

REVIEW

**From Prof. Snezhanka Zaprinova Topalova-Pirinska PhD
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Of dissertation for awarding the educational and scientific degree "Doctor"

Field of higher education: 7. Medicine and Sport

Professional field: 7.2 Stomatology

Doctoral program: Therapeutic Dental Medicine

Author: Dr. Bogomil Andonov

Implementation form of the Dissertation: Self-sufficient training

Department: Operative dentistry and endodontics, Faculty of Dental Medicine, Medical University - Plovdiv

Topic: "Temporary restoration in multi-visit endodontic treatment – clinical and laboratory studies"

Supervisors: Associate Prof. Dr. Silviya Dimitrova PhD

Prof. Plamen Zagorchev DS

General presentation of the procedure and the doctoral student

In accordance with Article 32 of the Regulations for the Implementation of the Law for the Development of the Academic Staff in Republic of Bulgaria, Injunction of the Rector #P-32/11.01.2022 and protocol #1 from the meeting of the Scientific Council, I have assigned to present a review of the completed Dissertation of Dr. Bogomil Andonov.

All of the presented hard copy materials are in compliances with Article 70 (1) Part I. Awarding the educational and scientific degree "Doctor" and scientific degree "Doctor of sciences" of the Regulations for Academic Development at Medical University – Plovdiv/28.01.21 and includes all required documents.

Dr. Bogomil Andonov is born on 31.12.1980. From 1994 until 1999 he studies at the high school with humanitarian profile "St. St. Cyril and Methodii" Plovdiv. In 2005 Dr. Andonov graduates from Medical University – Plovdiv, Faculty of Dental Medicine with "Master's Degree" and since 01.03.2008 is an assistant professor at the Department of Operative Dentistry and Endodontics. He completes his program for specialty in Operative Dentistry and Endodontics in the period 2008-2011.

After his graduation from the university, Dr. Andonov started practicing as a dentist at ET "AIPPADM – Dr. Trifon Antonov" and since 2010 he is working in his own dental practice "Dr. Bogomil Andonov AIPPADM" EOOD.

Dr. Andonov presents a list of attendance at numerous hands-on courses, lectures and seminars where he has enhanced his professional skills. He have selected as an opinion leader of Dentsply Sirona during the period between 2017 and 2019. All the acquired competences gave him the opportunity to give lectures, presentations and to lead hands-on courses at different dental forums in Bulgaria. In his CV Dr. Andonov notes the usage of different special dental devices, the development of a device what enhances the visibility during the endodontic

treatment and the participation in the development of a product what enhances the quality of the infection control in the dental practice.

Dr. Andonov works on two scientific projects in the period 2009-2011 and 2020-2021 financially supported by Medical University – Plovdiv. He have nominated as university coordinator for an international university project Global Oral Health Initiative focused on student exchange and education in the spirit of philanthropy, altruism and volunteering.

Dr. Andonov is co-author of six articles and three of them are part of his Dissertation.

Relevance of the topic and advisability of the set goals and objectives

In the clinical practice often, the planned endodontic treatment requires more time, visits, follow-ups, additional medication and procedures. To ensure isolation from the oral environment and eliminate the risk of additional bacterial contamination, the endodontic access in the tooth should be temporarily restored. This procedure requires materials with good adhesion to the dental structures, sufficiently hard and resistant to chewing load and, if possible, easily removable without adverse effects on the cavity walls and subsequent permanent restoration of teeth. The control over the complete removal of the used material for temporary restoration is also imperfect. These and many other theoretical and practical endodontic problems await their solution.

I accept the choice of the topic as a desire to participate in the global search to ensure high success of endodontic treatment by achieving optimal isolation of the endodontic space from the oral environment in need of long-term treatment. That is why I define it as contemporary and suitable for scientific research.

The indisputable need for temporary sealing of the endodontic cavity and the understanding of the related problems determines the appropriateness of the goal, objectives and development of this Dissertation. Dr. Andonov aims to evaluate the insulating ability of materials for temporary restoration in multi-visit endodontic treatment and to study the characteristics of the cavity walls to achieve optimal peripheral bond. He defines six tasks.

1) A survey about the implementation of the temporary restorative materials by the dental practitioners in Bulgaria.

2) Microbiological study of the insulating properties of temporary restorative materials *in vitro* with three subtasks related to determining the bacterial contamination of the endocavities of temporarily obturated teeth incubated in medium with *Str.mutans* and 2% methylene blue, dye penetration and its inhibitory effect on contamination with *Str.mutans*.

3) Comparative assessment of the permeability of electromagnetic radiation through three selected temporary restorative materials.

4) Comparison of temporary restorative materials remnants and changes in the endodontic cavity volumes after removal of temporary obturations in three ways (with turbine and diamond bur, ultrasound and diamond tip or with Er: YAG laser) with two specific subtasks.

5) Scanning electron microscopy (SEM) examination of the changes of dentin from the cavity walls after the removal of temporary restorations of glass-ionomer cement (GIC) and light cure composite.

6) Study of the isolation of endodontic cavities by zinc-calcium-sulphate or light cure temporary restorative materials *in vivo*.

Awareness of the problem

The literature review is informative and structured in accordance with the unexplained problems and with the research tasks planned by Dr. Andonov. The analyzed literature data have focused mainly on the need for temporary or preliminary restoration of endodontic treated teeth and the materials used for isolation of endodontic cavities, tools, methods and control options for their removal, the consequences for dentin and cavity. Particular attention have paid to the applied laboratory (for dye penetration, insulating properties and duration of isolation) and microbiological methods (bacterial penetration) for the study of the properties of temporary restorative materials. The review ends with a very brief formulation of the unresolved issues regarding the temporary restoration of endodontic treated teeth, giving grounds for the choice of the Dissertation topic and determining to some extent its purpose and tasks. Dr. Andonov is aware with the state of the problem and creatively summarizes the literary material.

Research methodology

The section "Material and methods" is described in the order of the tasks and is quite extensive in relation to the total volume of the Dissertation. Various research methods and objects have used, which are adequate to the defined six tasks. A sociological method has applied through a cross-sectional survey using an extensive questionnaire (Appendix 1). Tasks 2, 3, 4 and 5 have performed on specially prepared samples of extracted permanent teeth. The study design of task 2 is excellent and well presented. Bacterial growth was determined on blood agar and glucose broth. Dye penetration was determined under magnification with a light microscope. For task 3, a detector of the intensity of the transmitted electromagnetic radiation through samples of hard dental tissues and through the three studied temporary restorative materials have used. In the performance of the set fourth task, the presence of temporary restorative materials remnants has registered by direct observation with naked eye, under a microscope or under a microscope with an additional light source. The changes in the volumes of the endodontic cavities before obturation and after removal of the temporary fillings have assessed by electronic weighing according to a special methodology (Appendix 4). The design of Task 4 has also shown schematically. Timing of the removal of temporary restorations has done using three methods. The methodology for preparation of dental specimens for SEM has described in detail. The primary information and analysis of the collected data has processed with the statistical programs IBM SPSS version 26, version 17, Minitab version 19, Kolmogorov-Smirnov test, One-way ANOVA, nonparametric analysis, Pearson chi-square and others.

The chosen research methods allow achieving the set goal and obtaining an adequate answer to the tasks of the Dissertation.

Characterization and evaluation of the Dissertation

The content and the structure of the presented scientific work meets the requirements of Medical University Plovdiv and is in accordance with the Law for the Development of the Academic Staff in Republic of Bulgaria.

The total volume 182 pages includes the following chapters: introduction 2 pages, literature review 35 pages, aim and tasks 2 pages, materials and methods 45 pages, results and

discussion 52 pages, conclusion 3 pages, inferences 2 pages, recommendations to dental practitioners and main contributions of 1 page, literature 20 pages, appendices 11 pages, publications 2 pages and declaration 1 page.

The literature guide on the topic covers 264 sources, eight of which are by Bulgarian authors. Distributed according to the time of publication, 63 articles have been published in the last 5 years (2017-2021) or 118 in the last decade (2012-2021).

The studies have conducted in 2019-2021. The research material seems sufficient. The collected results, followed by their discussions in accordance with the known scientific data, have presented in the order of the main tasks. The evidence has presented in 6 tables, 67 figures and 7 appendices.

By its nature, the Dissertation is mainly experimental, which has proven by the laboratory tests on extracted teeth in the performance of tasks 2-5. In my opinion, this fact should have been reflected accordingly in the title of the Dissertation and instead of "... clinical and laboratory research" it should have been laboratory and clinical research.

The survey (task 1) proves the widespread use of temporary restorative materials in endodontic treatment by 201 dental practitioners and has well presented. An analytical comparative analysis of the obtained results and the literature data has made. However, I do not see statistical indicators of the importance of the comparisons and conclusions in the text of the results of tasks 2, 3 and 4. There are no specific summaries, inferences or conclusions after presenting the author's results on the tasks, which particularly diminishes the researcher's achievements.

The essence of any research, including a Dissertation, has expressed in a definite and clear way in the conclusions. The given conclusion does not summarize the researcher's opinion on the survey and proven dependencies, but ends with an assessment of the relevance of the problem discussed in the Dissertation and the need to cite "more in-depth research in the near future", an appropriate expression for introduction or end of review.

Dr. Andonov drew nine conclusions, some of which have not based on his own results. Conclusions 1 and 2 are not a consequence of the research. In my opinion, the conclusions should reflect the most significant results of each study in highly synthesized manner. In this case, the implementation of task 1 seems self-serving and its implementation has belittled because there is no conclusion. Conclusion 3 is solid and focuses on experimental practice and future studies of the permeability around different dental materials and the degree of insulation of the cavity walls. Conclusion 4 should grade the effectiveness of the studied temporary restorative materials for isolation of endodontic cavities from bacterial contamination. I find the clinical trial planned for task 6 underestimated, because no conclusion has given based on the researcher's own results and their statistical processing.

Recommendations 1 and 2 to the dental practitioners are not based on evidence from undertaken researches, because the effectiveness of the combinations of different temporary restorative materials or the insulating properties of teflon used as a spacer under temporary restorative materials has not been studied. This part with recommendations to the dental practitioners determines the practical nature, and to some extent the practical contribution of the Dissertation. I am aware of several important recommendations that should been made based on the evidence from the research.

Scientific and practical contributions and significance of the work

Dr. Andonov identifies four original contributions and 4 confirmative. I accept these contributions from the researches carried out in the Dissertation topic. I appreciate the original idea to test the insulating ability of the most commonly used materials (zinc oxide-calcium sulfate, glass-ionomer cements and flowable light cure composites) for temporary sealing of endodontic treated teeth and to explore ways to maintain more healthy dental structures when removing these materials. However, I challenge the wording of the fourth original contribution because it does not examine the "... properties of temporary restorative materials in clinical settings", but only the ability of two representative temporary restorative materials to isolate the endodontic space from contamination for 14 and 21 days.

Evaluation of the Dissertation publications

The list presented in the Dissertation includes three full-text articles in electronic editions, two of which are international. They have published in 2020-2021. Three scientific reports have presented at international conferences held in Bulgaria in 2020-2021, co-authored mainly with scientific supervisors. The realized publishing activity corresponds to the minimum national requirements under Article 26 (2), (3) of the Law for the Development of the Academic Staff in Republic of Bulgaria.

The participation of Dr. Bogomil Andonov in a successfully completed research project "Comparative study of methods for studying the insulating properties of materials for temporary restoration of endodontic treated teeth" from the competition "Doctoral and postdoctoral projects" - DPDP- 11/2020 is related to the Dissertation topic.

Personal participation of the researcher

The preliminary and statistical preparation of the data, the description of the results, the derivation of dependencies, the formulation of conclusions and contributions are merit of Dr. Bogomil Andonov. The personal participation of the researcher on a self-study basis in the implementation of the researches for the Dissertation topic and the processing of the obtained results is indisputable, despite the participation of other researchers in the research teams. This even gives him an advantage in planning and organizing further research.

Abstract

The presented abstract in Bulgarian is an abbreviated version of the Dissertation and fully reflects the goals and objectives, methods used, results achieved and conclusions. The content of the Dissertation has reduced to 64 pages and has contained all parts of the Dissertation except for the bibliography and the literature review, from which only the unsolved problems are included, as it should be. The evidence has also reduced to 1 table and 47 figures.

Critical remarks and recommendations

I allow myself to point out some inaccuracies in the Dissertation.

There is a discrepancy in the methodology of Task 3, because on page 65 it is written that the samples are made with a thickness of 1 and 2 mm, and on page 67 it is noted that the samples are standardized in size and their parameters are 8 mm in diameter and 2 mm thickness.

The terms sample or samples are used both for the selected teeth (for example p.72) and for the experimental samples, stages and for taking material for examination.

The number of teeth prepared and examined with different methods and means varies from one to five, which calls into question the statistical reliability. The methodology of task 2 works with a different number of groups and teeth during stages first and second. For example, at the first stage 40 teeth have examined in three main groups, respectively of the three temporary restorative materials with two subgroups, in each of which three samples are included. Second stage covers 31 teeth, divided into 3 main groups and 12 subgroups, of which 6 with 1 sample (staying consecutively in glucose broth and dye or vice versa), 3 subgroups with 2 samples (only in methylene blue) and 3 subgroups with 5 samples (only in glucose broth). I do not mark the control groups for both stages. It is not clear on what grounds such an uneven distribution of samples, with some repetition, has based. In my opinion, the number of samples in the subgroups is insufficient.

The presented design of the methodology of subtask 4.1 also shows a different number of groups and included samples, depending on the means used to remove the three tested temporary restorative materials. Subsequently when presenting the results on page 118 in five of the samples (it is unclear by which tools they have prepared and what has their relative share) I quote "the view under magnification turns out to be sufficient". This statement seems unmotivated and is statistically unconfirmed. The following page 119 explains the change in the volume of the cavity due to the temporary restorative material remnants in the "third sample". I repeat that improper use of - sample, stage, leads to inaccuracies, ambiguity and reader confusion.

The strange thing when the results have presented of the first stage of task 4 is the discrepancy of average values of the time required change in cavities volumes reported in the text and the reported data in tables 2, 3 and 4 on pp. 119-123. The following statement "increase in endodontic cavity volume is considered acceptable when it is below 20% (normal)" on page 123 should be supported by scientific evidence.

Different temporary restorative materials require different removal tools not only because of their structure, composition, hardness, color and permeability to electromagnetic radiation, but also because of the preservation of the remaining healthy tooth structures. I am convinced of the methodological imperfection of the removal of temporary restoration with Calasept Temp using a turbine and a diamond bur, which inevitably causes greater loss of hard dental tissues and increase in the volume of the cavity (12% according to the result on page 120).

The methodology of task 4.1 does not explain why the endodontic cavities have washed twice with 5.25% NaOCl, 3% H₂O₂ and 90% alcohol (the recommended use of 70% ethyl alcohol) after the root canals filling and before application (p.86). The cavities have irrigated with 90% alcohol immediately before the complete removal of the temporary restorations and taking the cotton swab as a possible carrier of bacterial contamination permeability between the cavity walls and the temporary restorative materials, too (p.87). The idea of this double flushing of the cavity after obturation of the canals remains inexplicable, which differs from the clinical practice in the application of the therapeutic method of vital extirpation. The other sterile agents should have be used for rinsing in order to remove debris and residues from the removal of temporary obturations.

It is also unclear why during the preparation of the endodontic cavity after filling the canals, the Calasept Temp for isolation (still uncured) is placed above the orifices and immediately washed again, after which the sample has taken for initial sterility before temporary filling. If there is no typo, the methodology is unsupported. In this regard, I notice a difference in the isolation of the orifices by placing Calasept Temp over the base of the pulp chamber before filling the cavity with temporary restorative materials in the study of task 2 and isolating the floor of the cavity with phosphate cement in the gradual implementation of task 4.

I notice incorrect marking of figures on page 98, lack of the cited tables 7 and 8 on page 110, after the announced first table on page 99. I note that Calasept Temp does not polymerize.

Despite the noted findings and considerations, the Dissertation in its entirety has methodically planned and implemented in the extreme conditions of a global pandemic.

Recommendations for future implementation of the contributions and results presented in the dissertation

The developed Dissertation topic contains truthful analyzes and conclusions based on scientific facts in general. On page 116, Dr. Andonov states ongoing laboratory studies for "refinement of light sources and the technique of their application in clinical conditions." My assessment of Dr. Andonov as an excellent teacher and specialist who keeps up with the latest developments in science and dental practice, give me hope that he will actively continue his research in accordance with the emphasis on endodontics and in the near future he will provide us with new tools ensuring effective endodontic treatment.

Conclusion

Dr. Bogomil Ognyanov Andonov has conducted purposeful, for the most part independent research work and he presents a Dissertation with thematic relevance, sufficient evidence and results of theoretical and practical significance. The presented Dissertation shows that he has in-depth theoretical knowledge and professional skills in the scientific specialty "Therapeutic Dentistry", demonstrating qualities and skills for independent research.

The Dissertation contains scientific and practical results, which represent an original scientific contribution and meet the requirements and criteria of the Law for the Development of the Academic Staff in Republic of Bulgaria, the Regulations for application of the Law for the Development of the Academic Staff in Republic of Bulgaria and the relevant Regulations of Medical University - Plovdiv.

Due to the above, I confidently give my positive assessment of the research presented by the peer-reviewed Dissertation, abstract, results and contributions, and I invite the esteemed scientific jury to award the educational and scientific degree "Doctor" to Dr. Bogomil Ognyanov Andonov in the doctoral program in "Therapeutic Dentistry".

31.01.22

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