

HEALING OF APICAL PERIODONTITIS AFTER UNINTENTIONAL EXTRUSION OF AH PLUS SEALER: A RETROSPECTIVE RADIOGRAPHIC ASSESSMENT

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ABSTRACT

Aim of the study: to evaluate the healing of apical periodontitis, after unintentional extrusion of AH Plus sealer on root canal treatments and non-surgical retreatments. **Materials and methods:** sixty-four teeth with apical periodontitis (21 initial root canal treatment and 43 non-surgical retreatments) were treated by 2 endodontists. They were rotary prepared and filled using warm vertical condensation technique. All the teeth presented unintentional canal overfilling, recorded on postoperative radiograph. The patients were monitored clinically and radiographically at 1 and 2 years after the treatment. Two independent observers assessed the radiographs and determined the outcome according to PAI score pooled in a 3-category scale (1 or 2 - healed, 3 - uncertain, 4 or 5 - nonhealed). Mann-Whitney, Fischer's exact, and Wilcoxon tests were used for group comparisons. **Results:** Initial PAI score and tooth location in the maxillary arch were the factors that significantly affected the outcome. Initial PAI score was statistically significant lower in healed than in nonhealed or uncertain outcomes ($p<0.001$). Healing occurred more frequently in the maxillary teeth, compared to mandibular teeth ($p=0.007$; $p<0.05$). At 1 year recall, a healed outcome was observed in 78.12% teeth and mean PAI score decreased from 3.42 to 1.28 ($p<0.001$). At 2 year recall, the healed outcome increased to 81.25%. The majority of teeth presented a persistence of extruded AH Plus, both at 1 (89.07%) and 2 (89.59%) years recall. **Conclusions:** Treatment outcome in teeth with apical periodontitis was not related to the persistence or resorption of sealer extrusion. The best results were registered in maxillary teeth, especially in teeth with lower initial PAI score.

Keywords: endodontic outcome, apical periodontitis, unintentional overfilling

INTRODUCTION

The role of root canal obturation is to prevent the entry of fluids from periapical tissue or saliva into the root canal, as well as the penetration of bacteria and their virulence factors from the root canal into periapical tissue [1]. The quality of root canal obturation has been shown to be the most significant outcome predictor for root canal treatment [2]. One of the major controversies is the apical limit of preparation and obturation.

Many authors have considered the apical constriction and the cementum-dentinal junction the apical limit of root canal therapy [3]. Ideally, the root canal filling should remain inside the endodontic system of the root canal [4]. However, there are situations when overfillings occur, specifically when vertical condensation techniques are used in root canal obturation [5], [6].

In the presence of apical periodontitis, some studies report signs of inflammation of

periapical structures upon contact with extruded sealer [7]. Also, it has been suggested that overfilling can affect the prognosis due to deficient apical seal [8] or may slow down the healing process of apical periodontitis [9], [10]. AH Plus (Dentsply DeTrey GmbH, Konstanz, Germany) is the most commonly used sealer in endodontics, due to its qualities: long sealing duration, radiopacity, dimensional stability, and excellent biological properties [11]. When freshly mixed, it has an alkaline pH with antibacterial activity. Also, it activates alkaline phosphatase that helps the mineralization process, leading to a better outcome of periapical healing [12]. It has been said that overextension with AH Plus may impair the outcome of treatment in teeth with apical periodontitis [8]. When overfilling, it is difficult to demonstrate if sealer itself is the cause for disease or a deficient apical seal plays the biggest role.

The information regarding influence of overfilling on outcome is scarce in the literature. Different studies have compared the effects of different sealers on the outcome [9], [13]. A study evaluated the effect of unintentional extrusions of different sealers and gutta-percha after lateral condensation [10], but none of them focused on the impact on outcome of unintentional overfilling with AH Plus sealer at 1 and 2 year-follow-up. Therefore, the aim of this study was to evaluate the healing of apical periodontitis, after unintentional extrusion of AH Plus sealer on root canal treatments and non-surgical retreatments. The null hypothesis was that there is no difference in the clinical and radiographic healing of apical periodontitis after initial root canal treatments and non-surgical retreatments in teeth with unintentional sealer extruded.

MATERIALS AND METHODS

A total sixty-four teeth with apical periodontitis that exhibiting postoperative unintentional canal overfilling, from 44 patients, were included in this study. Before starting the treatment, informed consent was obtained from all subjects involved in the study. Twenty-one of these treatments were initial root canal treatments, while 43 were non-surgical retreatments. All teeth were radiographed before and after the treatment. Patients were informed about the importance of the follow-ups examination. The recalls were scheduled at one and two years post-operatively, respectively.

Inclusion criteria were: patients 18 years of age or older; symptomatic or asymptomatic apical periodontitis confirmed clinically and radiographically; teeth showing unintentional overfilling with sealer in the postoperative radiograph; cases with at least 1-year follow-up.

Exclusion criteria were: teeth without preoperative apical periodontitis; teeth presenting sealer or gutta-percha extrusion from previous treatment; teeth with overextended gutta-percha points; teeth with previous surgical treatment; teeth with perforation, vertical root fracture, separated instruments.

Access cavities were performed using round high speed burs, under rubber dam isolation. Working length was determined using apex locator (VDW Gold GmbH, Munich, Germany) and confirmed radiographically. Teeth that needed initial root canal treatments were rotary prepared with Protaper Next (Dentsply Maillefer, Ballaigues, Switzerland) or Reciproc system (VDW GmbH, Munich, Germany) to a minimum size of 25.06. Non-surgical retreatment cases were approached using retreatment rotary instruments – ProTaper Retreatment system (Dentsply Maillefer, Ballaigues, Switzerland) or Reciproc system

(VDW GmbH, Munich, Germany) without solvents. The canals were irrigated with 2 ml 5.25% sodium hypochlorite using a 30G needle placed at working length - 1 mm after each rotary instrument used. Final irrigation consisted of 5 ml 5.25% sodium hypochlorite, ultrasonically agitated for 1 minute using Irrisafe (Satelec, Acteon, Switzerland) (3 cycles of 20 seconds), followed by EDTA 17% solution for 1 minute and distilled water.

All teeth were filled using AH Plus and warm vertically compacted gutta-percha, recording the overfilling on postoperative radiograph. A temporary coronar filling was placed (Ketac Molar, 3M ESPE, Germany) and the patient was scheduled for a final restoration. Most root canal treatments were performed in a single visit. Only some complicated cases, with flare-ups were postponed, applying calcium hydroxide for 7 days. The first recall was scheduled at one year post-operatively. The second – at 2 years post-operatively.

Clinical examination included signs and symptoms, recorded as absent or present. The criteria for success were absence of pain or tenderness to percussion, absence of pain to palpation, absence of sinus tract, no loss of function or bite-discomfort, no increased tooth mobility, absence of periodontal pockets and a good quality of coronal restoration. Periapical radiographs were obtained with a digital imaging system, using parallel technique. The pre-operative, post-operative and follow-ups radiographs were evaluated by two endodontic specialists. The observers determined the outcome through a combination of the clinical and radiographic findings according to PAI score [14] and set a 3-category scale:

- Healed: no clinical signs and symptoms, the lesion is absent, PAI scores 1 or 2

- Uncertain: no clinical signs and symptoms, the lesion has reduced in size, PAI score 3

- Nonhealed: some clinical signs and symptoms, the lesion is unchanged or increased in size, PAI score 4 or 5

For multirrooted teeth, the outcome was determined according to the root with the poorest outcome. When evaluations provided by the 2 examiners disagreed, the observers discussed the case until consensus was reached. If doubts continued, a third experienced examiner was consulted and a consensus was attained. Also, a lot of outcome predictors were recorded: gender, age, tooth location, arch, size of periapical lesions, type of treatment – primary/retreatment, persistence or resorption of extruded sealer, initial PAI, recall time.

Statistical analysis: for group comparison Mann-Whitney, Fischer's exact, and Wilcoxon tests were used. IBM SPSS Statistics version 29 was used for data analysis. The level of statistical significance was set at $p < 0.05$.

RESULTS

A total of 64 teeth from 44 patients were included, 30 females and 14 males (mean age of 37.98 ± 11.3 years). Twenty-one teeth were primary treatments, while 43 were non-surgical retreatments. All of teeth presented unintentional canal overfilling with sealer on the postoperative radiographs. All of patients were present at 1 year recall, but only 48 (75%) of them came to the 2 year follow-up.

At 1 year recall, mean PAI score decreased (from 3.42 to 1.28; $p < 0.001$), a healed outcome was observed in 50 (78.12%) teeth and an uncertain outcome was registered in 10 (15.62%) teeth. At 2-year recall, from a total of 48 teeth, 39 (81.25%) of cases were healed, 6 (12.5%) was uncertain, and 3 (6.25%) were nonhealing. The majority of

teeth presented a persistence of extrusion material represented by AH Plus, both at 1 (89.07%) and 2 (89.59%) years recall.

The factors that could have affected the outcome (gender, age, group of teeth,

arch, size of periapical lesion, initial PAI score, recall time, type of treatment, persistence or resorption of sealer) were recorded (Table 1).

Table 1 Data for teeth outcomes (healed, uncertain, nonhealed) and factors that affected the outcome

	Teeth outcomes			Extruded AH Plus	
	Healed	Uncertain	Nonhealed	Persistence	Resorption
Sex					
Female	30	6	3	36	3
Male	20	4	1	24	1
Age					
<45 y	33	6	4	39	4
≥45 y	17	4	0	17	4
Group of teeth					
Anterior					
Max.	13	1	0	12	2
Mand.	4	3	1	6	2
Posterior					
Max.	9	1	0	7	3
Mand.	25	4	3	27	5
Arch					
Maxillary	23	2	1	21	5
Mandibular	25	10	3	31	7
Initial PAI					
3 or less	34	2	1	33	4
More than 3	16	8	3	19	8
Recall time					
1 year	50	10	4	57	7
2 years	39	6	3	43	5
Type of treatment					
Initial RCT	16	4	1	16	5
Non-surgical retreatment	34	6	3	36	7

The factors that significantly affected the outcome of root canal treatment were the initial PAI score and the maxillary arch. We observed that initial PAI score was statistically significant lower in healed outcomes than in nonhealed or uncertain outcomes ($p<0.001$) (fig. 1 a,b,c,d and fig. 2 a,b,c).

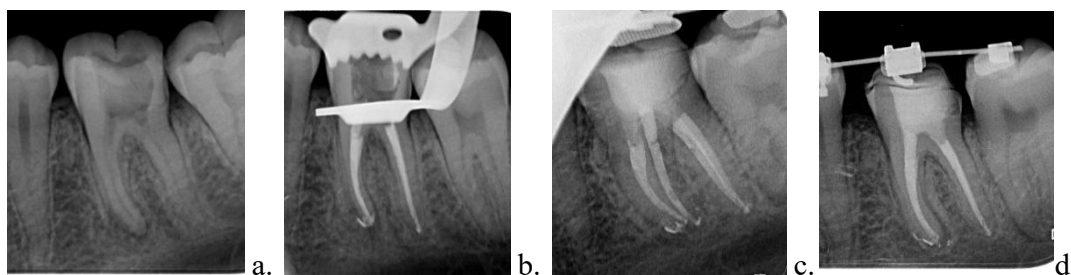


Fig. 1a. preoperative radiograph, PAI 3 b. postoperative radiograph c. after 1 year, healed, d. radiograph after 2 years, healed



Fig. 2a. preoperative radiograph, PAI 4 b. postoperative radiograph c. after 1 year, uncertain

Healing occurred more frequently in the maxillary arch ($p=0.007$; $p<0.05$). This is the reason why a better healed outcome was observed to the maxillary teeth (88.46%) compared to the mandibular teeth (65.78%) (fig.3 a,b,c,d). The persistence or resorption of extruded sealer did not affect the outcomes ($p>0.05$). Therefore, the null hypothesis is supported.



Fig. 3a. preoperative radiograph, PAI 3 b. postoperative radiograph c. after 1 year, healed, d. radiograph after 2 years, healed

DISCUSSION

This retrospective case-control study evaluated cases of unintentional overfillings during root canal treatment and non-surgical retreatment on teeth with apical periodontitis. The results indicate that the persistence or resorption of extruded sealer did not affect the outcomes, supporting the null hypothesis. This is in consonance with other studies showing that sealer extrusion has no influence

on treatment outcome of teeth with apical periodontitis [15], [16], [17]. On the other hand, it has been suggested that healing may be substantially delayed in some teeth with periapical lesions and sealer extrusion [18], which goes against the results of the present study.

However, it has showed that most of the contemporary filling materials exhibit significant cytotoxicity only before setting

[19]. Most sealers lose in time their irritant components and become relatively inert. Contemporary sealers as it is AH Plus, when extruded through the apical foramen in small amounts, exert no significant toxicity [9].

The issues of overfilling and overextension are not synonymous and must be differentiated. Overfilling means a three-dimensional obturation in which a portion of material extrudes beyond the apical foramen, while overextension refers to the extrusion of filling material as a result of overinstrumentation, which may cause excessive enlargement of the apical foramen. The present study assessed only cases with overfilling, to search the effect on apical periodontitis healing of the extruded sealer alone.

Teeth with apical periodontitis usually present apical root resorption [20], and this may lead to deformations that compromise the apical filling quality. It is very hard in these conditions to achieve an adequate apical seal and therefore leakage of tissue fluids reaches residual bacteria and supplies substrate for their growth.

The chronic apical periodontitis were assessed by means of the periapical index (PAI). The initial PAI score that reflects the size of periapical lesion was a statistically significant factor for a favorable outcome – the smaller the initial periapical lesion (3 or less), the better the healing. Many lesions healed in the first year (78.12%) and this percentage has increased to 81.25% in the second year. Large periapical lesions take longer to heal because there is a greater diversity of bacteria penetrating deep into the dentinal tubules over long distances, making endodontic treatment often ineffective or more challenging [21].

With the exception of tooth location, the parameters that could have affected the outcome such as sex, age, tooth type, recall time and type of treatment were found to not

have an influence on the treatment outcome. The maxillary teeth healed better (88.46%) than mandibular teeth (65.78%) both in treatment and retreatment. This is in agreement with the findings of most outcome studies [21], [22] and in disagreement with others [5], [23].

We do not observed a significant statistical difference between the favorable outcome of initial (76.19%) and root canal retreatment (79.06%) which is in line with the recent findings of other outcome studies [5], [18], [22].

All the teeth included in this study were filled using warm vertical condensation technique which is known to led to a greater number of canals in which material extrusion occurred. It was used only one sealer – AH Plus packaged in a jet syringe composed of epoxy resin and amines. It is one of most used sealers in endodontics and it has excellent biological properties. In this study, the majority of teeth presented a persistence of sealer extrusion, both at 1 and 2 years recall. Similarly, it was described the persistence of AH Plus after long-term follow-up, due to its low rate of solubilization [9]. However, our results support the idea that unintentional AH Plus sealer extrusion may not jeopardize endodontic outcome.

The study has limitation. The lack of extruded AH Plus on the radiograph does not automatically mean that it was completely removed from the periradicular tissues. In fact, in a small number of cases we observed the resorption of sealer on long term recall visits, but the „disappearance” might be due to the resorption of barium sulfate from the AH Plus composition. On the other hand, the bidimensional nature of radiographs can contribute to overestimation of the healing response and consequently the outcome [24]. Furthermore, sealer extrusion can be operator dependent. The selected patients and their teeth were treated by two experienced

endodontists, but it is possible that in the current study an unintended comparison of these specialists was performed.

CONCLUSIONS

Treatment outcome in teeth with apical periodontitis was not related to the

persistence or resorption of sealer extrusion. No preoperative predictors were found to have a direct influence on the treatment outcome, with the exception of the initial PAI score of periapical lesion and the maxillary arch. AH Plus presented very low resorption rates, but it did not jeopardize the endodontic outcome.

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