

REVIEW

By: **Prof.Dr. Ventsislav Todorov Tsvetkov, PhD**

Head of ENT Department of Military Medical Academy, Sofia

Member of the scientific jury

Regarding: A defense procedure of **thesis: “Algorithm for clinical application of virtual planning, modelling and 3D printing in local, regional and microvascular reconstructions of complex maxillofacial defects”, for acquiring of the scientific degree “doctor of sciences”, Domain 7. Healthcare and sport, Professional range 7.1. Medicine, Scientific Specialty “Neurosurgery”**

Author: **Assoc.prof.Dr. Nikolay Svetoslavov Yanev, PhD**

Scientific jury Mandate: № РД-26-1325/30.05.2022, of the Managing Director of MHATEM “N.I.Pirogov”, based on article 32, paragraph 2 and 3 from the Statue Book regulations for development of the academic staff in MHATEM “N.I.Pirogov”, according to a resolution of the Scientific Committee, protocol № НД-01-2/18.05.2022 г.

The submitted materials set is in accordance with the Statue Book regulations for development of the academic staff in MHATEM “N.I.Pirogov” – Sofia.

Short CV data

Assoc.Prof.Dr. Nikolay Yanev is a leading maxillofacial surgeon, actively working on the topic of complex surgical treatment of severe oncologic diseases in the facial area, together with different deformations, trauma, complicated inflammatory pathology, temporomandibular joint diseases, etc.

He possesses a double master degree in Medicine and Dental Medicine and a Maxillofacial Surgery (MFS) specialty certificate

He has worked and specialized in the MFS Clinics of the Military Medical Academy - Sofia in the period 2003 - 2005, in the Specialized Hospital for Active Treatment for MFS - Sofia, at the University College London Hospital, the Royal Derby Hospital, as well as in "N.I. Pirogov" University Hospital for Emergency Medicine - Sofia, where he heads the MFS unit. He obtained his doctorate degree after defending a dissertation on the topic: "Mechanism-related pain treatment - experimental models and pharmacological effects" at the Medical University of Sofia and was an associate professor successively at the Department of Pharmacology of the Medical University of Pleven, the Scientific Research Institute of the Medical University of Pleven and in MHATEM "N.I. Pirogov".

He is a member of:

- European Association for Craniomaxillofacial Surgery

- British Association for Oral and Maxillofacial Surgery
- The General Medical Council of UK
- European Board of Oral and Maxillofacial Surgery
- The Scientific Group - SORG
- The Association of Oral and Maxillofacial Surgeons in Bulgaria
- The Bulgarian Medical Union
- The Bulgarian Dental Union

Associate Professor Nikolay Yanev is a national emergency consultant in the field of maxillofacial surgery in Bulgaria and regularly participates in interdisciplinary teams on the treatment of complex pathology in the head and neck area, together with specialists in Neurosurgery, Otorhinolaryngology, Plastic and Reconstructive Surgery, Ophthalmology, etc.

Structure of the dissertation

The dissertation consists of: used abbreviations, introduction, literature review, aim and objectives, own research, material and methods, results and discussion, conclusion, implications, bibliography. It is illustrated with 12 tables and 147 figures and is spread over 246 standard pages. The bibliography includes 253 literary sources, 15 in Cyrillic and the rest in Latin.

The aim of the dissertation work is to create an algorithm for clinical application of the methods of virtual 3D planning, modeling and printing in local, regional and microvascular reconstructions of extensive bone defects in the maxillofacial region, after the implementation of the relevant surgical treatment and follow-up of its results.

In that connection, five tasks corresponding to the set goal have been formulated.

1. Systematization of the necessary preparatory examinations and the steps in the process of virtual planning, modeling and corresponding bony maxillofacial surgical intervention.

2. Production of individual 3D jaw models for patients with bone resections and reconstructions and individualization of standard reconstructive implants based on them, as an initial stage of application of digital methods in surgical practice.

3. Complete process of digital planning, modeling, operative simulation, production of surgical transfer guides and 3D patient-specific implants.

4. Intraoperative application of the individualized standard implants according to the produced 3D jaw models, as well as the 3D printed patient-specific implants and surgical guides.

5. Summarizing an algorithm for applying the methods of virtual 3D planning, modeling and printing in local, regional and microvascular reconstructions of extensive bone defects in the maxillofacial region.

Various modern methods are used and standard clinical approaches are systematized; paraclinical methods - incl. laboratory, instrumental, informational, technological and medical-engineering, as well as operational methods in the preparation, surgical treatment and follow-up of patients with reconstructive operations of complex maxillofacial defects.

According to task 1. An initial protocol in our country has been created for a computer-tomographic examination of patients undergoing microvascular reconstructive surgery in the head and neck area, with a donor area in a remote part of the body. This protocol allows the generated image information to be directly exported to the planning server and simultaneously used for the purposes of digital planning methods.

According to task 2. For each patient, Prof. Yanev constructs a patient-specific model, representing one of the first significant achievements of the application of digital methods in the field of clinical surgical practice.

According to task 3. For each individual clinical case, a complete process of generating digital models of maxillofacial pathology, as well as the donor area for microvascular skeletal reconstruction, virtual planning and simulation of the resection and reconstructive phase of the surgical intervention was carried out. Sets of surgical guides were produced to transfer the virtual plan to the real operation.

According to task 4. The individualized standard titanium implants according to the produced 3D jaw models are applied together with microvascular and regional axial reconstructions. When using the reconstructive guides, a very good precision of adaptation to the donor bone structures and absolute matching of the planned position and angulation of the bone graft fixation holes in its position to the patient-specific implant and in its relation to the recipient bone structures were reported.

According to task 5. Based on the acquired clinical experience, Assoc.Prof. Dr. Yanev creates an algorithm for the application of digital-assisted methods in cases of local, regional and microvascular reconstructions of complex and extensive defects in the maxillofacial region.

In the achieved results section of the dissertation, the impressive personal surgical experience of Assoc.Prof. Dr. Nikolay Yanev from the clinical application of virtual planning, modeling and 3D printing both in cases of resections and regional reconstructions, as well as in cases of microvascular operations for restoration of extreme complex jaw and facial defects are presented. Microvascular reconstructive operations are one of the most difficult interventions for surgical teams to perform. The results presented in the dissertation in this regard are impressive, both in terms of one-stage repair of complex defects, and in relation to dealing with intraoperative and postoperative microvascular complications. Aesthetic and functional rehabilitation of patients has been achieved, and the possibilities for detailed preoperative computer planning, which can be carried over in full, in detail, during the actual operative intervention, creates new better possibilities for accuracy, predictability and stability of surgical results. In this regard, the application of the described digital methods in full, in the patient series operated on by Prof. Yanev, is a significant contribution to the development of modern surgery in Bulgaria.

After data analysis and evaluation of the obtained results, between three and four conclusions were drawn for each of the five tasks.

I give a high overall assessment result of the dissertation work and in particular of the eight contributions presented.

Contributions and significance of the dissertation work

1. A specialized protocol has been created for computer-tomographic examination of patients who are to undergo microvascular reconstructive surgery in the head and neck area, with a donor area in a remote part of the body. It allows the generated image information to be directly exported to the planning server and simultaneously used for the purposes of digital planning methods.

2. The first series of fully virtual planned and 3D modeled microvascular reconstructions of extensive maxillofacial defects stabilized with laser sintered patient-specific implants was performed. This clinical project is based on international technological cooperation and Bulgaria's own surgical experience.

3. The application of both individualized standard implants and patient-specific implants with the two main reconstructive methods of complex maxillofacial defects – microvascular and regional axial flaps – has been verified.

4. A series of virtually planned resection and reconstructive surgical guides were applied for the first time in clinical practice in our country for the exact transfer of the virtual plan in each of the performed real operative interventions.

5. A series of innovative hybrid multisegmental mandibular patient-specific implants were virtually designed and clinically applied in fibular microvascular reconstructions, with an implant base restoring the contour of the jaw according to the individual characteristics of the patient and a stabilizing part of the implant allowing positioning of the fibular bone section in optimal alveolar mandibular position, with a view to correct intraoral restoration and dental prosthetics.

6. Two-piece Titan-PEEK mandibular and craniofacial implants were virtually designed, manufactured with combined 3D technology and clinically applied.

7. Virtual planning and clinical application of navigated dental implants in previously virtually planned microvascular fibular reconstructions, stabilized with 3D printed patient-specific implants, was performed.

8. An algorithm was created for the clinical application of the methods of virtual 3D planning, modeling and printing in reconstructions in the maxillofacial area, which could be used on an interdisciplinary basis by all specialists working in this complex area of the human body.

Abstract

The abstract fully meets the requirements and represents in a synthesized form the main structural elements of the dissertation work. A good impression is created by the varied statistical processing of the data, and although its nature is analytical rather than hypothetical, it possesses a high value in terms of the specific clinical details it presents, which are not only innovative but also extremely difficult to obtain, in the specificities of the health system of Bulgaria.

On the topic of the dissertation, 15 publications in specialized scientific publications and 6 participations in scientific forums are presented.

The dissertation fully meets all the requirements of the Law on the Development of the Academic Staff in the Republic of Bulgaria and the Statue Book of MHATEM "N.I. Pirogov", Sofia, for its application.

In conclusion: I give a positive assessment of the dissertation work on the topic "Algorithm for clinical application of virtual planning, modeling and 3D printing in local, regional and microvascular reconstructions of complex maxillofacial defects" and I will vote with a "YES" for **Assoc.prof.dr. Nikolay Svetoslavov Yanev, PhD**, to acquire the scientific degree "Doctor of Sciences" in the scientific specialty "Neurosurgery".

Sofia, June 2022 г.

REVIEWER:

(Prof.Dr Ventsislav Tsvetkov, PhD)