze DA, Avanesyan SS, Grimm WD, Filatova NV, Kalinin AV, et al. Phytochemical Characterization, Antioxidant Activity, and Cytotoxicity of Methanolic Leaf Extract of *Chlorophytum Comosum* (Green Type) (Thunb.) Jacq. *Molecules.* 2022;27(3):762. doi:10.3390/molecules27030762
 22. Chmyrev VP, Polutina TN, Moiseev AV, Oboturova NP, Kolesnikov RO, Baklanov IS, et al. Analysis of the state of food safety in the Russian Federation. *J Hyg Eng Des.* 2022;38:111-8.
 23. Heasman P, Esmail Z, Barclay C. Peri-implant diseases. *Dent Update.* 2010;37(8):511-2, 514-6. doi:10.12968/denu.2010.37.8.511
 24. Xi D, Wong L. Titanium and implantology: a review in dentistry. *J Biol Regul Homeost Agents.* 2021;35(1 Suppl. 1):63-72.
 25. Siddiqui SA, Singh P, Khan S, Fernando I, Baklanov IS, Ambartsumov TG, et al. Cultural, Social and Psychological Factors of the Conservative Consumer towards Legal Cannabis Use—A Review since 2013. *Sustainability.* 2022;14(17):10993. doi:10.3390/su141710993
 26. Remizova AA, Sakaeva ZU, Dzgoeva ZG, Rayushkin II, Tingaeva YI, Povetkin SN, et al. The Role of Oral Hygiene in The Effectiveness of Prosthetics on Dental Implants. *Ann Dent Spec.* 2021;9(1):39-46. doi:10.51847/HuTuWdD0mB
 27. Liu Z, Zhang ZJ, He KT, Huang RJ. Research progress on the effects of the interactions between phage and periodontal pathogens on periodontal disease. *Zhonghua*

- Kou Qiang Yi Xue Za Zhi. 2021;56(12):1282-6.
doi:10.3760/cma.j.cn112144-20210428-00201
28. Kowalski J, Górska R, Cieślik M, Górski A, Jończyk-Matysiak E. What Are the Potential Benefits of Using Bacteriophages in Periodontal Therapy? *Antibiotics (Basel)*. 2022;11(4):446.
doi:10.3390/antibiotics11040446
29. Pinto G, Silva MD, Peddey M, Sillankorva S, Azeredo J. The role of bacteriophages in periodontal health and disease. *Future Microbiol.* 2016;11(10):1359-69.
doi:10.2217/fmb-2016-0081