

**TO THE MEMBERS OF THE SCIENTIFIC JURY,**

APPOINTED BY THE RECTOR OF  
MU-VARNA WITH ORDER  
№ P-109-599/ 23.12.2020 AND  
BASED ON PROTOCOLE  
№32/17.12.2020 FROM THE FACULTY COUNCIL  
OF FACULTY OF DENTAL MEDICINE-VARNA,  
CONCERNING CONFERMENT OF EDUCATIONAL  
AND SCIENTIFIC DEGREE “DOCTOR OF  
PHILOSOPHY”

**STATEMENT**

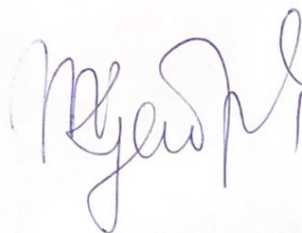
BY

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Regarding a dissertation entitled: **“3D Printed Prototypes of Cast Metal Denture Frameworks Fabricated by Laser Stereolithography Printer”** for conferment of the educational and scientific degree “Doctor of Philosophy” (PhD) to **Dr. Preslav Plamenov Penchev**, PhD student at the Department of Dental Materials Science and Propaedeutics of Prosthetic Dental Medicine, FDM- Varna, Medical University “Prof. D-r Paraskev Stoyanov” – Varna

**Scientific Supervisor: Assoc. Prof. Stoyan Georgiev Katsarov, DMD, PhD**

Dr. Preslav Penchev was born in 1991 in Ruse, Bulgaria. He graduated Medical University “Prof. D-r Paraskev Stoyanov” – Varna in 2016 and the same year was appointed as an Assistant Professor at the Department of Prosthetic Dental Medicine. Has been working as an Assistant Professor at the Department of Dental Materials Science and Propaedeutics of Prosthetic Dental Medicine since its establishment in 2018. Dr. Preslav Penchev has been a student in the PhD training program of the Medical University of Varna since 2019. As an Assistant Professor he conducts practical training of students on Prosthetic Dental Medicine in Bulgarian and English.



## STRUCTURE AND EVALUATION OF THE DISSERTATION

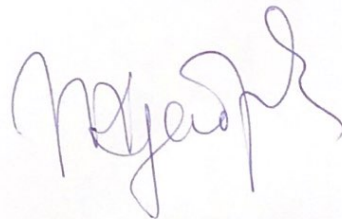
The dissertation is well-structured in 160 pages, 18 of which are appendices. The distribution of the individual parts of the dissertation is as follows: introduction – 3 pages, literature review - 37 pages, aim and tasks – 26 pages, results and discussion – 50 pages, conclusion and contributions – 5 pages, bibliography – 15 pages and appendices – 18 pages. It is illustrated with 78 color figures and 2 tables. The structure of the dissertation is matching the regulation of Medical University – Varna as it contains all of the mandatory parts according to the accepted standards.

The conventional casting process is considered to be an inaccurate and time-consuming method for denture framework fabrication. Thus, it is optimized by the CAD/CAM technology adoption during the past few decades. As a result, the manual labor and highly skilled work are reduced. The additive manufacturing technologies have become commonly used in dental laboratory practice during the past few years. They have all the advantages of the digital technologies as well as allow fabrication of objects with intricate structure and high accuracy. **The topic of the dissertation is relevant**, because of the increasing application of the additive technologies in dental laboratory practice and also the available issues according to their use.

In the introduction, the author emphasizes on the additive manufacturing opportunities for fabrication of cast metal dentures and especially the main features of the stereolithography. All of the various theoretical aspects of the thesis are presented in the **literature review**, as the author demonstrates his extensive knowledge of the presented topic. The analysis of the review formulates the aim of the dissertation.

**The aim and the tasks** fully correspond to the topic and the content of the dissertation. The aim is a logical consequence of the precise analysis of the literature review. The tasks are well formulated and allow a detailed presentation and discussion of the study aim.

**Materials and methods.** The methods are appropriately selected to provide objective and reliable results. They are presented in a way to guarantee the experiments reproducibility.



For the first task of the study a comparative study is made, which examines the temperature related physical changes of different materials used for denture pattern fabrication. For the purpose of the study the main features of a stereolithography resin are compared to the characteristics of different materials which are well-known and commonly used in practice.

For the purpose of the study of the second task statistical methods are used for evaluation of the discrepancies that appear to specimens with various characteristics, which are made of two different types of resins for 3D printing.

For the purpose of the third task the effect caused by objects made of different stereolithography resins to their investing mold during the burnout process is observed. For the purpose of the study of the 2-nd and the 3-rd task the specimens of each group are 3D printed together, which provides identical production conditions for each group and guarantees the results reliability. Each group of observed molds are heated together, which also allows a reliable result to be achieved.

The fourth task presents two innovative approaches which incorporate extensively the digital technologies into the conventional casting process. The observed methods are presented in detail, which allows their easy reproduction.

The achieved **results** are presented comprehensively and are well analyzed. They are also supported by photos, figures and tables.

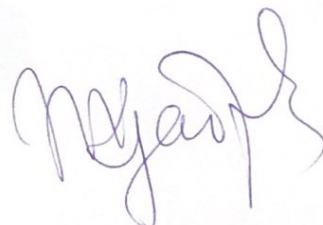
The **discussion** of the results is performed correctly, as it reveals all of the newly discovered issues and compare the achieved results to those gained from other authors.

The **conclusions** are formulated optimally. There are 9 main conclusions presented concerning the application of the observed stereolithography resins in the casting process. As a result of the collected data, two new approaches to the casting process are also suggested.

## CONTRIBUTIONS

### Contributions of scientific and applied nature:

- **Contributions of original nature:**



1. The temperature related physical changes of different materials (Pattern Resin I<sub>2</sub>S™, C-cast, CAD/CAM wax, Castable Resin®), used for fabrication of patterns for casting from dental alloys, are examined.
2. The better accuracy of SLP 3D printing process is proved, when Castable Wax® is used instead of Castable Resin®.
3. It is proven that the post-curing process of Castable Resin® objects is not mandatory or even useful, because it may cause an object deformation.
4. The role of object's weight (for those made of Castable Resin® or Castable Wax®) to the generated forces against the mold wall during the process of thermal elimination is examined. Thus, a modification of objects structure as hollow with vents is suggested.
5. It is proven that the object of Castable Wax® and Castable Resin® can be invested by using different than the prescribed investment materials, as Sherbondina® Rapid for instance.

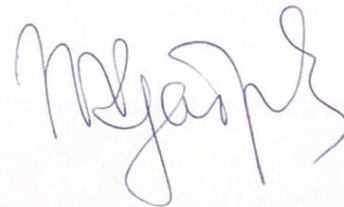
**- Contributions of a confirmatory nature:**

1. It is confirmed that the material Castable Resin® is suitable for denture pattern fabrication, when the production accuracy and the amount of ash content are examined. It is also suggested a proper temperature rate and investment material to its use.
2. It is confirmed that Castable Wax® and Castable Resin® allow 3D printing of objects with great accuracy. The recorded deviations are around 25,27 µm. for Castable Resin® and 13,87 µm. for Castable Wax®.
3. The role of direction of 3D printing process to the production accuracy is confirmed.

**Contributions of applied nature:**

**- Contributions of original nature:**

1. A method for digital planning and 3D printing of a sprue system, made in accordance to the parameters of prefabricated casting ring and casting cone, is suggested.
2. It is developed a new method for digital planning of a sprue system, casting ring and casting cone and further 3D printing as a single object.



## PUBLICATIONS RELATED TO THE TOPIC

Three publications in English are presented. Two of them are published in foreign journals and one in Bulgarian. Dr. Penchev is a single author of one of them, and a co-author of the rest.

The dissertation of Dr. Preslav Penchev, entitled: **“3D Printed Prototypes of Cast Metal Denture Frameworks Fabricated by Laser Stereolithography Printer”**, is a scientific study with a number of contributions with original and applied nature. The author demonstrates an extensive knowledge in the field of Prosthetic Dental Medicine as well as the necessary qualities and ability to conduct independent scientific researches.

## CONCLUSION

The dissertation of Dr. Preslav Penchev, entitled: **“3D Printed Prototypes of Cast Metal Denture Frameworks Fabricated by Laser Stereolithography Printer”**, is a scientific study with a number of contributions with original and applied nature. The author demonstrates an extensive knowledge in the field of the Prosthetic Dental Medicine as well as the necessary qualities and ability to conduct independent scientific researches.

**I give my overall positive assessment of the dissertation and I will vote confidently with “YES” for the conferment of educational and scientific degree “Doctor of Philosophy” to Dr. Preslav Plamenov Penchev.**

22.01.2021

Varna, Bulgaria

Reviewer:  .....

/Assoc. Prof. Iveta Katreva, DMD, PhD/