

To the Chairman of the Scientific Jury,  
determined by Order № P-2004 / 02.11.2021  
of the Rector of the Medical University – Plovdiv

Attached I present: **Opinion**

on the procedure for acquiring **educational and scientific degree "Doctor"**  
with candidate **Dr. Yanko Dimitrov Zhekov** on the topic: **Speciality in the  
application of fibrous composite splints made by CAD / CAM technology in  
the treatment of periodontally compromised teeth**

Prepared the opinion: **Prof. Dr. Yavor Stefanov Kalachev, Ph.D.**

Scientific specialties: **General and Prosthetic Dentistry**

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## OPINION

from

**Prof. Dr. Yavor Stefanov Kalachev, MD, Department of Prosthetic Dentistry, Faculty of Dental Medicine, Medical University – Plovdiv**

on dissertation for awarding **educational and scientific degree "Doctor"**

Doctor's program: Prosthetic dentistry

**Author: Dr. Yanko Dimitrov Zhekov**

**Form of doctoral studies:** independent preparation

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

### **Brief biographical data about the doctoral student:**

Dr. Yanko Dimitrov Zhekov was born on July 12, 1990 in the town of Kardzhali.

In 2015 he graduated from MU - Plovdiv with a degree in Dental Medicine. Regular member of BDA.

In 2017, after passing a competitive exam, he started working as an assistant in the Department of Prosthetic Dentistry, FDM, MU - Plovdiv.

The dissertation presented to me for review contains 186 standard typewritten pages with a bibliography of 229 authors, of which 68 in Cyrillic and 161 in Latin, and 2 appendices. The dissertation is well structured, which made it easier for me to prepare the review.

**The Introduction** points out the fact that currently CAD/CAM technologies are widely used in dentistry, which allows to obtain accurate parameters: shape, thickness of the fixing layer, distance to the edge of the gum and the cutting edge of the tooth, etc. The use of CAD/CAM technology minimizes the human factor influencing the accuracy of structures. The above facts determine their possibility for application in the manufacture of splints in the treatment of pathological mobility of the teeth and determine the relevance of the dissertation.

**The literature review** addresses in detail issues related to: development of splinting from antiquity to the present day; modern technologies and materials used for immobilization of teeth with pathological mobility; materials for CAD/CAM technology used for the manufacture of extracoronary splints, etc.

The above facts give grounds for the doctoral student to formulate:

**The aim** of the dissertation: to study the advantages of fibrous composites for the production of splinting structures by CAD/CAM technology.

**The materials and methods** of the research are correctly selected, the use of a sufficient number of modern statistical methods for processing the obtained data guarantees the receipt of reliable and objective results.

In order to fulfill the set aim, 4 tasks have been formulated and completed. The most important results obtained for the individual tasks are:

**First task:** Investigation of the bond strength between materials designed for CAD/CAM technology and adhesive cement in different surface treatments.

From the tested samples, representing four materials, subjected to treatment with diamond drill, sandblasting and laser treatment, a different behavior was observed for each sample compared to the control group.

The same roughness was observed after treatment with a diamond file and sandblasting for the Trilor sample, while in the other samples, the treatment with a diamond file resulted in smoother surfaces. The largest difference in roughness after these two treatments was observed in BioHPP, where after sandblasting, the sample was three times rougher than the treatment with a diamond file. In general, after both types of treatments, the Trilor material shows the highest roughness, while the ZrO<sub>2</sub> ceramic looks the smoothest.

When comparing the four materials after the last type of processing, the largest difference between types of materials is observed. For the Trilor sample,

the laser treatment resulted in twice the roughness, and the Vita Enamic showed surface smoothing. In the other two samples, comparable values of the surface were observed when comparing the control with the laser treatment. The images show that there is no significant change after laser treatment.

The treatment affects the bond strength by improving it. The nature of the destruction, the roughness, the possibility of sticking between the pin and the base must be taken into account, ie. creating good adhesion between the two materials. This is clearly seen in the control group without treatment with Vita Enamic material. In addition, the positive effect of the additional processing is evident in all materials. The highest bond strength (13.88 MPa) is observed in ZrO<sub>2</sub> ceramics treated with diamond file, and the largest increase in the bond strength to the untreated surface is found in BioHPP material after sandblasting - over twelve times despite its lower values compared to the other materials.

In the case of **fibrous composite material** after laser treatment, the bond strength is 142.66% (1.4 times) higher than that without treatment. When treated with a diamond file, the improvement in bond strength is weaker - about 26.9% higher than the untreated surface. The largest change in bond strength occurs during sandblasting - 203.26%, ie. more than twice.

In the case of **BioHPP** material, the bond strengths have the lowest values, but there is still an improvement in the bond strength relative to the untreated control surface. After laser treatment, the bond strength increased by 123.53% (twice), and during treatment with diamond file 470.59% (five times). The highest change in the bond strength occurs during sandblasting - 6.31 MPa, which value exceeds by 1137.25% (twelve times) the value of the untreated surface.

The improvement of the connection in **Vita Enamic** after laser treatment is 33.81%. Sample treated with diamond file, the bond strength reaches the highest value of 13.06 MPa for Vita Enamic, which is 57.16% higher than the untreated surface. The change in sandblasting is weaker - about 7.67%. Despite the high values of the bond strength with pre-treatment compared to without treatment, it does not exceed 60%.

**ZrO<sub>2</sub>** ceramics have a good mechanical bond without pretreatment (5.39 MPa) and also improve after pretreatment. After laser treatment the bond strength increases by 47.57% compared to that without treatment, when treated with diamond file it reaches its maximum value of 13.88 MPa, which is an

increase of 157.51% (more than twice) and is the highest bond strength for the material . There is an increase in the bond strength in the case of sandblasting by 45.27% compared to the untreated control sample, which increase is lower by 2.3% and close to that of the laser treatment.

**Second task:** Application of an atomic force microscope in the study of the possibilities for polishing and glazing of materials intended for CAD/CAM technology.

From the tested samples, representing four materials subjected to polishing, glazing and nanophilic coating, a different behavior was observed for each sample:

In the case of nanophilic coating, flattening of the surface was observed due to the application of an additional layer on the polished surface. Thus, compared to the parameter Sa, for Trilor the value is more than three orders of magnitude higher after polishing, compared to the glazed sample of the same material. This trend is maintained for all other samples, with the exception of ZrO<sub>2</sub> ceramics, where no significant differences are observed.

In the three-dimensional images, almost mirror surfaces are observed in the glazing and coating of all samples, while in the polishing significant differences are observed.

In the Trilor specimen, a completely rugged surface was observed, while in the Vita Enamic and BioHPP laminar topographies (ie parallel elongated stripes of protrusions and depressions) were observed.

In the case of a sample of ZrO<sub>2</sub> ceramics, the smoothest surface after polishing is observed. Comparison of the Sa values of the roughness parameter for Trilor and ZrO<sub>2</sub> ceramics shows that polishing leads to differences from 0.28 μm for Trilor to 0.01 μm for ZrO<sub>2</sub> ceramics. After glazing, all samples show relatively identical values.

**Third task:** Proposing our own laboratory protocol for planning and production of innovative design of extracoronary splints using CAD/CAM technology and making recommendations to dental technicians.

The splints are characterized by high accuracy of fitting to tooth tissues. Their design creates conditions for maintaining hygiene and they are produced with a minimum number of stages compared to traditional methods. CAD/CAM technology thus allows for accurate reproduction of all planned parameters of

the future splint: thickness, shape, distance to the marginal edge of the gum and the cutting edge of the tooth, thus minimizing the human factor, which negatively affects accuracy of construction. The manufacturing technology in the study allows the use of materials that could not be used in traditional clinical methods.

**Fourth task:** Clinical evaluation of fibrous composite extracoronary splints made, made by CAD/CAM technology and derivation of a clinical protocol and recommendations for the practice of D.

- eliminates the need for a conventional impression and all the resulting problems: the possibility of infection, errors from plastic and volumetric changes in the impression material, displacement of the teeth when taking an impression, etc .;

- shortened clinical and technological time is observed for the patient and for the clinician;

- facilitates the process of communication between doctor and patient;

- facilitates the process of digital modeling, etc.

The important **contributions** of the dissertation can be grouped as:

#### **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 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.

### **Assessment of publication activity**

With reference to the dissertation, Dr. Yanko Zhekov presents 3 publications and 3 participations in scientific forums. This fact proves that the topic developed in the dissertation is his personal work.

**The abstract** objectively reflects the dissertation. It is made according to the requirements of the law for development of the academic staff.

I have no critical remarks on the dissertation given to me for review.

### **Conclusion:**

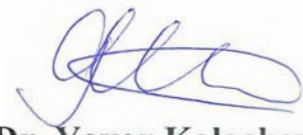
The dissertation of Dr. Yanko Dimitrov Zhekov is an in-depth study of the application of fibrous composite splints made by CAD/CAM technology in the treatment of periodontally compromised teeth.

The obtained results are valuable for clinical practice and can serve as a basis for future research, and the treatment approach as a method of choice for prosthetic treatment.

**I confidently** giving my positive vote for awarding the educational and scientific degree "Doctor" to Dr. Yanko Dimitrov Zhekov

Plovdiv

07.11.2021

A handwritten signature in blue ink, appearing to be 'Yavor Kalachev', written in a cursive style.

**(Prof. Dr. Yavor Kalachev, MD)**