



**UNIVERSITATEA DE MEDICINĂ ȘI FARMACIE  
DIN CRAIOVA  
ȘCOALA DOCTORALĂ**



DOCTORATE THESIS

**-SUMMARY –**

**ASPECTS OF ENDODONTIC TREATMENT FAILURE**

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## **SUMMARY**

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*Keywords: apical periodontitis, root resorption, vertical root fractures*

## INTRODUCTION

The data in the literature show optimistic success rates, over 90%, but it must be accepted that orthograde endodontic treatments and retreatments may fail and subsequent complications and treatment options must be considered. The etiology of endodontic treatment failure is multifactorial. The research proposes a pertinent approach to the aspects encountered in practice in the course of therapeutic failure in order to succeed in explaining its possible causes.

## THE CURRENT STATE OF KNOWLEDGE

The first section of the doctoral thesis is structured in two chapters and presents a synthesis on the factors involved in the failure of endodontic treatment, starting from the information provided by representative national and international studies.

*Chapter 1- Endodontic treatment-* includes notions regarding the objectives, principles, indications of endodontic treatment according to the requirements and recommendations proposed by the profile societies.

*Chapter 2 - Failure of endodontic treatment* - addresses the defining elements, starting from the most important factor that is attributed to the persistence of the microbial infection. Chronic apical periodontitis is a periapical inflammatory process, in response to the presence of microorganisms, or other irritants, that come from the root canal [1]. Much of the periapical tissue is destroyed, resulting in the formation of different types of lesions, with the concomitant resorption of the bone and the roots of the affected teeth [2]. Radicular resorption frequently accompanies teeth with periapical pathology and according to the latest WHO classification [3] is a separate pathology, K 03.3. Neville et al. [4] classifies it as another form of non-carious dental lesion, stating that external resorption is

common and patients may have detectable root resorption on close radiological examination. In teeth with endodontic treatment root fractures are increasingly common in dental practice and, although they are more difficult to diagnose, should be detected early to prevent damage to the supporting tissues [5]. The prevalence of vertical root fractures in endodontically treated teeth is between 11% -20% [6].

### PERSONAL CONTRIBUTION

The second part of the doctoral thesis includes three research directions, being conducted three studies corresponding to the most important failures of endodontic treatment which, in our opinion, often call into question the preservation of those teeth on the arches.

#### *Chapter 3 - Working hypothesis and general objectives.*

The working hypothesis started from the finding that several clinical conditions may contribute alone or in combination to the failures of endodontic treatment.

*Highlighting the contribution of each category of factors to endodontic treatment failures is the central objective of this research.*

#### *Chapter 4. Histological and immunohistochemical study of chronic apical periodontitis*

The study focused on the histopathological aspects and the immunohistochemical profile of the chronic apical periodontitis, apical granuloma, starting from the clinical and radiographic aspects.

*The objectives of the histological study* were oriented towards establishing the histological diagnosis of the examined periapical lesions, the evaluation of the connective tissue with the assessment of the inflammatory infiltrate, as well as the assessment of the character of the inflammatory state according to evolution. The histological study

supported by a previous clinical and radiological diagnosis is useful for evaluating the changes that occur at the apical level, but also for the differentiation of the apical periodontitis from other non-inflammatory lesions [7].

*Material and methods:* The study was performed on 78 samples represented by periapical granulomas, examined under a microscope in the Histology Laboratory of the University of Medicine and Pharmacy Craiova. In the present study, the samples represented by the apical granulomas were incorporated in paraffin and the following techniques were used to color the sections: Hematoxylin-Eosin (HE) staining, the most common method of highlighting tissues and tricromic, Goldner-Szeckeli (GS) staining.

*The objective of the immunohistochemical study* was to compare the morphological characteristics of the structure of the apical granuloma with the immunohistochemical indicators of marker expression.

*Material and methods:* The study focused on the immunohistochemical highlighting of B cells with anti-CD20 antibody, of T cells with anti-CD3 antibody, of plasmocytes with CD79-alpha antibody, of mast cells with tryptase, of macrophages with CD68 antibody.

*Results and discussions:* Microscopic examination showed the presence of connective tissue with a chronic inflammatory infiltrate without the presence of epithelial tissue, confirming the diagnosis of conjunctival granuloma. The immunohistochemical study showed the presence of inflammatory cells, B and T lymphocytes, macrophages, mast cells and plasmocytes, which are a clear indication for the existence of an immune reaction within the apical granuloma. The interaction between microbial factors and defense mechanisms always leads to a process of

resorption at the apical level, which mainly means bone loss [2].

***Chapter 5. Epidemiological study and optical coherence tomography of root resorption***

*The objective* of this study was to draw attention to this lesion, which is poorly studied in the literature and which is clinically encountered with chronic apical periodontitis. The scientific objectives were oriented towards the assessment of the prevalence and other epidemiological parameters of root resorption and an OCT study of the roots of the teeth with root resorption, to appreciate the aspects of this lesion.

*Material and methods:* The epidemiological study is a retrospective type and was performed on orthopantomographs. The data were analyzed according to the radiological aspect of the root resorption and were correlated with the demographic characteristics of the group, through a presentation of very well structured and chosen cases. The study of external inflammatory radicular resorption performed by optical coherence tomography was performed on extracted teeth.

*Results and Discussions:* In the presented study the prevalence of root resorption was increased, 42.5%. External root resorption had a much higher prevalence than internal root resorption. Inflammatory external root resorption was the most common form of external resorption in this study, both in men and women, especially in the middle-aged group. It had the highest prevalence in the jaw, molars and premolars. Root resorption was frequently associated with asymptomatic apical periodontitis 81.41%, in teeth with pulpal necrosis 45.13% or with endodontic treatment 36.28%. Other clinical studies associate external inflammatory root resorption with periapical lesions in a proportion of 61.4% to 100% [8]. Similar to Tsesis's study and in this study, external

inflammatory root resorption was mostly correlated with complications of pulp infections with a radiological image showing a shortening of the root in the apical portion [9]. Examination of OCT revealed the loss of hard dental tissues, the irregular, lacunar appearance of the root surface and the presence of a demineralization in the resorption area. The information obtained could be supported and correlated with those of other studies, which confirm that the structural elements visualized by this method are cement and root dentin for which the OCT signal is different [10, 11].

#### ***Chapter 6. Clinical-statistical and radiological study of vertical root fractures.***

*The main objective* was to determine the prevalence of root fractures of endodontic cause within the reasons of dental extraction and also the relevance of the radiological examination in root fractures of endodontic cause.

*Material and methods:* The retrospective clinical-statistical study was performed at the Oral Rehabilitation and Endodontic clinics of UMF Craiova on extracted teeth that had radicular fractures. In order to establish the relevance of the radiological examination in the diagnosis of root fractures of endodontic cause, a few representative cases have been selected evidenced by orthopantomography or cone beam computed tomography.

*Results and discussions:* Root fractures in teeth with endodontic treatment are the second cause of dental extraction in the patients studied and most of the extracted teeth that had root fractures were devital teeth with endodontic treatments, especially the maxillary premolars. The prevalence of root fractures that resulted in tooth extraction was higher in

this study than in others [12, 13, 14]. Regarding the relevance of the radiological examination in vertical root fractures, orthopantomography and retroalveolar radiography were only relevant when the fractured fragments had a large displacement. In many of the clinical situations encountered, the diagnosis of certainty was established at the time of extraction.

## **7. General discussions**

Although there are authors who believe that CBCT can provide faster information than histological examination [15], it is the gold standard for a definite and differential diagnosis of periapical pathological lesions. Periapical lesions can determine an immune response and are the main defense mechanism against infection and bacterial toxins. It should be emphasized that vertical root fractures were highlighted more securely with CBCT than with conventional radiographs, which is also supported by Salineiro et al. [16]. The study we undertook is a complex one, in that we evaluated from several imaginary perspectives, introducing the optical coherence investigation, which allowed the deep visual accessibility of the hard dental structures specific to the external radicular resorption, and the data obtained were aligned with those of other studies published in the specialized literature [11, 12].

## **8. General conclusions:**

1. The diagnosis of chronic apical periodontitis, although based on the radiological aspect, represented by the periapical radiotransparency, cannot be established with certainty, except by a surgical biopsy and a histological examination. The inflammation around the root apex represents the response of the host tissues to the chronic irritation of microbial, chemical and mechanical causes, produced by stimuli from the

endodontic space.

2. The immunohistochemical study showed the presence of inflammatory cells, B and T lymphocytes, macrophages, mast cells and plasmocytes, which are a clear indication for the existence of an immune reaction within the apical granuloma. The main means of defense against bacterial aggression is the complex immune response, triggered in the examined tissues, the results of the study indicating the existence of a cell-type immune process and a humoral immune reaction. Chronic inflammatory infiltrate without the presence of epithelial tissue confirms the diagnosis of conjunctival granuloma.

3. External inflammatory root resorption is the most common form of root resorption. It is a less studied lesion, with a high prevalence, which is frequently associated with asymptomatic chronic apical periodontitis. Examination of OCT revealed the loss of hard dental tissues, the irregular, lacunar appearance of the root surface and the presence of a demineralization in the resorption area.

4. According to the last study of this research, root fractures of teeth with endodontic treatment are the second cause of dental extraction in the patients studied. This high proportion of root fractures in teeth with endodontic treatment can be attributed to the incorrect selection of cases that have benefited from endodontic treatment, excessive occlusal forces, the complexity of the pre-existing pathology in these teeth, the over-instrumentation of the root canals, the creation of incorrect access cavities and the decreased incision. teeth after devitalizing the teeth.

5. Vertical root fractures were also observed in endodontically treated teeth restored with large, voluminous coronal fillings from amalgam or composite resins, and even in teeth restored with unidentate crowns or

included in dental bridges. CBCT imaging allowed the establishment of a definite diagnosis of root fractures in teeth with endodontic treatment.

6. Several research methods have been used for each study, which involves for the first study the histological investigation and the immunohistochemical research, for the second statistical study and OCT and for the last study the statistical and radiological research based on OPG and CBCT.

7. There is an interdependence between the presence of periapical lesions, root resorptions, root fractures and posterior teeth, a higher failure rate is observed in the lateral teeth, therefore a correct endodontic therapeutic attitude, correlated with restorative and prosthetic suitable treatments, is recommended to keep the tooth functional on the arch.

8. The originality of the thesis consists in approaching some subjects that have not been analyzed in the context of endodontic treatment: inflammatory external root resorption and root fracture after endodontic treatment. To our knowledge, there are no data on the prevalence of root resorption in Romania.

9. The research may have applicability, starting from the conclusions made. Thus, the histological examination can orient the doctor on the evolutionary or resorptive aspect of the apical periodontitis, the OCT examination can be useful in establishing the diagnosis of root resorption, and in establishing a diagnosis of root fracture certainty in the teeth with endodontic treatment, the CBCT examination is the most suitable .

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