

ABSTRACT

The habilitation thesis entitled "**Current trends in the study of materials and orthodontic diagnostic methods**" summarizes the professional achievements obtained after obtaining my Ph.D. degree, as well as the development plan of my scientific, didactic and professional career in the field of Dental Medicine.

In the **first part** of the habilitation thesis, structured in five chapters, are presented the main scientific research activities carried out in the field of orthodontic materials and the different diagnostic methods used in orthodontics. The second part of the thesis describes the plans of professional career development, focusing on the objectives and describing the main activities for their realization.

The orientation of my scientific research was mainly the study of the biomechanical properties of the materials used in orthodontics and the risks they can represent to dental and periodontal structures. I also consider that one of the prerequisites for a successful orthodontic treatment is the correct and complete diagnosis of each individual case. Thus, determining the role of modern diagnostic methods, as well as the importance of the digital planning, has been a significant part of my scientific concerns.

In the first sub-chapter the research was focused on the roles of modern methods of diagnosis and planning in fixed orthodontic treatment: three-dimensional evaluation of the upper airways, the position of the mandibular condyle, the efficiency of the use of digital planning and the visualization of therapeutic goals (VTO), exemplifying these methods in an interdisciplinary treated clinical case of hypodontia. Digital tools have proven useful, predictable, and effective, making the treatment steps easier and less time-consuming.

The *second part* of the first chapter included the studies of the aesthetic and classical nickel-titanium open-coiled springs, vestibular attachments and wires used as fixed retentions. Their mechanical properties (fracture resistance, modulus of elasticity, rigidity) have been tested using special testing machines and conditions that simulate as closely as possible the conditions



of their intraoral use. Research results have shown that aesthetic coating affects the rigidity of NiTi open coil springs, with statistically significant differences between springs with the same characteristics but different manufacturers. Also, our studies showed that although both welding techniques used in vestibular attachments have proven to be appropriate, the detachment of welded joints could occur if the welding surface is not increased, and the mechanical properties of the braided wire used as a retention change during intraoral use.

The *third sub-chapter* had as study objective the orthodontic mini-implants, both in terms of insertion torque values and changes in their surface properties. New, used, and sterilized implants have been compared, and the conclusions are that different cleaning and sterilization methods have different effects on the insertion torque. Not all cleaning methods are recommended in terms of surface topography, some significantly altering the mini-implants. Once inserted, the mini-implant properties are significantly changed, any re-use should be considered with caution.

Sub-chapter 1.4 tried to elucidate the properties of orthodontic devices obtained by modern manufacturing methods, three-dimensional printing, and vacuum-forming, simulating various conditions of use and sterilization. Surgical guides printed by SLA and DLP methods used for inserting palatal mini-implants are new devices, relatively recently introduced in orthodontic practice, so the importance of testing them was explained. There are demonstrated differences in methods and materials used, but also in the sterilization effect on them. The major advantage of mobile devices remains the possibility of hygiene, thus reducing periodontal consequences.

Studies in *sub-chapter 1.5* focused on the risks and complications of fixed orthodontic treatment in terms of carious lesions, enamel microhardness, alveolar bone modifications and root resorption. Orthodontic treatment has the possibility to improve aesthetics and function of the dental system, but it can be potentially harmful if basic principles are not respected during the treatment.

The second part of the habilitation thesis presents my plan for professional, scientific, and academic career development, presenting both the achievements obtained so far from the



teaching, academic and scientific research activity and the critical success factors that will help me achieve the proposed objectives. Proposed objectives and future directions of scientific research are described in detail. The proposed research topics are the study of the correlation between radiologically determined skeletal maturation and the level of hormones in the puberty period to optimize orthodontic treatment and the study of the zygomatic arches morphology and their reproduction by three-dimensional printing methods for the development of a predictable protocol for the insertion of zygomatic plates.

In the third part of the habilitation thesis are presented the bibliographical references associated with the two sections of the habilitation thesis.

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