

**“VICTOR BABEȘ” UNIVERSITY OF
MEDICINE AND PHARMACY OF TIMIȘOARA
DOCTORAL SCHOOL
DENTAL MEDICINE DOMAIN**



HABILITATION THESIS

**MODERN INTERDISCIPLINARY RESEARCH
IN THE FIELD OF DENTAL MEDICINE**

ABSTRACT

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ABSTRACT

The present habilitation thesis entitled “**Modern Interdisciplinary Research in the Field of Dental Medicine**” reflects on my post-doctoral research work, along with my academic and professional achievements. My scientific activity has a profound interdisciplinary character, proven by the fruitful collaborations over the years with many departments and academic institutions in the country and abroad, from various fields of study: orthodontics, paediatric dentistry, dental aesthetics, genetics, histology, dental prosthetics, implantology, dental materials, orthognathic surgery, toxicology and drug industry, medical and mechanical engineering etc. In modern dental medicine, interdisciplinarity is essential to integrate valuable knowledge regarding the diagnosis, treatment planning and the therapeutic approach from multiple domains, especially when we have to address complex non-syndromic or syndromic cases. Interdisciplinary research, education, and practice bring together insights from diverse domains to foster innovation, and collaboration in order to maintain high standards of health and safety for our patients.

The results of my post-doctoral collaborations have been published in numerous scientific articles in national and international journals: 49 articles in journals indexed in WoS (ISI impact factor journals); 44 articles in journals indexed in international databases; one ISI Proceedings article; 13 abstracts in journals indexed in WoS (ISI impact factor journals); 40 abstracts in journals indexed in international databases.

My scientific activity was complemented by 116 scientific works presented at national and international scientific events (posters, oral presentations and conferences). I also authored and co-authored four books, one manual for students and three chapters in published books which covered a range of topics in orthodontics, genetics and public health for students, residents, specialists and Master of Science students.

My Hirsch Index has a value of 8, with a total of 184 times cited (175 without self-citations) according to the citation report on Web of Science (Clarivate, September 2024).

The first section of the habilitation thesis comprises the most relevant results of my scientific endeavours which have been focused on four major directions, namely, the interdisciplinary scientific research in the field of biomaterials and medical

bioengineering, clinical and technical aspects related to the use of implants in dental medicine, innovative methods and analysis assays of synthetic compounds frequently used in dental medicine, and craniofacial and dentoalveolar morphology in orthodontic patients.

Subchapter 1.1. addresses my interdisciplinary scientific research in the field of biomaterials and medical bioengineering, especially in the field of ceramic materials, polymers and alloys used in dental medicine.

The use of biomaterials in dentistry involves a combination of expertise from fields such as materials science, biology, chemistry, and engineering. Biomaterials have a wide range of rapidly increasing applications, with different biomechanical properties required for various uses.

In prosthodontic dentistry, the combination of minimally invasive tooth preparation techniques and the use of feldspathic ceramics provide clinicians with a conservative alternative to classical dental restorations. In this regard, we focused on vertical preparations and no-prep approaches, in order to assess the survival rate, failure modes, and aesthetic outcomes of feldspathic veneers.

In the field of cosmetic dental medicine, lithium disilicate ceramics have gained popularity as a viable option for the manufacturing of retainers because this material combines both durability and aesthetic properties, therefore we investigated the survival rate of full-contour lithium disilicate retainers in conjunction with layered lithium disilicate restorations, in post-treatment orthodontic patients.

Regarding the dental polymers, several aspects related to biomechanical properties are presented in this section of the thesis: the wear resistance of vacuum-formed retainers made from PETG (polyethylene terephthalate glycol) under high load forces; the mechanical characteristics of thermoplastic and thermos-set resins utilized in orthodontic appliances, focusing on their surface hardness and indentation elastic modulus; the influence of three types of artificial saliva on the failure load of the elastic ligature; the effects of different disinfection and sterilization protocols on the mechanical properties of 3D-printed surgical guides for orthodontic implant placement, fabricated using SLA (stereolithography) and DLP (digital light processing) technologies, to determine which of the sterilization or disinfection methods least affected the clinical performance of the surgical guides.

The following part of the thesis presents the most relevant research on the biomechanical properties of dental alloys, particularly: the mechanical properties,

surface characteristics and coating stability and force levels of as-received and retrieved coated and regular NiTi archwires; the load-deflection ratio of epoxy-coated NiTi coil springs compared to uncoated springs, highlighting potential variations in the manufacturing processes of coated springs between different manufacturers; the tensile and shear breaking force of laser and TIG (tungsten inert gas) welded joints, focusing on their application in joining stainless-steel orthodontic bands and buccal tube attachments without filler material, providing insight into the practical aspects of using these welding methods under various clinical conditions including patients with parafunctional habits who may exert higher bite forces.

Subchapter 1.2. includes research on clinical and technical aspects related to the use of dental implants and orthodontic mini-screws.

One of our main objectives was to compare the insertion torque values and the changes in surface morphology between new, unused mini-implants and mini-implants subjected to different cleaning and sterilization methods after their insertion in pig mandibular bone.

We also assessed the effect of using fewer drills for implant osteotomies on peri-implant crestal bone levels in human patients over a one-year period and we analysed the connection between the diameter of the implant, marginal peri-implant bone loss (MBL), and the survival rate of 6-mm implants.

Subchapter 1.3. introduces a range of innovative methods and analysis assays of synthetic compounds frequently used in dental medicine (octenidine, cetylpyridinium chloride, povidone-iodine, and sodium hypochlorite), with the goal of enhancing the quality of care and the comfort of the patients. We also explored the safety profile, potential cytotoxicity and irritant effects of chlorhexidine digluconate on various cell lines, including immortalized human keratinocytes (HaCaT), human gingival fibroblasts (HGF), and epidermal cells (JB6 Cl 41-5a), along with its irritant action on the chorioallantoic membrane (CAM) in ovo.

Because of the rising interest regarding the use of chemo mechanical caries removal (CMCR) methods as a response to the increasing demand for aerosol-free and minimally invasive dental procedures, especially in paediatric dentistry, we focused our attention on investigating the global development and interest in CMCR methods, specifically analysing the literature on two commonly used compounds Carisolv and BRIX3000. By utilizing bibliometric analysis tools like VOSviewer, the

study examined trends, keyword co-occurrences, and the collaborative networks among authors and institutions.

In the final **subchapter 1.4.**, we concentrated on the changes that occur in craniofacial and dentoalveolar morphology in orthodontic patients. One of our goals was to evaluate the skeletal and dental changes in growing patients with Angle Class II division 2 malocclusion, utilising several cephalometric from the Björk-Jarabak and Tweed's analyses.

As arch dimensions change with growth, it is important to differentiate between changes caused by natural growth and those induced by orthodontic appliances, therefore, another research direction of ours involved the assessment of the effects of rapid palatal expansion using a two-arm palatal expander on dento-alveolar and skeletal morphology, using several metric and angular measurements before and after expansion: interpremolar and intermolar width, molar rotation and tipping, alveolar tipping and palatal depth.

The second section presents my academic evolution and main achievements in my teaching career. Over the years I have carried out practical activities in the following subjects: paedodontics, 4th and 5th year – Dental Medicine (2008-2014); orthodontics and dentofacial orthopaedics, 5th year – Dental Medicine (2008-2023), 6th year – Dental Medicine (2008-present) and 6th year – Dental Medicine in English (2017-present); technology of orthodontic appliances, 3rd year – Dental Technology (2021-present).

More than a decade ago, I introduced the optional course “Principles of Interdisciplinary in Orthodontics” for the dental students in the 6th year, and the optional course “Behaviour Management in Dental Medicine” for the dental students in the 4th year.

In order to harmonize the students' knowledge with the new trends in the field, I proposed the introduction of two new optional courses, which were already approved and will be taught in the following years. The optional course “Modern Concepts in Orthodontic Technology” will be addressed to 3rd year students from the Dental Technology study program, while the optional course “Modern Concepts of Prophylaxis Assistance in Orthodontic Practice” will be addressed to 3rd year students from the Dental Prophylaxis Assistance study program. The main objective of these courses is to familiarize the students with the digital technologies implemented in modern orthodontics.

Since 2014, I have been teaching and continually improved the "Orthodontics and Dentofacial Orthopaedics" course for the 6th year students from the Dental Medicine study program, and since 2017, I have also been teaching for the Dental Medicine in English study program. Since 2021, I teach the mandatory course "Technology of Orthodontic Appliances" for the 3rd year students from the Dental Technology study program. The course curriculum has been updated in accordance with the progress of modern dental medicine and dental technology.

My scientific and academic achievements were possible because of my professional training period presented in **the third section**. Thus, my professional evolution included several qualifications and achievements: Doctor of Dental Medicine (DMD) – Faculty of Stomatology, “Victor Babeș” University of Medicine and Pharmacy of Timișoara; Competence in preventive dental medicine; Senior specialist in general dentistry; Senior specialist in orthodontics and dento-facial orthopaedics; Doctor of Dental Medicine (PhD); Competence in oral Implantology; Specialist in paedodontics; Psycho-pedagogical training program Level I and II.

My membership in several prestigious professional organizations, including the European Orthodontic Society, the Romanian Association for Excellence in Orthodontics, and the International Association of Paediatric Dentistry, allowed me to stay informed, connected, and at the forefront of the profession. I participated in over 40 postgraduate specialization courses in orthodontics, periodontology, implantology, endodontics, dental aesthetics, and radiology. In summary, my professional activity reflects a deep dedication to excellence in dental medicine in general and orthodontics in particular.

The last section focuses on my scientific, academic and professional perspectives.

Scientific Perspectives

I consider that interdisciplinarity and innovation are an integral part of scientific research, playing a significant role in the medical and dental training of our students, therefore I intend to continue developing the following research topics: biomaterials and medical bioengineering (nanotechnology and its applications in the field of orthodontics, improving the antibacterial properties of orthodontic resins; smart polymeric materials; the biomechanical performance and surface properties of orthodontic implants); digital technologies in dental medicine (3D and artificial intelligence (AI) driven cephalometric analysis; digital treatment planning; 3D intraoral

scanning; 3D photography; CBCT for improved diagnosis and treatment planning, pre-surgical planning for orthognathic surgery and implant placement; 3D printing technologies); lasers in orthodontics – soft and hard tissues applications and laser-sintered orthodontic appliances; innovative methods for the analysis of compounds used in dental medicine; craniofacial and dentoalveolar morphology in non-syndromic and syndromic patients.

I aim for realistic objectives, as feasible as possible, and therefore, I consider that the active involvement in multidisciplinary national or international research teams facilitates the achievement of many relevant goals: increase the scientific reputation of the department, faculty and university, while addressing scientific research topics of interest; attract public and private funds for financing research, as well as identifying sources to consolidate financial independence; continue conducting research on the topics discussed in my doctoral thesis; establish strategic research areas that also involve inter- and transdisciplinary components; valorise future research results by publishing them in high ranked (Q1 and Q2) ISI (Web of Science) indexed journals, in PubMed or other BDI indexed scientific papers, in journals from traditional medical centres etc.; organize scientific events in collaboration with national and international professional organizations or non-governmental organizations.

Academic Perspectives

I intend to continue enhancing the curriculum and teaching methods at “Victor Babeș” University of Medicine and Pharmacy of Timișoara, aligning them with European standards and fostering an integrative and multidisciplinary approach in dental education. I plan to develop new didactic materials and to re-edit existing ones, ensuring that the latest scientific advances are incorporated into the educational framework. I am committed to promoting the professional development of young researchers and maintaining high standards of academic excellence.

These are some of my future perspectives regarding of my academic career: promote active-participatory methods centred on the student; improve the teaching techniques and facilitate the transmission and accumulation of information; diversify the evaluation techniques, with a focus on student performance and acquired competencies; motivate students in the complex learning process; implement programs that ensure continuity in the training process of the future dentists, dental technicians and post-graduate residents; promote innovations and strategies for improving the curriculum in the field of dental medicine; promote educational exchange

programs; develop the practical and social skills of students and residents; focus on the quality assurance in learning and teaching in higher education; capitalise on my professional, teaching, and scientific experience for the future coordination of PhD students.

Habilitation has the potential to open a new stage in my academic career, facilitated by my previous experience, competence, involvement, and loyalty towards the institution where I was trained. In the new capacity that I hope to acquire, I intend to coordinate the activity of PhD students and channel their research towards the latest trends and discoveries in the field of dental medicine.

Professional Perspectives

My main professional objective is to promote innovation and new developments in science and technology within our university clinic, to implement new working methods, to foster innovative thinking and to maintain a stimulating working environment for my colleagues and collaborators, in order to increase the quality of medical care, specifically the quality of the results and the efficiency of orthodontic treatment, patient satisfaction and comfort.

I have set myself the permanent goal of continuing my professional development by continuously improving my knowledge in the field of dental medicine in general by collaborating with my colleagues, my residents and future PhD students in new projects and by actively engaging in postgraduate specialization courses.

Last, but not least, I want to consider the social implications of orthodontic care, particularly for underprivileged or socially disadvantaged cases. Therefore, I will try to the best of my abilities, along with the help of my students, residents and collaborators, to be part of programs that increase the access to dental and orthodontic care, emphasising the need for preventive and interceptive measures, especially for the young population in our community.