

Review Report

by

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Department of Dental Material Science and Prosthetic Dental Medicine,

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prepared in accordance with Order No. P-109-137/23.02.2023 of the Rector of the Medical University – Varna and Protocol No. 1/27.02.2021 of the Scientific Panel

on a dissertation report entitled

“Adhesion of Dental Porcelain to Ti6Al4V Alloy Produced by CAD/CAM Technologies”

with author Yavor Gagov, DMD, for the awarding of a Doctoral Degree in the Prosthetic Dental Medicine Doctoral Program in the field of higher education 7. Health and Sports, professional direction 7.2 Dental Medicine, full-time doctoral studies, Department of Dental Material Science and Prosthetic Dental Medicine, Faculty of Dental Medicine, Medical University – Varna

Dissertation advisors:

Prof. Eng. Tsanka Dikova, PhD, Dcs

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

General Presentation of the Procedure and the PhD Candidate

The materials submitted by the PhD candidate are in accordance with the requirements of the Law on the Development of the Academic Staff of the Republic of Bulgaria, the Implementing Regulations of the Law on the Development of the Academic Staff of the Republic of Bulgaria and the Regulations on the Conditions and Procedures for the Acquisition of Scientific Degrees and Academic Positions at the Medical University - Varna, and include:

1. Order No. P-109-35/31.01.2020 r. for enrolment in a full-time Orthopedic Dentistry Doctoral Program in the Department of Clinic of Prosthetic Dental Medicine, Faculty of Dental Medicine – Varna with dissertation advisors Prof. Eng. Tsanka Dikova, PhD, Dcs, and Assoc. Prof. Dr. Ivet Katreva, DMD, PhD;
2. Extract from Protocol No. 12/27.01.2023 of the Academic Board meeting with a positive decision on readiness for defense;
3. Order No. P-109- 137/23.02.2023 on expulsion with the right to defense within one year;
4. European format CV signed by the PhD candidate;
5. Protocol of examination in the specialty;
6. List of publications and participations in scientific forums related to the dissertation, signed by the PhD candidate;
7. Copy of Master’s Degree Diploma;
8. Dissertation and printed abstract.

Yavor Vasilev Gagov, DMD was born on 11.03.1982. He graduated in 2004 in Dental Technology from the Medical College – Varna, and from the Faculty of Dental Medicine, Medical University – Plovdiv in 2010. From 2014 until now he has been an assistant professor at the Faculty of Dental Medicine, Medical University of Varna, Departments of Clinic of Prosthetic Dentistry and Dental Materials Science and Prosthetic Dentistry. He holds seminars in Prosthodontics of Prosthetic Dentistry and Clinic of Prosthodontics.

Characteristics of the Dissertation Structure

The dissertation of Gagov, DMD is structured correctly and has the necessary basic sections of a dissertation required by the Regulations of Medical University – Varna for the structure of a dissertation, namely: table of content, abbreviations used, introduction, literature review, aim and objectives, material and methods, results and discussion, conclusions, general conclusions and guidelines for future work, contributions, publications, participation in scientific forums and bibliography. The dissertation is developed in 152 standard pages, and is illustrated with 63 figures and 15 tables. The bibliography consists of 185 sources, 28 of which are in Cyrillic and 157 are in Latin.

Topical Relevance

Porcelain-fused-to-metal crowns and bridges are the primary fixed prostheses in everyday clinical practice. A wide range of precious and non-precious alloys are used for their fabrication. Cobalt-chromium dental alloys have so far been the most widely used due to their high mechanical properties, high corrosion resistance and biocompatibility, ease of production by casting, high durability and relatively low cost. In prosthetic dentistry, much attention has recently been paid to pure titanium and its alloys for the production of PFM infrastructures. Modern CAD/CAM milling technologies and selective laser melting are a good alternative for the production of dentures from titanium and its alloys. They provide higher precision and guaranteed or even higher mechanical properties of the parts compared to conventionally cast ones. Each of these technologies determines a specific surface morphology and roughness, which may influence the adhesion strength of the porcelain to the titanium infrastructure. Since adhesive strength is essential for the durability of a porcelain-fused-to-metal fixed prostheses, various methods are used to increase it. The influence of different surface treatments on the adhesion of porcelain to titanium and its alloys made by milling is still unclear. Therefore, I believe that the topic chosen by the PhD candidate and his supervisors is relevant and suitable for a dissertation.

Knowledge of the Problem - Literature Review

The literature review focuses on various issues in the relationship of porcelain and the denture base of PFM prostheses. The review also examines the opportunities that titanium alloys provide to prosthetic dentistry.

Unfortunately, one of the disadvantages of titanium is its high melting temperature and reactivity, which make it difficult to produce parts by casting. The PhD candidate has pointed out new directions to solve this old problem emphasizing modern CAD/CAM milling technologies as a major alternative for the fabrication of dentures from titanium and its alloys.

Aim and Objectives

The aim of this dissertation is to evaluate the adhesion of dental porcelain to Ti6Al4V alloy processed by CAD/CAM technologies.

To address this objective, four tasks are formulated. These are aimed at investigating the properties of Ti6Al4V alloy processed by two CAD/CAM technologies and the changes that occurred, from the chosen processing method, to establishing the influence of the processing on the adhesion strength of the porcelain to Ti6Al4V alloy.

Methodology of the Study

The tasks of the dissertation are solved with well-chosen experimental methodologies that allow adequate statistical processing leading to an objective assessment of the research results. The PhD candidate demonstrates the ability to work in a team, given the interdisciplinary nature of the doctoral studies. The experimental part is precise with sufficient quantitative evidence.

Characteristics and Evaluation of the Dissertation

The dissertation is the personal work of Yavor Gagov, DMD completed in time under the supervision of his supervisors. The results and conclusions have significant scientific and applied value. The protocol for working with the Ti6Al4V alloy by milling is actually applicable to dental practice.

Particular attention is paid to the differences in surface texture and density of specimens made by different technologies. The results of the second and third problems concerning the adhesion between Ti6Al4V specimens, obtained by milling or by SLS, are interesting and can explain the differences in the results with the texture of the boundary surface. As a merit of the dissertation one can point out the numerous combinations of various factors influencing the adhesion.

Conclusions of the Dissertation

The PhD candidate determines the normal, tangential, and minimum and maximum von Mises equivalent stresses at the edge point of the porcelain coating and the intermediate layer of bonding agent for all groups of specimens studied. A non-uniform distribution of the equivalent stresses at the edge of the porcelain along the interface with the metal was found. It is shown that the normal stresses along the Y-axis, which act perpendicular to the porcelain/metal, bonding/metal or porcelain/bonding interface, have the highest value. The high Y-axis normal stresses are the main reason why coating damage on the metal surface occurs adhesively by detachment in milled and laser-built specimens without bonding agent.

In the milled alloy group, the trend of stresses follows the trend of adhesion strength: sandblasting raises the stress values, while mere bonding lowers them. Gagov, DMD demonstrates that combined treatment of milled alloy in the intermediate layer of bonding agent generates the highest equivalent and normal stresses. Furthermore, in SLS specimens, bonding treatment increases the stresses at the bonding/metal interface.

Contributions

Yavor Gagov, DMD divides the contributions of his dissertation into scientific and applied contributions. Of these, 11 are original and two are applied. Of the scientifically applied contributions, the conclusion on the use of an intermediate layer of VITA NP BOND PASTE bonding is of importance because it lowers adhesion. As well as the development of two laboratory protocols for the fabrication of porcelain-fused-to-metal fixed prostheses from Ti6Al4V alloy made by CAD/CAM milling and selective laser melting.

Publications Related to the Dissertation

Yavor Gagov, DMD has presented 3 publications and 3 contributions to scientific forums, all in English. They are sufficient and meet the requirements of the Regulations on the conditions and procedure for the acquisition of scientific degrees and the holding of academic positions at the Medical University – Varna.

Abstract

The abstract of the dissertation is in accordance with the requirements of the Medical University – Varna. It contains **48 pages in which the aim, the tasks, the material, the research methods and the obtained results are presented in tables and colored figures. Also included are the conclusions, contributions, publications and participation in scientific events related to the dissertation.**

CONCLUSION

The dissertation of Yavor Gagov, DMD entitled “**Adhesion of Dental Porcelain to Ti6Al4V Alloy Produced by CAD/CAM Technologies**” is an original scientific work written personally by the author. The merits and contributions of the dissertation are highly significant. Taking into account the criteria for obtaining a Doctoral Degree as specified in the Law on the Development of the Academic Staff, its implementing Regulations and the Regulations of the Medical University – Varna, and based on my long-standing personal experience, I give a positive assessment and **I will vote convincingly "Yes"** for the award of a Doctoral Degree to Yavor Vasilev Gagov, DMD.

25.03.2023

Varna

Prof. Dr. Metodi Abadzhiev, DMD, PhD, DSc

