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THE EXPERIENCE OF USING A NEW PHARMACOLOGICALLY ACTIVE COMPOSITION OF NANOSTRUCTURED FLUORAPATITE IN THE TREATMENT OF EARLY MANIFESTATIONS OF INCREASED TOOTH ABRASION

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ABOUT ARTICLE

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Abstract: Despite the obvious successes in the field of preventive and conservative dentistry, the prevalence of abrasion of teeth (ITP) continues to grow: during the period 1992-2004, the proportion of diseases of hard tissues of teeth with elimination properties increased from 30.9 ± 1.8% to 38.2 ± 1.3%, i.e. increased by 7.3% [1, 7-10]. Many issues related to the diagnosis and planning of an integrated approach to the provision of dental care to patients with moderate CAH have not yet been sufficiently studied and covered [2]. Biologically active calcium phosphate in gel or colloidal state is currently of increasing interest in many areas of clinical medicine related to the problem of regeneration of soft and hard tissues of the body. It has been established that the biological activity of apatite largely depends on the size of its particles or grains, and the higher the dispersion of the substance, the more pronounced it is [3]. The use of pure compounds, as well as various combinations of bioactive substances to improve properties such as adhesion, bioactivity and biocompatibility, is also very promising [4]. A promising direction of modification of calcium hydroxyapatite (HCA) from the point of view of obtaining materials with improved properties is the introduction of fluorine and silicon atoms into the structure of HCA. This transformation increases the stability of the material in the

chemically active environment of the human body (due to the presence of fluoride ions) and increases its biological activity (due to the presence of silicate ions), while maintaining the inherent biocompatibility of HAP [5]. Nanotechnology is used in the study, production and use of nanostructures, devices and systems, including targeted control and modification of the shape, size, interaction and integration of their constituent nanoscale elements (1-100 nm) to obtain objects with new chemical, physical and biological properties. A number of technologies and methods. Direct transport of medicines to the focus of the pathological process can increase the effectiveness of existing drug therapies [6]. A promising direction in modern dentistry is the creation of new pharmacological agents with particle sizes of the order of 10-9 (nanoparticles) for noninvasive treatment and early prevention of dental diseases. The aim of the study was to study the effectiveness of new pharmacologically active compositions of nanostructured fluorohydroxyapatite in the treatment of early symptoms of dental hyperextension.

INTRODUCTION

The preparation of new pharmacological compositions in gel form was carried out at the Ural Branch of the Russian Academy of Sciences, the I. Ya. Postovsky Institute of Organic Synthesis (Academician, Doctor of Chemical Sciences Chupakin O.N., Doctor of Chemical Sciences Honina T.G.) and the Institute of Solid State Chemistry (Doctor of Chemical Sciences Savirzhanov N.A., Bogdanova E. A., Candidate of Chemical Sciences). The compositions were transferred to the Department of Physiotherapy of Oral Diseases of the UGMU of the Ministry of Health of Russia (Head of the Department, Doctor of Medical Sciences Mandra Yu.V.) for conducting research. The basis of the new pharmacological composition was organosilicon glycerohydrogel of the composition Si (C3 H7 O3)4 -6C3 H8 O3 -24H2 O. The gel has high transdermal activity, is non-toxic (RF Patent No. 2255939, IPC A61K 47/30, 2005) and is a nanostructured calcium fluorohydroxyapatite (nFAP). under the guidance of D.M.N. L.P. Larionov, UGMU of Pharmacology and Clinical Pharmacology of the Ministry of Health of the Russian Federation In a previous study on experimental animals conducted by the Department of Pharmacology and Clinical Pharmacology, the safety of the use of pharmacologically active compositions was proved. [11].

The study involved 153 patients aged 18 to 45 years. All patients had unilateral or multilateral wear of hard dental tissues with intraemal or dentin-punctate exposure, without complex carious lesions of

hard tissues. All patients were diagnosed with increased tooth erosion (K03. 0) grade I according to Bushan, localized." Exclusion criteria - temporomandibular joint dysfunction; - hypertension of the masticatory muscles; - the presence of pain symptoms due to exposure of the root cement. Patients were divided into two groups depending on the depth of damage to hard tissues in the area of facet obliteration according to the Smith-Knight classification: I - patients with facet obliteration in enamel (Smith-Knight index index = 1) and II - patients with facet loss in the upper layer of coated dentin (point exposure of dentin, Smith index-Knight = 2). Within the groups, the patients were divided into subgroups by random sampling. Group I included 74 patients. The control group (20 patients) received standard treatment with 10% calcium gluconate, which was applied to the teeth for 3 minutes, followed by application of NaF 2% (Borovsky E.V., Leus P.A.). The study group (26 people) received treatment in the form of a single 5-minute coating of the tooth surface with nFAP pharmacologically active composition, followed by repeated application in a month. The comparison group (28 patients) received treatment with ROCS Medical mineral gel in a mouth guard applied daily for 30 minutes before bedtime for three weeks. Patient group II consisted of 79 people. The control group (20 patients) received standard treatment with 10% calcium gluconate for 3 minutes, followed by application of 2% NaF to the teeth (Borovsky E.V., Leus P.A.) five times a day. The study group (30 people) received a single 5-minute coating of the tooth surface with the pharmacologically active composition of NaFAP, followed by coating with Clinpro Varnish XT (3M) sealant. The procedure was repeated a month later. The comparison group (29 people) received treatment coated with Clinpro Varnish XT (3M) sealant, followed by repeated application after a month. The following methods were used to diagnose the early stages of caries, assess the increasing intensity of the carious process and the level of resistance of hard dental tissues to caries: visual inspection and probing, vital staining of enamel with 2% methylene blue, light-induced fluorescence and electrometric methods. The functional state of the enamel was determined using the enamel resistance assessment test - TER test (L.I. Kosareva, I.K. Lutskaya). To assess the quality of life (QOL) of patients, a specially validated QOL questionnaire "Dental Health Impact Profile" (OHIP-49 RU) was used (Gileva O.S., 2009). A visual analog pain scale (VAS) was used to objectify the assessment of pain intensity in patients participating in the study (Hawker G.A. et al., 2011). Statistical data processing was based on the principles of variation statistics. To solve graphical problems, we used EXCEL 2007 spreadsheets (Windows 7: Home Premium, Microsoft, USA) and the StatisticaforWindows program, ver. 6.0.

RESULTS OF THE STUDY

the highest frequency of surface erasability by groups of teeth (incisors and canines of the lower jaw) was high - 64%; incisor edges of the canines of the upper and lower jaw - 19.6%; tips of the canines of the lateral group of teeth of the upper and lower jaw - 27.4%; unilateral (13.7%) and symmetrical erosion of the vestibular area of the upper and lower teeth jaws - 31.37%. The main morphological elements that enhance erosion are occlusive surfaces (planes) and crater-like depressions. At the stage of assessing defects inside the enamel, probing revealed the presence of damaged, rough enamel surfaces visible to the naked eye. Vertical percussion, comparative percussion and thermal testing were painless. Transillumination revealed internal cracks in the damaged enamel. When examining defects in dentin, probing in the area of the junction of enamel and dentin is painful. The warm test for cold irritation is positive in 62% of cases. The pain is of moderate intensity and short-term. Percussion is painless. During transillumination, the damaged enamel is whitish in color, with scattered cracks and chips in places. 100% of patients have carious lesions of the hard tissues of the teeth. The average caries index is 12.11 ± 0.45, which corresponds to the average caries level according to the WHO classification. At the first visit, 29.4% had satisfactory hygiene, 55% - unsatisfactory and 15.6% - poor. Therefore, before starting the course of treatment, all patients underwent professional oral hygiene and received individual hygiene training and a choice of remedies. The average value of the hygiene index was 2.11 ± 0.28, which indicates an unsatisfactory level of oral hygiene in the sample. The average value of the PMA index in all patients was 26.49 ± 0.55, and the severity of gingivitis in the modification of C. Parma (1960) was mild; this is a modification of Parma (1960). The symptoms of the patients were mainly represented by soft and hard plaque (99.96%), bleeding gums (52%), supra- and subgingival tartar (44%) and impaired gum attachment with the formation of clinical pockets (13%). The average values of periodontal indices were 0.72 ± 0.19 in group I and 0.84 ± 0.25 in group II, indicating a mild degree of periodontal lesion (Russel, 1956).According to the PMA and PI indices, there were no significant differences between the two groups, which indicates a high resistance of enamel to caries.After a year of follow-up in patients of the control group, after a year of follow-up in patients of the control group, there was no positive dynamics in the index of resistance of hard tissues of teeth to caries; The value of the TER test increased by 51.93% (2.5 ± 0.2) in patients of the study group and by 45.46% (3 ± 0.3) in the comparison group. The average value of the TER test in group II (Smith-Knight index: 2) before treatment was 5.1 ± 0.3, in the control group - 5.2 ± 0.1, in the study group - 5.1 ± 0.1 and in the comparison group - 5.0 ± 0.2. The values of the TER test in patients with an initial increase in caries resistance at the time of treatment before the start of remineralizing therapy correspond to the average level of caries resistance. There were no significant differences in the indicators of enamel caries resistance before and immediately after application of the composition. A month after the end of the

prescribed course of treatment, the TER-test index in the control group increased by 7.7% and amounted to 4.8 ± 0.1. In the study group, the positive dynamics of the TER-test index was 21.57% (4.0 ± 0.1), and in the comparison group - 14% (4.3 ± 0.2).After 6 months, the control examination showed an increase in tooth enamel resistance to caries by 50.99% (2.5 ± 0.1) in the study group and by 30% (3.5 ± 0.1). Laboratory parameters in the control group approached the indicators of caries resistance before treatment; after a year of follow-up, laboratory parameters of patients in the control group corresponded to those before treatment. The TER indicators in the study group did not change after 6 months of follow-up and amounted to 50.99% of positive values (2.5 ± 0.1), while the TER indicators in the comparison group increased by 44% and amounted to (2.8 ± 0.1). In the first subgroup of patients, there were no significant differences in electrical measurements before and after the use of remineralizing agents: the control group - 4.1 ± 0.1, the study group - 4.1 ± 0.2, the comparison group - 4.2 ± 0.2. After a month of observation, the electrical conductivity of the enamel decreased by 25% (3.0 ± 0.1) in the study group and by 14.29% (3 .6 ± 0.1) in the comparison group. In the control group, no significant changes in the conductivity index were observed during one year of follow-up. At the end of the course of treatment, the positive dynamics of the index was 2.44%, and after 6 months, the enamel conductivity index recovered to its original value; after 6 months, the tooth enamel conductivity index was 2.0 ± 0.3 (+51.22%) in the study group and 3.7 ± 0.2 (+11.91%) in the comparison group; when observed for 1 month years 2.8 ± 0.3 in the study group and 3.8 ± 0.1 in the comparison group. In the comparison group, a decrease in the electrical conductivity of the enamel was observed by 14.29% after a month; when observed six months and a year later, the electrical measuring index increased slightly by 2.38%, respectively. In the second subgroup of the study (Smith-Knight index: 2) the average electrical measurement index was 8.26 ± 0.45, 8.2 ± 0.2 in the control group, 8.4 ± 0.2 in the study group and 8.2 ± 0.2 in the comparison group. The electrical conductivity index of the enamel after the application of the remineralizing agent remained unchanged and amounted to 8.2 ± 0.1 in the control group. Immediately after the application of the pharmacologically active nFAP composition followed by the application of Clinpro Varnish XT (3M) sealant, the electrical conductivity index decreased by 30.96% to 5.8 ± 0.2 in the study group. In the comparison group, tooth enamel coated with sealant also showed a decrease of 26.83% (6.0 ± 0.1). In the control group, no significant changes in the electrical conductivity index were observed during the one-year follow-up period, however, six months after the end of the course of treatment, the electrical conductivity of the enamel recovered to the initial value and a positive index dynamics was observed - 1.21%. After 1 month of follow-up, the electromechanical index was 2.5 ± 0.3 (70.24%) in the study group and 2.5 ± 0.2 (69.52 %) in the comparison group; After 1 year of follow-up, the electromechanical index was 2.8 ± 0.3 (3.57%) in the study group and 3.1 ± 0.3

(7.3%) in the comparison group. To assess patients' satisfaction with the results of treatment, including achieving an aesthetic effect, relieving symptoms of hypersensitivity and related changes in their psycho-emotional state and social well-being, patients were offered a questionnaire before and after treatment. The positive results of treatment of the initial form of PSS due to the improvement of hypersensitivity symptoms against the background of remineralization of hard dental tissues were accompanied by a certain improvement in the integral indicators of dental quality of life.An analysis of the initial indicators of the quality of life of patients with initial symptoms of PSS and the values obtained showed that the most significant indicators for patients were psychological discomfort -4 points, social maladjustment - 3.2 points, psychological deterioration - 2.2 points and damage - 1.9 points; In the initial symptoms of PSS, the unimportant criteria of the questionnaire were functional limitations, physical pain and functional impairment. The use of a modified treatment algorithm led to an improvement in the integral indicator of quality of life by 2.5 times. The criteria for the effectiveness of treatment were: - preservation of electrometry and TERtest indicators - homogeneous structure and color gamut of the enamel surface during fluorescence examination - disappearance of hypersensitivity with persistent remission. - Excellent results (23.3%) were obtained with persistent remission of hypersensitivity and a decrease in electroanalytical, TERtest and fluorescent indicators (restoration of the tonal scale and opalescence of enamel, homogeneous texture by visual, luminescent and computer analysis) during a one-year period of observation of fixed indicators of TER, electroanalysis and fluorescence. Against the background of a recurrence of hypersensitivity in the patient, a good result was obtained in 34.8% of cases. A satisfactory result - in 33.1% of cases, the main parameters of observation decreased without complaints of hypersensitivity. An unsuccessful result was that there was no dynamics of indicators, hypersensitivity decreased in - 8.8% of cases; during the one-year follow-up period, in 91.2% of cases, stable remission was observed without progressive loss of hard tooth tissues; in 56.4% of patients, hypersensitivity symptoms were resolved during the one-year period; in other cases, hypersensitivity symptoms decreased in - 8.8% of cases; in other cases, symptoms decreased in - 8.8% of cases; in other cases, symptoms decreased in - 8.8% of patients; in other cases, symptoms decreased in - 8.8% of cases. Fixation of the indicators of electrical resistance and electrical conductivity of the enamel led to the recurrence of hypersensitivity symptoms in 34.8% of cases; in 8.8% of cases, there was no dynamics of indicators and a decrease in hypersensitivity was observed.

CONCLUSIONS

1. The use of the pharmacologically active nFAP composition led to a twofold increase in the index of caries resistance of tooth enamel and this effect persisted until one year of follow-up. nFAP preparations used twice with an interval of one month in a dental clinic, ROCS medical mineral preparations used for three weeks at home, as well as the same growth index in the TER.2 test. The use of Clinpro Varnish XT (3M) sealant (also in combination with the pharmacologically active nFAP composition) led to a twofold increase in caries resistance of tooth enamel, and the results remained stable during one year of follow-up. The introduction of the pharmacologically active nFAP composition into the treatment regimen for the initial symptoms of increased teething showed an improvement in the therapeutic effect by 20.99% after 6 months of follow-up and by 6.9% after 1 year.3. The pharmacologically active composition of nFAP in the experiment, 1 month after application to the hard tissues of the teeth, reduced the electrical conductivity of the enamel by 25%. The maximum effect was observed after six months, while the indicator decreased by 2 times; after a year of observation, the electrical conductivity index increased by 28.58%, but was still 1.4 times lower than the initial value before treatment; 4. Immediately after applying ClinPro Burnish XT (3M) sealant, the electrometric index decreased by 26.8%. The combination of sealant and pharmacologically active nFAP composition reduced the electrical conductivity index of tooth enamel by 9.6% compared with the use of sealant alone with the observed kinetics up to one year.5. A new pharmacologically active composition based on nanostructured fluorohydroxyapatite has been used to treat tooth abrasion. it has proven its effectiveness in the treatment of the initial symptoms of increased

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