

## REVIEW

by

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**of dissertation work on topic**

**„Adhesion of Dental Ceramic to Ti6Al4V Alloy, Fabricated by CAD/CAM Technologies”**

for awarding of the educational and scientific degree "Doctor" (PhD) in the doctoral program "Prosthetic Dentistry" in the higher education area 7. Health and Sports, professional field 7.2 Dental Medicine

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Form of doctoral studies: full-time

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### **General presentation of the procedure and the PhD student**

The submitted electronically materials are in accordance with the requirements of the Law on the Development of the Academic Staff in the Republic of Bulgaria (LDASRB), the Rules for the Implementation of the LDASRB and the Rules for the Terms and Procedures for Acquiring Scientific Degrees and Holding Academic Positions at the MU - Varna and includes: Order No. P-109-35/31.01.2020 for full-time enrollment in the doctoral program "Orthopedic Dentistry" in the Department "Clinic of Prosthetic Dentistry", FDM – Varna, with scientific supervisors Prof. Eng. Tsanka Dikova, DSc, and Associate Professor Iveta Katreva, PhD, DDM; transcript-excerpt from protocol No. 12/27.01.2023 from the meeting of the DC with a positive decision on readiness for defense; order No. R-109-137/23.02.2023 for deduction with right of defense within one year; European format CV with the PhD candidate's signature; protocol of an exam held in the specialty; a list of publications and participation in scientific forums related to

the dissertation, signed by the doctoral student; a copy of a diploma for the "master's" degree; dissertation and printed abstract.

Yavor Vasilev Gagov, DDM, was born on March 11, 1982. From 2001 to 2004, he studied dental technician specialty at the Varna Medical College. From 2014 until now, he has been an assistant in the departments of "Clinic of Prosthetic Dentistry" and "Dental Materials Science and Prosthetic Dentistry", FDM, MU-Varna. He conducts practical classes on "Propaedeutics of Prosthetic Dentistry" and "Clinic of Prosthetic Dentistry".

### **Characteristics of the structure of the dissertation work**

The dissertation work of Yavor Gagov is structured correctly and has the necessary main sections of a dissertation, required by the Regulations for the conditions and procedure for acquiring scientific degrees and holding academic positions at the MU - Varna.

The dissertation contains 152 standard pages distributed as follows: table of contents 2 pages, abbreviations used 1 page, introduction 2 pages, literature review 37 pages, aim and objectives 1 page, material and methods 17 pages, results and discussion 73 pp., conclusions 2 pp., general conclusions and directions for future work 3 pp., contributions - 2 pp., publications and participation in scientific forums - 1 pp. and bibliography 9 pp. The dissertation work is illustrated with 15 tables and 63 figures. The bibliography consists of 185 references, 28 of which are in Cyrillic and 157 are in Latin.

### **Actuality of the topic**

In the last decade of the 20th century, two trends were clearly outlined in the prosthetic dentistry - the development of materials and technologies for the production of all-ceramic constructions, and the development and improvement of materials and technologies for the production of metal-ceramic constructions.

Regardless of the introduction and repeated improvements of polycrystalline constructions made of zirconium dioxide ceramics, their application in multi-unit constructions is limited to the construction of two-unit bridge bodies, and in the presence of connectors suitable in terms of area and design. These circumstances prove that metal-ceramic constructions are the universal means for the prosthetic restoration of various sized defects of the tooth arches.

The problems with allergies and corrosion resistance of metal-ceramic constructions are solved to a large extent with the introduction and improvement of titanium and titanium alloys for the fabrication of metal infrastructures. On the other hand, with the introduction of CAD/CAM technologies in the production of metal frameworks, the accuracy of complex constructions is improved, as the problems that are created during their casting are avoided.

These circumstances allow me to state that the topic chosen by the PhD student and his academic supervisors is relevant.

### **Knowing the problem - a literature review**

The literature review deals with improvements in the field of metal-ceramic constructions. The review is focused on the possibilities that titanium and titanium alloys provide for clinical practice. The problems with the wide usage of titanium began to be solved with the first successful casting of a titanium crown 50 years ago. Unfortunately, conventional casting is impossible with traditional equipment and refractory materials due to the extreme chemical activity of titanium.

The PhD student has indicated the new directions for solving this old problem. The detailed discussion of the issues that the two directions for the processing of titanium and its alloys pose to the practice and the reasons for preferring one of the two options is a logical preparation for the formulation of the goal and the tasks to be solved.

The overview would have won if it had not addressed the propaedeutic statements about the types of crowns, but had been directed from the very beginning to the problems of dental metal ceramics.

### **Aim and tasks**

The aim of the dissertation is to evaluate the adhesion of dental ceramics to Ti6Al4V alloy fabricated by two CAD/CAM technologies.

To solve this theoretically and practically important goal, four interrelated tasks have been formulated. They are aimed at investigating the properties of the Ti6Al4V alloy produced by two CAD/CAM technologies and the changes determined by the selected manufacturing method. This reflects and makes it necessary to establish the influence of the production method on the adhesion strength of ceramics to Ti6Al4V alloy, which is solved with the second and third tasks. The development of a laboratory protocol for the fabrication of Ti6Al4V metal-ceramics produced by the investigated CAD/CAM technologies is of great practical value.

### **Investigation methodic**

The aim and tasks of the dissertation work are solved with precise experimental methods, which are well selected and allow an objective assessment of the research results. This can be linked to the rich experimental experience of the scientific supervisor Prof. Ts. Dikova and shows that the dissertation student knows how to work in a team in the way he prepared the

samples and tested them. The research material is well selected and sufficient in volume to obtain results that allow the formulation of reliable conclusions.

### **Characterization and evaluation of the dissertation work**

The dissertation work was carried out personally by Dr. Yavor Gagov under the guidance of his scientific supervisors. The results after conducting the experimental methods are convincing and can motivate the behavior of dental technicians and dentists when using Ti6Al4V alloy in their practical activities.

The results of the first task objectively prove that the fabricating method of the Ti6Al4V alloy - milling or by Selective Laser Melting (SLM) affects the properties of the obtained samples. The differences in the surface texture of the samples and their density are interesting. It is logical that the laser-built plates show a lower density –  $3.85 \text{ g/cm}^3$ , which as a relative density is 87.45%-86.85% respectively. The opinion of the PhD student when discussing the results of the first task "Therefore, the production method defining a specific microstructure of Ti6Al4V alloy leads to differences in the values of microhardness and modulus of elasticity of the milled and SLM fabricated samples" is experimentally supported.

The results of the second and third task regarding the adhesion between the Ti6Al4V samples - obtained by milling or by Selective Laser Melting are very interesting and can explain the differences in the results with the surface texture at the interface. In addition, here, as a merit of the dissertation work, one can point out the many combinations of various factors affecting adhesion. The parallel in the interpretation of the results obtained by the standard method and the finite element method is also interesting.

The laboratory protocols for manufacturing metal-ceramic constructions from Ti6Al4V by milling and SLM, built on the basis of the experimental studies, are a contribution from a practical point of view.

### **Conclusions and recommendations**

Each of the tasks finishes with conclusions, which are a consequence of the analysis of the obtained results. The dissertation ends with a short conclusion summarizing the established regularities and conclusions.

### **Contributions**

Dr. Yavor Gagov formulates his contributions as scientific-applied and applied. Of the scientific-applied ones, 7 contributions are original nature and 1 is confirmatory. The

contributions have theoretical and practical value for the colleagues-practitioners and will allow for the enrichment of clinical practice in the field of fixed prosthodontics.

### **Assessment of dissertation publications**

In connection with the developed dissertation work, Dr. Gagov has presented 3 publications and 3 participations in scientific forums, all in English. Their number is sufficient and meets the requirements of the Regulations for the terms and conditions for acquiring scientific degrees and holding academic positions at the MU - Varna.

### **Abstract**

The abstract of the dissertation is in accordance with the requirements adopted by the MU - Varna.

The purpose, tasks, material, research methods and obtained results are presented on 48 pages, illustrated with tables and colored figures. The conclusions, contributions, publications and participation in scientific events related to the dissertation are also included.

### **CONCLUSION**

Dr. Yavor Vasilev Gagov has presented an up-to-date dissertation with original applied results. Based on extensive experimental material, it presents interesting results and reaches conclusions that are useful for the practice and theory of prosthetic dentistry.

In accordance with the criteria for the acquisition of the educational and scientific degree "Doctor", specified in the Law on the Development of the Academic Staff in the Republic of Bulgaria, the Regulations for its Application and the Regulations of the Medical University of Varna, I give a positive assessment to the dissertation work "Adhesion of dental ceramic to Ti6Al4V alloy, fabricated by CAD/CAM technologies" and I will vote for Dr. Yavor Vasilev Gagov to be awarded the educational and scientific degree "Doctor" in scientific specialty "Orthopedic dentistry"

Sofia  
21. 03. 2023

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