

THE ROLE OF ORAL HYGIENE IN THE EFFECTIVENESS OF PROSTHETICS ON DENTAL IMPLANTS

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ABSTRACT

The article presents for the first time indicators of the state of peri-implant tissues and oral hygiene in users of prosthetic implants, depending on the clinical and operational conditions: compliance with the terms of medical examination, the presence of periodontal diseases, the level of individual oral hygiene. Long-term clinical and radiological indicators of the effectiveness of prosthetics on implants, index indicators of hygiene, and condition of periodontal and peri-implant tissues were studied. The factors and the degree of decrease in the effectiveness of implantation, hygiene, and periodontal indices in patients with dentures on dental implants are described. The results of the analysis of the role of systematic medical examination, professional oral hygiene, and full-fledged individual hygiene in maintaining hygienic and periodontal indicators for users of prosthetic implants are presented. The article describes the effectiveness of various types of individual oral hygiene, including interdental products, irrigators, and “Phagodent” gel-based on bacteriophages in individuals with dental implants. A subjective assessment of the hygienic aspects of prosthetics on implants in people with high motivation to care for the oral cavity and those who do not comply with the terms of medical examination and professional hygiene is put up for discussion.

Key words: Prosthetics, Dental implants, Teeth, Hygiene.

Introduction

Extensive experience in using the dental implantation method in Russia 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 [1-8]. The prevalence of inflammation is limited in the gums around implants-mucositis and accompanied by resorption of the underlying bone tissue – periimplantitis, according to various data, occurs at least 30% and 10%, respectively, on the example of three years after the completion of prosthetics [9-12]. In the absence of treatment, peri-implantitis ends with implant disintegration; treatment of peri-implantitis is a complex problem associated, in addition to eliminating inflammation, with the need to restore lost bone tissue [13-19].

All studies aimed at the prevention and treatment of mucositis and peri-implantitis indicate a negative role of insufficient oral hygiene [20-22]. Against the background of the well-known low motivation of the population to ensure an adequate level of individual oral hygiene, the development of effective approaches to the hygienic state of the mouth at the stages of implantological treatment remains an urgent task. Hygienic aspects in patients with implants can be considered in several directions: in the

dynamics of the course of implantological treatment, consisting of several surgical and orthopedic stages; in the dynamics of the use of prostheses on implants; optimization of the volume of individual oral hygiene using specific hygiene methods and medical support.

The nine-year experience of prosthetics on implants described by Uzunyan N. A. reflects only the removal of implants due to peri-implantitis depending on different implantation conditions [23-27]. The work describes that 2% of implants were removed after 5 years, 7.6% - after 7 years, and 7.7% - after 9 years, which indicates the onset of the phase of full adaptation of the implant to the conditions of functioning for 7 years. The frequency of implant removal depends less on the state of health, and more on the initial state of periodontitis and hygiene (in patients with periodontitis, implant disintegration was 7.9%, without periodontitis 4.1%; with a satisfactory level of hygiene 4.3%, with insufficient hygiene-9.5%). There was no statistically significant difference in the frequency of implant removal between implants of different localization, while disintegration was more common in Lekholm/Zarb type IV (10.5%) with the complete absence of teeth (13.4%), and in short implants (12.9%). The provoking role of cement fixation of prostheses on implants for the development of peri-implantitis, which leads to the

disintegration of 9.7% of implants over nine years, is shown.

In a difficult clinical situation – with the complete absence of teeth, D. A. Bronstein used implants with a long-term analysis of peri-implant tissues (10 years) [13]. Previously, during the same period, the results of implantation were analyzed by different doctors in Moscow concerning patients with the partial and complete absence of teeth. Among more than 4,500 implants after 10 years of loading, 44.6% had mucositis, and 30.8% had periimplantitis (the initial one is twice as common as in the degree of half the length of the implant. 5.1% of implants were removed due to peri-implantitis. In the group of own observation for ten years, the listed indicators were 30.4%, 40.7%, and 12.5%. The conclusion is made about more favorable results of prosthetics on implants in the partial absence of teeth, despite the lower microbial contamination of the oral cavity in the complete absence of teeth (apparently, the smaller number of support implants and, mainly, the removable nature of prosthetics in the complete absence of teeth)

Three years of follow – up of prostheses on implants in patients with metabolic syndrome, undertaken by Remizova A. A., revealed a good level of hygiene only in 12.7% of people with fixed prostheses and 9.7% - in removable prostheses on implants [28-30]. Gum recession was very often observed in implants: 38.2% of patients with fixed and 39.1% with removable prostheses; the SPI index was 4.77 and 5.83, respectively.

Rubtsova N. G. focused her research on clinical and laboratory evaluation of the cleaning ability of toothbrushes in patients with orthopedic structures on dental implants [29, 31-34]. She studied the state of the mouth in 476 patients with orthopedic structures on intraosseous implants. At the same time, 30 people cleaned their natural teeth and prosthetic structures on implants with a manual toothbrush. The remaining patients were divided into subgroups depending on the period from the moment of completion of prosthetics and depending on the use of different toothbrushes (electric, sound, ion, ultrasound). Brushing your teeth was recommended twice a day for 3 minutes. The survey included a survey, a questionnaire, and the determination of hygiene indices. Before the start of differentiated use of brushes, 70% of patients with implants had three months of brushing their teeth with a regular manual brush, the level of hygiene continued to be unsatisfactory for many, while the majority of patients with other brushes had a sufficient level of hygiene (79.4-100%). The greatest cleaning effect of an ultrasonic toothbrush (medium hardness, with multi-level trimming of the brush field and an average vibration frequency of 96 million per minute (1.6 MHz) is proved. According to the PLIC index, the cleaning efficiency of manual toothbrushes is 47.4%, electric 52.3%, sound 61.6%, ionic 59%, and ultrasonic 65.3%. Scanning electron microscopy showed the wear of toothbrushes in three months to the extent of

58.4% – for manual, 41.1% – electric, 40.9% – sound, 42.5% – ion, 27.5% –ultrasound. After the survey, we received disappointing data on the attitude to oral hygiene in patients with implants. 58.5% of respondents do not comply with dental hygiene recommendations, 31.2% do not comply with the terms of medical examination. Among hygiene products, the majority choose only a manual toothbrush (76% of respondents), the rest – electric; half of the respondents use dental irrigators, and interdental hygiene products-no more than 10.0%. The hygiene value is shown by a strong positive correlation with the cytological study parameters ($r_s = 0.796$ to 0.962).

The purpose of the article

Justification of the periodicity of professional oral hygiene and the volume of individual oral hygiene at the stages of implantological treatment and use of dentures on dental implants.

Objectives of the work

1. Study long-term clinical and radiological indicators of the effectiveness of prosthetics on implants, index indicators of hygiene, and condition of periodontal and peri-implant tissues.
2. Study the factors and degree of decrease in the effectiveness of implantation, hygiene, and periodontal indices in patients with dentures on dental implants.
3. Analysis of the role of systematic medical examinations, professional oral hygiene, and full-fledged individual hygiene in maintaining hygienic and periodontal indicators for users of prosthetic implants.
4. Compare the effectiveness of different volumes of individual oral hygiene, including interdental products, irrigators, and “Phagodont” gel-based on bacteriophages in individuals with dental implants.
5. Analysis of the subjective assessment of the hygienic aspects of prosthetics on implants in people with high motivation to care for the oral cavity and those who do not comply with the terms of medical examination and professional hygiene.

Materials and Methods

The Department of dentistry №.3 of the North Ossetian State Medical Academy of the Ministry of Health of the Russian Federation analyzed the results of prosthetics on implants of 158 people (the first group), consisting of 93 women and 65 men; 74 patients aged 20 to 40 years and 84 patients aged 40 to 60 years. Before the start of prosthetics, 26 people had a complete absence of teeth (on one or both jaws), while the remaining 132 had a partial absence of teeth (K08.1).

363 titanium intraosseous implants from different companies were previously installed using the classic two-stage method and had different prosthesis designs. Among the prostheses on implants, most were metal-ceramic crowns or non-stretched bridge prostheses (151 prostheses,

106 people, 219 implants), and among the removable ones – with beam fixation on two, three, or four implants (17 prostheses in 17 people on 54 implants); 9 people with the complete absence of teeth (9 prostheses, 51 implants) had fixed dentures on five or six implants with a shortened dental row from the standard dental rows – the so-called conditionally removable dentures; among the fixed prostheses in a small number were all-ceramic crowns and bridges (31 prostheses, 26 people, 39 implants). The first group was divided according to the terms from the moment of completion of prosthetics: one year – 55 people, two years – 51, and three years – 52.

Dispensary control included clinical and index evaluation of periodontal and peri-implant tissues, professional oral hygiene, occlusal correction, and semi-annual orthopantomography [1, 3, 4, 35, 36]. Also, the index examination of hygiene and periodontitis was carried out in the following periods: before the start of treatment (when applying to the clinic), after pre-implantological 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).

Results and Discussion

Before the start of implantological treatment, the following indicators of hygiene and periodontal disease were detected in the experimental group (**Table 1**).

Table 1. Hygiene and periodontal indicators in the examined group before the start of implantological treatment.

Index	Value
Green J. C., Vermillion J. R. oral hygiene index (OHI-S)	3,8±0,7
gingivitis index Loe H., Silness J. (GI)	1,3±0,3
Muhlemann index in Cowell modification (MI)	1,2±0,2

Table 2. Indicators of hygiene and periodontium in dynamics of implant treatment.

Control	Index	Index							
		1	2	3	4	5	6	7	8
Before treatment		3,8	-	1,3	1,2	43,2	2,8	304	36,7
After sanitation		0,8	-	0,7	0,4	22,2	0,9	102	13,3
Before implants opening		1,5	-	1,3	1,0	31,4	1,6	206	-
After professional hygiene and implants opening		0,5	-	0,7	0,5	24,3	1,0	99	-
Before the start of a permanent prosthesis		2,1	1,9	1,4	1,2	31,8	1,7	266	-
After professional hygiene and fixation of prostheses		0,8	0,7	0,7	0,5	27,3	0,8	114	18,3

PMA index in Parma modification, %	43,2±5,5
organoleptic index (OI)	2,8±0,4
Halimeter index, ppb	304±26
Detection of periodontal pathogens, %	36,7

Following the algorithm of implantological treatment, the indicators of hygiene and periodontal tissues varied significantly. As a result of dental and periodontal rehabilitation before the implants were installed, all indicators significantly improved: OHI-S-0.8±0.2; gingivitis index GI-0.7±0.2; Muhlemann index-0.4±0.1; PMA index-22.2±3.1%; OI index-0.9±0.2; Halimeter index-102±14.3 ppb; detection of periodontal pathogens-13.3%.

As a result of the period of implant osseointegration (up to six months), the lack of individual hygiene in many patients worsened the indicators on average for the group: OHI-S – 1.5±0.3; gingivitis index GI – 1.3±0.9; Muhlemann index – 1.0±0.3; PMA index – 31.4±9.9%; OI index – 1.6±0.3; Halimeter index – 206±34.2 ppb.

Performing professional hygiene in patients before installing gum shapers or abutments again improved the state of hygiene and periodontal health: OHI-S-0.5±0.1; gingivitis index GI-0.7±0.2; Muhlemann index-0.5±0.2; PMA index-24.3±8.1%; OI index-1.0±0.1; Halimeter index-99±17.5 ppb.

Made, as a rule, from polymer materials, temporary fixed prostheses significantly worsened the hygienic condition of the mouth due to their ability to adsorb plaque and made it necessary to conduct professional hygiene before fixing permanent prostheses. Thus, the indices OHI-S, IGSK, GI, Muhlemann, PMA, OI, and Galimeter index deteriorated to 2.1±0,3; 1,9±0,2; 1,4±0,1; 1,2±0,2; 31,8±6,6%; 1,7±0,3%; 266±30 ppb.

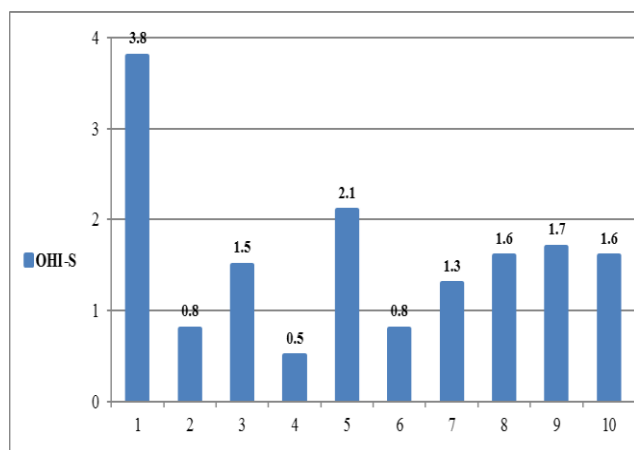
During the experiment quarterly indicators in the dynamics of the functioning of prostheses on implants were determined before the professional hygiene (**Table 2**).

After 3 month	1,3	1,2	1,1	0,8	31,5	2,0	156	25,0
After 6 month	1,6	1,1	1,3	0,9	31,9	2,2	168	-
After 9 month	1,7	1,3	1,1	0,9	32,2	2,3	149	-
After 12 month	1,6	1,3	1,2	1,0	31,8	2,3	172	26,7

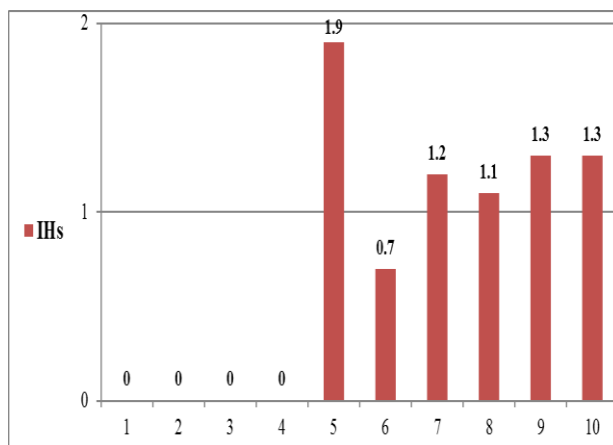
Note: 1 – OHI-S; 2 – index of hygiene of super constructor (IH_s); 3.GI; 4.MI; 5.PMA 6.OI; 7. Halimeter index; 8. Periodontal pathogens.

Professional hygiene carried out according to the indicated indications normalized the listed indicators at the stage of fixing permanent prostheses, respectively, to 0,8±0,2; 0,7±0,1; 0,7±0,1; 0,5±0,1; 27,3±5,4%; 0,8±0,2; 114±13 ppb. PCR diagnostics of the pathogenic microflora of periodontal pockets performed at this stage – before fixing the prostheses-showed the content of periodontal pathogens equal to 18.3%.

Further quarterly examinations of patients with prosthetic implants revealed fluctuations in all microflora indicators with a pattern: deterioration of indicators after three months and the natural need for professional hygiene every three months. This practice led to the stabilization of indicators during the year of observation. For example, the indicators at twelve months did not differ significantly from three months, respectively, when examined before occupational hygiene and after occupational hygiene. So, before occupational hygiene, the indicators in twelve months were: OHI-S – 1.6±0.3, IH_s – 1.3±0.1, gingivitis index GI – 1.2±0.1, MI – 1.0±0.1, PMA index – 31.8±6.2%, OI – 2.3±0.3, Halimeter index – 172±29 ppb, periodontal pathogens index – 26.7%; after occupational hygiene all indicators corresponded to requirements for occupational hygiene and fixation of permanent prostheses. Results of the research of changes of OHI-S, IH_s, GI, MI, PMA, OI, halimeter index and periodontal pathogens content in the experimental groups are represented on **Figures 1-4**.



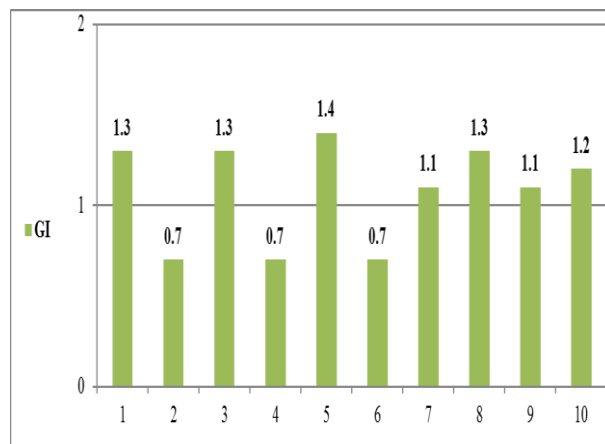
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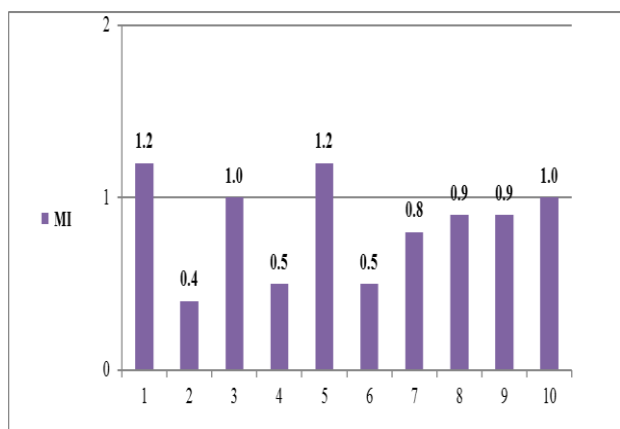
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Figure 1. Main indicators data:

a) Changes in OHI-S in the experimental group in the dynamics of implantological treatment: 1-before treatment, 2-after sanitation, and professional hygiene, 3-before implant opening, 4-after professional hygiene and implant opening, 5-before permanent prosthetics, 6-after professional hygiene and fixation of prostheses, 7-3 months, 8-6 months, 9-9 months, 10-12 months. b) Changes in IH_s in the experimental group in the dynamics of implantological treatment: 1-before treatment, 2-after sanitation, and professional hygiene, 3-before implant opening, 4-after professional hygiene and implant opening, 5-before permanent prosthetics, 6-after professional hygiene and fixation of prostheses, 7-3 months, 8-6 months, 9-9 months, 10-12 months.



a)

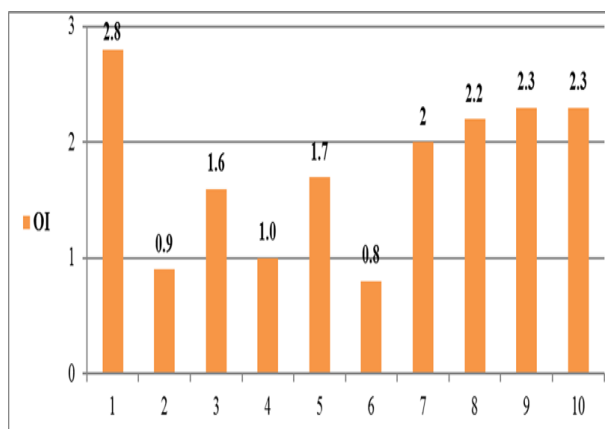


b)

Figure 2. Main indicators data.

a) Changes in GI in the experimental group in the dynamics of implantological treatment: 1-before treatment, 2-after sanitation, and professional hygiene, 3-before implant opening, 4-after professional hygiene and implant opening, 5-before permanent prosthetics, 6-after professional hygiene and fixation of prostheses, 7-3 months, 8-6 months, 9-9 months, 10-12 months.

b) Changes in MI in the experimental group in the dynamics of implantological treatment: 1-before treatment, 2-after sanitation, and professional hygiene, 3-before implant opening, 4-after professional hygiene and implant opening, 5-before permanent prosthetics, 6-after professional hygiene and fixation of prostheses, 7-3 months, 8-6 months, 9-9 months, 10-12 months

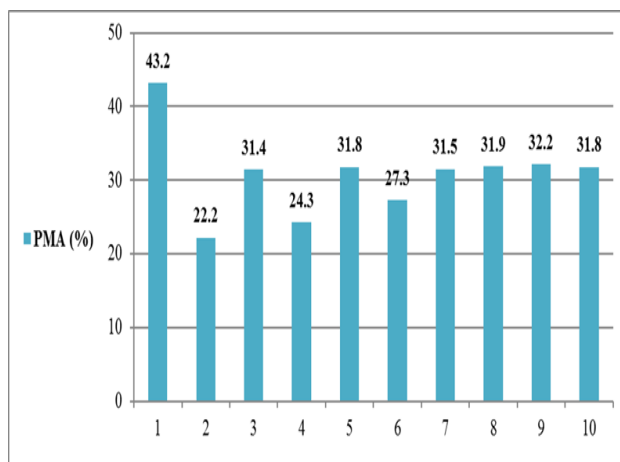


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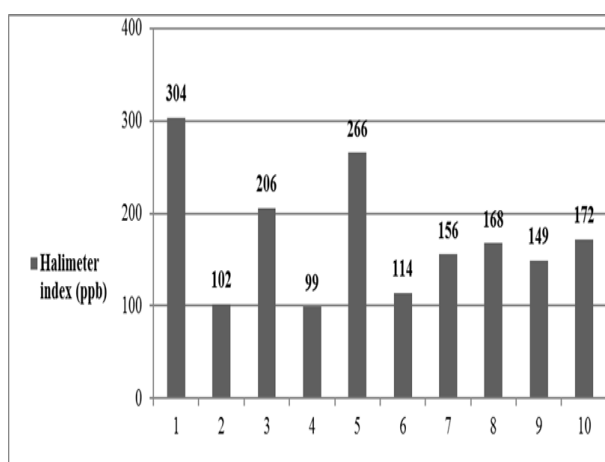
Figure 3. Main indicators data: a) Changes in PMA in

the experimental group in the dynamics of implantological treatment: 1-before treatment, 2-after sanitation, and professional hygiene, 3-before implant opening, 4-after professional hygiene and implant opening, 5-before permanent prosthetics, 6-after professional hygiene and fixation of prostheses, 7-3 months, 8-6 months, 9-9 months, 10-12 months.

b) Changes in OI in the experimental group in the dynamics of implantological treatment: 1-before treatment, 2-after sanitation, and professional hygiene, 3-before implant opening, 4-after professional hygiene and implant opening, 5-before permanent prosthetics, 6-after professional hygiene and fixation of prostheses, 7-3 months, 8-6 months, 9-9 months, 10-12 months



a)



a)

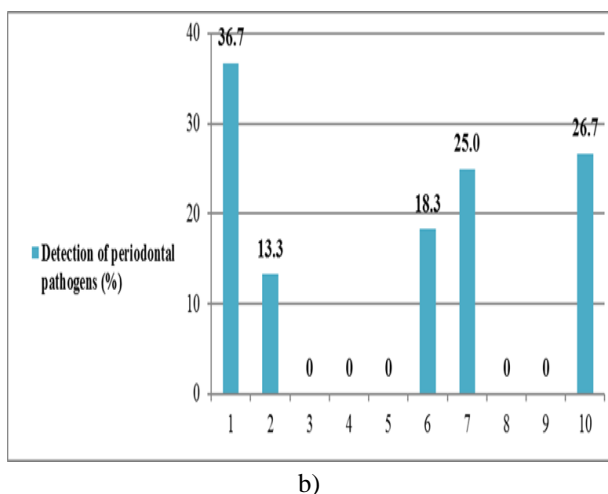


Figure 4. Main indicators data:

a) Changes in halimeter index in the experimental group in the dynamics of implantological treatment: 1-before treatment, 2-after sanitation, and professional hygiene, 3-before implant opening, 4-after professional hygiene and implant opening, 5-before permanent prosthetics, 6-after professional hygiene and fixation of prostheses, 7-3 months, 8-6 months, 9-9 months, 10-12 months.

b) Changes in periodontal pathogens content in the experimental group in the dynamics of implantological treatment: 1-before treatment, 2-after sanitation, and professional hygiene, 3-before implant opening, 4-after professional hygiene and implant opening, 5-before permanent prosthetics, 6-after professional hygiene and fixation of prostheses, 7-3 months, 8-6 months, 9-9 months, 10-12 months.

Against the background of periodic professional oral hygiene in the second group, a year after prosthetics, no cases of peri-implantitis or implant removal were registered; mucositis in individual implants was detected only in two patients (3,3%). Obtained data showed in **Table 3**.

Table 3. State of hygiene, periodontal and peri-implant tissues in patients with a prosthesis on dental implants (after 1 year).

Index	Value	P
Frequency of implant removal	0%	p>0,05
Detection of mucositis	3,3%	p<0,05
Detection of peri-implantitis (resorption 30%)	0%	p<0,05
Detection of peri-implantitis (resorption 50%)	0%	p>0,05
Green J. C., Vermillion J. R. oral hygiene index (OHI-S)	1,6	p<0,05

The index of hygiene of super constructor (IHs)	1,3	p>0,05
Gingivitis index Loe H., Silness J. (GI)	1,2	p<0,05
Muhlemann index in Cowell modification	1,0	p<0,05
PMA index in Parma modification	31,8%	p<0,05
Organoleptic index	2,3	p<0,05
Rate Halimeter (ppb)	172	p<0,05
Detection of periodontal pathogens	26,7%	p<0,05

On 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 (control group), the second – additionally used methods of interdental hygiene and a dental irrigator (experimental group 1), the third differed from the experimental group 1 by using a gel-based on bacteriophages of periodontal pathogens "Fagodent" at the end of hygiene measures (experimental group 2).

The choice of "Phagodent" gel as a preventive medication for local use is due to the originality of its action, harmlessness, and greater effectiveness without addiction in comparison, for example, with "Metrogil-Denta" gel. Data on the effectiveness of "Phagodent" are taken from several scientific studies [37, 38].

Observation over a year of three groups with the same number and characteristics with a different set of hygienic manipulations confirmed the expediency of prescribing interdental hygiene products and an irrigator in addition to the traditional oral care scheme (toothbrush, paste, rinse aid). As a result of this approach, several indicators are significantly improved (OHI-S, MI, and OI). 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 hygiene measures. Thus, when using "Phagodent", the OHI-S, the IHs, the GI, the MI, the PMA index, the OI, the Halimeter index, and the detection of periodontal pathogens against the background of professional oral hygiene during control after 12 months were 1,2; 0,8; 0,8; 0,5; 23,3%; 1,2; 133,0 ppb; 10.0%. If the role of interdental agents and dental irrigator in maintaining the level of hygiene in the presence of implants was shown in previous studies, the role of "Phagodent" is not sufficiently covered and the data obtained allow it to be included in the algorithm of standard oral care for patients with implants.

Summarizing the results of the study, it can be stated that the most important factors for reducing the effectiveness of prosthetics on implants in the long term, manifested in the form of mucositis and perimplantitis (and then removal of

the implant), are unsatisfactory individual oral hygiene and lack of systematic professional oral hygiene. A necessary condition for the basic prevention of inflammation in peri-implant tissues is timely hygiene measures at the stages of implantological treatment: before the implantation operation, before opening the implants when replacing temporary prostheses with permanent ones, and every three months when the prostheses are functioning on implants. The most effective complex of individual oral hygiene in patients with implants, according to a comparative study, is the use of interdental agents and irrigators, as well as the use of a gel-based on bacteriophages of periodontal pathogens "Phagodent". Effective motivation to observe individual oral hygiene is required based not only on information about modern dental hygiene measures but also based on the actual satisfaction of patients with the results of systematic professional oral hygiene.

Conclusion

1. Among the studied risk factors, irregular follow-up by a dentist, the presence of periodontitis, poor oral hygiene, Smoking, male gender, older age, removable prosthesis design, and an increase in the service life of prostheses lead to a significant decrease in the effectiveness of prosthetics on implants.
2. Professional hygiene at intervals of every three months provides a stable adequate level of hygienic and periodontal indicators for users of prosthetic implants and also reduces the detection of peri-implantitis.
3. Hygienic and periodontal indicators after preimplantation dental and periodontal sanitation deteriorate by the time the implants are opened, then before replacing temporary prostheses with permanent ones, and after three months of operation of prostheses on implants, which makes it necessary to conduct professional oral hygiene before these stages.
4. The use of interdental hygiene and irrigator in their oral hygiene of users of the implants improves the OHI-S index, MI, and OI. Additional use of the gel-based on bacteriophages of periodontopathogenic microorganisms "Parodent" provides the improvement of hygienic and periodontal indices in comparison with traditional volume hygienic measures.
5. According to the results of a survey of people who do not comply with the terms of medical examinations and professional oral hygiene, half of the users of dental implants with the motivation mainly lack time to fully comply with the dentist's recommendations for oral care; two-thirds rate the level of individual hygiene as excellent and good, although they note the progression or appearance of gum inflammation and bad breath.

Subjective evaluation of the hygienic aspects of the use of prostheses on implants individuals who observe systematic occupational health, characterized by a high level of personal hygiene and the effectiveness of professional care, using all assigned hygienic measures, a steady majority of

respondents on the need for professional oral hygiene once in three months.

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