

Critical Review

By Professor Georgi Rangelov Todorov, DMD

Re: The dissertation thesis by a self-study doctoral candidate from a doctoral training programme in Prosthetic Dentistry enrolled by Order No P-109-165 / 24.04.2019

Theme:

Application of laser SLA 3D printed temporary dental prostheses

I. Procedure presentation

This Critical Review has been produced on the grounds of Order No 109-599/06.12.2021 of the Rector of Medical University of Varna in compliance with ABAPA– art.5, para. 2 and the Implementation Rules of ABAPA– art.24, para. 6, and with the Rules of Advancement of the Academic Pool of the Medical University of Varna pursuant to Record No 1 / 05.01.2022 of the Academic Committee.

1. Background

Dr. Delyan Krasimirov Georgiev was born on 21st April, 1989 in Varna. In 2008 he finished the Ivan Vazov Language School in Plovdiv in the programme of intensive language studies in German and Russian.

In 2014 he was graduated with a Master's degree in Dental Medicine from the Faculty of Dental Medicine at the Medical University of Plovdiv.

Since 2016 he has been an Assistant Professor at the Medical University of Varna, Faculty of Dental Medicine.

He was enrolled as a self-study doctoral candidate in a doctoral training programme in Prosthetic Dentistry enrolled by Order No P-109-165 / 24.04.2019.

II. Dissertation thesis

1. Topicality of the researched theme

Temporary crowns and bridges are a prototype of the permanent prostheses. The size, shape and position of the temporary prosthesis is subject to multiple variation and correction. Any such correction is being discussed with the patient until fulfillment of the aesthetic target, however including only the above mentioned parameters without reference to the shade of the temporary dental prosthesis. Patient's choice of shade results in errors, specifically with the colour properties: hue, intensity, lightness.

Dr. Georgiev examines and presents the theoretical and practical perspective of laser SLA 3D printed temporary dental prostheses, and extensively researches the correlation between temporary dental prostheses and shade taking.

In my opinion, the innovative suggestions given in this aspect by Dr. Delyan Georgiev determine very precisely the topicality and need of the theme of his dissertation thesis.

2. Literary review

In this reviewed doctoral thesis, the bibliography is comprised of 270 authors, 7 of whom – in Bulgarian.

I deem the strongest support for the contemporaneousness and urgency of the theme is contained in the literary review:

- 42 % of the sources are published after 2011 (inclusive);
- 3 % of the sources are published in 2020;
- 21 of the referred publications (in non-Bulgarian sources) contain such of Bulgarian authors;

The literary review is given in 40 pages, and 6 pages cover a skillful analysis of materials and conventional methods for fabrication of temporary dental prostheses, pointing out the common mistakes, issues and complications.

Review of the modern technology – CAD/CAM, printing, the ISO standards are given in total of 12 pages. On page 17 and 18, the Egg-shell technique is extensively described, as it is used by the doctoral candidate in his research under objective one.

On page 7, shade, the parameters and properties of colour, dental shade standards, shade taking, devices for shade taking are analysed.

The Literary Review unit closes with conclusion and analysis of the availability of research and data on the application of temporary dental prostheses fabricated by adaptive technology, and the absence of data is indicated in the end.

3. Aim and objectives

Dr. Gerogiev sets the goal to explore the possibilities of application of laser SLA 3D printed temporary dental prostheses. To that end, the candidate formulates four objectives, namely:

- examining the impact on the shade of printed temporary dental prostheses of the Egg-shell type made from the transparent resin Dental LT Clear ® with various thickness of the wall;
- developing resin formulas that can reproduce proportionally and systematically the shade standards, logically relating to the colour theory;
- comparative analysis of the bending strength of the newly formulated resins in objective two
- developing a methodology for enhancing the bending strength of printed temporary dental prostheses by means of software modification of the digital files.

4. Original research and development

Material and methods

Dr. Delyan Delchev presents precisely, exhaustively and tangibly his original materials and methods in 22 pages and 33 figures in total. **I consider this exact approach and accurate protocol of presentation of the original materials and examinations to be an empirical contribution of Dr. Georgiev.**

Under Objective one, by means of 3D printing, two types of test pieces are produced, namely veneers with vestibular wall thickness respectively 0.5 mm and 0.8 mm that fit over the shade tabs of the VITA colour guide. The test pieces are printed on a 3D SLA printer Form 2® (Formlabs™) from the material Dental LT Clear Resin®(Formlabs™). Examination of colour is performed.

Under Objective two, three types of resins, distributed in three groups, are combined in different ratios. Thus, nine subgroups are derived, depending on the respective concentrations. This is described on page 55 and 56. After the polymerisation is finished, the shade of each sample is determined using the device VITA Easyshade® V. The results are taken, recorded and subject to statistical processing.

Under Objective three, in 10 test bodies of various shade combinations, the strength parametres under ISO standards are tested. On page 59, the correlation of shades are given.

For the realisation of objective 3, digital prototypes designed in specialised 3D optimisation software (Autodesk Meshmixer®) of the test pieces are suggested. The test pieces are designed with cylindrical shape of 45 mm length and 3.75 mm diameter.

The test pieces are provided with specifically fabricated clasp elements for the testing of the bending strength. The results are taken, processed and recorded in specialised software – LMT1xx Ver 1.12 (LAM Tehnologies, Italy). During testing, the software plots a graph for each test piece in each positioning of the clamping device and of the bending load device. As a starting position are taken 10 mm space between them and movement rate of 0.5 mm/sec.

Under Objective four, on a Frasco TM maxillary phantom model, it is reproduced the dental defect of missing teeth No 12, 11, 21, 22, and on mandibular phantom model – missing teeth No 45 and 46. The finish line is prepared as chamfer type in the following abutment teeth: for maxillary model – tooth 13 and 23, and for the mandibular model – tooth 44 and 47 respectively. Further the prepared abutments are scanned using a lab scanner D850® – product of 3Shape™. With 3Shape Dental System®, two bridges are modeled with their respective abutments 13 and 23, and 44 and 47. Selecting the “meshmix” button in the menu, a cylindrical object is formed to fit within the shape and dimensions of the pontic, and then exported as .stl file. The files are further analysed with 3Shape 3D Viewer®.

5. Results and discussion

The candidate presents the results of his study on total of 49 pages in 45 figures and 3 tables.

In objective one: The results are discussed with the help of 17 figures, and they lead to the conclusion that the application of egg-shell type of printed crowns from Dental LT Clear Resin®(Formlabs™) can significantly influence the greater portion of the employed shades. The suggested method for quick digital planning and easy realisation of the prototypes is not preferable for the aesthetic area. It could be used only for the distal areas. Therefore its application should be greatly reduced, and with scrutiny in cases where the impact over certain colour combinations would not be crucial. This, in general, limits the mass application, and for the better reproduction of the intended shades, alternative approaches should be found, so that the resulting shades match to the greatest possible extent the shade tabs.

In fig. 54, 55, 56, 57 the candidate aptly describes through comparative analysis the colour deviations, the lightness, intensity, and hue. **In the said figures, if I am correct, there are 5 indicators with 26 results in each, and with 4 parameters, which gives total of 624 processed findings. I definitely consider the conducted research with the impressive number of 624 processed statistical findings and the conclusions drawn to be an empirical contribution by Dr. Georgiv.**

In objective two, the results of the shade taking study of the test pieces confirm the initial hypothesis that the various combinations of the three source resins impact the final shade and cover a vast array of possible shades to chose from in the treatment, and in attaining maximum degree of matching with the natural teeth shade of the patients, thus achieving high aesthetic properties of the dental prosthesis. From the conducted tests and analyses, it is seen that the shades B1, B4 and C4 could be easily reproduced by the newly combined resins for temporary dentures, while with shades A4, B2, B3, and D4 the results diverge considerably from the admissible variance of shade that is visible for the patient and could bring about a possible dissatisfaction in terms of aesthetics. The limitations in the newly developed resins consist in the fact that they can not give a wide range of shades but only seven basic ones, and just three of them fit in the scope of the

admissible variance of shade and are imperceivable for the untrained patients' sight.

In objective three, in 7 figures and 3 tables it is argued that the optimal choice for the temporary dental prostheses with both high aesthetic and mechanical properties is that of the combination White Resin / Dental LT Clear Resin in a ratio of 4/6 that corresponds to shade B1/2M1. In this composition, the concentration of White Resin accounts for obtaining one of the patients' preferred shades (B1) that is the shade of bleached teeth, while the concentration of Dental LT Clear Resin is related to the better mechanical properties. These conditions make the combination of White Resin / Dental LT Clear Resin in ratio 4/6 appropriate for both the front area and the distal area of dentition. When Dental LT Clear Resin concentration is up to 60% it accounts for the transparency as in natural dentition, contributing to the successful imitation of the natural enamel and closer matching of the shades to the hard dental tissue in natural teeth.

In objective four, in 17 figures discussion based on the prosthesis type is given. In the fracture critical zones – the connector point between pontic and retention crowns – there is significant space for replacement. Another important benefit is the potentiality for reinforcement linearly in the direction of the masticatory forces, evident from the measured high values of replacement vertically in both of the bridges. The results obtained in both prove with certainty that the suggested modification allows for providing a significant space to be filled with materials of various structure, e.g. glass fiber reinforcement, or to be injected in the so formed cavity, a material of mechanical strength properties dominant over the limiting components under the foregoing objectives in this work.

6. Dissertation summary

The dissertation summary is properly structured in compliance with the requirements. It is comprised of 79 pages 80 figures and 3 tables, supported with 4 publications thematically relating to the doctoral thesis. The contributions are presented.

III. Impression


The dissertation thesis “**Application of laser SLA 3D printed temporary dental prostheses**” is analytical, thorough, purposeful, summarising the contemporary formulations and trends in prosthetic dentistry.

I consider the voluminous work of this study, the competently presented results in tables ad figures, the well formulated conclusions, the excellent performance in the statistical processing and interpretation of findings, the supporting publications to be undoubted proof of Dr. Gerogiev’s excellent knowledge of the topic.

I hereby express my positive opinion on the dissertation thesis written by Dr. Delyan Krsimirov Georgiev, “Application of laser SLA 3D printed temporary dental prostheses”.

I shall give my „**Pro**“ vote in awarding a Doctorate degree to Delayn Krasimirov Georgiew, MD.

Plovdiv
22.01.2022

Reviewer.....
Professor Georgi Todorov, DMD