Synergy of professional and home hygiene as the main tool for prevention of peri-implant diseases

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Abstract.
This publication updates the issue of public awareness and highlights the basic rules of professional and individual oral hygiene in the presence of implants. A low level of knowledge of the specifics of care during and after implant treatment leads to the risk of peri-implant diseases. This article contains basic algorithms for the prevention of such complications.

Keywords:
biofilm
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peri-implant diseases
“The main treasure of life is health. And to save it, you need to know so much...”

Avicenna

Topicality. Today, implantology has become one of the leading areas in the dental field of knowledge, which is closely intertwined with other areas of dentistry and requires the study of interrelated problems, their analysis and organization of preventive measures.

Thus, over the past 30 years, the incidence of periodontal tissues disorders, including peri-implant ones, has increased by 34%. Moreover, periodontal diseases have significantly rejuvenated and are ranked 12th in the world among the most common diseases. One of the most important reasons that led to such statistics is poor, incorrect individual and professional oral hygiene in various clinical circumstances, including the implant treatment [14].

The more widespread this area of dentistry becomes in the world, the more relevant the issue of effective individual oral hygiene at all stages of dental implantation appears to be.

Therefore, in this situation, the synergy of professional and individual home oral hygiene of implants is extremely important. Means and items of hygiene as well as methods used are of the utmost importance in both cases.

The durability and quality of functional use of implants as well as the orthopaedic constructions they support, and human health in general will depend on the correctness of their choice and compliance with the rules of application [19].

The aim of our work was to study this problem and create new approaches in the prevention of peri-implantitis and mucosides.

To do this, we have analysed:
- more than 100 different studies conducted by leading medical associations and institutes of the world in the field of “implantology” and presented in domestic and foreign publications. In particular, we analysed the publications of the most authoritative dental journals with a high impact factor: “Journal of dental research”, “Clinical oral implants
research”, “International journal of clinical periodontology”, “Journal of clinical periodontology”, “Clinical implant dentistry and related research”, “Clinical oral investigations”. (Note: the impact factor is an indicator of informational scientific significance and citations of scientific journals. The higher it is, the more authoritative the publication is);

- research results for 2019-2021 of the electronic medical database “PubMed” of the National Medical Library of the United States and the database of clinical trials of the company “Oral B” (2021);

- our clinical observations conducted on the basis of the private clinic “DM” and the Department of Maxillofacial Surgery of the Lviv Regional Clinical Hospital.

Main part

The results of the processed material allow the formation of new approaches to the assessment of dental status during implant treatment and the development of algorithms for individual and professional care of the oral cavity.

Thus, the studies of various world scientists indicate a high probability of peri-implant diseases:

- A systematic review with a meta-analysis, published on March 6, 2021 in an article by Professor Andrea Roccuzzo in the Journal of Clinical Medicine, showed that the global average prevalence of mucositis is 43% (range of different studies ranges from 19-65%), the average the prevalence of peri-implantitis is 22% (range 1-47%) [15].

- The 2018 research, published in the Journal of Clinical Medicine, referred to 218 patients who had dental implants placed between 1988 and 1992, all of whom were examined from 2000 to 2002 (in the period from 9 to 26 years after the initial examination for implantation) [13].

- 54.7% and 22.1% of patients were diagnosed with peri-implant mucositis and peri-implantitis, respectively.

- At the Forum of Implantology in 2013, professor Niklaus Lang presented the statistics of peri-implantitis, which amount to 43.3% of patients with 20 years of monitoring without proper and timely professional hygiene [9, 10].

- In his lecture on the pathogenesis and etiology of peri-implants at the online conference “Prelude Conference – 2021”
(13.04.21-17.04.21, UAP, online), professor Lang demonstrated a diagram of the accumulation of plaque with the subsequent occurrence of mucositis and peri-implantitis in the absence of dental hygiene. The reversibility of these processes has also been demonstrated, when dental hygiene is established, all inflammatory elements disappear. It has been proven that mucositis and peri-implantitis are reversible processes with timely and adequate treatment.

All the data indicate that the mucositis around the implant is much more pronounced and aggressive than gingivitis and the process of tissue stabilization is much longer, and also prove the cause-and-effect relationship of mucositis and peri-implantitis with the accumulation of bacterial biofilm, which leads to inflammatory changes in tissues.

Therefore, in order to form the most reliable and objective dental status during and after implant treatment, it is advisable to use the classification of diseases and conditions of periodontal tissues and peri-implant tissues, which was presented at the World Workshop in Chicago in November 2017 [3]:

- clear correlation between mucositis and biofilm;
- peri-implant mucositis - the reverse process, which demands 3 weeks of treatment;
- determining risk factors for mucositis: biofilm, smoking, radiation;
- there is a need for additional evidence of potential risk factors, including diabetes, lack of keratinized mucosa and excess cement;
- bleeding index is a key point in the diagnosis of peri-implant diseases;
- lack of regular maintenance therapy in patients with peri-implant mucositis is associated with a risk of peri-implantitis;
- plaque accumulation, smoking, excess cement - the main etiological factors;
- mechanical control of the biofilm by the patient is a significant preventive measure;
- professional intervention, and in fact mechanical hygienic treatment of surfaces, revealed a clinical reduction in inflammation;
placement of implants and orthopaedic structures on them should not interfere with mechanical cleaning (professional and individual).

Using this classification, we conducted an analysis of medical records (f. 043-o “Medical history of a dental patient”, electronic database of the clinic “DM” and the Department of Maxillofacial Surgery of the Lviv Regional Clinical Hospital for 2016-2021), which showed that in 5 years, 145 implants for 86 patients (including 40 implants from “BTI”, 105 – “Shorter”) were installed at both clinical departments, which closely cooperate in the field of implantology and further orthopaedics based on implants.

Single implantation predominates in 70 patients (81%), multiple implantation in 16 patients (19%). The loss of implants in the first year is 3% of the total number of installed 5 implants: (“BTI” – 2, “Shorter” – 3). Compared with these data, peri-implant diseases are less common.

Analysis of the data suggests that such a low percentage of implant loss is due to the absence of a bad habit (such as smoking) in implant patients of both clinical departments: among 86 patients, there was only 1 smoker, who gave up the habit during treatment.

The low level of mucositis and peri-implantitis (3.4%) is also explained by:

1) refusal to use abutments and classical approaches, and instead - the use of the technique “from the level of the implant”, which reduces the number of retention points for the accumulation of deposits and facilitates individual hygiene;

2) correctly compiled algorithm for professional and individual hygiene, with constant monitoring of performance;

3) high level of motivation of patients and previously conducted sanitary-educational work. (Before implantation at both clinical bases, the dental hygienist is instructed in detail on the detailed schedule of professional and individual hygiene; patients receive a primary set for home care; an individual plan of maintenance therapy and hygiene measures is worked out, which reduces the risk of mucositis and peri-implants). Patients after implantation also have a financial
incentive to maintain hygiene at the optimal level – special discounts and special offers for hygienic manipulations in the clinic at least once every 3 months).

In addition, based on the data collected (literature sources and clinical observations) it became clear that the main requirements of today’s leading hygienic schools throughout the world to medical and hygienic standards for dental implants both individual and professional oral hygiene, are:

1. Qualitative elimination of dental plaque, destruction of biofilm.
2. Prevention and slowing down the re-formation of biofilm.
3. Timeliness and regularity of hygienic procedures.
4. The presence of antiseptic, anti-inflammatory, bacteriostatic and refreshing components:
   - chlorhexidine is the gold standard in periodontology. Due to the positive charge of the molecule, it interacts with the surface of the bacterial membrane, which has a negative charge, penetrates the cell, joins the cytoplasm and destroys the cell from within. Today, the most effective is the combination of chlorhexidine with cetylpyridinium chloride, which enhances its action. Chlorhexidine kills bacteria and cetylpyridinium chloride kills toxins;
   - nanosorbents should be included as detoxifying, dehydrating, immunostimulating components, which are also able to increase the pH of the environment and deposit drugs with their subsequent release;
   - triclosan is a proven anti-inflammatory and bactericidal component;
   - copolymers prolongs the action of the agent for up to 12 hours.
5. Strengthening of the natural defence mechanisms of the oral cavity.
6. Prevention of damage to the surface of implants and orthopaedic structures supported by them (clinical probing around osteointegrated implants allows to determine the presence of blood – the main sign of instability of peri-implant tissues; in case of bleeding it is necessary to make a series of targeted X-ray images and find out what to focus
on - mucositis or peri-implantitis) [16].

7. Safety of medication and procedures for the oral cavity and the whole organism.

This allowed us to form our recommendations for a reasoned choice of tools, items and methods that are used today for the most effective individual and professional hygiene in people with dental implants; develop algorithms for their application at all stages of dental implantation.

**ALGORITHM OF HYGIENIC MEASURES AT DIFFERENT STAGES OF DENTAL IMPLANTATION**

1. **System (preparatory phase)**
   - It is of vital importance at this stage to teach the patient to brush his teeth properly, with various techniques (Charter, Bass classical and modified, Fonessa, combined techniques) and to make sure that he has mastered them.
   - Simultaneously with training and control of individual hygiene, motivate the patient to give up bad habits (smoking and alcohol consumption) if any, because they are one of the risk factors for premature loss of implants in the first year.

2. **Hygienic phase**
   - Rehabilitate the oral cavity and professional hygiene. The patient who lost his teeth, most likely, paid little attention to oral hygiene and if the situation is not corrected, the loss of the implant will be almost 100%.
   - After repeated quality control of individual hygiene, having made sure that the patient has consolidated hygiene skills, we move on to the next stage.

3. **Operational phase**
   - In the postoperative period (up to 14 days), it is important to provide optimal conditions for preservation of the implant and regeneration of bone and soft tissues.
   - At this stage, infection of the postoperative wound with pathogenic microflora is unacceptable, so it is important:
     - hygienic and antiseptic treatment of the operative field should be performed by a dental hygienist;
     - the area of surgery should not be cleaned with a brush at home for up to 14 days, but only rinsed with chlorhexidine-containing solutions (0.06% or 0.12%), while other parts of the oral cavity should be cleaned with a soft toothbrush "Sensitive" and "Implant", ("Tello", "Curaprox", "Sensodyne"),...
Switzerland). Additionally, you can use mousse “Peribioma” (“Biorepair”, Italy), which contains a unique complex of probiotics “detox complex”, which consists of vitamins A, C, E, witch hazel and hyaluronic acid, “anti-inflammatory complex”, which contains chic mastic, spirulina, calendula, eucalyptus and zinc as home care plan;
- it is recommended to use pastes containing chlorhexidine in the form of gels, which will gently and delicately clean the areas, where surgery was performed, and will promote the processes of regeneration and repair;
- 14 days after the surgery, introduce a surgical toothbrush with 12,000 special bristles (“TePe”, Sweden) into home dental care;
- when brushing your teeth, do not forget to remove plaque from the tongue, palate, inner cheeks;
- in the first week after each meal, rinse your mouth with antiseptics, and then rinse;

Notes:
1. If implantation is performed with immediate loading, the recommendations are the same as after the surgical phase.
2. If the patient has not undergone total rehabilitation, but only single structures based on the implant, the entire oral cavity is cleaned with a regular toothbrush, and a special delicate cleaning with a surgical brush - only in the area of implantation.
3. Elderly patients with reduced cognitive abilities deserve special attention. For them, hygiene can be adjusted by a percentage of chlorhexidine-containing products. It is advisable that they are prescribed 0.06% (not 0.12%)
chlorhexidine containing pastes and rinses for 1 month (not for 14 days).

4. Phase of osteointegration (6 months)

At this stage, hygienic measures are carried out according to the traditional scheme described above.

Given that during this period most patients use temporary dentures, they are given special attention:

- Prostheses are made as hygienic as possible (high level of polishing, wide gaps in the washing part of prostheses).
- For a successful implant integration process, there must be an extremely high level of hygiene (home and professional):

  1) care of prostheses:

  2) care of implants:

5. Phase of fixation of gingiva formers

At this stage it is necessary to provide conditions for the normal formation of tissues around the neck of the implant:

- thorough cleaning of the wound with rinses containing chlorhexidine bigluconate, cetylpyridinium chloride (“Perio

– local applications of gel “Solkoseril”, “Paroex”, “Perio aid”.

A significant difference of the second surgical intervention is the presence of metal structures in the wound area, which rise above the gums and at the same time are retention points for the microflora of the oral cavity. In order to prevent infection of the wound, mechanical cleaning of metal structures from plaque with a solution of sorbent in combination with antiseptic (“Atoxil”, furacillin, etc.) is carried out from the 3rd day [4, 1].

**Orthopaedic phase**

The final stage of implantation.


**Notes:**

1. An individual hygienic programme is created with the schedule of professional hygiene at least every 3 months.

2. Be sure to bring in a home care toothbrush “Universal care” ("Tepe", Sweden), with a bent head for efficient cleaning of the sublingual area.

**Stages of home care for implants**

1. Cleaning with a toothbrush:
   a) it is recommended to use an electric toothbrush (sound brush with nozzles in the form of a mono-bundle brush and a regular one, or a rotary one with a pressure sensor to avoid injuries and excessive pressure on the teeth). The head should consist of soft nylon fibers, contain the label “Soft”, “Sensitive”, “Implant”, rotating electric brushes “Oral-B 9000” (Germany), sound brushes “Philips Sonicare” (Netherlands) with hydrodynamic effect (combination of sound
vibrations and saliva), “G.U.M” (Japan), “Edel White” (Switzerland);
d) toothpaste should be low-abrasive (RDA ranging between 45-60) and contain prebiotics that will restore the normal microflora, enhance the remineralizing potential of the paste.

It is important to avoid the presence of tin fluoride and sodium fluoride in toothpaste. The presence of aminofluorides (not more than 900 ppm) is allowed only if there are plenty of preserved natural teeth in the oral cavity. It is important to avoid the presence of sodium bicarbonate in the composition.

2. Cleaning the interdental space:
a) with brushes that are suitable for implants (“Tepe”, Sweden, (“Curaprox”, Switzerland, “Edel White”, Switzerland, “G.U.M”, Japan). They have a regular spiral wire coil of metal base with a rounded smooth tip, which is safe for the implant surface. The dental hygienist selects the size of the brush individually for each clinical case;
b) with water and air floss “Prooral 5102” (“Prooral”, Switzerland), “WP-100 E2” (“Waterpik”, USA), “Professional Care OxyJet Irrigator MD20” (“Oral-B”, Germany), “Pecham Professional” (“Pecham”, USA), “Waterpulse V-660” (“Waterpik”, USA), “Jetpik JP51M Solo” (“Wash DELUXE”, USA), which are equipped with tanks for solutions, timers, several cleaning modes, mono- and turbo flows, gum massage function, several levels of water temperature and pressure regulation. A special narrow nozzle allows the water jet to reach areas of the interdental spaces that are inaccessible when cleaning with a regular toothbrush or floss. Water floss enhances the action of the brush and dental floss. Strong pulsating water
pressure massages the gums and the entire oral cavity, improving the quality of hygiene and blood supply to tissues.


The rinse should be non-alcoholic, as alcohol leads to dryness of the oral mucosa, reduces salivation, which is so necessary to counteract microorganisms. Since alcohol should not be used, it is recommended to use a rinse containing cetylpyridinium chloride – a cationic compound of Quaternary ammonium [18].

Numerous randomized trials in the United States have recently shown the effectiveness of a weak solution of sodium hypochlorite in combating biofilm, reducing the bacterial load in the oral cavity and bleeding. 0.05% solution of sodium hypochlorite (with regular use 2-3 times a week) guarantees almost complete destruction of Str. mutans, P. Sanguinis and Lactobacillus acidophilus. On the website of almost every dental clinic in the United States you can find recommendations for personal hygiene for patients with and without implants, and among them – the mandatory use at home of 0.25-0.5% sodium hypochlorite as the most effective method of combating dental plaque [17, 11].

The feasibility of using sodium hypochlorite in our country is questionable, as it is not mentioned in any protocol.

PROFESSIONAL HYGIENE IN THE PRESENCE OF IMPLANTS

Lack of professional hygiene can lead to the accumulation of deposits around the implant, the appearance of inflammatory
and destructive changes in the gums and bone and, ultimately, to the rapid loss of the implant itself. Regular professional hygiene prolongs the life of implants.

Professional hygiene should be performed by a dental hygienist at least every three months.

**Emphasis of professional hygiene on implants**

1. The modern GBT protocol approved by the American Board of Physicians (ACL) 2018-2019 provides for the use of air-flow with low abrasive powder (erythritol or glycine) to remove the biofilm before the PSR-screening test and after scaling. To date, in the context of the COVID-19 pandemic, in order to ensure anti-epidemic measures, the use of air-flow is prohibited, so the effect of these protocols has expired. This unit of professional hygiene is replaced by cleaning the surfaces of implants with pastes of variable abrasiveness “Cleanic” or “Clean polish” (“Kerr”, Switzerland) and pastes containing silicon oxide and xylitol: “Proxyt fine” (“Ivoclar Vivadent”, Liechtenstein) nylon circular brushes and rubber polishers for the corner tip [5].

2. Occlusion monitoring is especially important for patients with dental implants. In the event of any malocclusion, bite adjustment is recommended, and bite devices (caps) may be required to protect fixed restorations, especially at night. Hygienic care for caps – similar to the care of removable dentures.

After getting acquainted with the European and American protocols for professional hygiene on implants [5, 8], we adapted them and created our own **step-by-step algorithm for this manipulation**:

1. **Preparation.** Prepare the workplace and implement a set of infection control measures to prevent the spread of COVID-19.

2. **Protection.** Treat the surface of the patient's palms with disinfectant, have the patient wear goggles.

3. **Antiseptic treatment.** Carry out antiseptic treatment of the patient's oral cavity by alternating rinsing for 1 min with a 0.12% solution of “Chlorhexidine Dent” and 3% solution of hydrogen peroxide diluted with water 1:1.

4. **Retraction.** Retract the patient's cheeks and lips with OptraGate for optimal vision of the work area and protection...
of the patient's lips.

5. **Electromechanical scaling.** Remove the biofilm with a special nozzle (“Columbia 4R/4L”, “204S”, “H6/H7” (“HU-FRIEDY”, USA) to the piezoelectric scaler, use special atraumatic periodontal nozzles (“V-P10 VARIOS 970” (“NSK”, Japan), “SONICFLEX IMPLANT” “SONICFLEX” (“KAVO”, Germany) for super- and subgingival scaling (204SD, Mini-Five 1/2, Mini-Five 11/12, Mini-Five 13/14) – all work should be carried out in the presence of a powerful aspiration system.

6. **Manual scaling.** Continue removing dental plaque with hand tools using “Implancare” curettes and scalers adapted for use on implants (both plastic and titanium attachments can be used, as recent randomized studies prove the safety of titanium tools to the titanium base of the implant) [20].

7. **Air-flow surface treatment.** Carry out air abrasive treatment using low abrasive powders (erythritol and glycine). During the conditions of the COVID-19 pandemic this stage is not carried out! [8].

8. **Repeated rinsing of the mouth with 0.12% solution of “Chlorhexidine Dent” (Ukraine).**

9. **Polishing.** Polish the surfaces of the implants with pastes of variable abrasiveness “Cleanic” or “Clean polish” (“Kerr”, Switzerland) and pastes containing silicon oxide and xylitol “Proxt fine” (“Ivoclar Vivadent”, Liechtenstein), using nylon circular brushes and rubber polishers for the corner tip, polishing is carried out at micro-rotations (500-1000 rpm, accompanying the polishing process with intensive water irrigation [12].

10. **Protection.** Apply antimicrobial varnish “Cervitec Plus” (“Ivoclar Vivadent”, Liechtenstein) in the area of the sulcus throughout the implant. This prevents the re-formation of biofilm around the implant and orthopaedic structures, as it contains thymol and chlorhexidine (a special formula chlorhexidine diacetate, which has a prolonged bacteriostatic effect and does not contain fluorides) [6, 7].

11. **Recommendations.** Do not eat or drink for 1 hour after the procedure. Replace oral care items with new ones and, if necessary, change the algorithm of hygienic care, make an appointment for the next professional hygiene (in 1-3 months, depending on the clinical picture).
Conclusion. Dental implantation is a complex, multi-stage process that requires a responsible attitude not only of the dentist responsible for the operation, but also of the patient and the dental hygienist.

To minimize the risk of complications or rejection of the implant and maximize its service life, make it comfortable and pleasant, you need to uncompromisingly follow all the recommendations for hygienic care of the oral cavity [19].

To control the quality of professional and individual hygiene, we recommend using the criteria of the American Academy of Periodontology for periodic evaluation of the quality and functionality of implants during the examination [12].

1. The presence of deposits on the surface of the abutment.
2. Condition of peri-implant tissues.
3. X-ray examination of the level of bone tissue.
4. Occlusion control, condition of orthopaedic structures.
5. Depth of probing.
6. Bleeding and suppuration during probing.
7. Patient comfort.

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