GEORGIAN MEDICAL NEWS

ISSN 1512-0112

NO 2 (347) Февраль 2024

ТБИЛИСИ - NEW YORK

ЕЖЕМЕСЯЧНЫЙ НАУЧНЫЙ ЖУРНАЛ

Медицинские новости Грузии

საქართველოს სამედიცინო სიახლენი

GEORGIAN MEDICAL NEWS

Monthly Georgia-US joint scientific journal published both in electronic and paper formats of the Agency of Medical Information of the Georgian Association of Business Press. Published since 1994. Distributed in NIS, EU and USA.

GMN: Georgian Medical News is peer-reviewed, published monthly journal committed to promoting the science and art of medicine and the betterment of public health, published by the GMN Editorial Board since 1994. GMN carries original scientific articles on medicine, biology and pharmacy, which are of experimental, theoretical and practical character; publishes original research, reviews, commentaries, editorials, essays, medical news, and correspondence in English and Russian.
GMN is indexed in MEDLINE, SCOPUS, PubMed and VINITI Russian Academy of Sciences. The full text content is available through EBSCO databases.

GMN: Медицинские новости Грузии - ежемесячный рецензируемый научный журнал, издаётся Редакционной коллегией с 1994 года на русском и английском языках в целях поддержки медицинской науки и улучшения здравоохранения. В журнале публикуются оригинальные научные статьи в области медицины, биологии и фармации, статьи обзорного характера, научные сообщения, новости медицины и здравоохранения. Журнал индексируется в MEDLINE, отражён в базе данных SCOPUS, PubMed и ВИНИТИ РАН. Полнотекстовые статьи журнала доступны через БД EBSCO.

GMN: Georgian Medical News – საქართველოს სამედიცინო სიახლენი – არის ყოველთვიური სამეცნიერო სამედიცინო რეცენზირებადი ჟურნალი, გამოიცემა 1994 წლიდან, წარმოადგენს სარედაქციო კოლეგიისა და აშშ-ის მეცნიერების, განათლების, ინდუსტრიის, ხელოვნებისა და ბუნებისმეტყველების საერთაშორისო აკადემიის ერთობლივ გამოცემას. GMN-ში რუსულ და ინგლისურ ენებზე ქვეყნდება ექსპერიმენტული, თეორიული და პრაქტიკული ხასიათის ორიგინალური სამეცნიერო სტატიები მედიცინის, ბიოლოგიისა და ფარმაციის სფეროში, მიმოხილვითი ხასიათის სტატიები.
ჟურნალი ინდექსირებულია MEDLINE-ის საერთაშორისო სისტემაში, ასახულია SCOPUS-ის, PubMed-ის და ВИНИТИ РАН-ის მონაცემთა ბაზებში. სტატიების სრული ტექსტი ხელმისაწვდომია EBSCO-ს მონაცემთა ბაზებიდან.

WEBSITE

www.geomednews.com

К СВЕДЕНИЮ АВТОРОВ!

При направлении статьи в редакцию необходимо соблюдать следующие правила:

1. Статья должна быть представлена в двух экземплярах, на русском или английском языках, напечатанная через **полтора интервала на одной стороне стандартного листа с шириной левого поля в три сантиметра**. Используемый компьютерный шрифт для текста на русском и английском языках - **Times New Roman** (**Кириллица**), для текста на грузинском языке следует использовать **AcadNusx.** Размер шрифта - **12**. К рукописи, напечатанной на компьютере, должен быть приложен CD со статьей.

2. Размер статьи должен быть не менее десяти и не более двадцати страниц машинописи, включая указатель литературы и резюме на английском, русском и грузинском языках.

3. В статье должны быть освещены актуальность данного материала, методы и результаты исследования и их обсуждение.

При представлении в печать научных экспериментальных работ авторы должны указывать вид и количество экспериментальных животных, применявшиеся методы обезболивания и усыпления (в ходе острых опытов).

4. К статье должны быть приложены краткое (на полстраницы) резюме на английском, русском и грузинском языках (включающее следующие разделы: цель исследования, материал и методы, результаты и заключение) и список ключевых слов (key words).

5. Таблицы необходимо представлять в печатной форме. Фотокопии не принимаются. **Все цифровые, итоговые и процентные данные в таблицах должны соответствовать таковым в тексте статьи**. Таблицы и графики должны быть озаглавлены.

6. Фотографии должны быть контрастными, фотокопии с рентгенограмм - в позитивном изображении. Рисунки, чертежи и диаграммы следует озаглавить, пронумеровать и вставить в соответствующее место текста **в tiff формате**.

В подписях к микрофотографиям следует указывать степень увеличения через окуляр или объектив и метод окраски или импрегнации срезов.

7. Фамилии отечественных авторов приводятся в оригинальной транскрипции.

8. При оформлении и направлении статей в журнал МНГ просим авторов соблюдать правила, изложенные в «Единых требованиях к рукописям, представляемым в биомедицинские журналы», принятых Международным комитетом редакторов медицинских журналов - http://www.spinesurgery.ru/files/publish.pdf и http://www.nlm.nih.gov/bsd/uniform_requirements.html
В конце каждой оригинальной статьи приводится библиографический список. В список литературы включаются все материалы, на которые имеются ссылки в тексте. Список составляется в алфавитном порядке и нумеруется. Литературный источник приводится на языке оригинала. В списке литературы сначала приводятся работы, написанные знаками грузинского алфавита, затем кириллицей и латиницей. Ссылки на цитируемые работы в тексте статьи даются в квадратных скобках в виде номера, соответствующего номеру данной работы в списке литературы. Большинство цитированных источников должны быть за последние 5-7 лет.

9. Для получения права на публикацию статья должна иметь от руководителя работы или учреждения визу и сопроводительное отношение, написанные или напечатанные на бланке и заверенные подписью и печатью.

10. В конце статьи должны быть подписи всех авторов, полностью приведены их фамилии, имена и отчества, указаны служебный и домашний номера телефонов и адреса или иные координаты. Количество авторов (соавторов) не должно превышать пяти человек.

11. Редакция оставляет за собой право сокращать и исправлять статьи. Корректура авторам не высылается, вся работа и сверка проводится по авторскому оригиналу.

12. Недопустимо направление в редакцию работ, представленных к печати в иных издательствах или опубликованных в других изданиях.

При нарушении указанных правил статьи не рассматриваются.

REQUIREMENTS

Please note, materials submitted to the Editorial Office Staff are supposed to meet the following requirements:

1. Articles must be provided with a double copy, in English or Russian languages and typed or compu-ter-printed on a single side of standard typing paper, with the left margin of **3** centimeters width, and **1.5** spacing between the lines, typeface - **Times New Roman** (**Cyrillic**), print size - **12** (referring to Georgian and Russian materials). With computer-printed texts please enclose a CD carrying the same file titled with Latin symbols.

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.

5. Tables must be presented in an original typed or computer-printed form, instead of a photocopied version. **Numbers, totals, percentile data on the tables must coincide with those in the texts of the articles.** Tables and graphs must be headed.

6. Photographs are required to be contrasted and must be submitted with doubles. Please number each photograph with a pencil on its back, indicate author's name, title of the article (short version), and mark out its top and bottom parts. Drawings must be accurate, drafts and diagrams drawn in Indian ink (or black ink). Photocopies of the X-ray photographs must be presented in a positive image in **tiff format**.

Accurately numbered subtitles for each illustration must be listed on a separate sheet of paper. In the subtitles for the microphotographs please indicate the ocular and objective lens magnification power, method of coloring or impregnation of the microscopic sections (preparations).

7. Please indicate last names, first and middle initials of the native authors, present names and initials of the foreign authors in the transcription of the original language, enclose in parenthesis corresponding number under which the author is listed in the reference materials.

8. Please follow guidance offered to authors by The International Committee of Medical Journal Editors guidance in its Uniform Requirements for Manuscripts Submitted to Biomedical Journals publication available online at: http://www.nlm.nih.gov/bsd/uniform_requirements.html
http://www.icmje.org/urm_full.pdf
In GMN style for each work cited in the text, a bibliographic reference is given, and this is located at the end of the article under the title "References". All references cited in the text must be listed. The list of references should be arranged alphabetically and then numbered. References are numbered in the text [numbers in square brackets] and in the reference list and numbers are repeated throughout the text as needed. The bibliographic description is given in the language of publication (citations in Georgian script are followed by Cyrillic and Latin).

9. To obtain the rights of publication articles must be accompanied by a visa from the project instructor or the establishment, where the work has been performed, and a reference letter, both written or typed on a special signed form, certified by a stamp or a seal.

10. Articles must be signed by all of the authors at the end, and they must be provided with a list of full names, office and home phone numbers and addresses or other non-office locations where the authors could be reached. The number of the authors (co-authors) must not exceed the limit of 5 people.

11. Editorial Staff reserves the rights to cut down in size and correct the articles. Proof-sheets are not sent out to the authors. The entire editorial and collation work is performed according to the author's original text.

12. Sending in the works that have already been assigned to the press by other Editorial Staffs or have been printed by other publishers is not permissible.

Articles that Fail to Meet the Aforementioned Requirements are not Assigned to be Reviewed.

ავტორთა საყურადღებოდ!

რედაქციაში სტატიის წარმოდგენისას საჭიროა დავიცვათ შემდეგი წესები:

1. სტატია უნდა წარმოადგინოთ 2 ცალად, რუსულ ან ინგლისურ ენებზე,დაბეჭდილი სტანდარტული ფურცლის 1 გვერდზე, 3 სმ სიგანის მარცხენა ველისა და სტრიქონებს შორის 1,5 ინტერვალის დაცვით. გამოყენებული კომპიუტერული შრიფტი რუსულ და ინგლისურენოვან ტექსტებში - **Times New Roman** (**Кириллица**), ხოლო ქართულენოვან ტექსტში საჭიროა გამოვიყენოთ **AcadNusx.** შრიფტის ზომა – 12. სტატიას თან უნდა ახლდეს CD სტატიით.

2. სტატიის მოცულობა არ უნდა შეადგენდეს 10 გვერდზე ნაკლებს და 20 გვერდზე მეტს ლიტერატურის სიის და რეზიუმეების (ინგლისურ,რუსულ და ქართულ ენებზე) ჩათვლით.

3. სტატიაში საჭიროა გაშუქდეს: საკითხის აქტუალობა; კვლევის მიზანი; საკვლევი მასალა და გამოყენებული მეთოდები; მიღებული შედეგები და მათი განსჯა. ექსპერიმენტული ხასიათის სტატიების წარმოდგენისას ავტორებმა უნდა მიუთითონ საექსპერიმენტო ცხოველების სახეობა და რაოდენობა; გაუტკივარებისა და დაძინების მეთოდები (მწვავე ცდების პირობებში).

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. რენტგენოგრამების ფოტოასლები წარმოადგინეთ პოზიტიური გამოსახულებით **tiff** ფორმატში. მიკროფოტოსურათების წარწერებში საჭიროა მიუთითოთ ოკულარის ან ობიექტივის საშუალებით გადიდების ხარისხი, ანათალების შეღებვის 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 ფჩხილებში 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.

GEORGIAN MEDICAL NEWS
No 2 (347) 2024

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EFFECT OF SURFACE ABRASION AND TEMPERATURE TREATMENT ON METASTABLE TETRAGONAL ZIRCONIUM DIOXIDE (EXPERIMENTAL STUDY)

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Abstract.

One of the significant drawbacks of using zirconium dioxide as a framework for prosthodontic structures is its propensity for breakage. Paradoxically, the higher the optical performance of zirconium dioxide, the more its mechanical durability tends to decrease and vice versa. A detailed analysis of the technological process has uncovered divergent opinions and significant disparities in recommendations concerning the fabrication of zirconium dioxide prosthodontic constructs. There are different recommendations regarding the need for abrasive blasting and regeneration firing. Consequently, conducting an in-depth experimental study on this matter and implementing the resulting findings will significantly contribute to addressing the challenges of prosthodontic rehabilitation for patients utilizing zirconium dioxide.

Key words. Metastable Tetragonal Zirconium Dioxide (Y-TZP), CAD/CAM technology, regeneration firing, flexural strength.

Introduction.

The widespread adoption of zirconium dioxide as a framework material for prosthodontic constructs in everyday dental practice has brought to light its primary drawbacks, namely instances of construct breakage and delamination/chipping of porcelain layers from the frame [1-6]. There is disagreement on the rational implementation of the technological process on the part of both manufacturers and technicians. Sandblasting of frames of prosthetic construction is a popular method, which, at the expense of increasing the roughness of the surface of the frame, increases the degree of adhesion of porcelain masses [7]. The technique of sandblasting the inner surface of the frame is also widely used in order to improve the adhesion of the structure to the teeth. In order to fit a fully fired zirconia framework, it is often necessary to adjust it with a diamond bur of a suitable grade, which should be done under water cooling [6]. After the mentioned stage, it is usually recommended to perform the so-called zirconia regeneration firing [8,9]. There is an opinion that abrasive blasting causes the formation of microcracks due to the T-M phase transition (from tetragonal to monoclinic phase) with local expansion of the material, which is a kind of distraction areas preventing further development of microcracks [8]. However, high-temperature annealing can lead to phase reversal, removal of stress blocks in the material and thus to further development of cracks [9].

A review of the specialised literature on the effects of abrasive and heat treatment on fully synthesised tetragonal zirconia has revealed diametrically divergent opinions [4,8,9]. Based on the above, a study was carried out with the aim of 1. Determination of the type and degree of effect of sandblasting and diamond bur abrasive treatment on the hardness and phase state of yttrium-stabilized metastable tetragonal zirconium dioxide (Y-TZP). Determination of the results of so-called "regeneration" firing and, consequently, determination of its appropriateness.

The fracture of a ceramic material can be caused by a crack formed by a single microstructural defect as well as by the coalescence of multiple defects [1,10]. In practical applications, of interest are the resistance of the frame materials to elasticity and resistance to crack formation. The resistance to crack formation can be evaluated by two methods: 1. By transverse cutting of the material and further crushing it in a special testing device. 2. By determining the bending strength of the material.

We have chosen the latter as the more accurate and common type of research. Bending strength test is carried out by "three-point", "four-point" and biaxial loading methods. In the three-point test, a rectangular sample resting on two points is loaded from above at its centre. The strength is calculated by the maximum load at which the test sample of the corresponding dimensions is crushed, taking into account the load points and temperature [11]. Scanning electron microscope examination enables detailed visual examination of objects smaller than 1 μm, which allows to observe microscopic changes in the structure of the material.

Research Materials and Methods.

To conduct the research, samples of synthesized ZrO_2, stabilized Y_2O_3 (hereinafter referred to as Y-TZP) were prepared and divided into 5 groups:

- The samples included in the first group were sandblasted without subsequent regeneration firing.
- The samples included in the second group were subjected to sandblasting followed by regeneration firing.
- The samples included in the third group were subjected to abrasive blasting with a diamond bur without additional firing.
- The samples included in the fourth group were subjected to both diamond bur abrasive blasting and regeneration firing.
- The samples in the fifth group were not subjected to mechanical and temperature impacts, so they represent the control group.

Each group includes 10 samples of metastable tetragonal zirconium dioxide. In order to conduct a "three-point" test for bending strength, all samples were tested, that is they were crushed, which was followed by macroscopic and microscopic investigations.

In the next stage of the research, the samples were examined using a scanning electron microscope (magnification up to 1000x), which allowed visualisation of the structural changes caused by the different impacts. Experimental research was conducted in accordance with the ISO 6872:2008 (Dentistry-Ceramic materials) standard in the laboratories of specialized centers in Germany and the Czech Republic (Institut für Festkörperphysik, Ulm, Germany; CSMS_Československá Mikroskopická Společnost, Czech Republic). Statistical processing of the obtained results was carried out in the TIBCO Statistica v13 2022 programme by means of the ANOVA Origin statistical package of analysis of variance. Pre-sintered Y-TZP blocks (VITA In-Ceram YZ Cubes for in Lab, Vita Zahnfabrik), a total of 80 pieces, were used as research material.

After milling, the final firing was carried out in a VITA ZYRCOMAT® 6100 MS furnace (Vita Zahnfabrik, Germany) and 50 samples without internal defects were selected from the 80 samples using a light microscope. In the next step, they were divided into conditional groups:

The first group was labelled "SB" and the frames included in it were sandblasted with Al2O3 of 110 µm dispersity, for 10 seconds, at a distance of 1 cm from the frame, at a pressure of 3 bar.

The second group was labelled "SBS". They were subjected to the same treatment as the first group and additionally to the so-called "regeneration" firing at 1000°C for 15 min (regeneration mode - 25 min, start at 550°C, heating speed - 100°C/min).

The third group was marked with the letter "D". Their abrasive treatment was carried out with a specialized diamond bur for zirconium dioxide "ZR6850.FG.016 Crown and Bridge" (Komet, Germany).

The fourth group was marked with the letter "DS". The samples included in it were processed in the same way as the third group, with the difference that they were further fired (according to the above scheme).

The fifth group was marked with the letter "C" - as a control, and the materials included in it were not subjected to any impact at all.

All sample surfaces were cleaned and dried, and final dimensions were determined with an accuracy of 0.01 mm.

Research Methodology.

Determination of ultimate tensile strength of Y-TZP samples by three-point deformation method:

The ultimate tensile strength is defined as the maximum deforming force that the sample can withstand before damage occurs. In testing ceramic materials, only the initial rigid deformation is observed, after which the material breaks.

The research was carried out on an Instron 3369 device (Instron systems, Illinois Tool Works Inc, USA), which is equipped with a load sensor (STATIC LOAD CELLS) 2530-5KN (5000 newtons). In the study, the loading speed was 0.5 mm/s, the distance between the blocks was 10 mm. The load was applied at the intermediate point with an accuracy of 0.01 Newton.

The maximum stress in the test sample is calculated using the following formula: $\sigma_{flx} = 3PL/2WH^2$ [11], where

σ_{flx} - Ultimate Tensile Strength, MPa.

P - maximum load, Newton.

L - distance between the support points, mm.

W - width of the sample, mm.

H - height of the sample, mm.

For example, when the maximum load (P) is 3035.502 Newton, the distance between the supporting points (L) is 10 mm, the width of the sample (W) is 3.91 mm, the height of the sample is 2.96 mm. Then the formula will be calculated as follows:

$\sigma_{flx} = 3PL/2WH^2$

σ_{flx} =3 x 3035.502 x 10 / 2 x 3.91 x 2.96 =1329.112 Mpa.

Scanning Electron Microscope Research.

Scanning electron microscopy was used for visual analysis of the samples under study, which allows to study objects with the size of 1 micron and less. The study of specially treated samples was carried out at magnification 250-1000, using a microscope - Tescan VEGA II (Czech Republic).

Results.

Results of strength research of Y-TZP test samples by three-point deformation method:

As a result of the study it was revealed that sandblasting and sandblasting followed by regeneration firing affect the strength of Y-TZP samples.

In sandblasting, the average strength of the material was 1253.67 MPa and in sandblasting followed by regeneration firing, the average strength of the study object was 744.96 Mpa (Table 1).

It should be noted that the treatment of Y-TZP blocks with a diamond bur as compared to the control group (without mechanical treatment) did not reveal any significant difference and averaged 1061.12 MPa and 1062.67 MPa, respectively. Subsequent regeneration firing of blocks treated with a diamond bur revealed a decrease in strength with an average value of 951.47 MPa.

Statistical processing of the obtained results was carried out in TIBCO Statistica v13 2022 programme using ANOVA analysis of variance, which was used to compare the differences between the average values (Figure 1).

A comparison of the average values of the research results revealed the dynamics of the strength change of yttrium-stabilized metastable tetragonal zirconium dioxide: sandblasting increased the strength, and the subsequent regeneration firing caused a significant decrease in the strength.

Results of scanning electron microscope research.

The test samples were examined with a scanning electron microscope in order to identify possible visual changes caused by different types of impacts at the microscopic level. At this

Table 1. *Average values of all five testing samples.*

Sample Number	Sample Height H, mm	Sample Width W, mm	Distance between the support points L, mm	Traverse Speed V, mm/sec	Maximum Load, P, Newton	Bending Strength MPa
„SB“	2.90	3.88	10.00	0.5	2721.808	1253.674
„SBS“	2.91	3.90	10.00	0.5	1645.153	744.964
„D“	2.90	3.93	10.00	0.5	2337.8342	1061.122
„DS“	2.89	3.92	10.00	0.5	2078.702	951.466
„C“	2.91	3.92	10.00	0.5	2349.317	1062.678

point, the samples were magnified to varying degrees, but the results of the research with 1000x magnification were particularly informative (Figures 2-5).

The scanning electron microscope examination of samples: "C", "DS" and "D" revealed a similar homogeneous material structure.

The samples treated with sandblasting followed with regeneration firing turned out to be substantially different. Minor voids were detected in their crystal structure.

Discussion.

The present study showed that there is a difference between the final result of abrasive and thermal processing of zirconia.

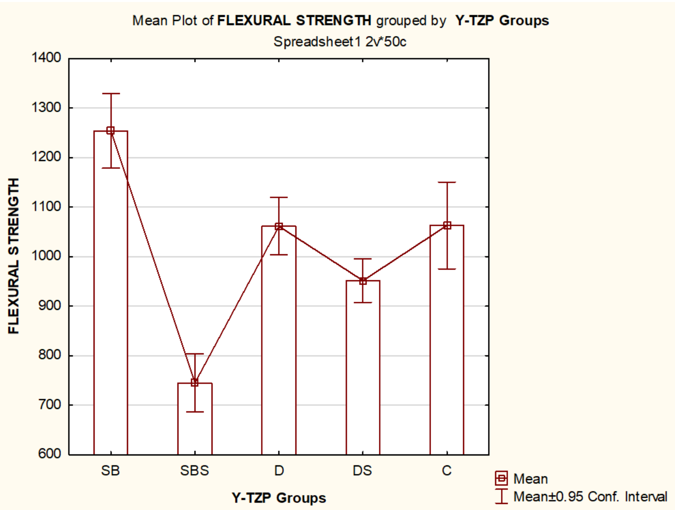

Figure 1. *Statistical processing of the obtained results was carried out in TIBCO Statistica v13 2022 programme using ANOVA analysis of variance, which was used to compare the differences between the average values.*

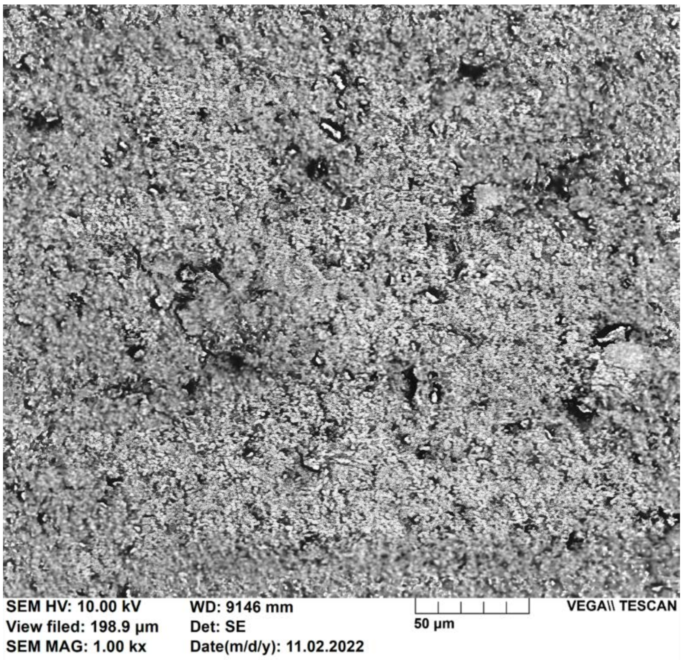

Figure 2. *Sandblasted sample with subsequent regeneration firing (sample from the group "SBS").*

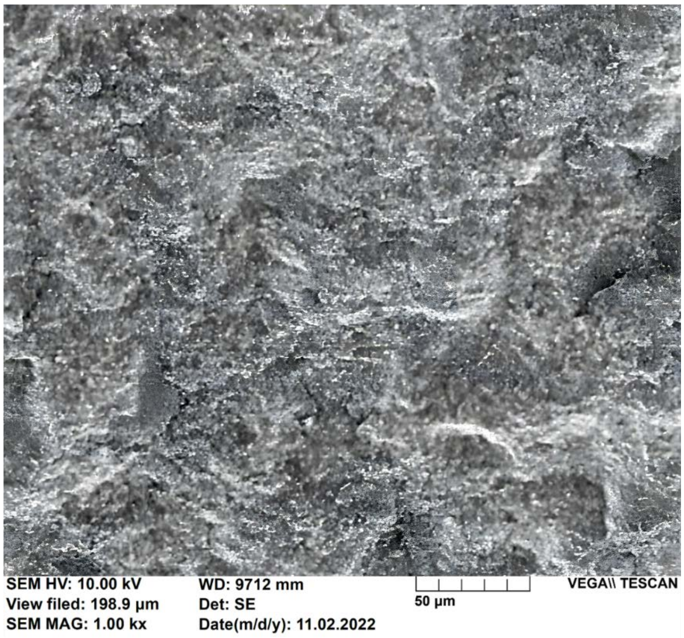

Figure 3. *Diamond burring treatment (sample from the group "D").*

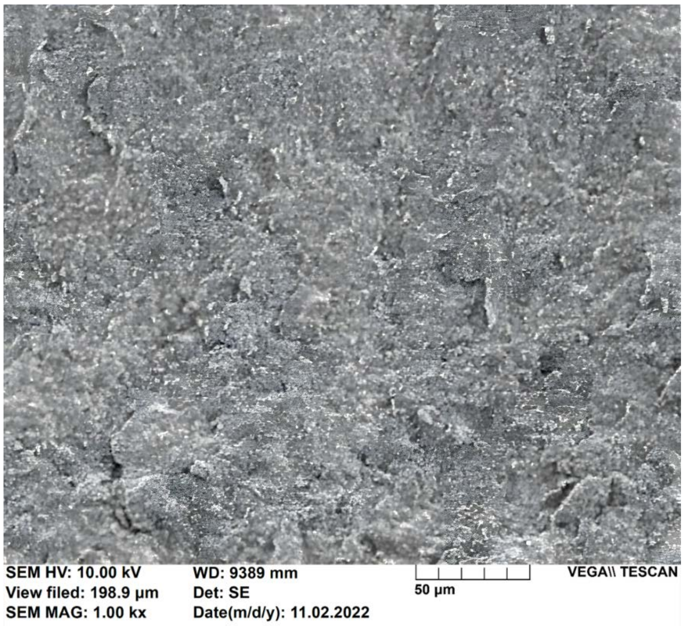

Figure 4. *Diamond burring, followed with regeneration firing (sample from the group "DS").*

The analysis of the results shows that mechanical sandblasting treatment influences the strength properties of zirconia dioxide samples. Thus, abrasive sandblasting treatment significantly increases the strength under bending of Y-TZP samples, while subsequent firing significantly reduces the strength of samples processed by sandblasting. The difference in values between samples of series D and C is not statistically significant; however, there is also a trend towards a decrease in bending strength after regenerative firing.

For visual analysis of experimental objects, the methodology of assessment using scanning electron microscopy at a magnification of 1000 times was employed. The study revealed

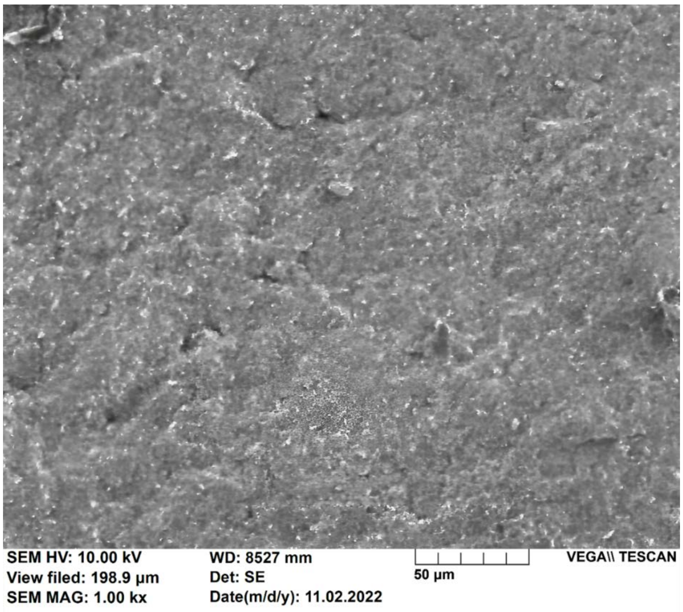

Figure 5. *Control group (sample from the group "C").*

a uniform dense structure of the material in all samples, except for the samples in the SBS series, where insignificant voids were present throughout the investigated material area. Presumably, the formation of these voids may be due to the sequential increase after mechanical processing, followed by a decrease in the volume of the material after firing due to phase transitions t→m and m→t.

Conclusion.

Post-abrasive regeneration firing of Y-TZP samples resulted in a significant decrease in the ultimate tensile strength of the material, which was confirmed by both the three-point deformation method and scanning electron microscope studies. Sandblasting of the test samples without subsequent regeneration firing increased the ultimate tensile strength of the material. The research results prompt us to question the necessity of what is commonly referred to as “regeneration firing”. While abrasive blasting, performed using the correct technique and materials, has no significant negative effect on the ultimate tensile strength of metastable tetragonal zirconia.

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Resume

Aim of study: One of the significant drawbacks of using zirconium dioxide as a framework for prosthodontic structures is its propensity for breakage. A detailed analysis of the technological process has uncovered divergent opinions and significant disparities in recommendations concerning the fabrication of zirconium dioxide prosthodontic constructs. Consequently, conducting an in-depth experimental study on this matter and implementing the resulting findings will significantly contribute to addressing the challenges of prosthodontic rehabilitation for patients utilizing zirconium dioxide.

Material and methods: To conduct the research, samples of synthesized ZrO_2, stabilized Y_2O_3 were prepared and divided into 5 groups. Each group includes 10 samples of metastable tetragonal zirconium dioxide. In order to conduct a "three-point" test for bending strength, all samples were tested, that is they were crushed, which was followed by macroscopic and microscopic investigations. In the next stage of the research, the samples were examined using a scanning electron microscope (magnification up to 1000x), which allowed visualisation of the structural changes caused by the different impacts. Experimental research was conducted in accordance with the ISO 6872:2008 (Dentistry-Ceramic materials) standard.

Results and conclusions: As a result of the study, it was revealed that sandblasting and sandblasting followed by regeneration firing affect the strength of Y-TZP samples. In sandblasting, the average strength of the material was 1253.67 MPa and in sandblasting followed by regeneration firing, the average strength of the study object was 744.96 MPa. The scanning electron microscope examination revealed that the samples treated with sandblasting followed by regeneration firing showed significant differences. Minor voids were detected in their crystal structure.

Post-abrasive regeneration firing of Y-TZP samples resulted in a significant decrease in the ultimate tensile strength of the material, which was confirmed by both the three-point deformation method and scanning electron microscope studies.

რეზიუმე

კვლევის მიზანი: ცირკონიუმის დიოქსიდის ერთ-ერთ გამოხატულ უარყოფით მხარეს წარმოადგენს აღნიშნული მასალის გატეხვა-დაზიანების შემთხვევები. ტექნოლოგიური პროცესის სიღრმისეულმა შესწავლამ გამოავლინა აზრთა სხვადასხვაობა და რეკომენდაციების მნიშვნელოვანი განსხვავებები ცირკონიუმის დიოქსიდისგან ორთოპედიული კონსტრუქციების დამზადების პროცესთან დაკავშირებით. შესაბამისად, საჭიროდ მიგვაჩნია აღნიშნული საკითხის სიღრმისეული ექსპერიმენტული კვლევა. მიღებული შედეგების იმპლამენტაცია მნიშვნელოვან წვლილს შეიტანს ცირკონიუმის დიოქსიდის გამოყენებით პაციენტთა ორთოპედიული რეაბილიტაციის გაუმჯობესებაში.

მასალები და მეთოდები: კვლევის ჩასატარებლად მოხდა სინთეზირებული ZrO_2–ის, სტაბილიზებული Y_2O_3–ის ნიმუშების გამზადება და მათი დაყოფა ჯგუფად. თითეულ ჯგუფზე განხორციელდა შესაბამისი მექანიკური და/ან თერმული ზემოქმედება, რის შემდეგ მოხდა ნიმუშების გამოცდა გამძლეობაზე სამწერტილოვანი მეთოდით, შემდგომი მაკრო და მიკროსკოპული კვლევით.

კვლევის შედეგები: Y-TZP ნიმუშების აბრაზიული დამუშავების შემდგომმა მარეგენერირებელმა გამოწვამ განაპირობა მასალის ზღვრული სიმტკიცის მნიშვნელოვანი შემცირება, რაც დადასტურდა როგორც სამწერტილოვანი დეფორმაციის მეთოდით, ისე მასკანერებელი ელექტრონული მიკროსკოპით განხორციელოებული კვლევებით. საცდელი ნიმუშების ქვიშაჭავლურმა დამუშავებამ, შედგომი მარეგენერირებელი გამოწვის ჩატარების გარეშე, კი მოახდინა მასალის ზღვრული სიმტკიცის გაზრდა. კვლევის შედეგებზე დაყრდნობით, შეგვიძლია ეჭქვეშ დავაყენოთ ე.წ. „მარეგენერირებელი" გამოწვის საჭიროება.

Резюме

Цель исследования: Одним из существенных недостатков использования диоксида циркония в качестве основы для протезно-ортопедических конструкций является его склонность к разрушению. Подробный анализ технологического процесса выявил расходящиеся мнения и существенные различия в рекомендациях относительно изготовления ортопедических конструкций из диоксида циркония. Следовательно, проведение глубокого экспериментального исследования по этому вопросу и реализация полученных результатов значительно способствует решению проблем протезно-ортопедической реабилитации для пациентов, использующих диоксид циркония.

Материалы и методы: Для проведения исследования были подготовлены образцы синтезированного ZrO_2, стабилизированного Y_2O_3, и разделены на 5 групп. Каждая группа включает в себя 10 образцов метастабильного тетрагонального диоксида циркония. Для проведения "трехточечного" испытания на изгибную прочность все образцы были испытаны, то есть разрушены, что последовало макроскопическим и микроскопическим исследованиям. На следующем этапе исследования образцы были исследованы с использованием сканирующего электронного микроскопа (увеличение до 1000x), что позволило визуализировать структурные изменения, вызванные различными воздействиями. Экспериментальные исследования проводились в соответствии со стандартом ISO 6872:2008 (Стоматология - Керамические материалы).

Результаты и выводы: В результате исследования было выявлено, что пескоструйная обработка и пескоструйная обработка с последующим регенерационным обжигом влияют на прочность образцов Y-TZP. При пескоструйной обработке средняя прочность материала составляла 1253.67 МПа, а при пескоструйной обработке с последующим регенерационным обжигом средняя прочность исследуемого объекта составляла 744.96 МПа. Сканирующее электронное микроскопическое исследование показало, что образцы, обработанные пескоструйной обработкой с последующим регенерационным обжигом, имели значительные различия. В их кристаллической структуре были обнаружены незначительные полости.

После абразивной регенерационной обработки образцов Y-TZP произошло значительное снижение предельной прочности материала, что было подтверждено как методом деформации на трех точках, так и сканирующим электронным микроскопическим исследованием.