1/2019

Deutscher Wissenschaftsherold

German Science Herald

InterGING

Bibliografische Information der Deutschen Nationalbibliothek
Die Deutsche Nationalbibliothek verzeichnet diese Publikation in der Deutschen Nationalbibliografie; detaillierte bibliografische Daten sind im Internet über http://dnb.dnb.de abrufbar.

Bibliographic information published by the Deutsche Nationalbibliothek
The Deutsche Nationalbibliothek lists this publication in the Deutsche Nationalbibliografie; detailed bibliographic data are available on the Internet at http://dnb.dnb.de .

Information bibliographique de la Deutsche Nationalbibliothek
La Deutsche Nationalbibliothek a répertorié cette publication dans la Deutsche Nationalbibliografie; les données bibliographiques détaillées peuvent être consultées sur Internet à l'adresse http://dnb.dnb.de .

Informazione bibliografica della Deutsche Nationalbibliothek
La Deutsche Nationalbibliothek registra questa pubblicazione nella Deutsche Nationalbibliografie; dettagliati dati bibliografici sono disponibili in internet in http://dnb.dnb.de .

Библиографическая информация Немецкой Национальной Библиотеки
Немецкая Национальная Библиотека вносит эту публикацию в Немецкую национальную библиографию; подробные библиографические данные можно найти в интернете на странице: http://dnb.dnb.de .

Información bibliográfica de la Deutsche Nationalbibliothek
La Deutsche Nationalbibliothek recoge esta publicación en la Deutsche Nationalbibliografie. Los datos bibliográficos están disponibles en la dirección de Internet http://dnb.dnb.de .

ISSN 2509-4327 (print)
ISSN 2510-4780 (online)

Deutscher Wissenschaftsherold
German Science Herald

№ 1/2019

Die Zeitschrift „Deutscher Wissenschaftsherold" ist eine Veröffentlichung mit dem Ziel ein breites Spektrum der Wissenschaft allgemeinverständlich darzustellen. Die Redaktionsleitung versteht sich als Vermittler zwischen Wissenschaftlern und Lesern. Durch die populärwissenschaftliche Bearbeitung wird es möglich unseren Lesern neue wissenschaftliche Leistungen am besten und vollständigsten zu vermitteln. Es werden Untersuchungen, Analysen, Vorlesungen, kurze Berichte und aktuelle Fragen der modernen Wissenschaft veröffentlicht.

Impressum
Deutscher Wissenschaftsherold – German Science Herald
Wissenschaftliche Zeitschrift
Herausgeber:
InterGING
Sonnenbrink 20
31789 Hameln, Germany
Inhaber: Marina Kisiliuk
Tel.: + 49 51519191533
Fax.:+ 49 5151 919 2560
Email: info@dwherold.de
Internet:www.dwherold.de
Chefredakeur:
Prof. Zamiatin P.M.
Korrektur:
O. Champela
Gestaltung:
N. Gavrilets

Auflage: № 1/2019 (April) – 20
Redaktionsschluss April, 2018
Erscheint vierteljährlich
Editorial office: InterGING
Sonnenbrink 20
31789 Hameln, Germany
Tel.: + 49 51519191533
Fax.:+ 49 5151 919 2560
Email: info@dwherold.de
Deutscher Wissenschaftsherold – German Science Herald is an international, German/English language, peer-reviewed journal and is published quarterly.
№ 1/2019
Passed in press in April, 2019
Printed in September
Druck: WIRmachenDRUCK GmbH
Mühlbachstr. 7
71522 Backnang
Deutschland

INDEXING: Index Copernicus, Google Scolar, Ulrich's Periodicals Directory, Fachzeitungen, MIAR.

http://miar.ub.edu/issn/2509-4327

REDAKTIONSKOLLEGIUM / INTERNATIONAL EDITORIAL BOARD:

Lists of references are given according to the Vancouver style

DDC-UDC 616.314-008.4–74–77–071 DOI:10.19221/201911

Borysenko A.V.
Doctor of Medical Sciences, Professor, Head of the Department of Therapeutic Dentistry O.O.Bogomolets National Medical University, Kyiv, Ukraine, anatoliyborysenko.nmu@gmail.com
Dudnikova M.O.
Ass. Professors, Ph.D., Department of Therapeutic Dentistry O.O.Bogomolets National Medical University, Kyiv, str. Zoologicheskaya, 1, Kyiv, Ukraine, mdudnikoffa@gmail.com

ELECTRONIC MICROSCOPIC RESEARCH OF TOOTH ENAMEL SURFACE AFTER USAGE OF DIFFERENT METHODS OF HOME BLEACHIG

Abstract*. Teeth colour plays an important role in the perception of a person, shaping his image and self-assessment. Thus, it has a significant influence on quality of life, due to its dental health. Nowadays world dental practice is increasingly focused on developing of more saving methods that provide the aesthetic needs of the patient. Aim. To study the influence of different bleaching agents on the ultrastructure of enamel by means of scanning electronic microscopy. Materials and methods. Investigation is undertaken on a 25 permanent teeth that were extracted for orthodontic indications in patients 20-30 years. For revealing of enamel surface structure changes after the action of bleaching facilities scanning electronic microscopy research method was used. Results. Electronic microscopic investigation showed that brushing with abrasive toothpaste with RDA=200 characterized by mechanical damage as a result of highly abrasive elements of toothpaste. Brushing with bleaching toothpaste RDA=120 led to less significant changes in enamel surface, indicated a less damaging effect of the paste on the surface of the enamel. Cleansing of the teeth with a paste with low abrasiveness (RDA of 75) caused minor damage to the enamel surface, indicated a slight abrasive effect of toothpaste. Bleaching with peroxide containing bleaching systems resulted in smooth enamel surface, which indicated that they to some extent dissolved the surface layer of enamel. Conclusions. Electronic microscopic studies confirmed the need of a differentiation of bleaching facilities, depending on the patient's teeth status. This will achieve an aesthetic effect with minimum damaging effects on hard tooth tissues. To prevent complications that arise as a result of bleaching, it is necessary to prescribe local remineralization therapy with hydroxyapatite- and fluoride containing facilities of individual or professional oral hygiene.*

Keywords: *discoloration, dental hard tissues, bleaching facilities, individual oral hygiene, ultrastructure of enamel, scanning electronic microscopy.*

Introduction. Changes of the teeth colour (discoloration, discoloritis) are common pathologic lesions of dental hard tissues among people of all ages. Teeth colour and its colour characteristics play an important role in the perception of a person, shaping his image and self-assessment. Thus, they have a significant influence on quality of life, due to its dental health [6, 8].

Nowadays world dental practice is increasingly focused on developing of more saving methods that provide the aesthetic needs of the patient. Today the most common procedure for improvement of teeth crowns colour is bleaching [12]. The demand of aesthetic dentistry services is relevant due to the high prevalence of dental diseases and bad habits that lead to hard tooth tissues discoloration (A. Watts, 2001). There are a quite a number of different bleaching facilities [15]. However, it should be noted that most of these facilities contain significant concentrations of peroxides that can damage hard tooth tissues [21, 20].

Thus, the results of clinical studies in recent years indicated the need for differentiation of bleaching facilities depending on patient's teeth status [2, 14]. This will ensure the most stable aesthetic and therapeutic result; reduce the level of teeth crowns preparation and therefore damage of the pulp and hard tooth tissues. Therefore, development of more effective and safe methods simultaneously correcting colour changes of hard tooth tissues is an actual problem of therapeutic dentistry.

As known, the action of the various bleaching systems and methods is in discoloration of organic matrix of interprismatic substances, with the insignificant dissolution of enamel surface, causing expansion of superficial and deep layers of enamel pores [12].

Objective. The aim of the investigation is to study the influence of different bleaching agents on the ultrastructure of enamel by means of scanning electronic microscopy.

Materials and methods of research. The object of the investigation – 25 permanent teeth that were extracted for orthodontic indications in patients 20-30 years (extracted incisors, canines, premolars upper and lower jaws).

The research method is scanning electronic microscopy – for revealing of enamel surface structure changes after the action of bleaching facilities.

Extracted teeth had been thoroughly washed from the blood in running water, cleaned from remains of soft tissues using brush at low revs. Each sample tooth previously prepared as follows. Tooth conventionally divided vertically into two parts. On one half of the crown applied liquid Opal-Dam (Ultradent Products Inc.) to isolate this part of the tooth and cured with polymerization lamp for 15 seconds, after which the samples were subjected to further investigation.

All teeth were divided into 2 groups: the first group – extracted teeth that had been brushed with abrasive bleaching toothpaste of varying abrasiveness index (15 samples); second – extracted teeth on enamel surface of which were applied peroxide containing facilities (10 samples).

Samples of the teeth of the first group were divided into 3 subgroups. The first subgroup (A-1) – enamel surface was brushed with toothpaste RDA=200 using a brush and micromotor at low rpm for 15 minutes. Then the sample tooth washed with running water and kept in sterile containers of isotonic solution (NaCl) to re-processing . This procedure is performed every day for 3 days, after which the sample was subjected to a scanning electronic microscopic research.

Second subgroup samples (A-2) were brushed with toothpaste RDA=100 for the same scheme for 3 days and subsequently performed scanning electronic microscopic research. Experimentally, it meets specified by the manufacturer using the method – brushing 1 per day at least 3 minutes for 2 weeks.

Third subgroup samples brushed by the foregoing scheme with toothpaste RDA=75 of 15 minutes a day every day for 6 days. Experimentally – is brushing twice a day at least 3 minutes for 2 weeks.

Samples of the teeth of the second group (B) were prepared for electronic microscopic examination as follows. On enamel surface of samples of B-1 were applied peroxide containing bleaching system Opalescence (Ultradent Products Inc.) with a concentration of active substances – 45% carbamide peroxide once, exposure time – 30 minutes. The samples of B-2 were applied bleaching system Yotuel 7 Hours (Biocosmetics laboratories) the concentration of active substance – 10% carbamide peroxide for 1 hour. Then the sample tooth washed with running water and kept in sterile containers of isotonic solution (NaCl) to re-processing. The procedure is performed daily for 7 days (equivalent recommended by the manufacturer of the term). Then the gel is washed from the sample under running water and stored in saline for further study.

Electronic microscopic study conducted by the method of F.M. Mammadov and other [9, 10, 11], by scanning electronic microscopy in the laboratory department of Institute of Materials Photoelectronics name after Frantsevich NAS of Ukraine (Head. Laboratory, Dr. A. Samiryuk). The study was conducted in several stages: preparation and teeth preparation, applying of different bleaching facilities, thin teeth sections preparation. To study the samples in a scanning electronic microscope from each sample tooth microsection of 0.5-0.7 mm, which had two surfaces, one of which was treated with bleaching agent (bleaching paste or system), the second – served as a control.

After teeth microsection preparation they were polished with fine-grained elastic discs «Soft-Lex» («3M»). Grinding and polishing teeth microsection surfaces performed to obtain a mirror surface. Just before electronic microscopic study teeth microsection surfaces were cleaned with petroleum ether. Teeth microsections were

fixed on brass pedestals using conductive carbon glue. They were placed in a vacuum chamber, where they spent spraying the surface of the gold thin sections (99,99%AU) to the formation of these films 150A thick pure gold. Such a top film thickness sufficient to further electronic microscopic study of samples in X-ray microanalyzer "Superprobe-733" (JEOL, Japan) (Petrov V.I.). After spraying pedestals with samples of thin sections were studied by X-ray microanalyzer "Superprobe-733" (JEOL, Japan). Absolution in the image of secondary electrons (SEI, Secondary Electron Image) 7 nM, working vacuum: 1x10-5A. The study was conducted at an accelerated voltage of 25 kV and beam current of 1x10-10A. The results were photographed with the built- in digital camera microscope, which is connected to a computer (hereinafter microphotographs of computer onto a CD-ROM).

The results recorded on electronic digital media with an increase in 1000. In micrographs obtained visually conducted comparing the objects.

All laboratory methods of research conducted at least five samples. The results were treated statistically [4, 23].

Results of the research. The areas of teeth enamel samples of all groups that are not subjected to pre-treatment of bleaching agents served as a control. In these areas typical enamel homogeneous structure was revealed. Clearly visible outlines of enamel prisms and natural furrows were present. On the surface of the enamel there were also areas without clear prisms outlines, uniform spaces between them filled with mineral crystals: the so-called aprismatic enamel. In general, the surface characteristic of the enamel was undergoing its usual pressures and the influence of hard food particles (Fig.1, 2, 3).

In the teeth microsection surfaces study, which were previously subjected to cleaning with abrasive toothpaste RDA=200 according to the scheme, revealed the following. The surface of enamel lost its distinctive topography of enamel prisms shape and structure – the so-called "smoothed enamel". On the enamel surface there were a lot of different depths scratches. These changes were the result of toothpaste highly abrasive elements action (Fig. 4, 5).

After brushing with bleaching toothpaste with abrasive index of 120 were found less significant changes in enamel surface compared with the results of A-1 group. In particular, more pronounced prismatic structure of enamel, areas of smooth enamel less pronounced. Almost no scratches and cracks on the surface of the enamel. Revealed changes suggest less damaging effect of the paste on the surface of the enamel (Fig. 6, 7).

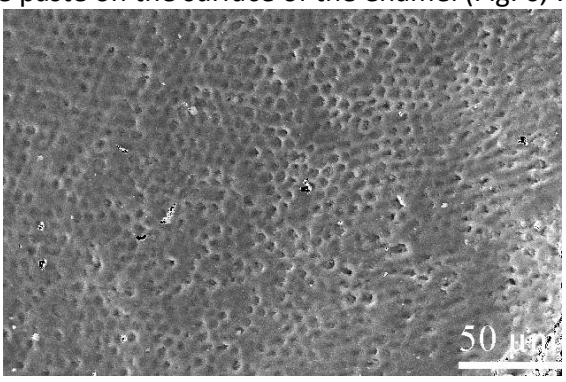

Fig. 1. Sound tooth enamel surface. Clearly visible prismatic structure of enamel surface with areas of aprismatic enamel. Scanning electron micrograph, x300

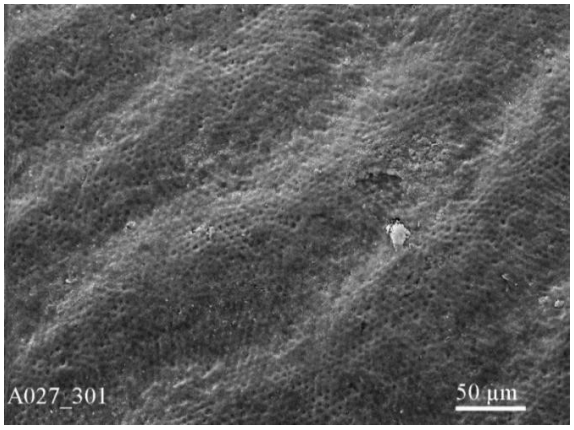

Fig. 2. Sound tooth enamel surface. Clearly visible prismatic structure of enamel surface with areas of aprismatic enamel and perikimata. Scanning electron micrograph, x300

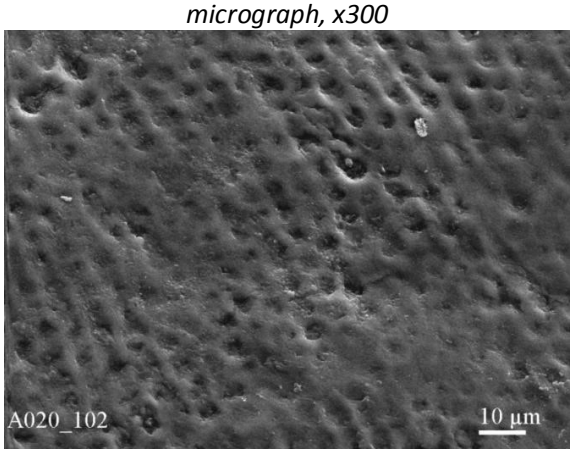

Fig. 3. Sound tooth enamel surface. Clearly visible prismatic structure of enamel surface with areas of aprismatic enamel. Scanning electron micrograph, x 1000

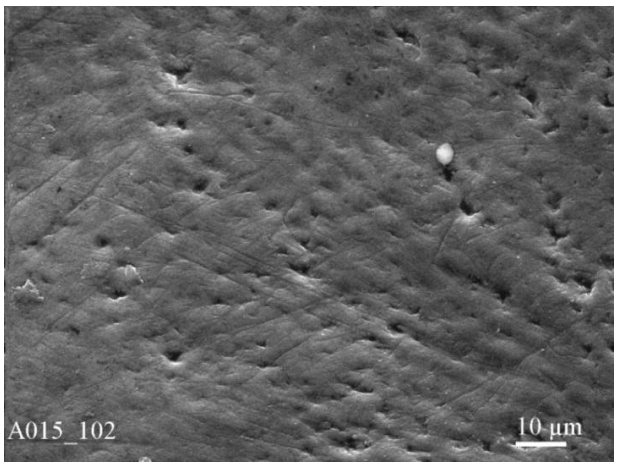

Fig. 4. Enamel surface of the tooth after cleansing with abrasive toothpaste with RDA=200. Smooth prismatic structure of enamel surface. Big number of different depths scratches on the enamel surface. Scanning electron micrograph, x 1000

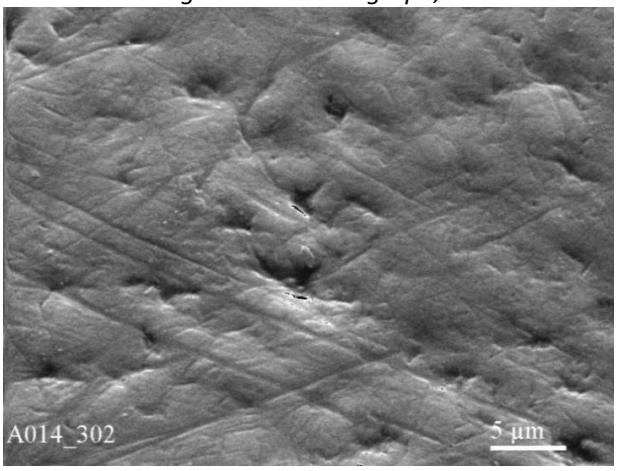

Fig. 5. Enamel surface of the tooth after cleansing with abrasive toothpaste with RDA=200. The enamel surface with almost lost enamel prisms. Large number of different depths scratches on the enamel surface. Scanning electron micrograph, x 2000

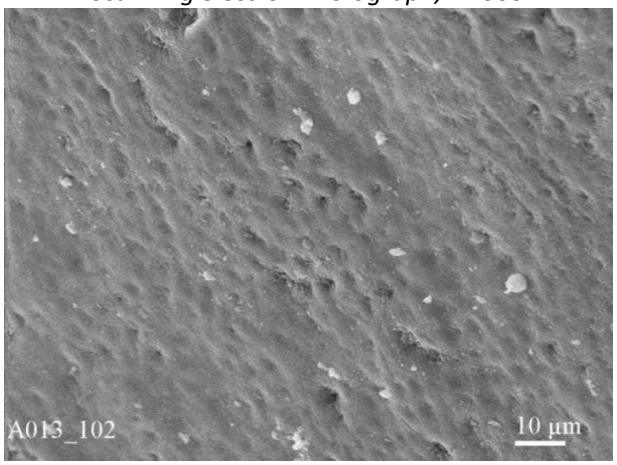

Fig. 6. Enamel surface of the tooth after cleansing with abrasive toothpaste with RDA=120. There are less noticeable enamel prisms without scratches on the enamel surface. Scanning electron micrograph, x 1000

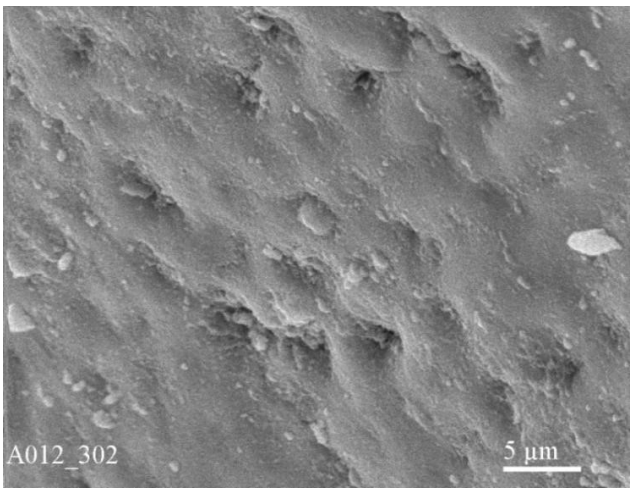

Fig. 7. Enamel surface of the tooth after cleansing with abrasive toothpaste with RDA=120. There are less visible outlines of the enamel prisms without scratches on the enamel surface. Scanning electron micrograph, x 2000

The analysis of teeth samples after brushing with a toothpaste with small abrasion (RDA=75) was revealed following. There were almost no changes in ultrastructure of the enamel – there were outlines of the enamel prisms. There is absence of smooth enamel areas. This indicates at slight abrasive effect of these toothpastes (Fig. 8, 9).

After usage of peroxide containing bleaching system Opalescence 45 % (Ultradent Products Inc.) was revealed the following. Enamel prisms outlines were practically lost. On the enamel surface were visible microscopic cracks, scratches, furrows, areas of demineralization of enamel crystals (Fig. 10, 11). Overall, this indicated that this bleaching system had less abrasive action.

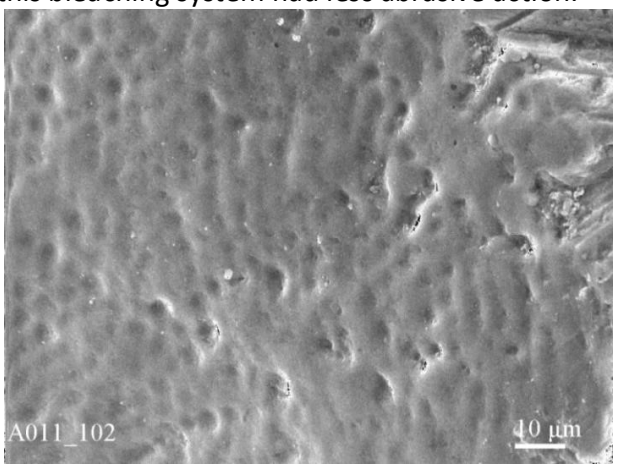

Fig. 8. Enamel surface of the tooth after cleansing with abrasive toothpaste with RDA= 75. Clearly visible outlines enamel prisms. Scanning electron micrograph, x 1000

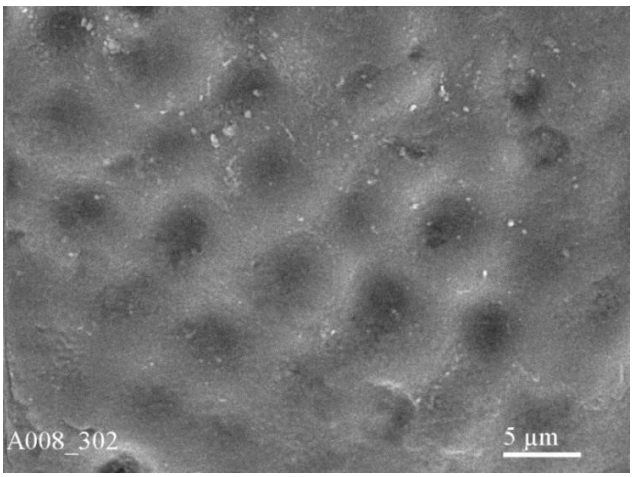

Fig. 9. Enamel surface of the tooth after cleansing with abrasive toothpaste with RDA= 75. Clearly visible outlines enamel prisms. Scanning electron micrograph, x 2000

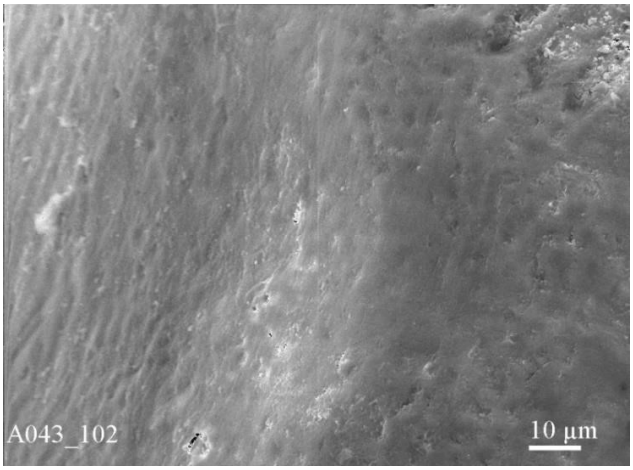

Fig. 10. Enamel surface of the tooth after usage of bleaching system Opalescence 45%. There are areas of smooth enamel and demineralization of enamel crystals. Scanning electron micrograph, x 1000

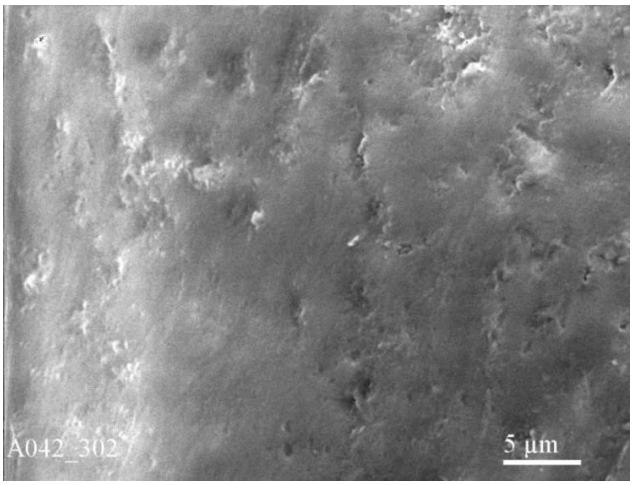

Fig. 11. Enamel surface of the tooth after usage of bleaching system Opalescence 45%. There are areas of smooth enamel and demineralization of enamel crystals. Scanning electron micrograph, x 2000

However, it greatly smoothed the surface of the enamel, which may indicate that this bleaching system to some extent dissolved the enamel surface layer.

After usage of professional bleaching system Yotuel 7 Hours (10% carbamide peroxide) destructive areas of enamel surface with "typical" ultramicroscopic structure were founded. Also, there were visible scratches on the enamel surface (Fig. 12, 13). Revealed changes suggest that this bleaching system dissolved the enamel surface and had relatively little abrasive effect.

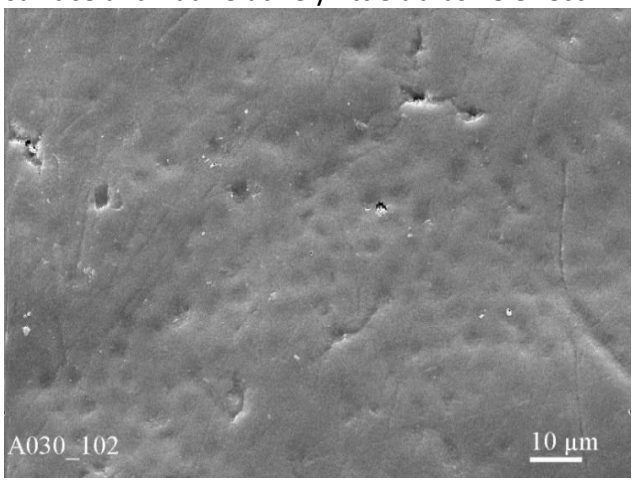

Fig. 12. Enamel surface of the tooth after usage of bleaching system Yotuel 7 Hours. Clearly visible destructive areas of enamel surface with "typical" ultramicroscopic structure. Scanning electron micrograph, x 1000

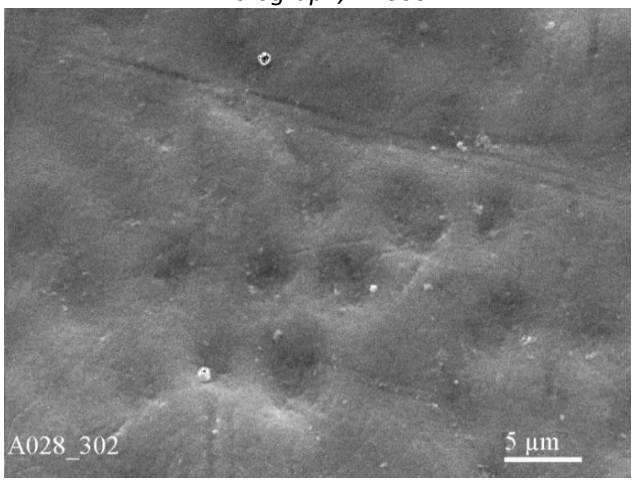

Fig. 13. Enamel surface of the tooth after usage of bleaching system Yotuel 7 Hours. Clearly visible destructive areas of enamel surface with "typical" ultramicroscopic structure. Scanning electron micrograph, x 2000

Discussion. An electronic microscopic investigation has shown that toothbrushing with a RDA 200 abrasive toothpaste causes a characteristic mechanical damage to the enamel

surface of the teeth due to the effect of the high abrasive elements of the toothpaste. Toothbrushing with whitening toothpaste with a RDA 120 abrasive index leads to less significant changes in the enamel surface, which indicates a lesser damaging effect of the paste on the enamel surface. Toothbrushing with toothpaste with low abrasive elements RDA 75 causes slight damage to the enamel surface, which indicates a slight abrasive effect of the toothpaste.

Bleaching of the teeth surfaces with a peroxide-containing whitening system Opalescence 45% (Ultradent Products Inc.) with less abrasive action results in smoothing of the enamel surface, indicating that this whitening system dissolves to a certain extent the enamel surface. The use of professional bleaching with the use of the Yotuel 7 Hours system results in the formation on the surface of enamel of areas of destruction of enamel with a "characteristic" ultramicroscopic structure. This indicates that this bleaching system dissolves the surface of the enamel although it has a relatively small abrasive effect.

The obtained data on the composition of bleaching toothpastes, their influence on the microflora and on the surface of the enamel of teeth provided the basis for a differential choice of personal hygiene products for use in the complex treatment of tooth discoloration in patients with periodontal disease.

Conclusions. The electronic microscopic investigation to some extent consistent with findings of a number of works which marked bleaching effectiveness of various facilities [18, 19, 13, 1, 16], their impact on enamel morphology [5, 17]. To prevent complications that arise as a result of bleaching, it is necessary to prescribe local remineralization therapy with hydroxyapatite- and fluoride containing facilities of individual or professional oral hygiene [7, 22, 3].

Electronic microscopic studies confirmed the need of a differentiation of bleaching facilities, depending on the patient's teeth status. This will achieve an aesthetic effect with minimum damaging effects on hard tooth tissues.

References:

1. Carrasco LD, Guerisoli DM, Rocha MJ. Efficacy of intracoronal bleaching techniques with different light activation sources. Int Endod J 2007; 40 (3): 204–208.

2. Efremova EV. Sotsialnyie, klinicheskie i psihologicheskie aspektyi otbelivaniya zubov. [avtoref. dys.] Moskow gos. med.-stomatolog. un-t. – Moskow, 2010. 21 s.

3. Fedorov YuA, Drozhzhina VA, Matelo SK, Tumanova SA. Klinicheskie vozmozhnosti primeneniya sovremennyih remineralizuyuschih sostavov u vzroslyih. 2008; 3: 32–34.

4. Glants S. Mediko–biologicheskaya statistika. Per. s angl. Moskow: Praktika, 1999. 459 s.

5. Götz H, Klukowska MA., Duschner H, White DJ. Physical, morphological, and micro-Raman chemical studies on bleaching strip effects on enamel, coronal dentin, and root dentin. J Clin Dent. 2007; 18 (4): 112–119.

6. John MT, LeResche L, Koepsell TD. Oral health-related quality of life in Germany. Eur. J. Oral. Sci. 2003; 111 (6): 483–491.

7. Joiner A, Pickles MJ, Tanner C. An in situ model to study the toothpaste abrasion of enamel. J. Clin. Periodontol. 2004; 31 (6): 434–438.

8. Llewellyn CD, Warnakulasuriya S. The impact of stomatological disease on oral health-related quality of life. Eur J Oral Sci. 2003; 111 (4): 297–304.

9. Mamedova FM, Krahmalev VA, Abdrasulova DS. Izgotovlenie shlifov iz nedekaltsinirovannyih tkaney zuba. Med. zhurnal Uzbekistana. 1981; 2: 77-78.

10. Mamedova FM, Krahmalev VA. Mikroskopicheskaya anatomiya kornya zuba. – Moskva, 1988. 131 s.

11. Mamedova FM, Krahmalev VA, Abdrasulova DS. Optiko-mikroskopicheskoe opredelenie ob'emnoy strukturyi dentina korney zuba cheloveka. Stomatologiya. 1980; 4: 12-14.

12. Mazo A, Ronkin K. Vyibor metoda otbelivaniya zubov. Institut stomatologii. 2010; 46: 102–104.

13. Nixon PJ, Gahan M, Robinson S, Chan MF. Conservative aesthetic techniques for discoloured teeth: 1. The use of bleaching. Dent. Update. 2007; 34 (2): 98–100, 103–4, 107.

14. Rocha Gomes Torres C. The future of dental bleaching. J. Contemp. Dent. Pract. 2012; 13 (5): 11.

15. Savelev PA. Sovershenstvovanie himicheskih metodov otbelivaniya

pigmentirovannyih vitalnyih zubov putyom povyisheniya rezistentnosti emali i dentina. [avtoref. dys.]. Stavrop. gos. med. akademiya. Stavropol, 2006. 21 s.

16. Severina TV. Analiz effektivnosti otbelivaniya tverdyih tkaney zubov pri ispolzovanii razlichnyih domashnih sistem. Med. alfavit. Stomatologiya. 2012; 3: 46–48.

17. Sulieman M, Addy M, Macdonald E, Rees J. S. A safety study in vitro for the effects of an in-office bleaching system on the integrity of enamel and dentine. J. Dent. 2004; 32 (7): 581–590.

18. Sulieman M. An overview of bleaching techniques: I. History, chemistry, safety and legal aspects. Dent. Update. 2004; 31 (10): 608–610, 612–614, 616.

19. Sulieman M, Addy M, Macdonald E, Rees J. S. The effect of hydrogen peroxide concentration on the outcome of tooth whitening: an in vitro study. J. Dent. 2004; 32 (4): 295–299.

20. Umeda G. Teeth-whitening best restricted to dental offices. Hawaii Dent. J. 2009; 40 (1): 4.

21. Vavilyuk A. Otbelivanie zubov: mifyi i fakty. Institut stomatologii. 2008; 41: 56–57.

22. Worschech CC, Rodrigues JA, Martins LR, Ambrosano GM. Brushing effect of abrasive dentifrices during at-home bleaching with 10% carbamide peroxide on enamel surface roughness. J. Contemp. Dent. Pract. 2006; 7 (1): 25–34.

23. Yunkerov VI, Grigorev SG. Matematiko-statisticheskaya obrabotka dannyih meditsinskih issledovaniy. SPb. VmedA, 2002. 266 s.

Deutscher Wissenschaftsherold
German Science Herald

Bibliographic information published by the Deutsche Nationalbibliothek
The Deutsche Nationalbibliothek lists this publication in the Deutsche Nationalbibliografie; detailed bibliographic data are available on the Internet athttp://dnb.dnb.de

№ 1/2019 – 10
Passed in press in April 2019

ISSN 2509-4327
01
9 772434 201902