

ABSTRACT

The habilitation thesis, titled “**Models, simulations and applications in pediatric dentistry and orthodontics,**” presents, in a synthetic and well-documented manner, the results of the scientific research, teaching activities and professional accomplishments achieved since being conferred the scientific title of Doctor, as well as my career development plan, based on my accumulated and attested experience in **the field of Dentistry**. The objective of this thesis consists in **obtaining the certificate for conducting doctoral research** within I.O.S.U.D of the University of Medicine and Pharmacy of Tirgu Mures.

The first part of the habilitation thesis has been structured in four subchapters, devoted to the presentation of the most relevant professional, scientific and academic accomplishments: five research projects won in competitions and carried out after the completion of my PhD, classified according to research directions; contributions brought to the processes of equipping and developing the department of paediatric dentistry and the special library (developed and implemented software, books, articles); research management activities.

Transposing clinical realities and phenomena through computerised simulation has required the permanent development of the computer systems in the field and has opened new research and applicability directions: computerised projection and modelling of dental structures; simulation of tooth movement; orthodontic biomechanical reactions. The major advantage of computerised simulations consists in the possibility of anticipating tissue reactions, which occur during treatment, on the basis of the specific data and configuration of the initial situations. At the same time, the process analysis of stress and structurally induced deformations allows adequate orthodontic rehabilitation through the implementation, at the propitious moment, of corrective actions, with the view of avoiding iatrogenesis or limit situations: reducing the intensity of forces, rehabilitating the periodontal support, adopting therapeutic breaks, in mutual agreement with the patient.

Subchapter 1.1. “Implementation of modern methods of modelling and numerical simulation in orthodontics” presents the modern and innovative approach to investigating biochemical reactions which occur at the level of dento-periodontal structures, under the action of orthodontic forces. The conducted research was based on The Finite Element Method, a numerical analysis method which allowed the extremely precise identification of structural stress and of deformations; in the case of applications and simulations, we used the ALGOR analysis programme, which offered the possibility of modelling and structure analysis, as well as the advantage of processing the CAD files of various types.

In *Subchapter 1.2. “ Experimental research on biochemical reactions during orthodontic tooth movement,”* the phenomena occurring at the level of dento-periodontal structures under the influence of some orthodontic forces of known intensity were analysed and compared, from quantitative as well as qualitative perspectives. The results which are relevant for the interpretation of biomechanical reactions were: deformations after the direction of the force-action, the stress resulting from the three-dimensional space, the stress after the direction of the force-action.

The quantification of the biochemical reactions following the application of orthodontic force and the development of comparative studies regarding tooth behaviour in the adult patient with various degrees of alveolar bone resorption has constituted the objective of the research presented in detail in *Subchapter 1.3. "Biomechanical applications and numerical correlations in the orthodontic treatment of the adult patient."*

The research topic titled "Oral complications in children with malignant diseases," approached in an interdisciplinary context – paediatric dentistry and paediatric haematology-oncology – was investigated within two research projects, won in competitions. In *Subchapter 1.4. "Clinical and radiological studies regarding oral complications in children suffering from acute leukemia. Computer-based applications,"* the following activities and obtained results are presented: the prevalence and distribution of tooth development disorders; tooth decay intensity; defects in the mineralisation of the enamel structure; eruption episodes of permanent teeth; development and implementation of the OROMON computer-based system, a database which allowed data management and processing, as well as the final statistical analysis.

In the **second part** of the habilitation thesis, following the personal experience accumulated, I have outlined the objectives for the development of my professional, scientific and academic career and I have identified three **future research directions**, within the current context of scientific accomplishments (a research project approved for financial support within the UEFISCDI-PNCDI III competition – Demonstrative Experimental Project 2016 and a project submitted to the CIGCS 2016 competition at UMF Tîrgu Mureş): the identification of risk factors involved in the modulation of genetic predisposition in severe early childhood caries (S-ECC); the process analysis of oral mucositis in children with malignant diseases; new solutions for the orthodontic mini-implants through technologies of electrochemical anodising for the development of nanostructured coatings based on TiO₂.

My aim consists in the development of paediatric dentistry education, with its centre of excellence at Faculty of Dentistry, within The University of Medicine and Pharmacy of Tîrgu Mureş and I support the development of the department of paediatric dentistry, which I supervise within the Faculty: the introduction of inhalation-sedation methods for children with anxiety and the creation of a department devoted to dental treatment of children with special needs. Also, considering the current international teaching approach, represented by the introduction of programmes and equipment for simulation of conventional reality and virtual reality, I consider it propitious to support the development of practical activities within the department of paediatric dentistry, through the implementation of simulation methods. I assume my involvement in elaborating the project "Centre for Conventional and Computerised Simulation in Dentistry" within the Faculty and I consider that fulfilling this objective will contribute to a higher quality of the educational process and to forming graduates with a high level of professional competency.

Part Three of the habilitation thesis contains bibliographical references for the previous two sections of the thesis.