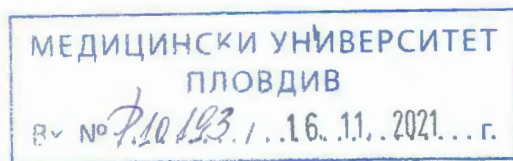


TO THE MEMBERS OF THE SCIENTIFIC JURY,  
APPOINTED BY ORDER OF THE RECTOR OF MU -  
PLOVDIV -R-2004 / 02.11.2021

ON THE BASIS OF PROTOCOL №8 /  
27.10.2021 FROM THE FACULTY COUNCIL OF FDM-PLOVDIV UNDER  
THE PROCEDURE FOR AWARDING THE EDUCATIONAL AND  
SCIENTIFIC DEGREE "DOCTOR"



**OPINION**

FROM

ASSOC. PROF. DR. IVETA PLAMENOVA KATREVA, D.M.

MEDICAL UNIVERSITY "PROF. Dr. P. Stoyanov"-VARNA, FACULTY OF  
DENTAL MEDICINE,

DEPARTMENT OF PROSTHETIC DENTISTRY CLINIC

OF DISSERTATION WORK FOR AWARDING AN EDUCATIONAL AND  
SCIENTIFIC DEGREE "DOCTOR"

in the scientific specialty "Orthopedic Dentistry"

Professional field: 7.2. Dentistry

Field of higher education: 7. Health and sports

**Author:**

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**Topic:**

**"Speciality in the application of fibrous composite splints made by  
CAD/CAM technology in the treatment of periodontally compromised  
teeth"**

**Academic supervisors:**

**Prof. Dr. Hristo Kisov, MD**

**Assoc. Prof. Dr. Elena Firkova, MD**

Dr. Yanko Dimitrov Zhekov was born on July 12, 1990 in the town of Kardzhali. He graduated from a language school 2009. In 2015 graduated from MU - Plovdiv with a degree in Dental Medicine. Since 2016 is a postgraduated in Prosthetic Dentistry at the FDM of MU-Plovdiv. In 2017 Dr. Zhekov is an assistant at the FDM - Plovdiv, Department of Prosthetic Dentistry. He is a member of the Bulgarian dental association and the Bulgarian Academy of Aesthetic Dentistry.

### **GENERAL ANALYSIS OF THE DISSERTATION**

The dissertation of Dr. Yanko Zhekov, PhD student in self-study at the Department of Prosthetic Dentistry, FDM, MU-Plovdiv, is written on 186 pages, illustrated with 54 tables, 72 color figures and contains 7 applications. The structure of the dissertation is in accordance with the requirements of the Regulations of MU-Plovdiv, including all the main elements of the generally accepted in our country structure for presenting a dissertation.

The literature review covers 38 pages, purpose and tasks - 1 page, materials and methods - 32 pages, results and discussion - 70 pages, recommendation<sup>to</sup> to dentists and dental technicians - 3 pages, 1 page - conclusion, 5 pages - conclusions, 2 pages - self-assessment of the contributions, 25 pages - bibliography, 5 pages - appendices and 2 pages - publications, The literature contains 229 literary sources, of which 68 in Cyrillic and 161 in Latin.

One of the clinical manifestations of periodontitis is the increased mobility of the teeth, which can be eliminated with the prophylactic-therapeutic method of splinting. This achieves blocking and connecting the teeth with a stable connection, redistribution of masticatory pressure and limitation of trauma from occlusion.

The active<sup>development</sup> development of dental materials at the end of the 20th century allowed the development of new methods for immobilizing teeth. Composite

splints reinforced with glass or polyethylene fibers are widely used in practice. They are durable, do not cause discomfort and meet the aesthetic requirements of patients, but create retention areas for the growth of microorganisms and impair oral hygiene, which in turn reduces the service life of the splint.

The introduction of CAD/CAM technologies in dentistry made it possible to obtain accurate and at the same time aesthetic designs, reproducing all planned parameters such as shape, thickness of the fixing layer, distance to the gum edge and the cutting edge of the tooth. Working with digital technologies minimizes the human factor influencing the accuracy of structures.

**The topic of this dissertation is extremely relevant** given the rapid development of CAD/CAM systems, intraoral scanning devices, the promotion of digital impressions in dentistry, as well as many unexplored issues related to the accuracy of milling, the choice of materials for making and fixing splints. The solution to many of these problems lies in the study of the physico-mechanical properties of structural materials, the study of polishability and the adhesive properties of fixing materials.

**The literature review** examines in detail and critically all the main aspects related to the development. The introduction to the scientific work points to the topicality and issues of the topic. Dr. Yanko Zhekov demonstrates a very good awareness and analytical approach in presenting scientific data from the studied sources. The review ends with a thorough analysis, which convincingly justifies the need for more in-depth research, as the hypotheses justify the aims and objectives of the dissertation.

**The aim and tasks** fully correspond to the topic and content of the dissertation. The aim is formulated as a logical conclusion from the analysis of the literature review. The tasks are precisely and clearly formulated and fully correspond to the set aim.

**Materials and methods.** The chosen methodology is comprehensive and is fully consistent with the implementation of the tasks. Methods have been selected that are objective and guarantee the reliability of the results obtained. They are systematized in a separate chapter and by tasks.

**Task 1,** 40 prototypes were made according to the international standard (ISO 29022) from each of the following 4 materials: fibrous composite (Trilor; Bioloren Srl; Italy), thermoplastic high-tech polymer based on PEEK (BioHPP; Bredent; Germar<sup>®</sup>), hybrid ceramics (Vita Enamic; VITA Zahnfabrik, Germany), ceramics based on zirconium dioxide (Ceramán; Dentstore SRL). Polypropylene transparent matrices for injection molding and polymerization of the second element of the study - cylindrical pin of composite cement (Panavia V5; Kuraray, Japan) were printed for the samples. The prototypes of each material are divided into 4 groups according to the method of their surface treatment. An assessment and comparison of their roughness parameters with an atomic force microscope was performed. The bond strength with universal testing machine was investigated.

**In the 2nd<sup>nd</sup> task** the possibilities for polishing and glazing of the materials from the previous task, intended for CAD/CAM technology, are investigated.

**Task 3**, own laboratory protocol for planning and production of innovative design of extracoronary splints by CAD/CAM technology has been developed and recommendations to the specialists in dental technology have been summarized. A digital impression with an intraoral TRIOS scanner (3Shape) is included. The design and parameters of the splints are created in Sirona InLab software, and subsequently they are made by the method of milling in the CAM-module.

**In 4th tas<sup>th</sup>** a clinical evaluation of extracoronary splints made of fibrous composite, made by CAD/CAM technology, was made. A clinical protocol for work and recommendations for the practice of dentists have been derived. 16

patients aged 55 to 65 years in good general condition with satisfactory oral hygiene and second degree mobility of the teeth were selected.

**The results** of all tasks are analytically described and well illustrated with many photos and figures in support of their reliability and objectivity. Appropriate statistical methods are used.

**In the first task**, the data are presented in detail in tables with multiple color topographic and three-dimensional images, which clearly depict the changes in roughness after the corresponding surface treatment of the samples. The comparative analysis of the results includes eloquent diagrams. The fibrous composite material demonstrates the largest change in bond strength after sandblasting - 203.26%. Although the BioHPP material represents the lowest values of strength bonds, they reach their maximum of 6.31 MPa also in sandblasting. The bond improvement in Vita Enamic reaches its highest value of 13.06 MPa after treatment with a diamond drill. ZrO<sub>2</sub>-based ceramics have a maximum bond strength of 13.88 MPa again after treatment with a diamond file, which is an increase of 157.51% (more than twice) over the untreated surface and is the highest mechanical strength for the studied materials.

**The results of the second task** were obtained after measuring the relief and surveying the surfaces of 12 samples made of the materials studied in the previous task, divided into 4 groups. The data are presented in 8 tables with attached topographic and three-dimensional images. Existing and well-known products are presented, as well as new concepts for optimal surface polishing. The results obtained from the surface roughness parameters for glazed surface can be considered better.

**On the third task**, the accumulated results indicate the ceramics of ZrO<sub>2</sub> as the material with the most difficult finishing and especially in fine forms. Trilor, BioHPP and Vita Enamic materials, on the other hand, have much better

handling properties due to the relatively simple operating protocol compared to ZrO<sub>2</sub> ceramics.

The results of the fourth task are systematized in tabular form using modified USPHS criteria of Ryge and Cvar for direct clinical evaluation of indirect splinting structures after cementation. They were followed on the 6th and 12th month postoperatively. Photographs are also presented chronologically. All splints in the study show excellent characteristics in terms of criteria - change in splint color, splint-tooth border staining, survival, success (Alpha score).

**The author's discussion** is correct and includes questions that have arisen in the course of his research. A comparative analysis was made between own results and data published by other researchers in the field.

**Conclusions.** The dissertation provides an opportunity to draw a number of conclusions on the problems. The conclusions are systematized by tasks and are a logical consequence of the detailed and critical discussion of our own clinical and laboratory results, collected when working with indirect splinting structures made by CAD/CAM technology.

## **Contributions**

### **Contributions of a confirmatory nature**

1. It has been established that there is no universal method for unraveling materials for CAD/CAM technology that will be adhesively cemented.
2. The roughing<sup>g</sup> of the Trilor and BioHPP materials showed the best results when treated with a sandblasting machine. Other rake methods can be used as an alternative to sandblasting.



3. The use of Er: YAG laser to create a retention surface can be used as an alternative to sandblasting in Trilor and Vita Enamic fibrous composite material.
4. The use of a diamond file for roughing gives the best results in ZrO<sub>2</sub> ceramics and Vita Enamic hybrid ceramics.
5. Chemical glazing of the materials used in the study shows better results compared to polishing except for ZrO<sub>2</sub> ceramics where similar results are observed.
6. It was found that from the materials used in the study for CAD/CAM technology it is possible to make extracoronary splints.
7. Clinical follow-up examinations at 6 months and 1 year show fibrous composite material as suitable for splinting periodontally damaged teeth.

#### **Contributions of scientific and applied nature**

1. For the first time, a load element of a universal testing machine is modified in order to conduct a connection strength test according to an international standard.
2. Prototypes have been developed which allow two-way testing of the bond strength.
3. For the first time a laboratory protocol for planning and manufacturing of extracoronary splints using CAD/CAM technology has been developed and recommended.
4. For the first time a clinical protocol for cementation of extracoronary splints made with CAD/CAM technology has been developed and recommended, based on laboratory results and tested in clinical conditions.
5. BioHPP was first used to make coronary splints.
6. For the first time, fibrous composite material for CAD/CAM technology is used to make extracoronary splints.

### **Publications and participations related to the dissertation**

The dissertation and the author's abstract present a list of 3 publications directly related to the topic. In all three articles Dr. Yanko Zhekov is the first co-author. They have been published in one national and two international scientific journals.

### **ABSTRACT**

The abstract consists of 68 pages and reflects all the main parts of the dissertation. Creates a clear and complete picture of the dissertation, methods, main results, conclusions and contributions. Contains suitable figures, diagrams, tables and photos.

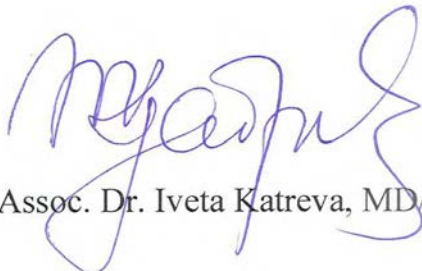
### **CONCLUSION**

The dissertation of Dr. Yanko Dimitrov Zhekov on "Specificity in the application of fibrous composite splints made by CAD/CAM technology in the treatment of periodontally compromised teeth" is a current scientific development, with a number of contributions of confirmatory and scientifically applied nature. The author demonstrates in-depth scientific knowledge in the field of prosthetic dentistry, qualities and opportunities to conduct independent research.

**I give my overall positive assessment of the dissertation and I will vote confidently with "Yes" for the award of the educational and scientific degree "Doctor" to Dr. Yanko Dimitrov Zhekov.**

15.10.2021

Varna



/ Assoc. Dr. Iveta Katreva, MD/