UMF
UNIVERSITATEA DE MEDICINĂ ȘI FARMACIE IULIU HAȚIEGANU CLUJ-NAPOCA

HABILITATION TREATISE

- ABSTRACT -

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Innovative contributions to oral and maxillofacial surgery and implantology

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Summary

Abstract

The habilitation thesis entitled **"Innovative contributions to oro-maxillofacial surgery and implantology"** summarizes my activity following the graduation of my PhD thesis entitled "Possibilities of facial defects and calvaria reconstruction with indigenous biomaterials" in 2007, under the supervising of Prof. Dr. Alexandru Rotaru, confirmed by Order of the Ministry of Education, Research and Youth nr. 3439/12.03.2008 (Diploma series F Nr. 0005448). My doctorate thesis focused on research of improved methods of use of autochthonous biomaterials for craniofacial bone reconstruction, covering a large variety of areas, from bone cysts, dental pathology, post tumor extirpation defects, posttraumatic defects and many others, comprehensively.

The first part of the thesis presents an overview of the academic, scientific and professional activity in the chapters of the first part.

Academic domain

I am currently Associate Professor at the Discipline of Maxillofacial Surgery and Implantology, Department of Maxillofacial Surgery and Radiology (I) of the Faculty of Dental Medicine of the "Iuliu Hatieganu" University of Medicine and Pharmacy from Cluj-Napoca, with twenty years of experience in the academic field.

In this respect, my constant endeavour was to improve my teaching and professional skills. I also developed the teaching methods used after graduating a course of a psycho-pedagogy. It enabled my adaptation and allowed me to individualize education required by the students, as well as delivering more attractive and interactive classes.

Since the beginning of my teaching career, I delivered seminars and subsequently courses, seminars and clinical rounds of Oral and Maxillofacial Surgery and Implantology for Dental Medicine students from the Romanian, English and French sections, as well as for the students of the faculty of Dental Technology and students of the faculty of Medicine. I conducted licence theses of students from the Romanian, English and French sections.

I strived to update the students and residents on information about the entire scope of their curriculum.

This ongoing improvement of the teaching materials according to the current standards in this field as well as research and development novelties was added to a rich clinical case presentations data base, all intended to convey knowledge that founds the formation of a professional in our domain.

I encouraged permanent and open communication with students and residents, and was involved and committed to answer their requests and conciliate their concerns. I also endorsed participation of students and residents in research, and in pursuing academic careers.

I edited, authored and coauthored books and chapters in national and internationally acknowledged Publishing Houses, as well as monographs.

The list of textbooks is enclosed in the thesis and comprises 14 authored or coauthored books and book chapters (an international textbook, one national textbook, 5 national books, 7 national book chapters).

Research activity

I obtained my PhD diploma in 2007 for the doctoral thesis entitled "Possibilities of facial defects and calvaria reconstruction with indigenous biomaterials" under the coordination of Prof. Dr. Alexandru Rotaru.

Over the last period I continued to develop strategies for extending my innovation and development work in research projects, in order to expand the study on biomaterials, titanium craniofacial and dental implants, orthognathic surgery of oral and maxillofacial deformities, stem-cell based tissue engineering, to name only a few.

To this end, I was committed to creating research and collaboration teams among specialists from related fields, such as orthodontists, radiologists, dentists, ENT surgeons, neurosurgeons, oncologists, as well as physicists, chemists, mechanical engineers, biomaterial engineers etc.

I published 74 ISI indexed papers from the beginning of my career (72 after my PhD diploma). I also authored 39 publications indexed in international data bases. The impact of the research work is outlined by an h-index of 12 according to Clarivate Analytics Web of Science Core Collection.

I am member in various scientific and professional societies, including the Romanian Society of Oral and Maxillofacial Surgeons (SRCOMF), the European Association for Cranio-Maxillofacial Surgery (EACMFS) and International Association of Oral and Maxillofacial Surgery (IAOMS).

Between the year 2007 and 2020, I participated as lector and chairman in over 100 local, national and international scientific manifestations including courses, congresses, conferences, and symposiums, thus contributing to increasing the visibility of our university.

I also activated as member and vice-president in the organizing committee of numerous congresses with international participation.

I was responsible in charge for our university in a national research project, grant won by competition, CEEX Contract nr. 21/2005, PC-D, entitled: „Development of research activity and infrastructure for implant-prosthetic innovative therapies using distration and guided bone regeneration (OSTEOMAX)" (2005-2007).

I developed multidisciplinary research teams, which were activated in the research projects.

I also was member in the team of 14 research and institutional grants, which are detailed in a table in the treatise.

Three of these projects were international research projects, as follows:

- European Frame Program 7 Project - SEDENTEXCT (list of participants: Project Partners | SEDENTEXCT). "Enhanced Safety and Efficacy of New and Emerging Dental X-ray Imaging " (SEDENTEXCT), grant agreement no. 212246 (2008-2011)
- European Frame Program 7 Project – SME - 2011 "The Direct Manufacturing of Personalised Implants using Selective Laser Melting, IMPLANT DIRECT" (2012-2014)
- European Frame Program 7 Project - grant agreement no. 604984 code: FP7 OPERRA, „**D**entomaxillofacial paediatric **im**aging: an **I**nvestigation **t**owards low dose **ra**diation induced risks (DIMITRA)" - „OPERRA - Open Project for the European Radiation Research Area" (2014-2017).

The treatise describes the main areas in which we conducted the research. Thus, a first field refers to the optimization and quantification of the osseointegration process of titanium implants and its alloys. To this end, we have developed study directions regarding the surface treatments of titanium implants and alloys, as well as the physico-chemical properties of the Ti6Al7Nb alloy.

We analyzed and innovated surface treatments designed for Ti6Al7Nb implants, but also the manufacturing of Ti6Al7Nb implants through SLM. Following the research outcomes we performed in vivo testing of implants with surface treatments and quantification of the osseointegration process by innovative methods. We also developed a specific histological examination protocol for micro-CT examination and BMD determination, the results of which are shown below.

Another research direction was the investigation and quantification of the quality of osseointegration of implants with surface treatments by SEM and EDX. We substantiated this analysis protocol by evaluating the quality of the investigation with SEM examination (Scanning electron microscope), EDX examination (Energy-Dispersive X-ray Spectroscopy) and determining the Ca / P ratio by EDX and the importance of quantifying this ratio to determine osseointegration.

A priority area for me in recent years has been comparative clinical and histological studies on the use of ceramic implants versus titanium implants in oral implantology.

We have also expanded our research in the field of custom implants manufactured by SLM, and in the reconstruction of complex 3D defects in the maxillofacial sphere.

For this approach we researched various rapid prototyping techniques (Additive Manufacturing). We also studied SLM materials that can be used in the medical industry and the stages of making a prosthesis using the SLM technique.

These studies allowed me to continue the research in the multidisciplinary team for the manufacturing processes and use in medical practice of customized 3D implants manufactured by SLM. For this purpose, we substantiated an original working hypothesis for the use of customized implants, including innovative details about the design of the implant and its manufacture. The thesis also presents the results obtained after the application of this customized implant.

Orthognathic surgery for maxillofacial deformities is another priority area of our team's research. This thesis includes several studies related to the optimization and evaluation of the results of interventions in orthognathic surgery.

Closely related to disorders associated with maxillofacial deformities, we also conducted studies connected to the improvement of the obstructive sleep apnea syndrome (OSAS). We analyzed the prevalence and risk factors of this syndrome, as well as elements of orthodontic treatment associated in the surgical-orthognathic management of OSAS. Thus, we deepened the evaluation of mandibular advancement devices (MADs), Tongue Retaining Mouthpieces (TRDs) and transposed the findings to the management of the patient wearing oral devices in order to improve the surgical management of patients with OSAS.

Another area of interest for our team are TMJ disorders and dysfunction. In the context of the sustained activity in orthognathic surgery, we also conducted studies related to the evaluation of the changes induced by orthognathic surgery at the level of the temporomandibular joint, as well as the evaluation of the effects of orthognathic surgery interventions on the muscles. Following the analysis of large groups of patients we were able to optimize surgical approaches in orthognathic therapy and elaborate a treatment protocol with customized features of orthognathic treatment.

Professional activity:

I am Senior Physician and Head of the Oral and Maxillofacial Surgery Clinic of the Emergency Clinical County Hospital in Cluj-Napoca. I have also been member of the Administration Council of this hospital and president of this body since December 2020. I continuously strive to improve my surgical capabilities and academic ranking, by participating in formation and specialization courses, as well as exchange programs with many countries with traditional performance level in OMFS and implantology of high renown.

In these fields of work, I managed to accumulate expertise (from my exchange programs in Germany, France, Switzerland, Israel), aiming continuously for progress of our specialty.

As member in professional societies of oral and maxillofacial surgery, both national and international, I have constantly worked on the progress of our specialty. I am also founder member and president of the Society of Orthognathic Surgery from Transylvania („Societatea de Chirurgie Ortognatica din Transilvania"), founded in 2020.

I also participated in courses and conferences, which enabled me to improve and develop surgical therapies, including multidisciplinary protocols.

The second part of the thesis comprises the description of the plans for the evolution and development of the academic, scientific and professional career, the directions for future development in the domains of research, teaching and professional field and the practical applications of the action plans.

Academic activity

In the **academic, didactic field**, in the following years I will focus on:

- Improving the education and training methodology for the students of the Faculties of Dental Medicine and Medicine of the "Iuliu Haţieganu" University of Medicine and Pharmacy Cluj - Napoca, as well as for postgraduate studies and residents;
- Encouraging and direct involvement in research projects of young PhD students and even students;
- Projects of professional orientation and career support of the students of the faculty of Dental Medicine but also of the graduates;
- Contribution to maintaining the top ranking of our university among those in the country but also abroad, ensuring the high level of training of graduates of our university
- Implementation and capitalization of research results in education and training, as well as in practice;
- Training of students, master students, residents and doctoral students offering the most advanced therapeutic protocols in the field of oro-maxillofacial surgery and implantology

Research activity

In the field of **scientific research**, I intend to continue and expand the domains of expertise, but also to develop other research topics. The way I intend to develop them with our teams, following the previous results obtained or in future studies, as well as assigned priorities are described below.

- I will continue to permanently develop current research strategies, as well as new directions, by setting up research teams in the field of oral and maxillofacial surgery, as well as related fields, focused on clearly defined directions but also by encouraging young researchers and faculty
- Creating cooperation networks and partnerships with researchers from our institution but also from other centers
- Improving the protocols implemented in orthognathic surgery to obtain the best results, reducing postoperative discomfort and shortening therapeutic times;
- Increasing the quality of orthognathic surgery through the widespread use of new imaging methods and virtual planning of individual solutions, including for the correction of asymmetries and post-traumatic sequelae
- The use of 3D printed models contributes to the significant reduction of the effort and of the operative time, of the difficulty of the intervention through the correct preoperative personalized planning, by the realization of reliable surgical guides. This implicitly

increases the quality of results and performance from a functional and aesthetic point of view.

- Improving the symmetry obtained by using modern 3D planning for the optimal result (bone level and appearance and functionality of the soft tissue)
- New types of dental implants with superior biological, mechanical and aesthetic properties, which are not only biocompatible but even bioactive;
- Continuation of research to improve the osseointegration of titanium dental and craniofacial implants, including 3D printed ones, as well as zirconia dental implants
- Introduction of the progress obtained in 3D printing in current practice
- Study of biomaterials with improved parameters for bone and soft tissue reconstructions in the maxillofacial area, for faster, more predictable and more stable results;
- Continuation of stem cell studies;
- Increase frequency of application of osteodistraction techniques in oral implantology, with the reduction of the current inconveniences of these types of treatments;
- Improving diagnosis and planning in orthognathic surgery and implantology with the help of CBCT;
- Studies to obtain improved biological results in oral implantology through the use of nanotechnologies;
- Production and optimization of production processes but also of mechanical and biological parameters in the case of customized implants;
- Improving treatment protocols in the temporomandibular disorder syndrome, arthroscopic interventions;
- Improved neuroregeneration in the maxillofacial area
- Dissemination of research results in national and international scientific events
- Presentation of the results of studies in scientific publications in national and international journals, in international databases and listed on the Web of Science, in order to increase the international visibility of the department but also of our university.

Professional activity

As **professional** taks for the future, I will elaborate together with our team on the following topics in oral and maxillofacial surgery, to continue our previous and ongoing studies, as well as focusing on:

- Offering the highest quality surgical treatments and medical care, based on the latest and best performing protocols in all our fields of activity
- Increasing the quality of planning in orthognathic surgery by using new ways to establish the position of the temporomandibular joint (TMJ)

- Improving the results of orthognathic therapy by improving the detection of asymmetries and the determination of reference plans and landmarks
- Improving therapeutic results by increasing the accuracy of the manufacture of surgical models and splints in the field of traumatology and oral and maxillofacial deformities. This technique can also be of real value in the reconstruction of posttraumatic sequelae for establishing the osteotomy location and the degree of correction needed. A more precise restoration of facial symmetry is desirable in such patients, as well as optimal functional recovery.
- Increasing the ability to predict results by using soft tissue simulation software as well as imaging techniques to detect bone interference by virtually simulating individual osteotomies.
- Another direction addressed for improvement is the management of facial deformities using 3D planning. For optimal outcomes regarding the shape of the reconstructed region, both the bone contours and the soft tissues need to be restored.
- Continuing to implement the results of research projects in practice, "from bench to bed" in oral and maxillofacial surgery, as well as in implantology
- Dissemination of professional results in national and international interdisciplinary conferences and meetings.