POSITION

by

Prof. Dr. Tihomir Dobrinov Georgiev, D.M.Sc.

Head of the Department of Oral Surgery

Faculty of Dental Medicine, Medical University – Varna

Subject: Procedure for obtaining the educational and scientific degree of "Doctor" in the field of higher education 7. "Healthcare and Sports" within the professional direction 7.2. Dental Medicine in the scientific specialty "Therapeutic Dentistry," in accordance with the Order of the Rector of Medical University - Varna 109-418/03.10.2023.

Candidate Information:

Dr. Kostadin Stoychev Kostadinov was born on February 19, 1991, in Varna. In 2010, he completed

II. Scope and Structure of the Dissertation:

The dissertation work developed by Dr. Konstantin Kostadinov, titled "Multimodal Imaging Documentation in Dental Medicine," is relevant with its scientific and applied nature. It comprises 156 standard pages, including 33 pages of literature review, objectives and tasks - 1 page, original research encompassing materials and methodology, results and discussion - 91 pages, conclusion and findings - 4 pages. The work is illustrated with 98 figures, 39 tables, 6 graphs, and 4 appendices. The bibliography includes 259 titles, with 16 in Cyrillic and 243 in Latin script.

The literature review thoroughly and sequentially explores issues and methods related to tissue scanning in the oral cavity and the factors influencing their accuracy. In the "Conclusion on the Literary Analysis" section, the author emphasizes unresolved issues in dental imaging diagnostics. Based on this, Dr. Kostadinov highlights the significance of the problem and shapes the goal of the dissertation work.

III. Objectives and Tasks

Objective of the present dissertation:

education

• To investigate and compare the accuracy of tooth reconstruction using generated 3D models from CBCT and intraoral scanning, as well as on plaster models from conventional impression materials, in comparison to the results of intraoral measurements with a digital caliper.

To achieve the formulated objective, the following **tasks** were set:

Tasks:

1. Determine the accuracy of tooth reconstruction through the generation of a 3D model from CBCT.
2. Determine the accuracy of tooth reconstruction through the generation of a 3D model from intraoral scanning.
3. Determine the accuracy of tooth reconstruction through the casting of plaster models using polyether Impregum Monophase (3M ESPE) and A-silicone Elite HD+ (Zhermack).
4. Determine the reliability and accuracy of each of the investigated methods for reconstructing a diagnostic model of the lower jaw through the analysis of repeated linear measurements of interdental distances in the lower jaw.

Hypotheses:

1. Measurements on the plaster model obtained from A-silicone (Zhermack Elite HD+) are more accurate than those made on digital models from intraoral scanning compared to clinical measurements.
2. Measurements on the plaster model obtained from polyether (3M Impregum Penta Soft) are more accurate than those made on digital models from intraoral scanning compared to clinical measurements.
3. Measurements on plaster models from A-silicone (Zhermack Elite HD+) are more accurate than those on plaster models from polyether (3M Impregum Penta Soft) compared to clinical measurements.
4. Measurements on the 3D model from CBCT have the smallest deviations compared to clinical measurements.

IV. Relevance of the Topic and Justification of the Set Objective.

The topic of the dissertation is significant for dental medicine and dental imaging diagnostics. The advancement of digital technologies has led to the emergence of intraoral scanners, allowing dental practitioners to easily and quickly obtain a digital impression from their patients. According to some authors, intraoral scanners perform equally well and, in some situations, even better than conventional methods and materials. Currently, in the field of prosthetic dental medicine, there is an increasing trend towards fully digitally planned treatments, demonstrating

the high interest of dentists in these technologies and leading to the widespread adoption of intraoral scanners as part of dental practice equipment.

At present, research is being conducted focused on the use of computerized tomography (CBCT) technology as a means of generating 3D models, which find application in 3D printed models. Based on global and personal experience, the dissertation analyzes results and establishes a protocol for selecting the most appropriate therapeutic approaches.

V. Results

Dr. Kostadinov comprehensively and analytically presents the results of the study on the comparative values of measurements for all tasks. This demonstrates that the applied methods of analysis are his personal contribution.

VI. Conclusions

Based on the reported and analyzed clinical results, Dr. Kostadinov draws the following conclusions:

1. All investigated modalities demonstrate high reliability.
2. Linear measurements on plaster reconstructions of the lower jaw, obtained from elastomeric impressions, provide the highest measurement accuracy compared to controls.
3. Plaster reconstructions obtained from A-silicones demonstrate higher accuracy than those obtained through polyethers.
4. 3D reconstructions from CBCT (New Tom Giano HR) with a FOV of 10x10 demonstrate the lowest accuracy in linear measurements among the investigated modalities.
5. When strong radiopaque materials are present in the scanning area, the application of 3D reconstructions generated from CBCT (New Tom Giano HR) scans is impractical.
6. Measurements on reconstructions from intraoral scanning (3Shape Trios 4) are more accurate than those on 3D reconstructions from CBCT (New Tom Giano HR).
7. Measurements on reconstructions from intraoral scanning (3Shape Trios 4) tend to overestimate compared to control intraoral measurements with a digital caliper.
8. Measurements on 3D reconstructions generated from CBCT (New Tom Giano HR) tend to overestimate compared to control intraoral measurements with a digital caliper.
9. Measurements on plaster models from Impregum Monophase tend to overestimate compared to control intraoral measurements with a digital caliper.
10. Measurements on plaster models from Elite HD do not show a specific tendency for overestimation or underestimation compared to control intraoral measurements with a digital caliper.
11. The one-phase two-layer technique with Elite HD is a reliable method for generating plaster reconstructions of the lower jaw.

12. The one-layer technique with Impregum Monophase is a reliable method for generating plaster reconstructions of the lower jaw.
13. Converting .DICOM to .STL files using InVesalius 3.1 software is a fast and convenient method.
14. 3D Viewer (3 Shape) proved to be reliable software for conducting linear measurements.
15. According to the ALARA principle, assigning CBCT for the purpose of generating 3D reconstructions is not justified given their current limitations.
16. Separating the jaws during CBCT scanning facilitates the segmentation process in generating 3D reconstructions.

VII. Contributions

Based on the conducted research and the drawn conclusions, the following contributions to science and practice can be outlined:

Contributions with a confirmatory character:

1. It was confirmed that elastomeric impression materials are more accurate than intraoral scanners for generating tooth reconstructions.
2. It was confirmed that A-silicones are more accurate than polyethers for generating plaster reconstructions of teeth.
3. The reliability of all tested modalities was confirmed.
4. The impossibility of generating a 3D reconstruction from CBCT for diagnostic purposes (conducting measurements) in the presence of radiopaque materials in the scanning area was confirmed.
5. It was confirmed that with a large scanning field (FOV), generated 3D models are not as accurate.
6. The advantage of separating the two jaws during scanning with cone-beam computed tomography for the subsequent segmentation process was confirmed.

Contributions with an original character for the country:

For the first time in Bulgaria, an in vivo study is conducted, in which 3D reconstructions of the lower jaw are generated after scanning with cone-beam computed tomography.

For the first time in Bulgaria, the accuracy of 3D reconstructions of the lower jaw after scanning with cone-beam computed tomography is compared with those from intraoral scanning, A-silicone impressions, and polyether impressions.

VIII. Characteristics and Evaluation of the Dissertation Work

The study design includes appropriately selected materials and research methods for all tasks, ensuring the reliability of the results and contributing with an original character. Dr. Kostadinov's dissertation work is well-structured, containing all elements of a scientific study, and meets the requirements of the Higher Attestation Commission for Scientific Degrees and Titles in the Republic of Bulgaria and the Regulations for the Development of the Academic Staff at Medical University - Varna.

The results are accurately described and comprehensively analyzed. They cover all aspects of the stated objectives, allowing the achievement of the set goal.

IX. Evaluation of Publications and the Candidate's Personal Contribution

The list of publications provided by Dr. Kostadinov consists of three full-text publications printed in international scientific journals, where he is the lead author in all of them. This demonstrates a good understanding of the issues he addresses and his suitability for collaborative work.

The developed dissertation work is the personal contribution of the author in collaboration with scientific entities working in this field.

The abstract is developed in accordance with accepted academic requirements. Its content and clarity cover all parts of the presented scientific work.

The candidate has taken into account the preliminary critical remarks made.

X. Conclusion:

After a thorough examination of the documents and academic work provided to me, which demonstrate the scientific and professional development of Dr. Konstantin Kostadinov, I can confirm that the dissertation on the topic "Multimodal Imaging Documentation in Dental Medicine" is the personal work of the author and a scientific research with valuable contributions of an original and scientific-practical nature. I will vote positively with YES for the award of the academic degree of Doctor to Dr. Konstantin Kostadinov.

City of Varna   Prof. Tihomir Georgiev, D.Sc.
December 19, 2023