

Review
by
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on a dissertation for the award of a
educational and scientific degree “Doctor“

Author: Dr. Yordanka Donkova Shekeroval

Topic: „Rehabilitation of complete edentulous patients with complete dentures fabricated through a digital workflow – possibilities, advantages and limitation“

Analysis of the career profile of the doctoral student

Dr. Yordanka Donkova Shekeroval was born on 18.04.1990 in the city of Targovishte. She graduated from the Faculty of Dentistry-Plovdiv in 2015. Since 2018, she has been a part-time and later a full-time assistant in the Department of Prosthetic Dentistry. She participated in the practical exercises in the Clinic of Prosthetic Dentistry at the Faculty of Dentistry-Varna - Bulgarian and English language training

The dissertation submitted to me for review contains 232 standard typewritten pages with an included bibliography of 337 authors, of which 13 in Cyrillic and 324 in Latin. It is illustrated with 70 tables, 119 figures and 5 appendices. The dissertation is well structured, which made it easier for me to prepare the review.

The **Introduction** emphasizes the fact that complete tooth loss is considered an extreme form of pathological condition in prosthetic dentistry due to its complex impact on basic vital functions such as eating, breathing, and speaking, as well as on the psycho-emotional state and facial aesthetics. The primary goal of prosthetic rehabilitation in completely edentulous patients is to restore these functions by fabricating a complete denture that replaces the missing dental structures and transmits masticatory forces via the mucosa-bone pathway.

Despite significant advances in modern dental medicine and the introduction of innovative methods for restoring the masticatory system, conventional full dentures remain a widely used therapeutic approach due to their relatively simple technology and lower cost. The traditional protocol requires the completion of several sequential clinical and laboratory stages.

In recent years, digital technologies—and CAD/CAM systems in particular—have been increasingly adopted as an alternative to conventional methods for fabricating complete dentures. Despite data indicating higher precision and reproducibility of digital approaches, their potential for completely edentulous patients has not yet been sufficiently explored.

Individual anatomical and morphological characteristics, as well as age-related and functional changes following complete edentulism, do not allow for a standardized protocol for prosthetic treatment.

The above facts give grounds for the candidate to formulate:

The aim of the dissertation: based on clinical, experimental, and statistical studies, to investigate the possibilities, advantages, and disadvantages of using additive technologies in the rehabilitation of completely edentulous patients, while improving efficiency and precision through the development and implementation of an advanced digital protocol based on morphometric analysis, the experimental design of a custom tray, and a streamlined algorithm for clinical practice.

In order to meet the set aim, **5 tasks** have been formulated and completed.

1. Investigation of the dimensional characteristics and morphological features of the prosthetic field in completely edentulous patients through analysis of 3D imaging studies.
2. Clinical evaluation of complete dentures fabricated using a digital protocol via additive technologies
3. Development and validation of an experimental model of a custom impression tray aimed at optimizing the digital clinical-laboratory protocol for the fabrication of complete dentures.
 - 3.1. Legal protection of the developed model through registration of an industrial design patent.
 - 3.2. Investigation of certain physicochemical and biological properties of the experimental impression tray.
4. Assessment of time efficiency in taking functional impressions of the upper and lower completely edentulous jaws using various materials and techniques.
5. Development and implementation of an algorithm for reducing the steps in the partial digital workflow for prosthetic rehabilitation of completely edentulous patients, based on the results of a conducted experimental study.

The materials and methods of the study are correctly and adequately selected, the use of a sufficient number of modern **statistical methods** for processing the obtained data ensures that reliable and objective **results** are attained. The more important of them can be systematized as:

This dissertation presents a comprehensive analysis of the capabilities of digital technologies in the prosthetic rehabilitation of completely edentulous patients by integrating a morphometric, clinical, and statistical approach.

The developed digital protocol, including CBCT analysis, CAD design, and additive manufacturing, demonstrates a high degree of reproducibility and clinical applicability. The creation of a two-component morphometric algorithm ($U_s + U_f$) and the experimental “Occlutray” impression tray allow for the standardization and optimization of key stages of prosthetic treatment.

The results show that the digital protocol provides good aesthetic and phonetic outcomes but remains limited in terms of functional parameters such as retention, stability, and marginal fit. It was found that maxillary dentures demonstrate better clinical effectiveness, while mandibular dentures are characterized by greater variability, due to the anatomical and functional characteristics of the prosthetic field.

Analysis of the influence of age shows a statistically significant negative correlation with the clinical effectiveness index, which is more pronounced in maxillary dentures. In contrast, gender does not have a significant effect on clinical outcomes. These findings underscore the importance of individual anatomical and functional factors as key determinants of the success of prosthetic treatment.

Statistical analysis, incorporating parametric and nonparametric methods, confirms the reliability of the results and allows for an objective assessment of the digital protocol's effectiveness.

In practical terms, the study results indicate that digital technologies represent a promising tool in modern prosthetic dentistry, but their optimal application requires integration with clinical techniques, particularly in the functional design of the prosthetic field.

In conclusion, the digital prosthetic protocol can be considered an effective and viable alternative to conventional methods, if it is applied with the patient's individual characteristics in mind and in combination with clinically sound corrective approaches.

Based on the results obtained, the following important conclusions can be drawn:

1. A two-component morphometric algorithm has been developed to determine the size and shape of the individual impression tray using CBCT in combination with CAD/CAM
2. In cases of parameter mismatch, the use of modified or hybrid designs is justified.
3. The sagittal dimension of the mandible (Ls) is significant for the stability of the prosthesis.
4. Age and gender do not have a statistically significant effect on morphometric parameters.
5. The digital prosthetic protocol improves the accuracy and reproducibility of treatment.
6. Clinical adaptation remains a mandatory step despite digital standardization.
7. The “Occlutray” tray allows for the development of a parametric digital model.
8. A differentiated approach is required for the upper and lower jaws.
9. The integrated design represents a biomechanically sound solution with digitally controlled geometry.
10. PLA and ABS are suitable materials for 3D-printed impression trays.
11. Microbiological safety depends primarily on the sterilization protocol, and 3D-printed trays can be used safely in clinical practice.
12. The “Occlutray” tray significantly reduces clinical time without compromising accuracy.
13. The digital method is the fastest but has lower predictability.
14. Conventional methods are more age dependent.
15. The validated protocol is effective, reproducible, and clinically applicable.

The important **contributions** of the dissertation can be summarized as follows:

I. Contributions of a scientific and applied nature

1.1. Original contributions

1. It has been demonstrated that the fully digital prosthetic protocol ensures high effectiveness in terms of aesthetic and phonetic indicators but remains limited in terms of functional parameters (retention, stability, and marginal fit), necessitating clinical optimization and a hybrid approach.
2. An original design model of the “Occlutray” impression tray has been developed and protected as an industrial design by the Patent Office of the Republic of Bulgaria: Reg. No. BG – 9363, intended for functional impression-taking and registration of interarch relationships within a digital protocol for completely edentulous patients.
3. A two-component morphometric algorithm ($U_s + U_f$) has been developed to determine the size and shape of individual impression trays, applicable in the context of digital prosthetic planning.
4. A morphological proportionality between the dimensions of the maxilla and mandible has been established, with practical significance for parametric CAD design of complete dentures.
5. The concept of an anatomically differentiated digital approach to the design of impression trays for the maxilla and mandible is substantiated.
6. Differentiated clinical efficacy of fully digitally fabricated complete dentures has been established, with the superiority of maxillary constructions demonstrated in terms of functional indicators and higher variability in mandibular dentures.
7. Empirical foundations have been established for the parametric CAD design of the experimental “Occlutray” tray as part of the digital prosthetic protocol.

1.2.Confirming contributions

1. It has been demonstrated that age and gender do not exert a statistically significant influence on the morphometric parameters (Us, Uf, Ls, Lf) used in digital prosthetic planning.
2. The stability and age-independence of the morphometric indices as reliable guidelines for the rehabilitation of completely edentulous patients have been confirmed.
3. The clinical applicability and reproducibility of the digitally assisted protocol in a heterogeneous patient population have been confirmed.
4. It has been demonstrated that the microbiological safety of 3D-printed impression trays depends primarily on the sterilization protocol rather than on the material used (PLA/ABS).

II. Practical Contributions

1. Clinical guidelines have been formulated for optimizing the digital protocol, including the need for a hybrid approach in the functional design of the prosthetic field.
2. A partially digital protocol (CBCT–CAD–3D printing) has been introduced and optimized for the rehabilitation of completely edentulous patients with complete dentures while maintaining the reproducibility of results.
3. The clinical efficacy of the experimental “Occlutray” impression tray has been demonstrated as a time-saving alternative to conventional techniques, without compromising accuracy and stability.
4. The possibility of safe clinical use of 3D-printed impression trays within the digital protocol has been confirmed.
5. The advantages (timesaving, standardization, predictability) and limitations (need for clinical adaptation, variability in some methods) of the digital protocol in full-mouth prosthetic rehabilitation have been identified.

Assessment of publication activity

In connection with the dissertation, Dr. **Shekerova** presents 3 publications. This fact proves that the topic developed in the dissertation is his personal work.

The author's summary objectively reflects the dissertation. It is drawn up in accordance to the requirements of the law for the development of the academic staff.

I have no critical remarks on the reviewed thesis.

Conclusion:

The thesis of **Dr. Yordanka Donkova Shekerova** an depth study about **Rehabilitation of complete edentulous patients with complete dentures fabricated through a digital workflow**

The obtained results are valuable for clinical practice and can serve as a basis for future research.

I am confidently giving my positive vote for the award of the educational and scientific degree "Doctor" to Dr. Yordanka Donkova Shekerova.

Plovdiv
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(Prof. Yavor Kalachev, DMD, PhD)