

Comparative Evaluation of Treatment Efficiency of Inflammatory Complications after Orthopedic Treatment with Up-To-Date Methods of Pharmacotherapy

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Abstract

Nowadays implantation is getting more and more popular. At the same time dental implantation gives rise to complications. The problem of post-prosthetic complications after implantation reducing the implants lifetime is a matter of pressing concern. Scientific and methodological approaches to the origin of inflammatory processes in the area of dental implants supposes the impact on the main aetiopathogenetic links and are based on courses of therapeutic and hygienic procedures, as well as a local antibacterial therapy. At present, there is no single scheme of a pathogenetic approach that takes into account predicting factors in the diagnosis of risks of complications after dental implantation, it is hardly possible to implement early preventive measures and methods of chemotherapy in the early future that could prevent complications after dental implantation. This article presents a research which aims to enhance the efficiency of post-prosthetic complications treatment after dental implantation on the background of the up-to-date methods of chemotherapy.

Efficiency of combined methods of the treatment based on the combinations of ozone therapy at the local level with a transcranial electrical stimulation at the systemic level was proved and substantiated

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Introduction

For the last decade, in the professional literature there were the findings published on increased occurrence of post-prosthetic complications diagnosed in 26-38% of the cases¹. It was facilitated by widely used unjustified indications for dental implantation and lack of clearly defined goals of the whole bulk of dental implantological treatment². The problem is aggravated by the fact that there is no consensus about a nosological status of complications after dental implantation including the knowledge of

this or that type of a provoking factor in aetiology and clinical-morphological interpretation of peculiarities of the pathological process pathogenesis^{3,4}.

Post-prosthetic complications are mucositis and peri-implantitis⁵. Mucositis is an initial stage of the implant rejection when inflammation of the peri-implant tissue bears a reversible character^{6,7}. The patients complain of pain, edema, bleeding of the peri-implant area and discomfort on chewing⁸. In rare cases the patients lose appetite and weight, have a long-lasting fever and inflamed submaxillary lymphatic nodes⁹.

The dentist's main problem is firstly to detect the condition at an early stage and secondly to render not only a symptomatic but also a pathogenetic treatment considering the factors that provoke the pathology^{10,11}. In doing this, it is important to reduce the exacerbation period and prolong remission¹². Careful diagnosis,

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a treatment plan and complex treatment at the initial stage of the condition to prevent the loss of the implant helps solve the problem^{13,14}.

The aim of the research is to carry out a comparative evaluation of the treatment efficiency of post-prosthetic complications after dental implantation on the background of modern methods of chemotherapy and on the basis of clinical data.

Materials and methods

After a complex questioning and examination, all patients were randomized into 4 equal groups (35 patients each) according to the chemotherapy methods. In the first group the patients were treated with conventional methods (applications on the inflamed peri-implant area with "Metrogil-Denta" gel were fixed in the oral cavity with a Display-film) (12). The patients in group II were treated with ozone in addition to the conventional therapy. The procedure was as follows:

1. The pins of "Ozotron" machine are fixed with a thermoplastic material in occlusive masks;
2. A basic component of S-silicone is made;
3. The occlusive mask is evenly covered with a silicone material in such a way that all edges of the mask should be covered with silicone and without touching the mucosa.
4. The occlusive mask is positioned in the patient's oral cavity and the patient is asked to bite to see the traces of teeth.
5. After silicone has polymerized, the mask is taken out from the patient's oral cavity and checked for leak-tightness, lack of holes, slits, etc. If necessary, another portion of silicone is made to create leak-tightness, and it is put in the oral cavity.
6. PVC pipes from "Ozotron" are attached to the pins.

The treatment scheme of group III included transcranial electrical stimulation, strictly following the manual instructions of "Transair – 04".

In group IV a combined method of treatment was used when ozone therapy was applied alongside with transcranial electrical stimulation.

The general patients' condition was characterized by anxiety with signs of disturbed psychophysiological condition.

For this reason to achieve a good therapeutic effect the patients of all four groups were to take "Tenoten" according to the instruction: 1-2 tablets twice a day, in some cases the dose was increased up to 4 tablets a day for 3 months. The refresher course was 6 months later.

Examination was carried out using a standardized approach to the careful assessment of the teeth, periodontal tissues and restorations. When assessing the condition of teeth, implants and adjacent tissues, records were made about caries foci, abrasive defects and faulty alignment of prosthesis. By means of hygienic indices the level of the oral hygiene was detected (PCR index). Periodontium and the tissues adjacent to the implant were assessed with the help of periodontal indices (Iodine value by Svrakov, periodontal screening, papillae bleeding index, BOP)¹⁵. To assess the objective stability or mobility parameters (ISQ), Osstel Mentor apparatus was used. To detect sensitivity to pain, Hossli-Bergman scale of pain intensity with the help of pain index value (PIV) was used. The assessment was made in points from 0 to 4 before and after the treatment: no pain – 0, weak pain - 1, moderate pain - 2, strong pain - 3, unbearable pain – 4^{16,17}. The results were assessed before the treatment, on the 7th and 14th day of the dynamic treatment and observation.

Results

In the patients of all four groups (140 people) clinical and radiological indicators before and after the treatment were identical and correlated with the clinical picture of acute inflammation of peri-implant tissue. The main patients' complain was pain and gingival bleeding. They did not brush their teeth regularly and never were instructed about oral hygiene either by the dentist or hygienist. Professional hygiene was carried out once every two years. On careful examination pain sensitivity was determined using Hossly-Bergman scale. The pain index value (PIV) was $3,73 \pm 0,08$ points that corresponded to a strong and unbearable pain.

The first clinical symptom of post-prosthetic complications after dental implantation was bleeding after careful examination of the papillae with a periodontal probe. Clinical symptoms of mucositis included profuse bleeding

after papillae probing, edema and hyperemia. In some cases spontaneous bleeding and ulceration was noted. Objective examination showed unsatisfactory oral hygiene in all patients, simplified oral plaque index PCR was $72.7 \pm 1.79\%$ and Schiller-Pisarev test was positive, an intensive inflammatory process was noted – iodine value by Svarakov was 3.7 ± 0.3 points. Bleeding index BOP was 57.0 ± 3.5 points, and periodontal screening PSR was 1.7 ± 0.2 points, which was the evidence that the plaque and soft residuals as well as calcified debris should be removed. This confirmed the diagnosis of mucositis with the intact dentogingival attachment.

Implant stability quotient (ISQ) was 62.3 ± 2.0 that characterizes relatively high implant stabilization.

Radiological examination did not reveal any pathological elements. Damage to the cortical plate was not noted, peri-implant osseous tissue was not changed. Full osteointegration was noted in the area of dental implants. On examination of the cheeks and tongue mucosa lesions were absent. The mucosa was pale pink without any manifestations of a pathology.

On the 3d day all patients in this group complained of pain and bleeding, mainly while brushing their teeth. So, the pain index value was 3.4 ± 0.13 points, with $p > 0,05$ of the initial value. A similar situation was seen on determining the bleeding index BOP – 55.0 ± 4.0 , the gingival mucosa was reddish black being stained with Schiller-Pisarev solution, iodine value by Svarakov was 3.5 ± 0.12 , PSR – 1.2 ± 0.3 . Though there was a positive tendency noticed when examining the oral hygiene, PCR was $30.8 \pm 1.27\%$, which is 2.3 times less in relation to the initial value ($p < 0,05$). The implant stability quotient (ISQ) was 64.2 ± 2.3 , while the statistical significance of the differences was not determined in relation to the initial ISQ.

After 7 days of treatment of post-prosthetic complications after dental implantation with conventional methods, the clinical picture looked unchanged. The patient suffered from a strong pain, PIB was 3.03 ± 0.17 points, while 12 patients suffered from unbearable pain (4 points), 9 patients had a strong pain (3 points), in the rest of the patients pain was less expressed (1 and 2 points respectively), BOP – 49.5 ± 4.5 . Oral hygiene was satisfactory (PCR $26.6 \pm 1.04\%$). The stained gingiva was light

brown. Iodine value by Svarakov was 3.1 ± 0.2 , periodontal screening was in compliance with the clinical picture 1.1 ± 0.1 . ISQ was 63.7 ± 2.1 , that was the evidence of implants stability. The data obtained with the semiquantative estimation scale are presented in the Table.

After 14 days all patients noted improvement of the clinical picture in the oral cavity. Only 3 people complained of unbearable pain, 5 patients had the signs of a strong pain, the others either did not have any pain or complained of a weak pain. PIB was 1.56 ± 0.24 , but there was a statistical significance of the differences in relation to the previous values ($p < 0,05$). Bleeding index also dropped as much as 1.8 and made 28.0 ± 0.5 . On objective examination satisfactory oral hygiene was noted with PCR of $26.6 \pm 1.03\%$, iodine value by Svarakov was 2.4 ± 0.2 . ISQ slightly increased up to 57.5 ± 1.8 , whereas the statistical significance of the differences was absent.

Radiological examination did not show any deterioration of the clinical picture, the osseous tissue and cortical plate were without any changes.

Thus, the immediate results of the treatment and monitoring of the patients who were treated for mucositis using the conventional treatment schedule show that the treatment conducted was successful, though it was only after 14 days when inflammation, hyperemia and edema of the peri-implant tissues subsided.

The immediate clinical results (1-14 days) of the patients from group II, whose treatment of post-prosthetic complications after dental implants included ozone therapy, is presented in the following Table 1.

All patients showed a positive tendency to arrest inflammation of the periodontal tissue. So, the pain index value on the 3d day of observation decreased by 31,8%, while only 12 people complained of unbearable pain, 9 – of a strong pain and all the others did not have any complaints. Two weeks later, the pain index value dropped by 3.4 and this difference is statistically significant in relation to the same value before treatment and also in relation to the previous period of observation (7 days).

The level of oral hygiene significantly improved and in the immediate period of observation PCR index increased not more than by 30% that witnessed of the optimal level of oral hygiene.

After staining the gingival mucosa in order to detect how severe the marginal and alveolar gingival membrane around the implant was inflamed, the following data were obtained: those were only gingival papillae that were stained; on the 3d day of observation inflammation was moderately expressed and later the inflammation process became weak ($1,4\pm 0,2$ points and $0,8\pm 0,1$ points respectively).

Periodontal screening values determined further steps in diagnosis and treatment. On the basis of PSR it was decided to remove a soft dental plaque. At all stages PSR corresponded to code 1.

Papillae bleeding index also decreased at all stages of observation. So, on day 7 BOP reliably decreased by 2.2 and on day 14 – by 2.4 that proved stability of the process. The data obtained by Osstell-metry, made it possible to follow the changes in the implant stability index. On day 3 ISQ rose by 4%, on day 7 – by 11%, on day 14 – 17.7% and made 73.3 ± 1.7 , while statistically significant difference was noted in relation to the initial value ($p<0,05$). Objective data obtained during examination also prove fixture stabilization.

In the immediate period of observation on day 14 inflammation was completely arrested that proves anti-inflammatory and antimicrobial effect of ozone.

In the group of patients whose treatment plan contained transcranial electrical stimulation a slight improvement of the condition was noted in the immediate period of treatment.

The pain index value decreased at all stages of observation: on the 3d day - by 12.1%, on the 7th day - by 36.6% and on the 14th day by 3.1. Oral hygiene was assessed as optimal and did not require any additional preventive procedures, When stained with Schiller-Pisarev solution, the gingival mucosa was light brown, while the bleeding quotient and iodine value by Svarakov reliably decreased in relation to the initial value. So, after 3 days BOP decreased by 9.6%, on day 7 and 14 – by 1.5 and 1.8 correspondently (38.0 ± 1.75 and 31.0 ± 1.5 points), statistical significance of the differences was ($p<0,05$).

A significant increase in the implant stability was detected by means of Osstell-metry. For example, on the 14th day ISQ increased by 13.5% and made $68,9\pm 1,3$.

Radiological changes were not detected, as well as the cortical plate and peri-implant osseous tissue were not changed.

The clinical examination did not detect any signs of suppuration, necrotic alterations and fibrosis of the soft tissues.

After the clinical examination of the patients in group 4 the treatment plan of prosthetic complications after dental implantation included a combined method of treatment (ozone therapy alongside with transcranial electrical stimulation), dynamics of arresting the inflammatory process being drastically different from other groups.

On the 3d day of the treatment and observation, the pain index value was 2.0 ± 0.31 points. 8 patients complained of unbearable pain, 7 experienced a strong pain, 10 patients did not have any pain and the rest of them had either a weak or moderate pain. When the iodine value by Svarakov was determined, this factor decreased by 2.5 and made 1.5 ± 0.2 points. In this case a statistical significance of the differences in relation to the initial value, $p < 0,05$. BOP index was 42.0 ± 2.0 points that is 1.4 less ($p<0,05$). The oral hygiene was satisfactory, PCR – $17.5\pm 0.6\%$. Implant stability quotients (ISQ) was 66.4 ± 1.5 .

Edema, hyperemia and bleeding were moderately expressed, though the granulation tissue kept proliferating without any signs of inflammation or bleeding. There was no suppuration or necrotic changes. On the 7th day the improvement persisted: 14 patients did not feel any pain, and only 7 patients complained of unbearable pain. Papillae bleeding index reduced by 2.2 in relation to the previous value and made 19.4 ± 1.0 points, iodine value by Svarakov reliably decreased to 0.6 ± 0.1 points with statistical significance of the differences in relation to initial number and value in the 3d period of observation.

Edema, hyperemia and bleeding were only slightly expressed according to the semiquantative estimation scale.

Two weeks later, the pain index value was 0.13 ± 0.06 points, a simplified dental plaque index - $15.6\pm 0.8\%$, iodine value by Svarakov, PSR and BOP were zero that characterized a complete arrest of inflammation at this stage of observation. The implant stability quotient reliably increased by 10.9% and made 68.0 ± 0.5 .

Discussion

All groups showed a positive trend. However, the nature of the relief of the inflammatory process varied depending on the type of therapy. The obtained clinical data of patients whose treatment of mucositis was carried out using Metrogil-Dent gel applications in combination with a local drug delivery system (film, to fix the drug in the lesion), indicate that the majority of patients achieved a positive dynamics of the relief of the inflammatory process with correction of the level of oral hygiene. Conducted traditional treatment, aimed only at symptomatic effects, not taking into account the general systemic psychophysiological state of a person, was not effective enough.

The inclusion in the treatment regimen of ozone therapy with anti-inflammatory and antimicrobial goals is appropriate. The results obtained indicate a stable situation in the oral cavity. The inclusion in the treatment regimen of patients with post-prosthetic complications during the dental implantation of ozone therapy contributes to a more rapid relief of inflammation in the shortest follow-up periods and prevents the development of adverse adverse reactions from the oral cavity and soft tissues surrounding the implant. These changes are due to the action of ozone, which can activate NO synthetase, which leads to vasodilation of vessels and endothelial relaxation at the local level.

It is clinically justified to conduct transcranial electrical stimulation (TES) in patients with a violation of the psychophysiological state in order to reduce the number of exacerbations of post-prosthetic complications during dental implantation. The

data obtained confirm the effects of TES-therapy, based on the stimulation of sensitive structures of the brain through the penetration of electric current through the bone and soft tissues of the head. At the same time, clinical indicators improve due to the antistress and antidepressant effects of transcranial electrical stimulation. The combination of ozone therapy and transcranial electrical stimulation is an effective method of pharmacotherapy, contributing to the launch of all regulatory mechanisms of both vascular and extravascular origin. The effect of transcranial electrostimulation on opiodergic mechanisms helps to prevent the development of a stress reaction that proceeds as a sympathoadrenal reaction, increase the effect of ozone therapy not only at the local level, but also through an increase in the synthesis of nitric oxide, which in turn helps to normalize the state of peri-implant tissue and increase resistance organism.

Conclusions

Thus, treatment of patients with post-prosthetic complications after dental implantation with a combined method (combination of ozone therapy and transcranial electrical stimulation) is sufficient and expedient. A bilateral approach to the treatment of this pathology is justified, as the local ozone effect due to the anti-inflammatory and antimicrobial action arrest inflammation of the gingiva in the focus of pathology and application of transcranial electrical stimulation substantiates a pathogenetic approach to the therapy of post-prosthetic complications after dental implantation.

Signs/days	Pain	Simplified dental plaque quotient, PCR, %	Iodine value by Svarakov, points	Periodontal screening, PSR, points	Papillae bleeding quotient, BOP, points	ISQ
Before treatment	3.73±0.08*	72.7±1.79*	3.7±0.3*	2±0.1*	57.0±3.5*	62.3±2.0*
3 days	2.83±0.24*	19.6±0.64*	2.5±0.3*	1.1±0.2*	48.0±3.0*	64.8±1.3
7 days	2.37±0.27*	19.3±0.13*	1.4±0.2*	1±0.1*	25.5±3.5*	69.0±1.5
14 days	1.0±0.22*	22.2±0.4*	0.8±0.1*	1±0.1*	24.0±0.2*	73.3±1.7*

Table 1. Clinical picture dynamics in the immediate monitoring period in the patients of group II.

Note: * - statistical significance of the differences in relation to the data before treatment at p<0,05.

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Declaration of Interest

The authors report no conflicts of interest pertaining to any of the products or companies discussed in this article.

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