

სეზონისას კარიესის მქონე პაციენტებში გამოვლინდა ლიმფოციტების სონტანური პროლიფერაციული აქტივობის ზრდა 25,8%-ით, ნეიტროფილების ფაგოციტური აქტივობის ზრდა, ფაგოციტების რაოდენობრივი და ფაგოციტური ინდექსის უფრო მაღალი მაჩვენებლები, პათოგენური თვისებების მქონე საშუალო- და დაბალმოლეკულური იმუნური კომპლექსების მომატებული შემცველობა. გამოვლინდა პროანთებითი ციტოკინების – სიმსივნის ნეკროზის  $\alpha$ -ფაქტორის, IgG-ის მომატებული კონცენტრაცია, ასევე, სეკრეციული IgA-ს სარწმუნოდ დაბალი კონცენტრაცია. დადგენილია, რომ პაციენტებში გასტროეზოფაგური რეფლუქსური

დაავადებით და კარიესით აღინიშნება სუბკლინიკური იმუნური ანთების ნიშნების მქონე ცვლილებები იმუნურ სისტემაში.

ჩატარებული კვლევით გამოვლინდა კარიესული პროცესის სარწმუნოდ უფრო მაღალი ინტენსივობა პაციენტებში გასტროეზოფაგური რეფლუქსური დაავადებით, რაც დაკავშირებულია პირის ღრუს ლორწოვანი გარსის მუდმივი მჟავური გაღიზიანებით. დადგენილია პირის ღრუს სითხის ადგილობრივი იმუნიტეტის დარღვევა, რაც ვლინდება პროანთებითი ფაქტორების კონცენტრაციის მატებასა და სეკრეციული IgA-ს კონცენტრაციის შემცირებაში.

## STUDY OF THE HYGIENIC CHARACTERISTICS OF THE ORAL CAVITY UNDER THE COMPLEX EFFECT OF PHOTODYNAMIC THERAPY AND TSKALTUBO SPRING WATER RADON HORMESIS

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Inflammatory periodontal diseases hold the second place in the frequency and prevalence of dental diseases. Periodontitis is a disease of the tissues around the tooth in which the connection between the tooth and the gum is disrupted. The pathological process gradually damages the tooth cavity, with the loss of periodontal tissues, the tooth loses its bone support and this causes loosening of the tooth [1-5,8].

Today every third person suffers from periodontitis of some degree. Risk factors for periodontitis can be: improper oral hygiene, caries, improper occlusion, improper load on the chewing apparatus, malnutrition, especially a deficiency of proteins and vitamins [1,2,9]. Saliva is of particular importance as a natural biological environment; it plays an important role in the vitality of teeth and periodontium. Saliva maintains oral homeostasis [6,10,21].

To maintain the homeostasis of mineral metabolism in the oral cavity, it is important to have a combination of hydroxyapatites, which indicates the normal functioning of saliva, in order to maintain homeostasis of the dental tissue. For this, photodynamic therapy is very important, which does not have side effects, which is based on a special chemical preparation – photosensitizer, which is locally activated by electromagnetic radiation. Thus, a photochemical reaction occurs that affects the tissue. Radiation effect on tissues can be carried out both in oxygen and in non-oxygen environment [11-13]. The mechanism of photodynamic therapy is presented as follows: a molecule of photosensitizer that absorbs a ray quantum, passes into an excited triplet state and enters into two types of photochemical reactions.

In the case of a type 1 reaction, the direct interaction with the biological substrate occurs, resulting in the formation of free radicals.

In reactions of type 2, the interaction of an active photosensitizer and dissolved molecular oxygen occurs [11-14] oxygen-dependent interaction of substances with a ray (the so-called type 2 photodynamic therapy) was discovered in 1898 by O. Raab.

Thus, with the help of the photosensitizer “Rada Dent” and the apparatus “Photodin-K”, it became possible to treat inflammatory diseases of the oral mucosa with non-invasive methods. In this case, we will use radon inhalations and rinses with radon water, because it is the alpha radiation of radon in the water of Tskaltubo that is very important in the regulation of inflammatory processes and the maintenance of oral cavity homeostasis. As it is known, in recent years, the publications [15-17] have appeared that deny the carcinogenic effect of small doses of radiation caused by radon therapy, and, conversely, it is believed that this dose is characterized by the so-called “hormesis”, thus, our area of interest is the determination of the mechanism of action of radon hormesis and its use to maintain the homeostasis of mineral metabolism in the mouth [16,17,24]. The radioactivity of the Tskaltubo mineral water ranges around 1 nq/l, about 37 nq/m<sup>3</sup> [18,22]. Radon therapy has a pronounced analgesic effect on inflammatory processes in the nervous tissue. It accelerates the regeneration of nerve tissue and nerve fibers [18,24,26]. Radon possesses antiseptic, antioxidant, cytoprotective, anti-inflammatory, anti-cellulite properties. It maintains the elasticity of blood vessels, prevents the development of atherosclerosis, and reduces the risk of cardiovascular diseases. It has regenerative properties, therefore, the uniqueness of Tskaltubo water and the determination of the mechanism of action of radon are very relevant and require significant study [20,23,27].

Without treatment, periodontitis eventually leads to the destruction of the alveolar ridge, loosening of the teeth and their loss.

In connection with all of the above, our main goal is to study the method of photodynamic therapy, which has become widespread in recent decades. This method of treatment has gained popularity in the treatment of both oncological and non-oncological inflammatory diseases in dentistry and other medical fields. Photosensitizer “Rada Dent”, apparatus “Photodin-K” and inhalation of Tskaltubo water with radon and the complex

action of rinses every 6 months at the beginning, and then after 1 or 2 years for the treatment of inflammatory diseases of the oral mucosa by non-invasive methods. Both treatments allow treating mild periodontitis without the use of antibiotics and steroids. The main reason for patients seeking treatment is bleeding gums, unpleasant odor, and poor hygiene.

**Material and method.** Clinical and laboratory work is based on examining patients, drawing up a questionnaire with the following questions: Types of food: mainly carbohydrates, proteins, sweets, mainly fast food, frequent consumption of spicy foods, obligatory allergens, great attention was paid to oral care and hygiene, how many times one cleaned teeth and what toothpaste was used, how often it was changed and in what period of time, if there any other additional attributes for cleaning teeth were used (floss, dental floss, various rinses, etc.). At the first visit with a periodontal map was filled in, then deep scaling. Production of dental cast for teeth trays (the application of the "Rada Dent" photosensitizer was carried out using individual teeth trays). Then, photodynamic therapy begins for 3 or 5 visits, depending on the condition, visits were scheduled every other day. The application was made with a tray for 40 minutes, then the photosensitizer was washed off with a stream of water and activated with a diode laser.

The questionnaire also showed whether the patient is susceptible to: alcoholism, drug addiction, service: exposure to harmful production factors, the action of carcinogens, harmful environmental factors in the environment, as well as diseases of the gastrointestinal tract, endocrine diseases, cardiovascular diseases, cardiovascular diseases ... And, having analyzed all this and based on the data of the periodontal map, the stage and degree of development of periodontitis in the patient were determined. The age of the examined patients is approximately 18-35, 35-55 years old.

Determination of protein and non-protein endogenous SH-groups. SH - Protein and non-protein groups were determined by the Sedlack method [28].

Statistical analysis. When evaluating quantitative indicators, the mean, standard deviation was taken into account. Comparisons between groups were carried out according to Student's criteria for independent selection, and before and after the treatment - using the Student's pair test and ANOVA, for qualitative indicators - comparisons were made between groups using Fisher's exact test, and before and after treatment - using the Wilkeson test. Mathematical support is implemented using the IBM SPSS v22.0 software package.

The depth of the periodontal pocket was determined, the hygienic condition of the oral cavity was assessed by the hygienic index (Pi) - by the Fedorov-Volodkina method, the prevalence of inflammatory changes in the periodontal tissues was assessed using the papillary-marginal-alveolar index (PMA).

According to the method of Fedorov-Volodkina (Федоров А.А., Володкина В.В.) the hygienic condition of the oral cavity is defined as follows: the vestibular surface of the teeth 43, 42, 41, 31, 32, 33 is stained with the Schiller-Pisarev, Lugol or other solutions. The colored surface of the tooth crown is evaluated by a 5-point system: 1 - no coloration; 2 - coloration of 1/4 of the

tooth crown; 3 - coloration of 1/2 of the tooth crown; 4 - coloration of 3/4 of the tooth crown; 5 - coloration of more than 3/4 of the tooth crown. The formula for calculating the hygiene index: mean Nh. =  $\Sigma/6$ , where  $\Sigma$  - is the sum of the points of all 6 teeth; 6 - Number of teeth to be examined according to the results of the level of oral hygiene is determined. 1,1-1,5 points - good level of hygiene; 1.6-2.0 points - satisfactory; 2,1-2,5 points - unsatisfactory; 2,6-3,4 points - bad; 3,5-5,0 points - very bad. Fedorov-Volodkina hygiene index cannot be more than 5 and less than 1 point.

To determine the PMA index, a Schiller-Pissarev staining solution was applied to the vestibular surface of the gums and its position was determined for each tooth - in the areas of the gingival cavity, free (marginal) gums and attached (alveolar) gums. The inflamed areas turned dark brown [29].

Codes for assessing the degree of gingivitis 0 - no inflammation; 1 - inflammation of the gingival papilla; 2 - inflammation of the gingival papilla and marginal gums; 3 - inflammation of the gingival papilla, marginal and alveolar gums. The formula for calculating the significance of the index [2].

$$PMA = \frac{\text{Total sum of codes} * 100\%}{3 * \text{Number of teeth}}$$

#### Complex periodontal index CPI (MMCI 1987)

The CPI is used to assess the extent of damage to periodontal tissue. The examination of the oral cavity was performed using a dental mirror, dental probe and periodontal probe (for measuring periodontal pockets).

Evaluation criteria: 0 - no signs of periodontal damage; 1 - plaque; 2 - bleeding; 3 - tartar in the lower part of the gums; 4 - periodontal pockets; loosening of 5 tooth - 2-3 degree. The presence of several signs characterizes the relatively severe degree of the disease.

The CPI is calculated by the following formula:

$$\text{CPI (individual)} = \frac{\text{The sum of the signs}}{\text{Number of examined teeth}}$$

$$\text{CPI (individual)} = \frac{\text{The sum of the CPI (individual)}}{\text{Number of examined teeth}}$$

We checked the clinical and hygienic parameters of the patients in the dynamics - from the referral to the patient's clinic until the end of treatment. We also monitored them within 10 days, 6 months and one year after the end of treatment.

We conducted a complex dental examination of 135 patients aged 18-35 years and 35-55 years with periodontal pathology. Patients including 69 women, 66 men, were divided according to age and sex (Table 2).

135 patients underwent clinical-biochemical examination before and after treatment of periodontitis.

Table 1. Interpretation of the index meaning

The index meaning	The stages of gum inflammation
< 30%	Mild
31-60%	Moderate
>60%	Severe

Table 2. Distribution of the examined persons by age and sex

Distribution of patients with periodontal tissue diseases by sex and age	Sex women	Sex men
	18-35, 35-55	18-35, 35-55
Total	69	66
Group I	28	26
Group II	25	24
Control	16	16

Table 3. Distribution of patients by sex

Patient group	male		female	
	The number of the examined persons	P(%)±m	The number of the examined persons	P(%)±m
Main	53	55,0±6,7	50	55,5±6,7
Control	16	45,0±7,6	16	44,4±7,6
Total	69	42,5±4,95	66	57,4±4.95



Fig. Three visits after photodynamic therapy

The main group consisted of 69 female patients who had an inflammatory process in the periodontal tissues according to which they were divided

The other 2 groups included mild periodontitis - 28, moderate - 25 and control - 16. The second group included 66 male, and 26 patients with mild periodontal disease and the second group included 22 patients with moderate inflammatory periodontitis and a control group that had healthy periodontal tissue in 16 patients.

The distribution of the examined persons into groups by gender is shown in Table 3.

We did not establish a statistically significant difference between the groups by sex ( $p > 0.05$ ), therefore, the groups with this mark can be considered comparable.

We compared the main and comparable groups with each other also by age. The average age of patients with signs of inflammation in the periodontal tissues was  $25.0 \pm 0.4$  years, the corresponding indicator for patients without signs of inflammation was  $25.9 \pm 0.4$  years. There were no statistically significant differences ( $p > 0.05$ ) compared with the mean values of age in the groups, therefore the groups can also be considered comparable in this indicator.

At the study stage, the main group of patients who had an inflammatory process in the periodontal tissues were divided into

two subgroups. Patients of the first subgroup who were treated with Tskaltubo water inhalation and rinses, and patients of the second subgroup who were treated with both inhalation and rinses twice a day in the morning and evening.

As already mentioned, oral hygiene was assessed using the Hygienic Index (HI) according to the Fyodorov-Volotkina method and the Simplified Hygiene Index Green-Vermillion (1964), with patients divided by age. Hygienic condition deteriorated with age, before treatment, on visual examination, most patients showed gingival swelling, hyperemia, hypertrophy, retraction, cyanosis, bleeding Table 4.

The prevalence of inflammatory changes in periodontal tissues was assessed by the papillary-marginal-alveolar index (PMA) Parma (PARMA1960), the complex periodontal index CPI (MSM 1987) by the Russel (1956) periodontal index. Patients were divided according to age, the results of which are presented in Table 5.

Numerous experimental data are available on the fact that sulfhydryl groups of endogenous substances are involved in the prevention of primary processes of radiation damage, so we studied sulfhydryl-containing compounds in the brains of rats. As Table 7, radon inhalation appears to prevent the development of a brain disorders associated with peroxidation reactions.

Table 4. Oral Hygiene Complaints

Complaints	Main group		Control group	
	abs.	%	abs.	%
The degree of tooth loosening	3	11	1	6
Complains of uncomfortable sensations in the mouth, odor	6	18	2	11
Bleeding	11	37,0	2	11
Existence of tartar	5	16,0	-	-
Partial loss of teeth	6	17,0	1	6

Table 5. Inflammatory process of periodontal tissue by age

Periodontitis	18-22 y.	23-27 y.	18-20 y.	21-25 y.
Mild form	2.5	2.9	3.1	3.3
Moderate form	3.9	4.5	4.7	4.9
Control	1.3	1.5	1.3	1.6

Table 6. Indicator of CPI index, PMA index, Passel index Pi, changes in the indicators of the Fedorov-Volodkina index

CPI index							
Main group						Control gr.	Control gr.
Mild severity 18-30	Mild severity 30-55	Complex effect	Moderate severity 18-30	Moderate severity 30-55	Complex effect	Mild severity	Moderate severity
2.5±0,2	3.5±0,2	2.1±0,1 2.3±0,2	3.9±0,2	4.5±0,2	2.5±0,2 2.9±0,2	2.0±0,2	2.1±0,2
PMA index							
4.7±0,1	7±0,1	2.7±0,1 2.9±0,1	4.9±0,1	7.4±0,1	2±0,2 3.3±0,2	2.0±0,2	2.0±0,2
index Pi							
0.5±0,2	1.5±0,2	0.2±0,01 0.3±0,1			0.3±0,01 0.4±0,01	0,1±0,2	0,2±0,2
Fedorov-Volodkina index							
2.2±0,2	3.6±0,3	1.5±0,2 1.9±0,2	2.3±0,3	3.8±0,3	1.8±0,2 2±0,2	1,1±0,2	1,2±0,2

Table 7. Number of sulfhydryl groups ( $\mu\text{m/g}$  in tissue  $M\pm m$ )  $n=9$

	KControl	After rinses and inhalation
Non-protein-compound sulfhydryl group	1,03 ±0,123	1,70 ±0,109**
Total sulfhydryl group	33,00 ±1,22	37,16 ±1,44**

note: \*\*  $P < 0.05$ , comparison with control

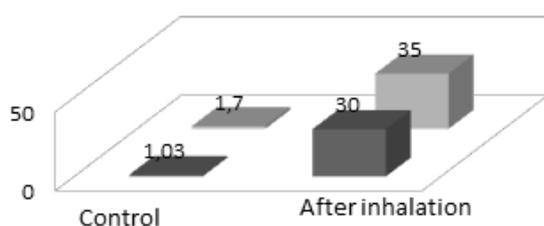


Diagram 1. Number of sulfhydryl groups

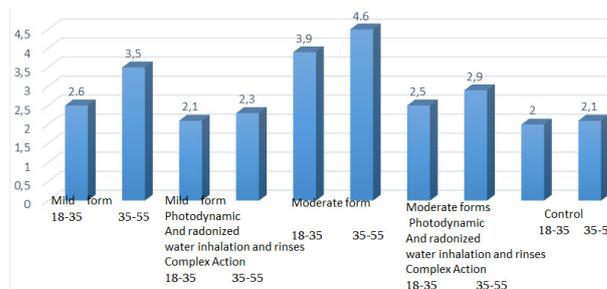


Diagram 2. The average value of the CPI index increases with age from 2.6 to 4.6



Diagram 3. The frequency of gingival retraction, hypertrophy, and hyperemia varies with age

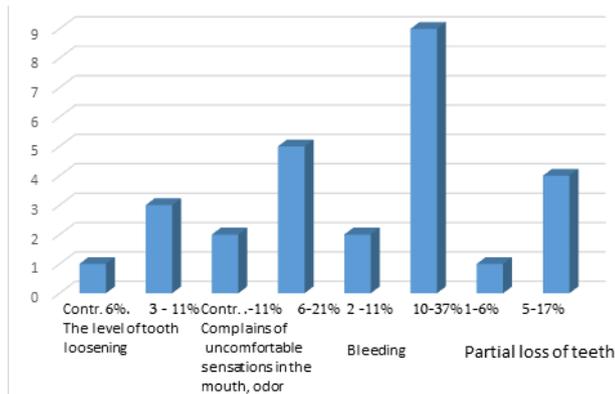


Diagram 4. The distribution of the quantitative characteristics of periodontitis is presented in the diagram of complains

Thus, it can be assumed that radon therapy suppresses peroxidation reactions and weakens the immune system.

With the help of the «Rada Dent» photosensitizer and the «Photodin-K» apparatus, it became possible to treat inflammatory diseases of the oral mucosa with non-invasive methods. At the same time, we will use radon inhalations and rinses with radon water, and the action of «Radon Dent» and alpha radiation of radon in the water of Tskaltubo regulates inflammatory processes and maintains oral cavity homeostasis.

We can conclude that the complex action of Rada Dent and Tskaltubo water (inhalation of Tskaltubo water and its use as rinses) leads to a gradual reduction and eventual eradication of the inflammatory process in the case of periodontitis. This can be explained by the unique properties that are characteristic of «Rada Dent» and Tskaltubo water. As we have seen, the above biochemical indicators are the determinants of periodontitis in patients with periodontitis, they are markers of the degree of periodontitis and we have clearly seen the complex action. High efficiency of «Rada Dent» and radon in the water of Tskaltubo - normalization of the action of oral enzymes, slowing down the inflammatory processes in the oral cavity and finally eradication. It is these unique properties that have become triggering the treatment and inhibit the initial stage of periodontitis.

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#### SUMMARY

### STUDY OF THE HYGIENIC CHARACTERISTICS OF THE ORAL CAVITY UNDER THE COMPLEX EFFECT OF PHOTODYNAMIC THERAPY AND TSKALTUBO SPRING WATER RADON HORMESIS

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The goal is to study the method of photodynamic therapy, which has become widespread in recent decades. This method of treatment has gained popularity in the treatment of both oncological and non-oncological inflammatory diseases in dentistry and other medical fields. We can conclude that the complex action of Rada Dent and Tskaltubo water (inhalation of Tskaltubo water and its use as rinses) leads to a gradual reduction and eventual eradication of the inflammatory process in the case of periodontitis. This can be explained by the unique properties that are characteristic of “Rada Dent” and Tskaltubo water.

As we have seen, the above biochemical indicators are the determinants of periodontitis in patients with periodontitis, they are markers of the degree of periodontitis and we have clearly seen the complex action. High efficiency of “Rada Dent” and radon in the water of Tskaltubo - normalization of the action of oral enzymes, slowing down the inflammatory processes in the oral cavity and finally eradication. It is these unique properties that have become triggering the treatment and inhibit the initial stage of periodontitis.

**Keywords:** radon water, “Rada Dent”, mild periodontitis, medium form.

#### РЕЗЮМЕ

### ОСОБЕННОСТИ ГИГИЕНЫ ПОЛОСТИ РТА В КОНТЕКСТЕ КОМПЛЕКСНОГО ДЕЙСТВИЯ ФОТОДИНАМИЧЕСКОЙ ТЕРАПИИ И РАДОНОВОЙ ИНГАЛЯЦИИ ВОДОЙ ЦХАЛТУБО

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Изучен метод фотодинамической терапии, который получил широкое распространение в последние десятилетия, завоевал популярность как в онкологии, так и в неонкологии, при лечении воспалительных заболеваний в стоматологии и других областях медицины. Фотосенсибилизатор «Рада Дент», аппарат «Фотодин-К» и ком-

плексное действие ингаляции радонизированной воды Цхалтубо могут быть использованы для лечения слизистой оболочки полости рта как неинвазивный метод. Комплексное действие позволяет лечить пародонтит легкой и средней степени тяжести без применения антибиотиков и стероидов.

#### რეზიუმე

პირის ღრუს ჰიგიენის თავისებურებების შესწავლა ფოტოდინამიკური თერაპიის და წყალტუბოს რადონიზირებული წყლით ინჰალაციის კომპლექსური მოქმედების ფონზე

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თბილისის სახელმწიფო სამედიცინო უნივერსიტეტი, <sup>1</sup>სტომატოლოგიური კლინიკა N1; <sup>2</sup>ბაეშვთა და მოზარდთა თერაპიული სტომატოლოგიის დეპარტამენტი; <sup>3</sup>თბილისის ი. ჯავახიშვილის სახ. სახელმწიფო უნივერსიტეტი, მედიცინის ფაკულტეტი, სტომატოლოგიური განყოფილება; <sup>4</sup>ი. ბერიტაშვილის სახ. ექსპერიმენტული ბიომედიცინის ცენტრი, რენტგენოლოგიის განყოფილება, საქართველო

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