

UNIVERSITY OF MEDICINE, PHARMACY, SCIENCE AND
TECHNOLOGY „GEORGE EMIL PALADE” FROM TÂRGU-MUREŞ

DOCTORAL STUDIES SCHOOL

DOCTORAL THESIS SUMMARY

CLINICAL AND BIOMECHANICAL STUDIES ON THE EFFECT OF MOBILE ORTHODONTIC APPLIANCES ON DENTAL STRUCTURES

PhD candidate Alexandru Ştefan Zalana

PhD Coordinator Prof. Univ Dr. Mariana Păcurar

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FARMACIE, ŞTIINŢE ŞI TEHNOLOGIE
„GEORGE EMIL PALADE”
DIN TÂRGU MUREŞ

Introduction: The increasing frequency of dento-maxillary anomalies determines the presence of patients in orthodontic practices for specific treatments, fixed appliances being more in demand in adolescents and adults, and mobile devices for younger patients. Painful sensation accompanied by discomfort and embarrassment when chewing are the most common side effects of orthodontic treatment. To these are added the aesthetic aspect related to the visibility of the device, as well as some side effects related to gingival recession, root resorption and traumatic or allergic lesions of the soft parts.

The action of mobile and fixed orthodontic appliances lies in changing the balance of existing dento-facial forces, by setting in motion a force / group of artificial forces or by facilitating and selectively directing the action of natural forces. Such forces have their starting point in: the properties of the materials from which the orthodontic appliances are made (elasticity of wires / rubber rings, etc.), the construction features of the orthodontic appliance and the inter-relationship of the orthodontic appliance with the elements of the dento-maxillary appliance.

The aim of the doctoral thesis was to compare the mechanical properties and surface properties of orthodontic springs used in making mobile devices by various methods, analyzing the corrosion phenomenon to which these springs are subjected in the oral environment. The idea of this research started with the "Smile Mobile" Project, launched by the Bucharest City Hall and which consisted in applying mobile devices such as palatal and lingual plates to a group of children with dento-maxillary anomalies belonging to Gymnasium Schools in Bucharest.

This **thesis comprises six studies:** three - in the general part and three - in the personal research part.

1. In the first chapter of the general part we presented, based on recent data from the literature, a summary of the principles of action of mobile orthodontic appliances, with emphasis on the description of active elements in wire, which trigger orthodontic forces at the dento-periodontal level.

2. The second chapter described some aspects of pediatric psychology, the motivation and intrinsic mechanisms of the doctor-patient relationship.

3. The third chapter presented some of the mechanical and surface properties of orthodontic arches, as well as the principles underlying orthodontic biomechanics.

The motivation of the research is presented in the second part - "**Personal Contributions**" - and is related to the need to assess the perception of a group of school patients included in the "**Smile Mobile**" Project launched by Bucharest City Hall through the Bucharest Hospitals and Medical Services Administration (A.S.S.M.B.). A clinical-statistical study was performed on the perception of mobile orthodontic appliances by patients and their possible adverse effects on the oral mucosa.

The first personal study was conducted based on QUESTIONNAIRES which were distributed to a sample of 63 subjects with 15 questions to identify patients perceptions of mobile devices and how they influenced their dental hygiene habits, relationships with colleagues, etc. Patients in the study had to complete an informed consent, signed by the parent or legal guardian.

The second study was an experimental one, performed on the mechanical behavior of orthodontic arches exposed to the environment in the oral cavity, in collaboration with the Faculty of Mechanical and Mechatronics Engineering, Department of Mechatronics and Precision Mechanics at the Polytechnic University of Bucharest. We compared the tensile

strength and the bending / shear strength of the orthodontic springs of Ni-Cr and Co-Cr used in making the wire elements of mobile orthodontic appliances of different diameters immersed in solutions similar to those in the oral cavity: artificial saliva, respectively artificial saliva and cola, at different time intervals, in order to quantify the optimal parameters of orthodontic force onset. We considered the null hypothesis that the properties of springs are not influenced by the oral environment.

The third study evaluated the corrosion behavior of orthodontic wires: stainless steel and Cr-Co by immersion tests, taking into account the principle that the corrosion resistance of an alloy determines its biocompatibility. The morphology and elemental composition were investigated using a scanning electron microscope - SEM equipped with an energy dispersion spectrometer - EDS, and the corrosion phenomenon was evaluated by immersing the wires in artificial saliva and artificial saliva with cola. The study was conducted with the support of the team from the Faculty of Materials Science and Engineering, Polytechnic University of Bucharest.

The results of the research were compared with recent data from other studies published in the literature and the clinical relevance of the studies is given by the fact that chromium-based alloys are recommended as the material of choice in making wire springs for mobile devices. Ni-Cr or Co-Cr, with a diameter of 0.7-0.9 mm, which has the lowest deformation under the action of orthodontic forces and a low degree of corrosion.

The originality of this paper consists in **the analysis and evaluation of the structural properties and deformation resistance of two types of materials: Co-Cr and Ni-Cr**, immersed in artificial saliva, as well as in artificial saliva and cola, with the recommendation not to exceed a certain degree of bending that would lead to the deformation of the spring, affecting its biomechanical action.

The general conclusions were formulated in a separate chapter.

The recommendation of the practice of a rigorous oral hygiene, with the use of additional means: dental floss, orthodontic toothbrush, fluorinated solutions lead to the reduction of spring corrosion and to minimize the adverse effects of orthodontic appliances, thus contributing to the success of treatment. Also, the correct handling of mobile devices during brushing helps to maintain the mechanical properties of orthodontic springs and reduce surface wear, with the effect of the dental movement imprinted by the doctor in correlation with the type of movement desired.

The corrosion phenomenon of the alloys used in the manufacture of orthodontic springs does not cause dental damage or soft tissue damage, because the amount of particles on the surface of these springs is negligible and is continuously removed by brushing, rinsing, chewing.

The bibliographic references are presented at the end of the thesis, in the order of their citation in the text.