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ЕЖЕМЕСЯЧНЫЙ НАУЧНЫЙ ЖУРНАЛ

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გამოიცემა თბილისის სახელმწიფო სამედიცინო უნივერსიტეტთან
თანამშრომლობითა და მისი პატრონაჟით

ЕЖЕМЕСЯЧНЫЙ НАУЧНЫЙ ЖУРНАЛ
ТБИЛИСИ - НЬЮ-ЙОРК

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GMN is indexed in MEDLINE, SCOPUS, PubMed and VINITI Russian Academy of Sciences. The full text content is available through EBSCO databases.

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Контактный адрес: Грузия, 0177, Тбилиси, ул. Асатиани 7, IV этаж, комната 408

тел.: 995(32) 254 24 91, 5(55) 75 65 99

Fax: +995(32) 253 70 58, e-mail: ninomikaber@geomednews.com; nikopir@geomednews.com

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GMN Editorial Board
7 Asatiani Street, 4th Floor
Tbilisi, Georgia 0177

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Fax: 995 (32) 253-70-58

CONTACT ADDRESS IN NEW YORK

NINITEX INTERNATIONAL, INC.
3 PINE DRIVE SOUTH
ROSLYN, NY 11576 U.S.A.

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2. Size of the article, including index and resume in English, Russian and Georgian languages must be at least 10 pages and not exceed the limit of 20 pages of typed or computer-printed text.

3. Submitted material must include a coverage of a topical subject, research methods, results, and review.

Authors of the scientific-research works must indicate the number of experimental biological species drawn in, list the employed methods of anesthetization and soporific means used during acute tests.

4. Articles must have a short (half page) abstract in English, Russian and Georgian (including the following sections: aim of study, material and methods, results and conclusions) and a list of key words.

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4. სტატიას თან უნდა ახლდეს რეზიუმე ინგლისურ, რუსულ და ქართულ ენებზე არანაკლებ ნახევარი გვერდის მოცულობისა (სათაურის, ავტორების, დაწესებულების მითითებით და უნდა შეიცავდეს შემდეგ განყოფილებებს: მიზანი, მასალა და მეთოდები, შედეგები და დასკვნები; ტექსტუალური ნაწილი არ უნდა იყოს 15 სტრიქონზე ნაკლები) და საკვანძო სიტყვების ჩამონათვალი (key words).

5. ცხრილები საჭიროა წარმოადგინოთ ნაბეჭდი სახით. ყველა ციფრული, შემაჯამებელი და პროცენტული მონაცემები უნდა შეესაბამებოდეს ტექსტში მოყვანილს.

6. ფოტოსურათები უნდა იყოს კონტრასტული; სურათები, ნახაზები, დიაგრამები - დასათაურებული, დანომრილი და სათანადო ადგილას ჩასმული. რენტგენოგრაფიების ფოტოასლები წარმოადგინეთ პოზიტიური გამოსახულებით **tiff** ფორმატში. მიკროფოტოსურათების წარწერებში საჭიროა მიუთითოთ ოკულარის ან ობიექტივის საშუალებით გადიდების ხარისხი, ანათალებების შედეგების ან იმპრეგნაციის მეთოდი და აღნიშნოთ სურათის ზედა და ქვედა ნაწილები.

7. სამამულო ავტორების გვარები სტატიაში აღინიშნება ინიციალების თანდართვით, უცხოურისა – უცხოური ტრანსკრიპციით.

8. სტატიას თან უნდა ახლდეს ავტორის მიერ გამოყენებული სამამულო და უცხოური შრომების ბიბლიოგრაფიული სია (ბოლო 5-8 წლის სიღრმით). ანბანური წყობით წარმოდგენილ ბიბლიოგრაფიულ სიაში მიუთითეთ ჯერ სამამულო, შემდეგ უცხოელი ავტორები (გვარი, ინიციალები, სტატიის სათაური, ჟურნალის დასახელება, გამოცემის ადგილი, წელი, ჟურნალის №, პირველი და ბოლო გვერდები). მონოგრაფიის შემთხვევაში მიუთითეთ გამოცემის წელი, ადგილი და გვერდების საერთო რაოდენობა. ტექსტში კვადრატულ ფხიხლებში უნდა მიუთითოთ ავტორის შესაბამისი N ლიტერატურის სიის მიხედვით. მიზანშეწონილია, რომ ციტირებული წყაროების უმეტესი ნაწილი იყოს 5-6 წლის სიღრმის.

9. სტატიას თან უნდა ახლდეს: ა) დაწესებულების ან სამეცნიერო ხელმძღვანელის წარდგინება, დამოწმებული ხელმოწერითა და ბეჭდით; ბ) დარგის სპეციალისტის დამოწმებული რეცენზია, რომელშიც მითითებული იქნება საკითხის აქტუალობა, მასალის საკმაობა, მეთოდის სანდოობა, შედეგების სამეცნიერო-პრაქტიკული მნიშვნელობა.

10. სტატიის ბოლოს საჭიროა ყველა ავტორის ხელმოწერა, რომელთა რაოდენობა არ უნდა აღემატებოდეს 5-ს.

11. რედაქცია იტოვებს უფლებას შეასწოროს სტატია. ტექსტზე მუშაობა და შეჯერება ხდება საავტორო ორიგინალის მიხედვით.

12. დაუშვებელია რედაქციაში ისეთი სტატიის წარდგენა, რომელიც დასაბეჭდად წარდგენილი იყო სხვა რედაქციაში ან გამოქვეყნებული იყო სხვა გამოცემებში.

აღნიშნული წესების დარღვევის შემთხვევაში სტატიები არ განიხილება.

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ფორმებთან მუშაობისას მკურნალობის ალგორითმის ასარჩევად აუცილებელია ება-სახის ცვლილებების გამოხატვის ხარისხის გათვალისწინება. ამ მიზნით შემუშავებულია ება-სახის ანომალიების გამოხატვის შესაფასებელი ინდექსი. ინდექსის შესაქმნელად გამოკვლეულია 120 პაციენტი მეზიალური და დისტალური ოკლუზიის გამოხატულობის სხვადასხვა ხარისხით. ჩატარდა თაბაშირის მოდელების, გვერდით პროექციაში თავის ტელერენტგენოგრამების ანალიზი

და ფოტომეტრული გამოკვლევა. მონაცემების ანალიზის შედეგად შემუშავებულია ინდექსი, რომელიც სარწმუნოებით ამტკიცებს ება-სახის ანომალიების გამოხატულობის ხარისხს და წარმოადგენს პაციენტების მკურნალობის მეთოდის შერჩევის დასაბუთებას. შემოთავაზებული მეთოდისა წარმოადგენს ება-სახის ანომალიების დიაგნოსტიკისა და მკურნალობის ტაქტიკის შერჩევის მოსახერხებელ ექსპრეს-წესს.

DETERMINATION OF CYCLIC FATIGUE OF A NICKEL-TITANIUM COXO SC PRO FILE USING A SIMULATION ENDODONTIC UNIT

Khabadze Z., Ismailov F., Makeeva I.

Peoples Friendship University of Russia (RUDN), Moscow, Russian Federation

The use of nickel-titanium instruments during endodontic treatment ensures high-quality treatment of root canals. However, during instrumentation in the curved root canals of nickel-titanium instruments experience cyclic loading, which leads to their breakage. The splinter of the tool in the root canal makes it difficult for high-quality processing and obturation of the root canal, which is a very urgent problem. To carry out instrumental processing in canals with various anatomical and topographic features, the files must have phenomenal flexibility, lack of straightening of the canal, and have a safe non-aggressive tip. And for this reason, one of the most popular nickel-titanium COXO SC PRO tools was selected as a study, which, according to the manufacturer, have all the listed properties.

The aim of the study is to determine the limit of resistance to cyclic loading and signs of breakage of the nickel-titanium endodontic instrument COXO SC PRO.

Material and methods. Cyclic fatigue was determined using a simulation endodontic unit (Fig. 1) simulating variations of root canal bends, designed on a 3D program and milled on 3D printing. The simulation endodontic block due to canals with different bends can be used to determine the cyclic fatigue of nickel-titanium instruments of martensitic and austenitic phases. It is designed taking into account the variations of root canals, equipped with a transparent cover to preserve the axis of rotation and the possibility of observing the rotation process of a nickel-titanium tool in the canals. Nickel-titanium endodontic instruments COXO SC PRO were used as studies. During the determination of cyclic fatigue, photo and video fixation was carried out. To observe changes in

the structure of a nickel-titanium tool after cyclic loading, the condition of the tools was examined before and after loading on an optical microscope, an electronic scanning microscope, the elemental composition was determined.



Fig. 1. Simulation endodontic unit. Dimensions 40.0 x 25.0 x 6.0mm, canal depth 2.2 mm

The simulation endodontic unit consists of 5 canals with different bends (90°, 45°, 30°, double bend 45° and triple bend 45°). NSK Endo-Mate TC2 was used as an endomotor. The well-known COXO SC PRO files were selected for the test. The mode of operation with the tools was specified in accordance with the manufacturer's recommendations. COXO SC PRO files have good elasticity without the risk of straightening the root canal, a safe tip and high cutting efficiency.

The process of determining cyclic fatigue. For the test of cyclic fatigue, close to clinical reception, it was decided

to carry out 3 stages of loading endodontic files:

1. Mechanical load test.

Using COXO SC PRO on a simulation endodontic unit, a vertically translational, passive file introduction with a rotation of 350 rpm/1.5 was carried out n.cm in the channels of the simulation block for 38-40 seconds in each canal.

2. Chemical load test.

It was carried out by immersing the file in 3.25% sodium hypochlorite for 2 hours. Then the file was washed with water, immersed in a disinfectant solution (5% alaminol solution) for 45 minutes, which includes alkylidimethylbenzylammonium chloride and glyoxal, surfactant, dye and water.

3. Physical activity test.

The endodontic instrument, which is in a sterile package, was subjected to autoclaving under the influence of 134°C, 1.2 atm for 45 minutes.

This was the end of the first cycle of a full-fledged cyclic fatigue test. The resistant file was subjected to a second load cycle after the first one.

During the mechanical load, a video recording was made and the number of revolutions performed before the breakage, the duration of work (in seconds) and the moment of breakage were calculated.

After tests to determine cyclic fatigue, a comparative examination of the surface of the nickel-titanium instrument was carried out before and after loading on an optical microscope MC-4-ZOOM and the ToupView program for systematization of both photo and video fixation. The samples were examined at a magnification of 50x.

For a detailed inspection of the structure of the nickel-titanium instrument, electronic scanning microscopy and studies of the structure and elemental composition were carried out on a JEOL JSM-6480LW microscope from JEOL with an energy dispersive prefix (EDX) X-MAX from Oxford Instruments (detector area 80mm²). A comparative examination of nickel-titanium instruments on an electron scanning microscope before and after loading was carried out.

The image pattern was studied in secondary electrons (SEI) and in back-reflected electrons (BEC).

Before the measurements, the samples were degreased with isopropyl alcohol and glued to the slide table using carbon tape, as shown in the Fig. 2.

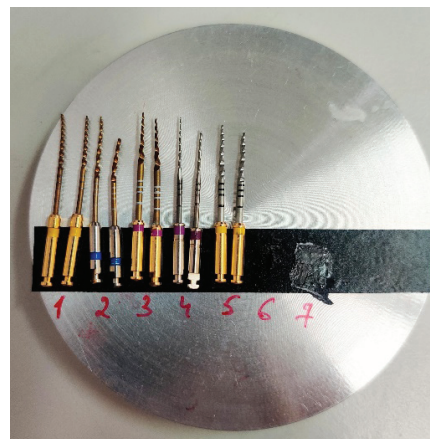


Fig. 2. The image of the slide table with attached samples

The use of nickel-titanium COXO SC PRO tools provides phenomenal flexibility in curved root canals, but as a result of cyclic loading, the probability of breaking off the nickel-titanium COXO SC PRO tool remains.

According to the manufacturer's official recommendation on the number of tools used, this is 15 root canals. The values for the number of tools used in the root canals obtained after the tests and the values for the number of tools used in the root canals vary according to the manufacturer's recommendations. During the study, loads corresponding to clinical reception were carried out: nickel-titanium COXO SC PRO files with sizes 02/19, 04/20, 04/25, 06/25, 04/35 after a series of tests showed different resistance to cyclic loading.

The total operating time of the nickel-titanium instrument in the canals of the simulation endodontic block was calculated from the moment of the first rotation to the moment of tool breakage. The number of revolutions was calculated on the condition that we work at 350 revolutions per minute or 5.84 revolutions per second. Then, the number of revolutions is multiplied by the number of seconds before the break, and thus we get the number of revolutions before the break. When calculating the number of revolutions according to the manufacturer's data per tool unit when working in 15 canals and a 40-second exposure of the tool in the channel, 3504 revolutions are expected before breaking off.

The results of cyclic loading are summarized in Table 1.

Table 1. The results of cyclic fatigue resistance

The results of cyclic loading			
Files	Mechanical load	Chemical and physical activity	Break-off time and number of turns
02/19	5 canals	2 cycles	227 sec /1325,68
04/20	5 canals	2 cycles	206 sec/1203,04
04/25	5 canals	2 cycles	202 sec/1179,68
06/25	4 canals	1 cycle	166 sec/969,44
04/35	5 canals	2 cycles	204 sec/1191,36

According to observations from video and photo fixation, it can be seen that the resistance to cyclic fatigue is strongly influenced by sodium hypochlorite 3.25%. When COXO SC PRO files are immersed in 3.25% sodium hypochlorite, black bubbles appear after 7 minutes (Fig. 3).



Fig. 3. Chemical load test of nickel-titanium tools COXO SC PRO

The appearance of black bubbles from COXO SC PRO nickel-titanium instruments in sodium hypochlorite of 3.25% aroused interest in determining the elemental composition of these bubbles. According to the study of the elemental composition, the black precipitate is sodium chloride with Zn and Ni dissolved in it. After washing off the black sediment from the surface of the nickel-titanium tool, there is no golden coating.

After autoclaving, during a detailed examination, the tip of the COXO SC PRO 06/25 file was deformed and there was no gold deposition, which is observed in other studies [8,9]. On other files, there was no gold dusting on the site of the alleged breakage (Fig. 4).



Fig. 4. Nickel-titanium tool COXO SC PRO 06/25 with no deposition in the area of the alleged breakage

After the load cycle, nickel-titanium instruments were studied using an electron scanning microscope. Scanning microscopy was carried out on a JEOL JSM-6480LW microscope manufactured by JEOL with an energy dis-

persive prefix (EDX) X-MAX manufactured by Oxford Instruments (detector area 80mm²). The images were obtained in secondary electrons in three different magnifications (300x, 1000x, 5000x) and in back-reflected electrons also in three different magnifications (300x, 1000x, 5000x), Fig. 5.

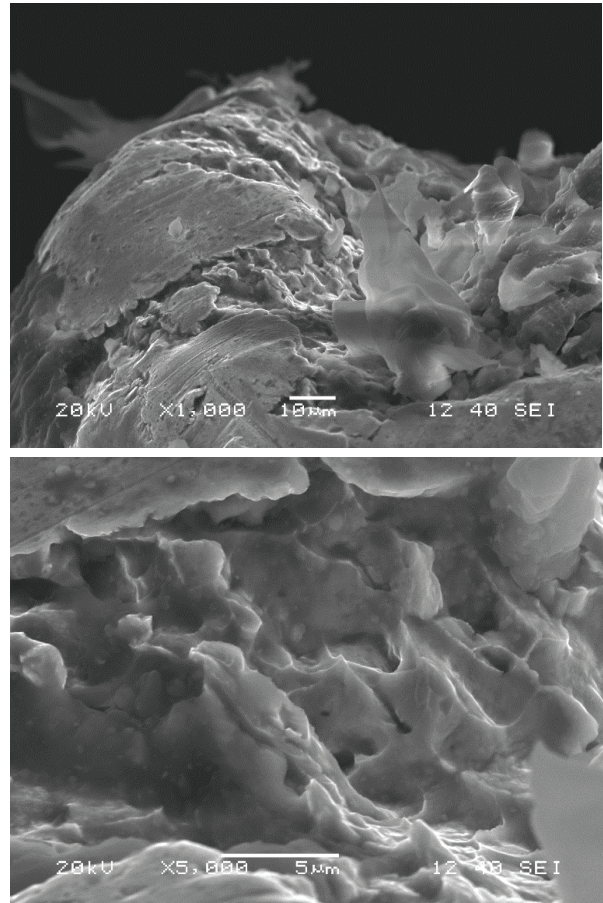


Fig. 5. Fractograms of the chip surface of a new, unused sample of COXO SC PRO 19.02 at different magnifications in secondary electrons

The fractogram of the cleavage surface of the cross-section of the new unused sample COXO SC PRO 19.02 shows an inhomogeneous crumpled structure with a large variation in the surface topography, including areas with alloy conglomerates and finely dimpled zones. The amorphous structural elements of the chip are unsystematic and mixed with organic fragments from the sample surface. The structural elements of the small-frame shape have sizes from 3.3 microns to 8.3 microns. Rare isotropic pores are observed in the images, they are observed mainly along the edges of structural elements and have sizes from 700 nm to 1.2 microns. No cracks found.

On the fractograms of the cleavage of the cross-section of the sample of the COXO SC PRO 19.02 sample obtained as a result of a series of workloads (1 cycle) including a twist fracture (volumetric stretching), a homogeneous finely dimpled structure with pronounced

and thinned edges of the edges of structural elements with dimensions from 0.5 microns to 3.3 microns is observed. Rare isotropic pores are observed mainly in the central zones of structural elements in the center of the

pits and have sizes from 0.1 microns to 0.6 microns. Conglomerates of both heavier and lighter elements were found on the rock, as well as organic fragments from the sample surface. No cracks were found.

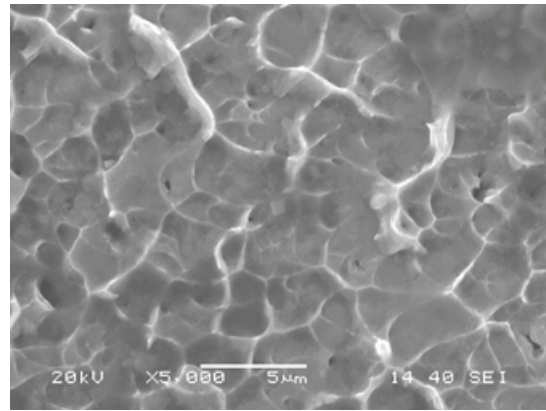
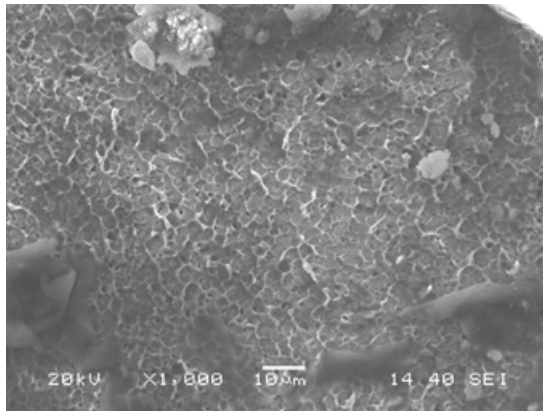


Fig. 6. Fractograms of the chip surface of the loaded, used sample COXO SC PRO 19.02 at different magnifications in secondary electrons

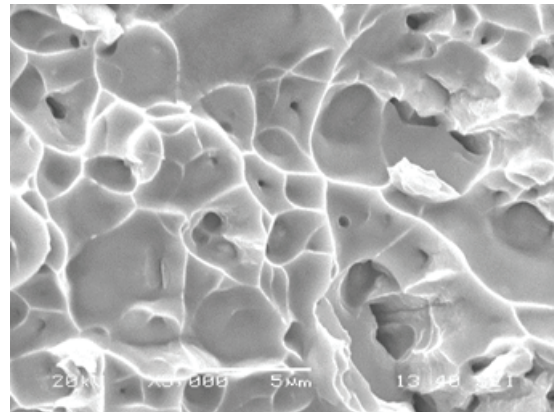
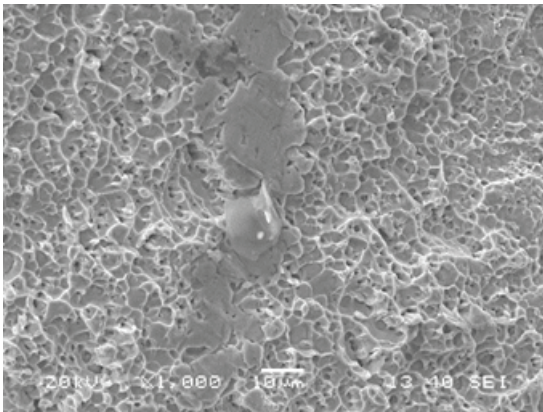


Fig. 7. Fractograms of the chip surface of the loaded, used sample COXO SC PRO 04.20 at different magnifications in secondary electrons

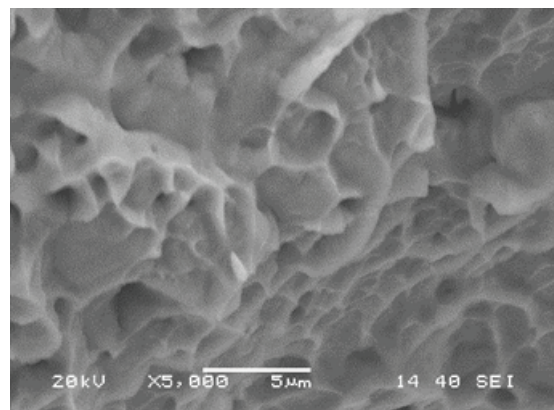
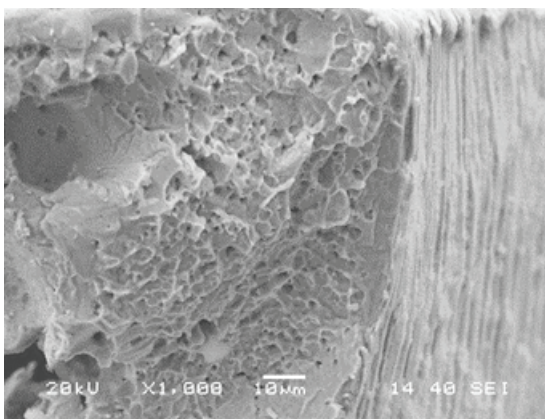


Fig. 8. Fractograms of the chip surface of a new, unused sample of COXO SC PRO 04.20 at different magnifications in secondary electrons

Fractograms of the cleavage of the cross-section of the sample of the COXO SC PRO 04.20 sample obtained as a result of a series of workloads (1 cycle), including a twist fracture (volumetric stretching), show a mostly homogeneous, finely dimpled structure with wavelike boundaries

and wedge-shaped edges of structural elements ranging in size from 1 microns to 6.8 microns. Often located isotropic pores are observed mainly in the central zones of structural elements, are evenly distributed over the surface of the sample chip and have sizes from 400 nm to 1.4

microns. Alloy conglomerates of various shapes formed during stretching and separation and organic inclusions from the sample surface were found on the rock. Micro-cracks consisting of several merged large pores are noted on some areas of the surface.

On the fractograms of the cleavage surface of the cross-section of the new unused sample COXO SC PRO 04.20, a non-homogeneous, partially finely dimpled structure with wave-like borders and wedge-shaped edges of struc-

tural elements with a large size spread from 800 nm to 9.3 microns is visible. Isotropic pores are observed in half of the structural elements of the surface, are not quite evenly distributed over the surface of the sample cleavage, are observed mainly in the central zones of the structural elements in the center of the pits and also have a variety of sizes, from 300 nm to 3.4 microns. In one of the areas of the surface there is a large crater with a width of 22.5 microns.

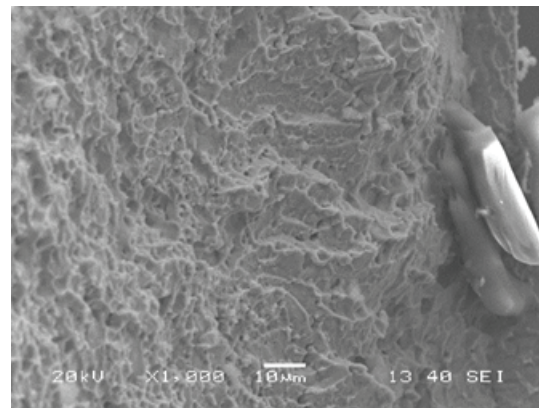
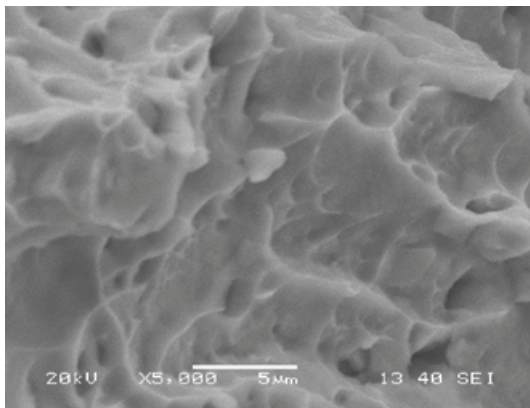


Fig. 9. Fractograms of the chip surface of a new, unused sample of COXO SC PRO 04.25 at different magnifications in secondary electrons

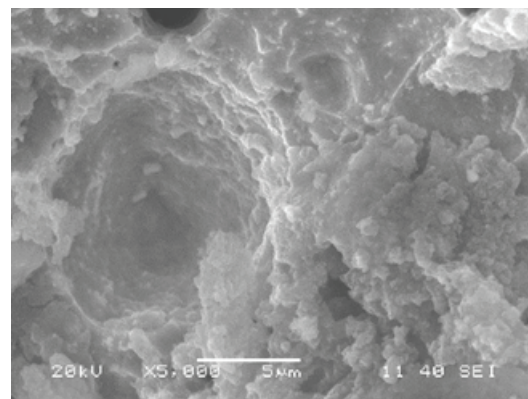
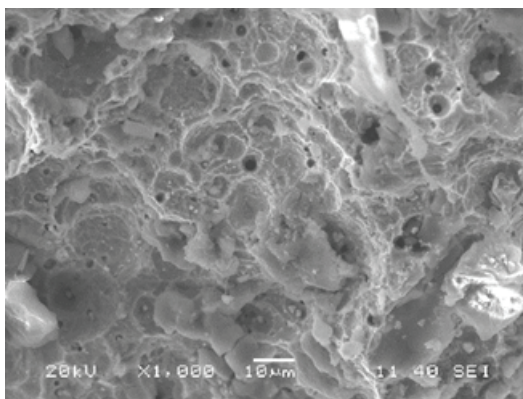


Fig. 10. Fractograms of the chip surface of the loaded, used sample COXO SC PRO 04.25 at different magnifications in secondary electrons

Fractograms of the cleavage surface of the cross-section of a new unused sample of COXO SC PRO 04.25 show a stepped break and a homogeneous, partially finely dimpled structure with wedge-shaped edges of rock-like fragments of structural elements ranging in size from 900 nm to 6.8 microns. Isotropic pores are observed in about half of the structural elements of the surface are not evenly distributed over the surface of the sample cleavage (grouped in the center), are observed mainly in the central zones of the structural elements in the center of the pits and have sizes from 400 nm to 1.6 microns. In one of the areas of the surface there are lump-like particles that have arisen as a result of breakage. No cracks were found.

On the fractograms of the cleavage of the cross-section of the COXO SC PRO 04.25 sample obtained as a result of a series of workloads (1 cycle) including a twist fracture (volumetric stretching), an extremely heterogeneous structure is

visible, there are craters of 5-10 microns in size. The sizes of rare isotropic pores vary from 200 nm to 2 microns. The surface is heavily contaminated with inclusions of both heavier and lighter elements, which is clearly visible in the image obtained in back-reflected electrons. No cracks were found.

On the fractograms of the cleavage surface of the cross-section of the new unused sample COXO SC PRO 06.25, a homogeneous finely dimpled structure is visible with thinned edges, but mostly flat edges of wedge-shaped structural elements with sizes from 1.4 microns to 5.8 microns. The images also show isotropic pores. Pores are observed both at the edges and in the central zones of structural elements and have sizes from 400 nm to 2 microns. The pores are represented in a moderate amount and are evenly distributed over the surface of the cleavage of the sample. Organic inclusions from the sample surface were found on the rock. No cracks were found.

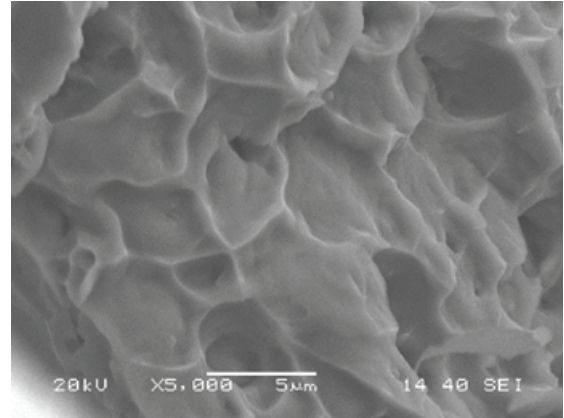
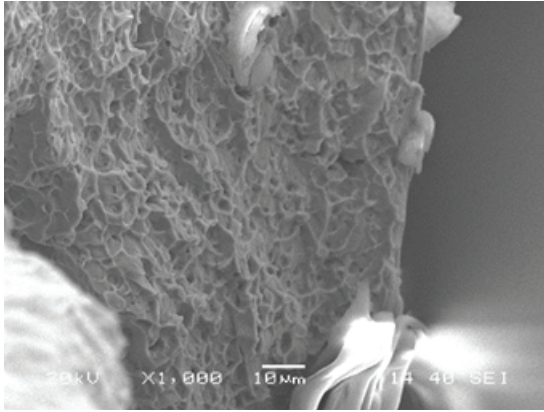


Fig. 11. Fractograms of the chip surface of a new, unused sample of COXO SC PRO 06.25 at different magnifications in secondary electrons

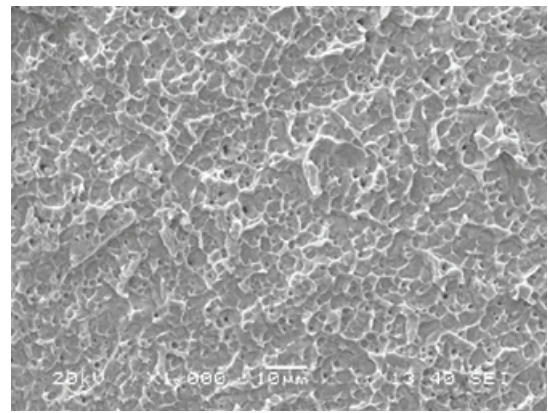
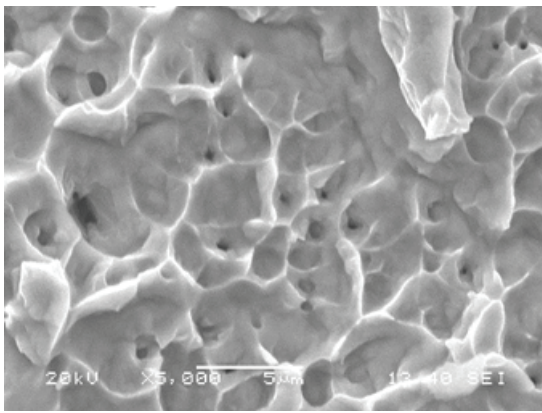


Fig. 12. Fractograms of the chip surface of the loaded, used sample COXO SC PRO 06.25 at different magnifications in secondary electrons

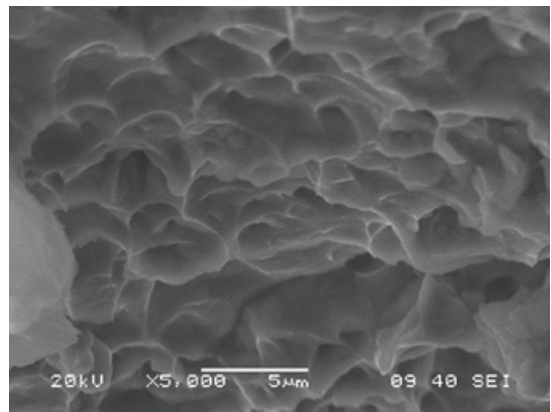
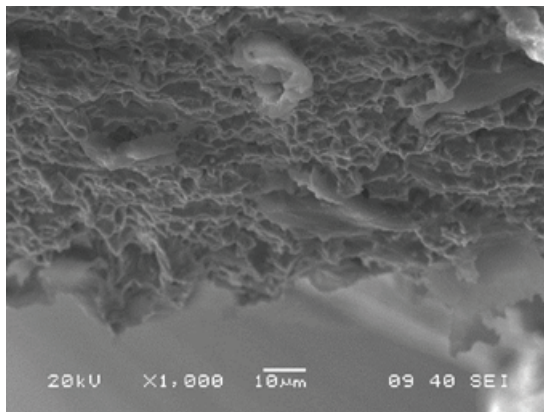


Fig. 13. Fractograms of the chip surface of a new, unused sample of COXO SC PRO 04.35 at different magnifications in secondary electrons

On the fractograms of the cleavage of the cross-section of the sample of the COXO SC PRO 06.25 sample obtained as a result of a series of workloads (1 cycle) including a twist fracture (volumetric stretching), a homogeneous finely dimpled structure with more pronounced wedge-shaped edges of structural elements with sizes from 1 to 7.5 microns is also observed. Isotropic pores are observed mainly in the central zones of structural elements in the center of the pits and have sizes from 500

nm to 1.5 microns. The pores are marked in no more than half of the structural elements and are evenly distributed over the surface of the sample cleavage. Small particles and conglomerates of alloy of various shapes were found on the rock, which appeared during stretching and separation. No cracks were found.

Fractograms of the cross-sectional cleavage surface of a new unused COXO SC PRO 04.35 sample show a highly polluted, homogeneous, finely dimpled struc-

ture with wedge-shaped edges of rock-like fragments of structural elements ranging in size from 1.2 microns to 4 microns. The pores of the isotropic form are

marked in part of the structural elements of the surface and have sizes from 400 nm to 3 microns. No cracks were found.

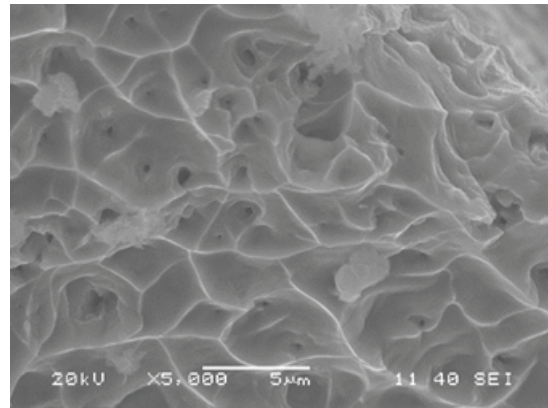
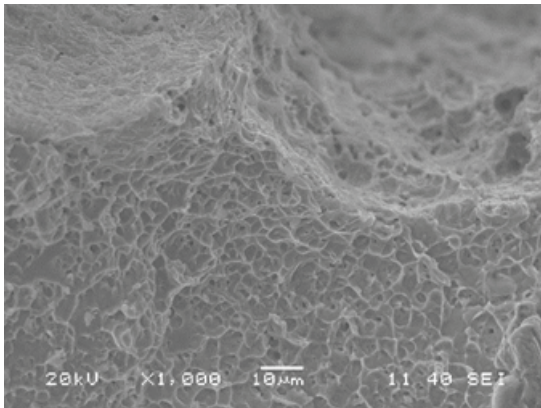


Fig. 14. Fractograms of the chip surface of the loaded, used sample COXO SC PRO 04.35 at different magnifications in secondary electrons

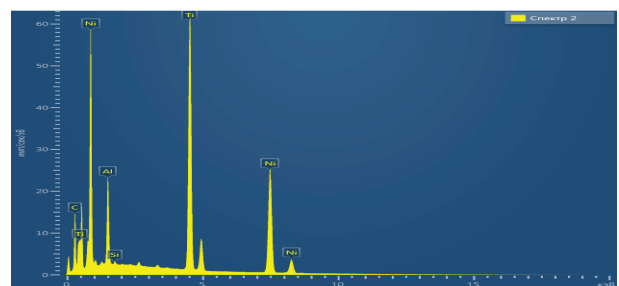
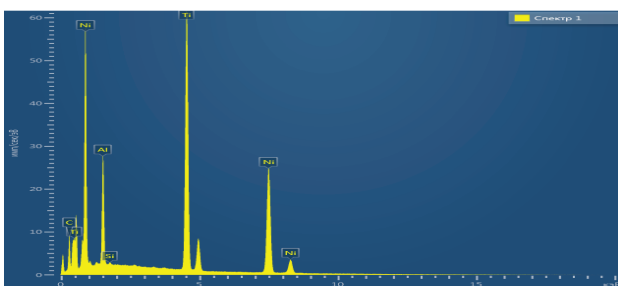
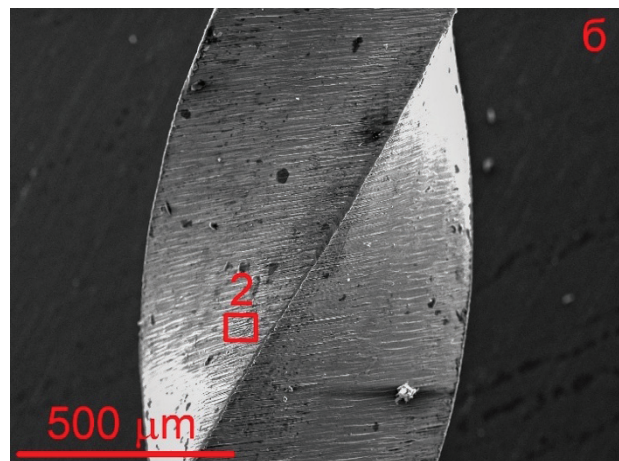
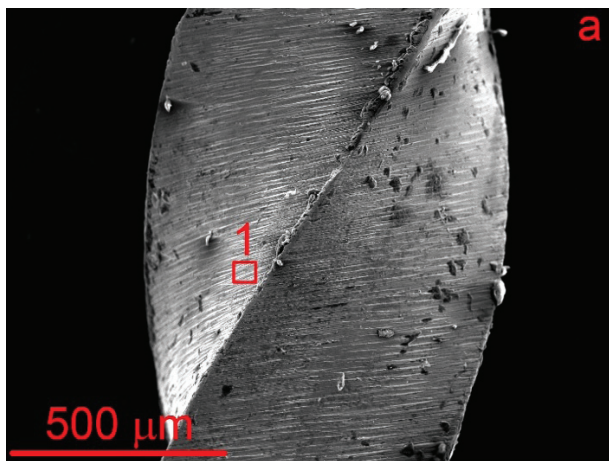


Fig. 15. Electronic image of samples a -1a, b - 1b. The images indicate the areas from which spectra 1 and 2 were accumulated

Fractograms of the cleavage of the cross-section of the sample of the COXO SC PRO 04.35 sample obtained as a result of a series of workloads (1 cycle), including a twist fracture (volumetric stretching), show a surface with a stepped fracture of a homogeneous, finely pitted structure, as well as wavelike boundaries and wedge-shaped edges of structural elements ranging in size from 1 to 8.5 microns. Isotropic pores of structural elements observed in the central zones of pits are often located, evenly distributed over the surface of the sample cleavage and have sizes from 400 nm to 1.4 microns. Organic inclusions from the sample surface were found on the rock. No cracks were found.

After obtaining a detailed image and a clear difference in structure between the tools before and after loading. It was necessary to evaluate the changes in the composition of the nickel-titanium tool COXO SC PRO after loading and without loading.

The entire representation of the image below was obtained in secondary electrons and COXO SC PRO 04/25 files were selected as the study. Samples of COXO SC PRO 04/25 (without load) were selected-1a and COXO SC PRO 04/25 (after loading)-1b. Figure 15 shows an image of the edge of the sample 1a and 1b. No changes in the appearance of the surface of the samples before and

after loading were detected, one can only notice that after processing the surface looks somewhat cleaner. The images indicate the areas from which the spectra were accumulated to determine the qualitative and quantitative elemental composition. Also, as an example, Figure 56 shows images of the spectra themselves, then tables with the specified quantitative composition will be used for analysis.

The table 2 shows that sample 1 consists of an alloy of

titanium, nickel and aluminum with a negligible silicon content. After loading, the content of Ti, Ni and Al decreases slightly, but the oxygen content increases. Both samples show a significant oxygen content. To check the oxygen content in the alloy, it was decided to break two samples of different production and check the oxygen content in the volume of the material and in the near-surface layer. Below, Figs 16 and 17 show electronic images of the fractures of samples 1a and 1b, respectively.

Table 2. The spectra of qualitative and quantitative elemental composition

	O	Al	Si	Ti	Ni
Spectra 1 (at%)	37,06	12,6	0,19	25,94	24,2
Spectra 2 (at%)	41,56	9,83	0,26	25,04	23,31

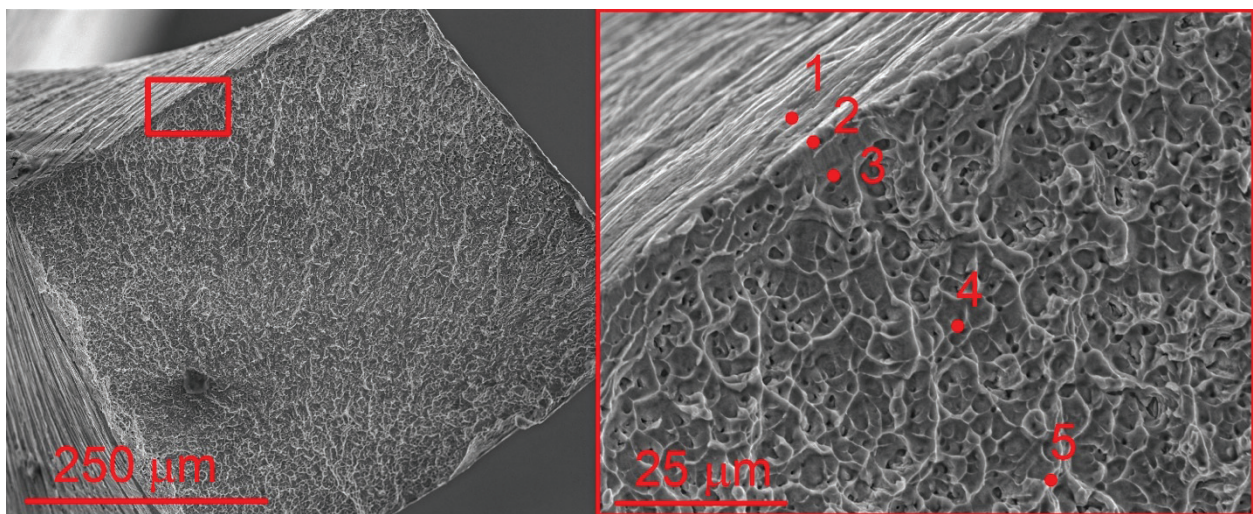


Fig. 16. Electronic image of the fracture of sample 1a

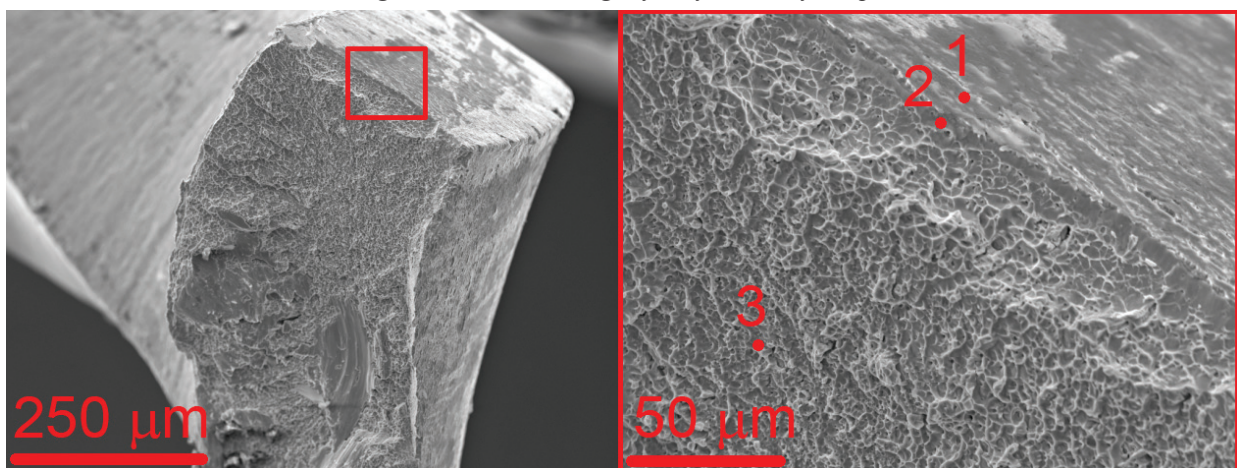


Fig. 17. Electronic image of the fracture of sample 1b

The quantitative elemental composition from the regions indicated in the image 27 and 28 is presented in Table 3.

From the data obtained, it can be seen that the high oxygen content is only in the near-surface layer. In the volume of the alloy, the amount of oxygen is not in a sig-

nificant amount. In the oxidized near-surface layer, an increased content of aluminum and an insignificant amount of silicon were also found. Silicon was not detected in the volume of the material. According to the study of the elemental composition, the black precipitate is sodium chloride and Zn and Ni dissolved in it.

Table 3. The spectra of quantitative elemental compositions

Sample 1a					
	O	Al	Si	Ti	Ni
spectra 1 (at%)	42,04	7,39	0,28	25,77	24,52
spectra 2 (at%)	2,24	0,75		48,52	48,49
spectra 3 (at%)	1,01	0,37		46,86	51,76
spectra 4 (at%)	0,54			50,37	49,09
spectra 5 (at%)	4,24	0,36		48,2	47,2
Sample 1b					
spectra 1 (at%)	57,97	4,80	0,66	21,32	15,25
spectra 2 (at%)	1,19	0,4		49,55	48,86
spectra 3 (at%)	1,06	0,32		49,54	49,08

Endodontic machine nickel-titanium files COXO SC PRO have phenomenal flexibility, but with a certain metallurgical composition, the influence of sodium hypochlorite in the form of leaching nickel and leaching titanium nitrite degrades strength characteristics. After the autoclaving cycle, the oxygen content in the near-surface layer increases, which leads to rapid breakage under mechanical load. In conclusion, COXO SC PRO nickel-titanium instruments are suitable only for one-time use in simple channels, during endodontic treatment.

After the tests, signs of tool breakage were revealed, this is the absence of golden deposition (titanium nitride) in the area of the alleged breakage. In the presence of an electron microscope, deformations on the surface of the instrument can be seen in the absence of golden spraying area, or it can be painted with methylene blue or caries marker, which penetrates into the deformation of the absence of golden spraying area.

Conclusion. Sterilization treatment, which is based on autoclaving, significantly reduces the strength characteristics of COXO SC PRO nickel-titanium files, which limits the use of these tools to one-time use without the risk of their breakage.

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SUMMARY

DETERMINATION OF CYCLIC FATIGUE OF A NICKEL-TITANIUM COXO SC PRO FILE USING A SIMULATION ENDODONTIC UNIT

Khabadze Z., Ismailov F., Makeeva I.

*Peoples Friendship University of Russia (RUDN),
Moscow, Russian Federation*

The use of nickel-titanium instruments during endodontic treatment ensures high-quality treatment of root canals. However, during instrumentation in the curved root canals of nickel-titanium instruments experience cyclic loading, which leads to their breakage. The splinter of the tool in the root canal makes it difficult for high-quality processing and obturation of the root canal, which is a very urgent problem. To carry out instrumental processing in canals with various anatomical and topographic features, the files must have phenomenal flexibility, lack of straightening of the canal, and have a safe non-aggressive tip. And for this reason, one of the most popular nickel-titanium COXO SC PRO tools was selected as a study, which, according to the manufacturer, have all the listed properties. The aim of the study is to determine the limit of resistance to cyclic loading and signs of breakage of the nickel-titanium endodontic instrument COXO SC PRO.

Sterilization treatment, which is based on autoclaving, significantly reduces the strength characteristics of COXO SC PRO nickel-titanium files, which limits the use of these tools to one-time use without the risk of their breakage.

Keywords: endodontic treatment, autoclaving, nickel-titanium instruments, cyclic loading, tensile strength of endodontic files.

РЕЗЮМЕ

ОПРЕДЕЛЕНИЕ ЦИКЛИЧЕСКОЙ УСТАЛОСТИ НИКЕЛЬ-ТИТАНОВОГО ФАЙЛА COXO SC PRO С ИСПОЛЬЗОВАНИЕМ ИМИТАЦИОННОГО ЭНДОДОНТИЧЕСКОГО УСТРОЙСТВА

Хабадзе З.С., Исмаилов Ф.Р., Макеева И.М.

*Российский университет дружбы народов (РУДН),
Москва, Российская Федерация*

Использование никель-титановых инструментов во время эндодонтического лечения обеспечивает высококачественное лечение корневых каналов. Однако во время инструментальной обработки в изогнутых корневых каналах никель-титановые инструменты испытывают циклическую нагрузку, что приводит к их поломке. Осколок инструмента в корневом канале затрудняет качественную обработку и obturацию корневого канала, что является весьма актуальной проблемой. Для

выполнения инструментальной обработки в каналах с различными анатомическими и топографическими особенностями напильники должны обладать феноменальной гибкостью и иметь безопасный неагрессивный наконечник. По этой причине выбран один из самых популярных никель-титановых инструментов COXO SC PRO, который, согласно инструкции, обладает всеми перечисленными свойствами.

Целью исследования явилось определение предела устойчивости к циклическим нагрузкам и признаков повреждения никель-титанового эндодонтического инструмента COXO SC PRO.

Стерилизационная обработка, основанная на автоклавировании, значительно снижает прочностные характеристики никель-титановых напильников COXO SC PRO, что ограничивает использование этих инструментов одноразовым применением без риска их поломки.

რეზიუმე

ნიკელ-ტიტანის COXO SC PRO ფაილის ციკლური დაღლილობის განსაზღვრა იმიტაციური ენდოდონტიური მოწყობილობის გამოყენებით

ზ.ხაბაძე, ფ.ისმაილოვი, ი.მაკეევა

*რუსეთის ხალხთა მეგობრობის უნივერსიტეტი,
მოსკოვი, რუსეთის ფედერაცია*

ნიკელ-ტიტანის ინსტრუმენტების გამოყენება ენდოდონტიური მეურნალობის დროს უზრუნველყოფს ფესვთა არხების მაღალხარისხიან მეურნალობას. თუმცა, მოხრილი ფესვთა არხების დამუშავების დროს ნიკელ-ტიტანის ინსტრუმენტები ციკლურ დატვირთვას განიცდის, რაც მათ დაზიანებას იწვევს. ინსტრუმენტის ნაშესხვრევი ართულებს არხის ხარისხიან დამუშავებას და ობტურაციას, რაც საკმაოდ აქტუალურ პრობლემას წარმოადგენს. არხების ინსტრუმენტული დამუშავებისათვის სხვადასხვა ანატომიური და ტოპოგრაფიული თავისებურებების მქონე ქლიბებს უნდა ჰქონდეთ განსაკუთრებული მოქნილობა და უსაფრთხო არააგრესიული თავი. ამ მიზეზით შერჩეულია ერთ-ერთი ყველაზე პოპულარული ნიკელ-ტიტანის ინსტრუმენტი COXO SC PRO, რომელსაც, ინსტრუქციის თანახმად, აქვს ყველა ზემოაღნიშნული თვისება.

კვლევის მიზანს წარმოადგენდა ნიკელ-ტიტანის ინსტრუმენტის COXO SC PRO ციკლური დატვირთვებისადმი გამძლეობის ზღვარის და დაზიანების ნიშნების განსაზღვრა.

ავტოკლავირებაზე დაფუძნებული სტერილიზაციური დამუშავება მნიშვნელოვანად ამცირებს ნიკელ-ტიტანის ქლიბების COXO SC PRO გამძლეობით მახასიათებლებს, რაც განსაზღვრავს ამ ინსტრუმენტების ერთჯერად გამოყენებას, მათი დაზიანების რისკის გარეშე.