ISSN: 0976-3031

Available Online at http://www.recentscientific.com

International Journal of Recent Scientific Research
Vol. 7, Issue, 9, pp. 13272-13276, September, 2016

International Journal of Recent Scientific Research

Research Article

ANALYSIS OF SCANNING ELECTRON MICROSCOPIC EXAMINATION OF THE APICAL ZONE OF TEETH WITH CHRONIC APICAL PERIODONTITIS - AN *EX VIVO* STUDY

Gusiyska A

Department of Conservative Dentistry, Faculty of Dental Medicine,
Medical University-Sofia, Bulgaria

ARTICLE INFO

Article History:
Received 17th June, 2016
Received in revised form 21st July, 2016
Accepted 05th August, 2016
Published online 28th September, 2016

Key Words:
Chronic apical periodontitis, electron microscopic examination, external apical resorption, periapical zone, periforaminalresorption.

ABSTRACT

Key stages in the treatment of chronic apical periodontitis (CAP) are the assessment of the status of the periapical zone, effective decontamination and subsequent sealing of the root canal space. The aim of this article is to analyze electron microscopic results from periapical zones examination in extracted teeth. The apices of 43 teeth (n = 43) were examined, allocated in two groups. After resection, the apices were fixed to stands for SEM-examination. Based on the analysis of the results, the following conclusions can be drawn: an external resorption around the apical foramen is established in 97.6% of cases in the teeth with radiographically diagnosed CAP.

INTRODUCTION

Apical resorption is a biological phenomenon, characterized by processes of cement and/or dentine depletion, resulting from the physiological or pathological activity of resorptive cells, called dentoclasts (a subclass of the osteoclasts) [7,9, 12]. A periapical lesion with a visible radiolucency is generally accompanied by some degree of root resorption. Several authors have verified that root resorption is commonly present when pathologic tissue surrounds the tooth apex [11, 15, 18]. Studies have suggested that the permanent dentition is protected against physiological resorptive processes, but pathological resorption has been found in cases of trauma, orthodontic treatment, expansion of tumor or cystic formations, or has been largely the result of inflammatory processes in the pulp tissue, etc. [14]. It has been histologically demonstrated that in internal root resorption, normal or necrotic pulp tissues are transformed into granulation tissue with giant multinuclear cells resorbing the dentin wall in the absence of the odontoblast layer and predentine [13, 23]. Stopping the internal resorptive processes is likely to occur through removal of the pulp and granulation tissue, as well as interruption of the blood supply to these tissues, necessary for the development of resorbing cells. Key stages in the treatment of chronic apical periodontitis (CAP) are the assessment of the status of the periapical zone, effective decontamination and subsequent sealing of the root canal space. The absence of a physiological narrowing is challenging to the achievement of satisfactory early and late therapeutic results. It makes probable either the over pressing of necrotic, infected material when preparing the endodontic space or the over-pressing of the sealer when sealing the root canal [9].

Our objective was to clarify some aspects of the findings in the apical zone of teeth with chronic apical periodontitis by applying *ex vivo* scanning electron microscopy (SEM) to the apical zone in order to detect the presence of resorption.

To clarify the available apical resorption, the peculiarities in the apical zone in teeth with CAP and the difficulties for the treatment, a comparative *ex vivo* SEM-examination was performed.

MATERIAL AND METHODS

For the purpose of this study the apices of 59 teeth (n = 59) were examined and divided into two groups:group I (n = 40) – apices with radiographically diagnosedCAP and group II (n = 19) – apices with normal radiographic periapical structures, extracted on the basis of orthodontic considerations. The teeth were stored in saline solution (0.9% NaCl) supplemented with thymol, at 4°C. The apical portions of the roots were resected at 5 mm coronary. After resection, the apices were fixed to stands for SEM-examination (Fig.1). The prepared samples

*Corresponding author: **Gusiyska A***
Department of Conservative dentistry, Faculty of Dental Medicine, Medical University-Sofia, Bulgaria

were vacuum coated with gold dust in an argon medium by using JEOL JFC- 1200 fine coater and examined with a scanning electron microscope (JEOL JSM-5510 SEM) at the corresponding magnifications (x 50, x 100).

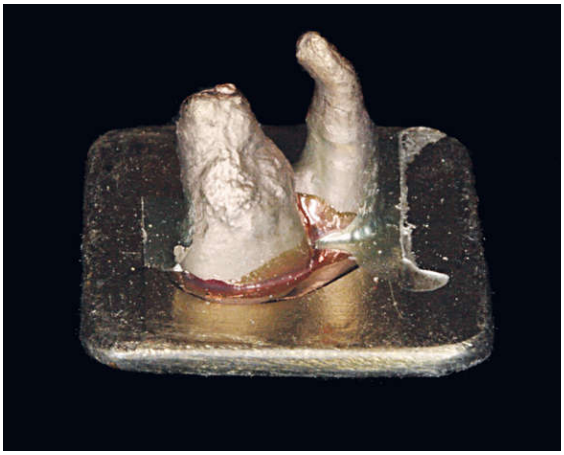

Figure1 Prepared stands for SEM-examination the apices are vacuum coated with gold dust.

The resorption stage of scanning electron microscopy images was classified into four levels (0, 1, 2 and 3) according to their periforaminal external apical resorption (EAR) - an area that circumscribes the apical foramen, and foraminal EAR - area that limits the profile or apical foramen perimeter. This classification was made according to modified criteria based on those described by Vier and Figueiredo [18]:

- absence of resorption-level 0;
- resorption affecting up to 1/4 of the examined area-level 1;
- resorption affecting more than 1/4 of the examined area-level 2;
- resorption affecting more than ½ of the examined area-level 3.

RESULTS

The results of the performed SEM-examinations of the apical zones (Table 1) showed that in 97.5% of the teeth with radiographically diagnosed CAP, there were external for aminal resorption and in 92.5% there were periforaminal resorption in varying degrees –from the initial (Fig.2) to the advanced stage of apical resorption (Fig.3,4,5). Of these, 3.4% were classified as superficial and 66.1% as severe. Only 30.5% were totally lacking resorption (Table 2).

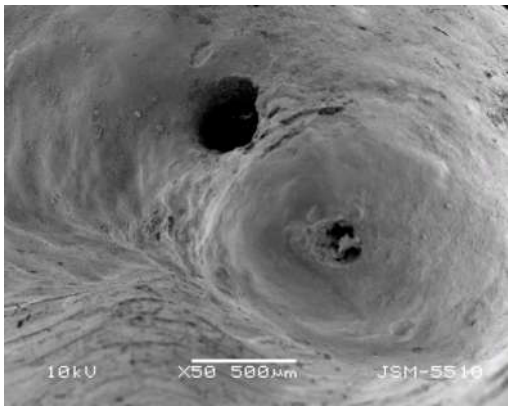

Figure 2 A SEM-image of a zone with initial resorption (x 50).

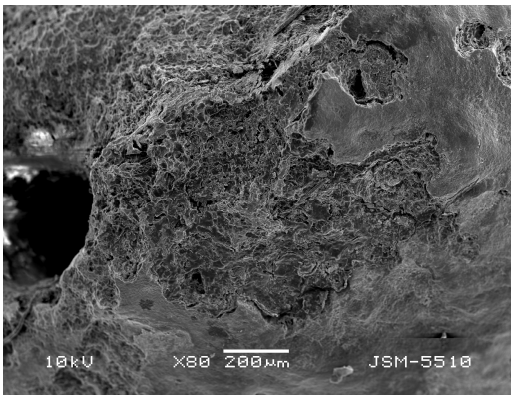

Figure3.A SEM-image of a zone with extensive internal resorption involving the apical foramen - periforaminal(x 80).

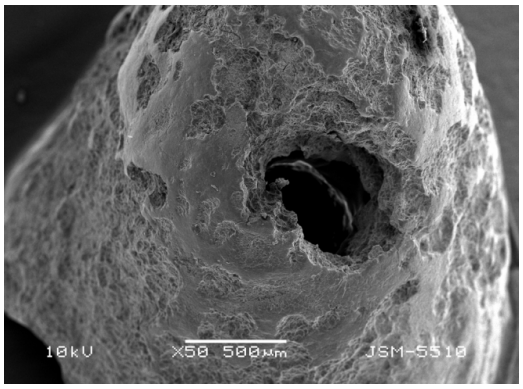

Figure 4.A SEM-image of the apical zone of a distobuccal root - periforaminal and intraforaminal resorption (x 50).

In 85.4% of the apices of the teeth with periapical lesions larger than 4 mm, there was also resorption of the foramen, causing destruction of the physiological constriction - periforaminal and intraforaminal resorption (Fig.5,6). These results are in support of the preliminary measured clinical widths of the constriction.

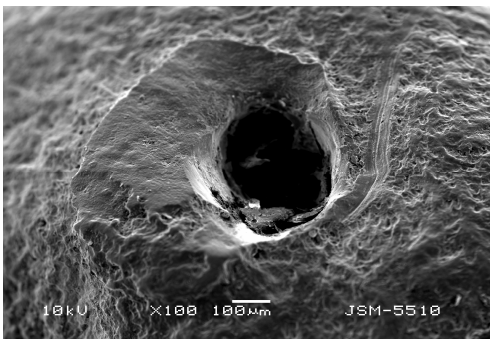

Figure 5 SEM-image of the apical zone of the first mandibular premolar root - periforaminal resorption (x 100).

Table 1. Extension levels of periforaminal and foraminal external apical resorption of dental apexes examined by scanning electron microscopy (SEM).

	Resorption			
	Periforaminal		Foraminal	
Resorption level	**n***	**%**	**n***	**%**
Absent	2	5	0	0
Superficialis	1	2.5	1	2.5
Severe	37	92.5	39	97.5
Total	40	100%	40	100%

*n=number of apices of teeth

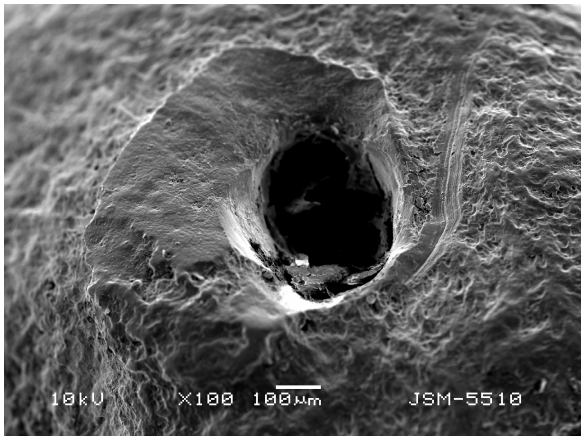

Figure 5.SEM-imageof the apical zone of the first mandibular premolar root - periforaminal resorption (x 100).

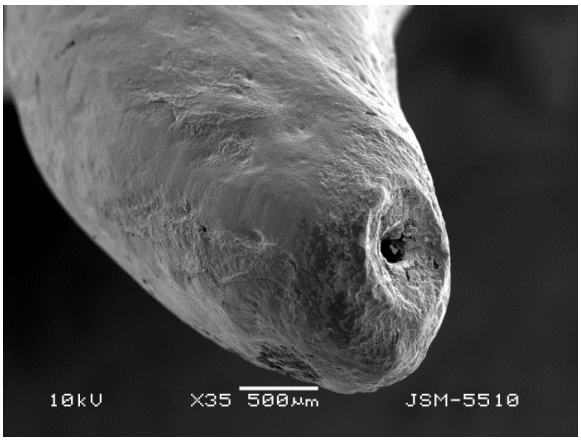

Figure 6 SEM-image of the apical zone of medial root of the first mandibular molar - intraforaminal resorption (x 35).

Table 2 Distribution of external apical resorption in all specimens (*n=59*).

	*n**	%
Absent	18	30.5
Superficialis	2	3.4
Severe	39	66.1
Total	59	100

*n=number of apices of teeth

In 57.1%, vales of the narrowing within the range of #35–55 were measured and in 34.4% – #60–140. In 32 of the teeth with CAP (80%) signs of resorption were found radiographically.

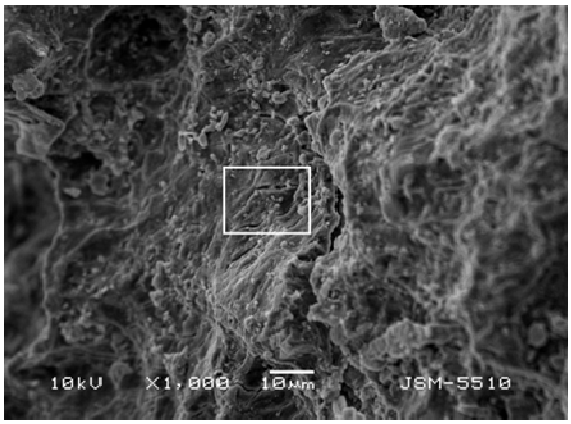

Figure 7 SEM image of external root resorption – SEM (magnification x 1000).

The irregular, lacunary-like zones of resorption favor the existence of microorganisms (*yellow arrows*) – these are the areas on the outer surface of the root, which cannot be treated instrumentally (Fig. 6, 7, 8).

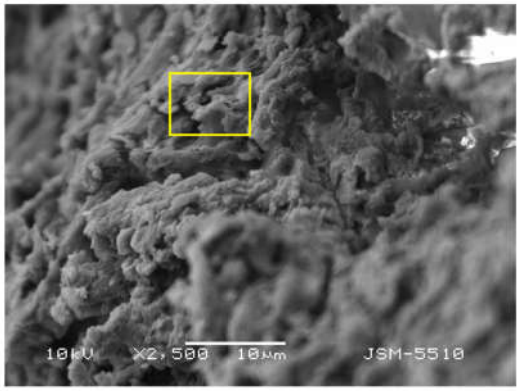

Figure 8 Magnification of the marked zone on Fig. 5 (x 2 500).

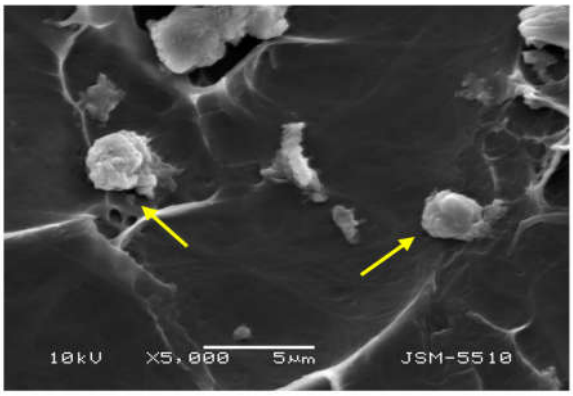

Figure 9 Magnification of the external surface of the root apex (x 5000) (the arrows indicate *E. faecalis*).

DISCUSSION

Several investigators used scanning electron microscopy (SEM) techniques to evaluate the apical zone - foramen apicale major and surrounding tissue of teeth with CAP [6, 10, 17, 26, 27]. Being the first stage of decontamination, the exact instrumental preparation of the pulp chamber and the root canal provides an access to the endodontic space and is a prerequisite for achieving maximum results in the next stages.

The exact determination of the following parameters: curves and shapes of the root canal as well as the selection of a treatment technique and instruments are of great importance for the treatment of teeth with CAP. For the precise condensation of gutta-percha and prevention of over pressing of either the gutta- percha or the sealer, which could injure the peri radicular tissues, the presence of an apical stop (an apical control area) for groups I, II, III or an apical barrier for group IV is required [19].

While adhering to the principles of creating an apical stop, the instrumentation of the root canal space and the apical zone protects the periapical tissues and the anatomical narrowing from trauma and transportation. By applying this technique of preparation, it is possible to increase the size of the main apical file, which is a prerequisite for adequate removal of the infected intracanal dentine and maximum removal of invaded microorganisms, inconsistency with the features of the root

canal system, while avoiding the increased risk of over instrumentation in the apical zone.

Clinical observations have shown that the increase in the size of the file applied last in the apical zone and the extension of the set conicity/taper substantially increases the volume of solution for irrigation, enhances debris evacuation to the maximum and minimizes the need of creating an apical dentine stopper.

The average statistical treatment of the root canal with file #40 (according to ISO) and taper 0.04 has been shown to preserve hard dental tissues and provide maximum irrigation in the apical third, adequate distance between the needle and the root canal walls and a possibility for evacuation of the solution towards the orifice. This has been confirmed by a number of authors [1, 3, 5, 21, 24]. The apical level of processing and the volume that should be removed during root canal preparations in this area are the subject of much discussion [4, 22, 24, 26]. Many modern machine Ni-Ti systems limit the processing area to a diameter of 250-300 µm, therefore avoiding the over preparation in the zone of narrowing. This is due to technical considerations aiming to create favorable conditions for obturation of the root canal system by applying warm condensation methods in order to avoid the extrusion of material in the case of a wider apical zone. However, biological considerations indicate otherwise [4, 13, 15, 18].

The apical narrowing and the apical foramen are areas that favor the development of microorganisms and the accumulation of bacterial biofilm that can remain mechanically and chemically untreated upon limited preparation [20, 25]. Lomçali *et al*. reported the presence of resorption lacunae on root external surfaces, which acts as niches facilitating the deposition and accumulation of periapical bacterial biofilm [16] as present in this current study (Figure 7, 8, 8).

Moreover, the natural size of the apical constriction (*foramen apicale minor*) typically ≥250-300 µm to 600 µm, implies an extended apical preparation [2].

CONCLUSION

Based on the analysis of the results, the following conclusions can be drawn: external resorption around the apical foramen is established in 80% of cases in the teeth with radiographically diagnosed CAP. In 97.5% of the apices of teeth with periapical lesions larger than 4 mm, resorption of the foramen was also observed, causing the destruction of the physiological constriction. In 69.5% of the *ex vivo* measured apices, values of the apical constriction within the range of #35–55 were measured and in 34.4% – #60–140.

References

1. Boutsioukis C, *et al*. The effect of apical preparation size on irrigant flow in root canals evaluated using an unsteady Computational Fluid Dynamics model. *Int Endod J*. 2010; 10:874-81.
2. Briseño-Marroquin B, El-Syed MAA, Willershausen-Zonnchen B. Morphology of the physiological foramen: I. Maxillary and mandibular molars. *J Endod*. 2004; 30:321-8.
3. Brunson M, *et al*. Effect of apical preparation size and preparation taper on irrigant volume delivered by using negative pressure irrigation system. *J Endod*. 2010; 36(4):721-4.
4. Card SJ, Sigurdsson A, Ørstavik D, Trope M. The effectiveness of increased apical enlargement in reducing intracanal bacteria. *J Endod*. 2002; 28(11):779-783.
5. Dalton BC, Ørstavik D, Phillips C, Pettiette M, Trope M. Bacterial reduction with nickel-titanium rotary instrumentation. *J Endod*.1998; 24:763-767.
6. Delzangles B. Scanning electron microscopic study ofapical and intracanal resorption. *J Endod* 989; 15: 281–5.
7. Gulabivala K, Patel B, Evans G, Ng YL. Effects of mechanical and chemical procedures on root canal surfaces. *Endod Topics*. 2005; 10:103-122.
8. Gusiyska A. In vivo analysis of some key characteristics of the apical zone in teeth with chronic apical periodontitis. *International Journal science and research* 2014; 3(12):2390-2393.
9. Gusiyska A. Periapical resorptive processes in chronic apical periodontitis: an overview and discussion of the literature. J of IMAB 2014; 20(5):601-605.
10. Hess JC, Culieras MJ, Lamiable N. A scanning electron microscopic investigation of principal and accessory foramina on the root surfaces of human teeth: thoughts about endodontic pathology and therapeutics. *J Endod* 1983; 9: 275–81.
11. Holland R, Valle GF, Taintor JF, Ingle JI. Influence of bone resorption on endodontic treatment. Oral Surg Oral Med Oral Pathol 1983; 55: 191–203.
12. Kabak Y, Abbott PV. Prevalence of apical periodontitis and the quality of endodontic treatment in an adult Belarusian population. *Int Endod J*. 2005;38-45.
13. Katebzadeh N, Sigurdsson A, Trope M. Radiographic evaluation of periapical healing after obturation of infected root canals: an in vivo study. *Int Endod J*. 2000; 33:60-66.
14. Lana MA, Ribeiro-Sobrinho AP, Stehling R, *et al*. Microorganisms isolated from root canals presenting necrotic pulp and their drug susceptibility in vitro. *Oral Microbiol Immunol*. 2001; 16:100-105.
15. Laux M, Abbott PV, Pajarola G, Nair PNR. Apical inflammatory root resorption: a correlative radiographic and histological assessment. *Int Endod J* 2000; 33: 483–93.
16. Lomçali G, Sem BH, Çankaya H. Scanning electron microscopic observation of apical root surface of teeth with apical periodontitis. Endod Dent Traumatol 1996; 12: 70–6.
17. Malueg LA, Wilcox LR, Johnson W. Examination of external apical root resorption with scanning electron microscopy. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 1996; 82: 89–93.
18. Möller AJR, Fabricius L, Dahlén G, Öhman A, HeydenG. Influence on periapical tissues of indigenous oral bacteria and necrotic pulp tissue in monkeys. *J Dent Res* 1981; 89: 475–84.

19. Murugan R, Ramakrishna S. Development of cell-responsive nanophase hydroxyapatite for tissue engineering. *Am J Biochem Biotech.* 2007; 3(3):118-124.
20. Nair PNR, Sjögren U, Krey G, Kahnberg KE, Sundqvist G. Intraradicular bacteria and fungi in root filled asymptomatic human teeth with therapy resistant periapical lesions: a long term light and electron microscope follow-up study. *J Endod*. 1990; 16:580-588.
21. Ørstavik D, Kerekes K, Eriksen HM. The periapical index: a scoring system for radiographic assessment of apical periodontitis. *Endod Dent Traumatol.* 1986; 2:20-34.
22. Peters LB, Wesselink PR, van Winkelhoff AJ. Combinations of bacterial species in endodontic infections. *Int Endod J.* 2002, 35:698-702.
23. Pierce A, Berg JO, Lindskog S. Calcitonin as an alternative therapy in the treatment for root resorption. *J Endod.* 1988; 14:259-64.
24. Souza-Filho FJ, *et al*. Antimicrobial effect and pH of chlorhexidine gel and calcium hydroxide alone and associated with other materials. *Braz Dent J.* 2008; 19(1):28-33.
25. Spatafore C, *et al*. Periapical biopsy report: An analysis over a 10-year period. *J Endod.*1990; 16(5):239-241.
26. Vier F, Figueiredo J. Prevalence of different periapical lesions associated with human teeth and their correlation with the presence and extension of apical external root resorption. *Int Endod J.* 2002; 35:710-719.
27. Vier-Pelisser F. *et al*. Apical resorption in teeth with periapicallesions: Correlation between radiographic diagnosis and SEM examination. *Aust Endod J* 2013; 39: 2–7.

****

How to cite this article:

Gusiyska A.2016, Analysis of Scanning Electron Microscopic Examination of the Apical Zone of Teeth with Chronic Apical Periodontitis - An Ex Vivo Study. *Int J Recent Sci Res.* 7(9), pp. 13272-13276.