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Prevention A Tooth Sensitivity After Professional Teeth Whitening.

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ABSTRACT

The article is devoted to the issue of professional teeth whitening. Considering changes occurring in the enamel structure and morphology and clinically manifesting by complications, it is demandable to apply reparative techniques and methods aimed at prevention of complications. It is widely known nowadays that dental professionals fail to avoid negative effects of whitening after these procedures, such as de-mineralization and dehydration of tooth tissues, increased discharge of micro- and macro-elements from the enamel surface layer and others. The aim of study was to investigate de-sensitive properties and clinical efficiency of the remineralizing gel "Radogel-GAMK". All patients were divided into three equal groups depending on the preparation applied. Using evidence-based techniques the authors have proved morphological and clinical efficiency of the protein-mineral complex (GAMK) for prevention and prophylaxis after teeth whitening complications. All recommended preparations applied in the study do not only eliminate increased teeth sensitivity but also provide restoration of mineral exchange in the enamel; this conforms to all parameters of the preparations. However, Radogel-GAMK is declared to have the best efficiency in reducing morphological characteristics of the enamel normalizing physiological dental processes after teeth whitening; this fact allows recommending this gel for practical use in clinical conditions.

Keywords: enamel whitening, hyperesthesia prevention, restoration of enamel morphology, desensitizers.

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RATIONALE

Beautiful straight white teeth do not only improve human appearance, but also define his aesthetic perception and appear to be a quality of life indicator. An aesthetic smile has become a professional “must-have” for people, whose activity is connected with public relations, meetings and speeches [1, 2].

Literature data demonstrate that 74% of the surveyed think that a bad smile negatively influences career; whereas 92% believe that an attractive smile provides success in private life [5].

Patient’s desire to have a white smile has always been of great interest among dentists; it has resulted in the active development of such a trend in aesthetic dentistry as teeth whitening [5, 7].

Coverage of population involved in the procedure of teeth discoloration elimination globally has its specific tendencies. Thus, according to Goldberg M. et al. data application of various types of teeth whitening reaches 90% of indicated cases in the dental practice in the North America. Literature data prove that approximately 80% of dental clinics in large cities in the Russian Federation offer the procedure of teeth whitening for their patients. Recently, demand for teeth whitening increases annually by several percents [6].

These facts result in arising of a great number of whitening systems for both – home and professional whitening, - in the dental market (ultra-violet, halogen, whitening with Potassium-Titanyl-Phosphate = KTiOPO_4 , “laser-like light” method). However, in spite of constant transformation of current and search for novel methods of whitening, nowadays dental professionals fail to avoid negative effects of whitening after these procedures, such as [1]:

- de-mineralization and dehydration of tooth tissues;
- increased discharge of micro- and macro-elements from the enamel surface layer;
- damage of mineral composition of the oral fluid manifesting by reduced concentration of calcium, magnesium, copper, zinc, manganese and iron;
- decreased activity of superoxide dismutase participating in the arrest of tissue inflammatory processes [2].

Stable teeth hyperesthesia appears to be the most common complication of the whitening system effect, being the most uncomfortable for patients. This results from the fact that the whitening system and technique effect is limited by discoloration of the inter enamel prisms organic matrix, washing off calcium and phosphorus, widening pores of surface and deep enamel layers; this leads to transformation of hydrodynamic processes in the tooth enamel. Fluid filling dentine canals easier reacts to external stimuli, this correlates with Brännström hydrodynamic theory of dentin hypersensitivity. According to Haywood et al (1994) and Nathanson (1997), approximately 67% of patients may experience hyperesthesia of various kinds during certain stages of whitening [4].

Based on the abovementioned, it is necessary to complete whitening procedures with remineralizing therapy to avoid negative consequences. In spite the fact, that currently there are a great number of techniques and preparations to cure hyperesthesia, the result of their application is not stable, short-termed and does not eliminate the possibility of recurrences. Thus, search and study for preparations able to neutralize these effects is especially acute in the context of growing demand for whitening [3].

Considering literature data and our research study results indicating at the developing disbalance of mineral components after application of teeth whitening systems, we believe that special attention should be paid to preparations restoring the enamel matrix. For this purpose, we applied remineralizing gel (“Radogel-GAMK) in our research study. This gel is recommended as a preparation for treating the incipient caries, and erosion of tooth hard tissues. This preparation has not been earlier applied to prevent complications and eliminate symptoms of hyperesthesia after the teeth whitening procedure. “Radogel-GAMK” is presented by gel composition on the water basis and contains a range of irreplaceable amino acids and basic mineral components of dental hard tissues: lysin – 0.3%, arginine – 1.2%, histidine – 0.1%, hyaluronic acid – 0.5%, and Ca+vitamin D+vitamin B₁₂ [4, 3, 5].

Each of the components has its own structural function in the organic and inorganic dental matrix. Restoration of the organic matrix is carried out due to the following components:

Lysin participates in collagen reproduction and tissue restoration; it also improves restoration of calcium amount and its transport to the bone tissue.

Arginine participates in the whole range of the exchange body processes; the most important thing is that it provides remineralizing potential of saliva due to formation of positively charged agglomerates carrying calcium ions and forming "arginine-calcium carbonate". Newly-formed structures in the presence of neutral pH values, sedimentate on the negatively charged dentine forming a sealing layer not only on the surface tooth tissues but deeply in the open dentine canals [52-55].

Histidine. This organic component is a part of amelogenins, which together with enamelines constitute approximately 90% of the entire organic enamel fraction. These proteins provide amelogenesis, being the basics of enamel formation and functional construction.

Factual ratio of these amino acids gives maximal properties of osmotic membrane to the tooth organic constituent forming a physiological tissue barrier for microorganisms.

Presence of **ions of calcium** in complex with **vitamin D** activates formation of the mineral tooth constituent providing enamel strengthening. **Vitamin 12** activates processes of substance mineral exchange in the enamel.

Hyaluronic acid (HA) has biological activity as well as biocompatibility, rheological properties, lack of antigenic specificity, irritating and other side effects. HA participates in regulation of tissue penetration. Due to the process of water binding in tissues, it has an important functional ability to transform intercellular substance into a gel-like matrix that support cells. Hyaluronic acid together with other amino acids participates in the formation of the enamel tissue barrier.

HA is a hydrophilous cross-linked polymer. These structures have an ability to swell in water forming insoluble space structure. Thus, hyaluronic acid is a major structure-forming glycosaminoglycan, since it concentrates around other glycosaminoglycans and forms proteoglycan aggregates; the latter having higher hydrophilic property and elasticity in comparison to free proteoglycans bind collagen fibers, other proteins, components of inter cellular substance, cells into the uniform system. This provides formation of "buffer storage capacity" that determines strength and elasticity of mechanical tissues, helps them overcome temporal exposure.

Hyaluronic acid ability to cover tissues exposed to damage is considered to be the most important ability.

Having studied the composition and properties of the components of "Radogel-GAMK" we may assume its efficiency regarding pharmacological correction of the symptom "dental hard tissue hyperesthesia" after discoloration tooth therapy with whitening preparations. Insufficient amount of information on the issue demands its further study [6, 7].

The aim of study was to investigate de-sensitive properties and clinical efficiency of the remineralizing gel "Radogel-GAMK".

MATERIALS AND METHODS

The study included 78 patients aged 19-45, having no expressed dental or somatic pathology. All patients were divided into three equal groups [5]:

- group I included 27 patients who applied "Radogel-GAMK" (OOO "Raduga-R", Russia) after the dental whitening procedures;
- group II included 25 patients who applied a preparation based on fluoride ("Ftorlak");
- group III included patients who applied "Hyposteth-ftor" (OOO "Raduga-R", Russia).

All preparations were applied immediately after whitening in accordance with the instruction for use.

The following methods were used in the study: an interview, an examination, the enamel-resistance test, acid biopsy of the enamel. We applied the index of dental hyperesthesia intensity test to register efficiency of hyperesthesia elimination after whitening.

The results were statistically processed using “Excel” and “Statisticav.6”, common parametric and non-parametric methods. Student t-test was used to compare average values of quantitative variables. Significant differences between groups were considered valid at error probability less than 5% ($p < 0.05$).

RESULTS AND DISCUSSION

The aim of application of remineralizing preparations was considered to be elimination of the effect of demineralization and increased tooth sensitivity. Thus, we registered degree of tooth hyperesthesia intensity in all groups at all stages of application of chosen preparations (Table 1).

Table 1: Alterations of dental hyperesthesia intensity at various stages of study in various patients’ groups

Groups	Before application of preparation	In 2 days after application	In 1 week after application	In 2 weeks after application
Radogel-GAMK	2.9±0.01	1.3±0.01	0±0.01	0±0.01
Ftorlak	2.9±0.01	2.1±0.02	0.5±0.01	0.5±0.01
Hyposteth-ftor	2.7±0.02	2.3±0.02	1.5±0.01	0.5±0.01

Analyzing results given in Table 1 we can conclude that all recommended preparations are reported to be highly efficient regarding elimination of the increased teeth sensitivity after teeth whitening and discoloration therapy. Index of dental hyperesthesia intensity decreased in 1.8±0.01 times in the group of patients who applied “Ftorlak” in a week of application of the preparation; index of dental hyperesthesia intensity decreased in 5.8±0.02 times in the group of patients who applied “Hyposteth-ftor” (OOO “Raduga-R”, Russia) during the same period. Index of dental hyperesthesia intensity decreased in 2.2±0.01 times in the group of patients who applied “Radogel-GAMK” (OOO “Raduga-R”, Russia) in a 2-day period, and hyperesthesia was completely eliminated in this group of patients in a week period ($p \leq 0.05$). Therefore, we can conclude that all preparations have an adequate desensitized effect, but “Radogel-GAMK” (OOO “Raduga-R”, Russia) has demonstrated the best results. The results are given in Table 1.

According to research results the enamel resistance before application of preparations was equal to average physiological values in all groups of patients, and no statistically significant differences were registered (Table 2) ($p \leq 0.05$). After application of preparations the enamel resistance increased in all groups of patients, but remineralization was the most efficient in the group “Radogel-GAMK” (according to results of the enamel-resistance test).

Table 2: Dynamics of alterations of the enamel-resistance test in the groups of patients (intensity of coloration was assessed in %)

Groups	Before application of preparation	In 1 week after application	In 2 week after application
Ftorlak	20.3±0.08	17.1±0.08	16.3 ±0.04
Hyposteth-ftor	22.3±0.01	15.4±0.09	15.1±0.07
Radogel-GAMK	21.5±0.03	15.0±0.01	14.2±0.08

Results on the enamel acid biopsy correlated with all values registered during the enamel-resistance test; and at the beginning of the study, immediately after teeth whitening, the calcium and phosphorus discharge was slightly lower than physiological values (Table 3).

Table 3: Results on the enamel acid biopsy, at various stages of study, in various groups of investigation (mcM/min)

Groups		Before application of preparation	In 1 week after application	In 2 week after application
Ftorlak	Ca	39.6±0.19	37.5±0.12	36.3±0.01
	P	23.6±0.02	22.1±0.03	21.4±0.03
Hyposteth- ftor	Ca	37.9±0.11	37.3±0.19	37.1±0.03
	P	22.8±0.01	22.6±0.04	23.2±0.05
Radogel- GAMK	Ca	38.5±0.17	37.2±0.04	32.1±0.07
	P	23.8±0.03	22.4±0.03	19.3±0.04

After application of remineralizing preparations the enamel acidic resistance increased in all groups. The efficiency of the enamel restoration was higher in the group of Radogel-GAMK application comparing to other groups ($p \leq 0.05$).

According to our research data all preparations applied in the study do not only eliminate increased sensitivity, but also help restore the enamel resistance; this is supported by the efficiency of the parameters declared. It has been also registered that level of the enamel general and acidic resistance after whitening procedures is frequently accompanied by the enamel demineralization, violation of mineral exchange and, consequently, teeth hyperesthesia. Thus, it is recommended to apply preparations providing elimination of complications after whitening on the structural and clinical levels.

CONCLUSIONS

Analyzing results of study, we can conclude that all recommended preparations applied in the study do not only eliminate increased teeth sensitivity but also provide restoration of mineral exchange in the enamel; this conforms to all parameters of the preparations. However, Radogel-GAMK is declared to have the best efficiency in reducing morphological characteristics of the enamel normalizing physiological dental processes after teeth whitening; this fact allows recommending this gel for practical use in clinical conditions.

1. All preparations applied in the study were highly efficient regarding elimination of the increased teeth sensitivity and had desensitized properties, but “Radogel-GAMK” (OOO “Raduga-R”, Russia) demonstrated the best results. Hyperesthesia was eliminated in the shortest period.
2. As clinical data demonstrated the enamel resistance before application of desensitized preparations correlated with average values registered after teeth whitening, and was approximately at the same level in all groups. After application of recommended preparations, the enamel resistance increased in all groups, but the best results were in the group of “Radogel-GAMK” application.
3. Results of the enamel acidic biopsy conformed to data obtained in the enamel-resistance test, and at the beginning of the investigation, immediately after teeth whitening, calcium and phosphorus discharge were slightly lower than physiological values. No significant differences were revealed in the comparison groups.
4. The enamel acidic resistance increased in all groups after the application of desensitized preparations, but therapeutical efficiency was higher in the group of “Radogel-GAMK” application.

Conflict of Interest

The authors declare that they have no conflict of interest.

Ethical approval

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed consent

Informed consent was obtained from all individual participants included in the study.

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