



Review

Of dissertation for awarding the educational and scientific degree "Philosophy Doctor" in scientific specialty 03.03.01. Therapeutic Dental Medicine In professional direction 7.2 Dental medicine from the field of higher education 7. Health care and sports

To Dr. Nikolay Maksimov Simeonov, independent doctoral student

Supervisor Prof. Dr. Ivan Filipov

Career profile analysis and brief biographical data for the PhD student:

Dr. Simeonov completed his secondary education at the High School of Mathematics "Academician Kiril Popov", Plovdiv in 2010, and later in 2018 he became a Master of Dental Medicine at the MU Plovdiv. He is a post graduate student in Operative dentistry and Endodontics and began his narrow specialization in 2020. He works as an assistant at the Department of Operative Dentistry and Endodontics, teaching students according to an approved curriculum, participates as a lecture assistant, in conducting state and semester exams and in preparing control tests of knowledge. In March 2023, he was enrolled as a PhD student, and in November of the same year he was dismissed with the right of defense. There is a good activity in terms of project activity - carried out exchanges under the Erasmus program in 2021 and 2023, teaching students under the same program in Plovdiv, a member of a project under the National Program "Young scientists and postdoctoral students" in 2020 and 2021. Successfully completed his participation in "Doctoral and postdoctoral projects in 2021 on the topic "Micromorphological assessment of the hybrid layer formed when applying adhesive systems containing 10-methacryloyloxydecyl dehydrogen phosphate on dentin treated with the Er:YAG laser".

Dr. Simeonov also has experience as a project coordinator in Bulgaria and a supervisor in a family company in the restaurant business in the USA.

According to the doctoral student's own assessment, he has an excellent command of English (level B2) and German at an elementary level.

He has good organizational skills, works well in a team, has self-discipline, ability to work intensively, attention to detail and ability to take responsibility.

General description of the presented materials

The materials presented to me for review on the defense of Dr. N. Simeonov in paper and digital form are in accordance with Art. 32, para. 1, item 4; art. 46, para. 1, 5 and 6 of the Higher Education Act, Art. 6 of DASRBA, art. 10 and 11 of the Regulations for the implementation of the DASRBA, ch. 5, Art. 68, paragraph 2. and Art. 70 (1) and include the following documents:

- Autobiography in European format
- Dissertation abstract
- Dissertation work of Dr. N. Simeonov
- Enrollment order
- Deduction order
- Declaration of originality

- List of publications
- Exam in the specialty - candidate minimum
- Minutes from the Department council when the candidate is expelled
- Certificate from doctoral school
- Attached 4 articles

Structure and sections of the dissertation:

According to the requirements of the Regulations of the MU Plovdiv, the candidate's dissertation work includes an introduction, literature review, goals and objectives, material and methods given by tasks, results presented on the various tasks, together with discussion, conclusions and main contributions.

The dissertation work of Dr. Nikolay Simeonov is written on 136 standard pages; has a one-and-a-half page introduction, 4 appendices - DMD lasers and adhesive systems questionnaire, modified ADA dental caries risk assessment criteria, criteria for clinical assessment of obturation in Class I cavities prepared with Er:YAG laser or rotary instruments and a self-etching adhesive system, as well as modified Cvar/Ryge criteria for the evaluation of obturation.

The literature review includes 30 pages and is about 1/4 of the dissertation, one page aim and objectives, 25 pages material and methods, 69 pages results and discussion, together with conclusions to each task, 1 page general conclusions, 1 page contributions, 1 page of publications and scientific communications and 19 pages of literature references. The structure and manner of writing the dissertation are in accordance with the requirements of the Regulations of the Medical University - Plovdiv (Article 69, Paragraph 2).

The dissertation includes 49 figures and 18 tables, and it is very well illustrated. Clinical cases from the last task are also presented. The bibliography includes 192 sources, of which 10 are in Cyrillic and 182 are in Latin, and one third approximately (32%) of the total number is from the last ten years that is proof for the actuality of the marked literature data. Along with some of the conclusions under each task, there are also recommendations for dentists regarding achieving optimal treatment results when preparing HDT with the Er:YAG laser (page 133).

Actuality of the problem being developed

Rapidly developing technologies and innovations in recent years, as well as patient demands for durable and highly esthetic restorations that hold and show stable adhesion, create for dental practitioners new opportunities, but at the same time appear as new challenges. Here comes into consideration the direction of minimally invasive procedures, which mainly fits into the use of high-energy lasers for the preparation of hard dental tissues (HDT).

These data show that the topic chosen by the dissertation is in accordance with modern trends, and has **an actual and scientific-applied significance**. It will enrich the knowledge and practice of colleagues in restorations of anterior and distal teeth in dentistry.

Literature review - knowledge of the problem

The literature review was prepared on the basis of 192 sources. The review has 9 main sections, including HDT and dental caries, dental lasers for the treatment of HDT, types of adhesive systems, 10-MDP, with a special chapter on adhesive systems and dentin prepared with Er:YAG lasers. The adhesive bond, the attempts to optimize the adhesive layer are

examined in detail and analytically. Special attention is paid to modern methods and devices such as confocal laser scanning microscope and energy dispersive spectrometer.

The review ends with a general conclusion that argues the goals and tasks of the upcoming scientific development. Unsolved issues are indicated, synthesized in 6 points. The analysis of the literature reference shows that the doctoral student Dr. Simeonov has correctly oriented himself to the future contributions of the researched scientific problem and has assessed what its in-depth examination will bring, from the point of view of current scientific knowledge. The review is professionally written, with well-arranged facts when presenting an issue. There is a good logical connection between the sections of both the review and the dissertation, and the style is understandable, clear and objectively critical.

All important sources that have had an impact on the formation of the opinion on the scientific problem of the **effect of the preparation of HDT with the Er:YAG laser on the adhesive layer have been included.**

Goals and tasks, materials and methods of research

The goal is briefly and clearly formulated, with 5 tasks attached to it. They reflect the scientific hypotheses and relevant questions that the research will follow. The main idea of the work is to investigate the characteristics of the adhesive layer in self-etching systems, after preparation with an Er:YAG laser.

The material includes 179 doctors of dental medicine (DMD) for the questionnaire survey, surveyed in the period June 2020 - July 2020, 25 extracted teeth for the laboratory studies and 30 vital teeth with defects according to indications - Class I cavities for composite materials in 30 patients from which 28 obturations were followed up at 6 months and 27 at 12 months.

Methods - a survey method, modern and objective methods such as confocal, laser scanning microscope (CLSM, (Leica Microsystems LAS AF – TCS SPE) and elemental analysis of dentin and adhesive layer by energy dispersive spectrometer were used. Surface observations were made using field emission SEM Jeol JSM-6390 (Japan), which is equipped with an energy-dispersive X-ray micro-analyzer (INCA, Oxford, UK) and corresponding software. Classical clinical methods for evaluating obturation and its relationship with caries risk in patients were also applied. Research methods are modern, objective and allow achieving the set goal and obtaining an adequate answer to the tasks solved in the dissertation work. The reliability of the obtained results was achieved through modern statistical methods: Fischer's exact test, Chi-square test, t criteria, one-way ANOVA and post-hoc pairwise comparisons using Tukey's multiple comparison test, independent samples t-test, Levin's test, Kolmogorov-Smirnov test. For comparisons between groups, the Mann-Whitney U test was used. The data from the obtained results were processed and compared with the statistical programs IBM SPSS, version 27(2020), Minitab version 19 (2020) and MedCalc, version 20.008 (20210) at a significance $p \leq 0.05$.

The results, appropriately illustrated with 49 figures and 18 tables, are discussed against the results of other similar studies.

Characterization and evaluation of the dissertation work and contributions

The PhD student studied the attitude towards the use of dental lasers and adhesive systems of Bulgarian DMD, having interviewed 179 colleagues from the Varna, Sofia and Plovdiv regions using a survey method. The survey includes a large number of signs of observation, such as, in addition to the standard gender, age, experience, specialty, practice data, attention

is also paid to materials, means and technical security in the treatment of dental caries, choice and approach when applying an adhesive system with or without 10-MDP, stages, etching - time and structures, method of etching - acid or laser, replacement of obturation - frequency. From the analysis of the data, it is found that the most preferred systems in the representative sample of DMD are the two-step adhesives with etch and rinse. Colleagues do not know if their system contains MDP, and according to the survey data, the laser is not preferred by DMD for etching HDT. Replacement of obturation due to impaired marginal adaptation occurs frequently in practice.

In in vitro conditions for the 2nd and 3rd tasks, Dr. Simeonov applied two modern methods and studied the morphological characteristics of the adhesive layer and the length of its penetration into the dentinal canals by CLSM (microscanograms and visualization of canal 1, canal 2 and superimposed image between them) and conducted elemental analysis of dentin and adhesive layer in preparation with Er:YAG laser by energy dispersive spectrometer.

In the 2nd task, after a thorough micromorphological evaluation of the adhesive layer and observation of its penetration into the dentinal tubules (DT), as well as through a total of 270 measurements of the length of resin tags, a greater length of penetration into the DT was proven in samples with an adhesive system and preparation with laser, and in them the length of resin tags greater than $32.67\mu\text{m}$ can be predicted, while in the samples prepared with a metal bur the length is below $32.67\mu\text{m}$. The dyes used were Rhodamine B and Fluorescein at a concentration of 0.1%.

When analyzing the data from the elemental analysis, a general decrease in C on the dentine surface was found when working with the Er:YAG laser, and an increase in C and Si when applying the adhesive system 10-MDP and laser. There is no difference in Ca/P ratios on the surface of dentin prepared with a laser or a metal bur. It was concluded that the different preparation leads to differences in the chemical composition of the dentin surface, and the application of the adhesive system with 10-MDP is associated with the detection of less inorganic substances compared to a prepared dentin surface.

As the final part of the study, clinical studies on direct restorations from composite materials and Class I cavities, prepared with Er:YAG laser and with applied adhesive with 10-MDP, which were followed at 6 and 12 months, are presented. It is found that there are no differences between the preparation of Class I cavities with classical rotary instruments and laser after 1 year. It is also proved that the used method of preparation and adhesion can be successfully applied in dental practice, and the risk of dental caries reduces the clinical durability of direct composite restorations regardless of preparation method.

On the basis of the obtained results, Dr. Simeonov makes 8 general conclusions, which logically follow from the obtained data and correspond to the tasks set. Clinical recommendations have also been made, mainly regarding the application of the Er:YAG laser to achieve an optimal clinical result in the preparation of HDT. These applied guidelines derive mainly from the clinical experience of the doctoral student and are not related to specific studies in the presented work.

The aim of the dissertation work has been achieved, and the set tasks have been fulfilled. Dr. Simeonov's contributions, 4 original and 3 confirmatory (in his judgment), are useful at the basic and clinical level and would assist colleagues interested in this problem.

Abstract

The abstract meets the requirements and fully reflects the main results achieved in the dissertation. In an orderly and clear way for the reader in a summarized form (56 pages), it gives an idea of the overall design of the work, aim and tasks, methods, results and main conclusions. It is illustrated very well technically with 15 tables, and 28 figures and diagrams. The content of the abstract fully corresponds to the content of the dissertation work.

Evaluation of the PhD student's publications and personal contribution

Doctoral student Dr. Simeonov has presented 4 publications, of which 3 in the scientific works of the Union of Scientists in Bulgaria, and one in the prestigious journal Folia medica, which is referenced and indexed in the Scopus database. In two of the publications he is the first author and in the other two he is the second author. There are also 2 scientific papers presented at scientific sessions, one of which has international participation.

I appreciate completely positive the personal participation of the doctoral student Dr. Simeonov in the conducted scientific research, as well as his ability to work with other specialists in a team.

Critical notes and recommendations

It is good to consider the term "plastic growths", which is probably an analogue of "resin tags" from the English literature. I think it is not very appropriate, and it is better to use the original name in English.

On page 51 in the abstract fig. 48 is fig. 28, and conclusion 5 of the results of the 3rd task is vaguely formulated.

It is also good for the author to publish his results, some of which are very interesting, in world database referenced publications other than Folia medica.

Conclusion

Dr. Simeonov's dissertation work, carried out independently and in collaboration with fellow specialists, contains scientific and scientific-applied results that are original and comply with the Development of the Academic Staff in the Republic of Bulgaria Act (DASRBA). The presented materials fully meet the requirements of MU - Plovdiv. The scientific work shows that the doctoral student Dr. Nikolay Simeonov possesses in-depth theoretical knowledge and practical professional skills as a scientific specialist and demonstrates qualities and skills for independent conduct of scientific research.

On the basis of everything said above and presented dissertation work "**Effect of the preparation of HDT with Er:YAG laser adhesive layer**" and his original contributions, I propose and vote with the conviction that Dr. Nikolay Simeonov be awarded the educational and scientific degree "Philosophy Doctor" in scientific specialty 03.03.01 therapeutic dentistry.

10.01.2024

Prof. R. Vasileva