

University of Medicine, Pharmacy, Science and Technology Targu Mureş Doctoral School

PhD Thesis Summary

Clinical-statistical studies on pulpal changes of young permanent teeth following orthodontic treatments

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Summary

The correlation between the presence of dento-maxillary abnormalities and the suffering of hard dental tissues has been pointed out by many researchers, and the existence of an important number of patients with dento-maxillary anomalies accompanied by dental, pulpal or periodontal changes early or late occurring during orthodontic therapy a field with multiple areas of research.

Without claiming to cover the entire territory as wide as the one of the interrelationships between the dento-maxillary abnormalities and endodontic pathology, this thesis aims to highlight:

- the relationships between the presence of dental abnormalities and pulpal changes, depending on the presence of inflammation;
- the involvement of the mechanical stress produced during the orthodontic treatment in the onset of inflammation, as well as of the fibrotic reactions in the pulp tissue;
- the negative effects of the orthodontic treatment on the dental structures, especially the occurrence of radicular resorption.

Clinical and radiological assessment of the pulp chamber before starting the orthodontic treatment especially in adults is the essential factor that can contribute to the prophylaxis and prevention of the dental-periodontal suffering, so multifactorial in the contemporary society. In this context, the planning of an interdisciplinary treatment allows important dental movements to be performed, even in adult patients with a dimensionally reduced periodontium, with edentations and teeth treated at the root level, provided that the dental movements be performed with light forces, respecting the genetically determined bone limits.

The general part of the thesis includes the description of the anatomical-histological structure of the dental pulp, as well as the biomechanical principles of the dental movement, with the evaluation of those movements generating adverse effects at the root level, such as the intrusion of the frontal group and the discovery and traction of the included teeth. Some general data on numerical simulations in dentistry are presented, using the finite element method. The Finite Element Method, FEM, is a modern numerical analysis method, with extremely varied fields of applicability. This method has as its starting point the real phenomenon, which is then cut into a number of elements with simple shapes, which are subsequently assembled to construct the final geometry of the structure.

The second part of the thesis, Personal Research, contains three studies.

The first study aims to investigate the correlations between the fixed orthodontic therapy and the adverse effects in a group of patients with malocclusions, from Mures County, treated with fixed orthodontic devices for a period of 3 years. The working hypotheses were the following:

1. If the fixed orthodontic treatment is a risk and predictability factor for the installation of pulpal changes, using the Pulpatest device
2. If the intrusion-type orthodontic movements are associated with radicular resorption
3. If the CBCT measurements are indicated in quantifying the degree of radicular resorption.

The study was performed on a group of 135 patients. From the initial batch, 30 patients were selected, divided into 3 sub-batches. Each of the 30 patients was investigated for pulp vitality testing, with Pulpatest at the time of applying the orthodontic device, 3 months after the device was applied and after 6 months, writing down the values recorded in a table. The results showed that the change of the pulp response from normal values to the reactivity range between 40-60 occurs in a small percentage, in 5% of the teeth tested, the upper lateral incisor being the most sensitive to all three classes of abnormalities. The pulp sensitivity values, determined with the pulp test, increase, which shows that as the orthodontic treatment progresses and the arches become thicker, the pulp reacts, through a sensitivity decrease.

The second study, the finite element method (FEM) analysis of the behavior of dental structures subjected to dental displacement – pulpal changes. The purpose of this study is to evaluate, through a FEM – Finite Element Method – analysis, the behavior of a biological structure consisting of: enamel – dentin – pulp – PDL – bone, subjected to an external load corresponding to braces with forces of various intensities and to notice its influence on the pulp structure. We simulated four types of the most common movements during fixed orthodontic therapy, uncontrolled tilting, controlled tilting, extrusion and intrusion. The results of the study showed that the stress values in all the elements of the modeled structure: Enamel – Pulp – PDL – Bone are progressively increasing as the value of the force acting on the brace increases, and the main phenomenon that occurs is fiber compression in the direction of the force action.

The third study, finite element method (FEM) analysis of the behavior of certain dental structures subjected to rotation, was performed in order to evaluate pulpal changes in the derotation movement, which is considered the most traumatic for the dental pulp. The results of the study showed that in orthodontic biomechanics, the rotational movement is the most dangerous one – especially for the pulp – there is the danger of its shearing, and from the point of view of braces positioning and action, it is preferable an action only on one face of the tooth, rather than simultaneous action on two of the opposite faces of the tooth.