

# Apically Extruded Sealers: Fate and Influence on Treatment Outcome

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## Abstract

**Introduction:** This retrospective study evaluated cases of unintentional overfillings for the fate of the extruded sealers and their influence on treatment outcome.

**Methods:** One hundred five teeth treated by a single operator and exhibiting overfillings in the postobturation radiograph were included in the study. Seventy-five teeth exhibited apical periodontitis lesions at the time of treatment. Sealers included Pulp Canal Sealer (Sybron Dental, Orange, CA), PCS Extended Working Time-EWT (Sybron Dental), Tubli-Seal (Sybron Endo), Endomethasone (Septodont, Saint-Maur-des-Fossés, France), AH Plus (DeTrey GmbH, Konstanz, Germany), and Apexit (Ivoclar Vivadent, Schaan, Lichtenstein). Recall radiographs were compared with immediate postobturation films for removal of the extruded material and status of the periradicular tissues. Data were grouped as 1-, 2- and >4-year recall and statistically analyzed using the chi-square and Fisher exact tests.

**Results:** As for the sealers' fate, the only statistically significant differences at the 1-year recall were observed when comparing Tubli-Seal with AH Plus, Apexit, and Endomethasone ( $P < .05$ ). At both the 2- and 4-year recalls, frequency of complete removal of AH Plus and Apexit was significantly lower when compared with all the other sealers ( $P < .05$ ). No other significant differences were observed between groups. As for the influence on treatment outcome, there were no statistically significant differences between sealers at all follow-up periods ( $P > .05$ ). Data from the >4-year recall revealed that 79% of the teeth with apical periodontitis lesions at the time of treatment had healed in comparison with 100% of the teeth with no apical periodontitis ( $P < .01$ ). **Conclusions:** Not all extruded sealers were predictably removed from the periradicular tissues. Treatment outcome was not significantly affected by the type of extruded sealer. A significantly better outcome was observed for teeth with no lesion in comparison with teeth with apical periodontitis. (*J Endod* 2016;42:243–249)

## Key Words

Endodontic sealers, endodontic treatment, overfilling, treatment outcome

Root canal obturation serves the main purpose of impeding the traffic of fluids from the periradicular tissues or saliva into the canal as well as bacteria and their virulence factors and antigens from the canal to the periradicular tissues (1). Ideally, the filling material should be restricted to the intraradicular space (2, 3). Studies have shown that the highest success rate of endodontic treatment is observed for teeth with root canal fillings ending 0–2 mm short of the radiographic apex, and cases with underfillings or overfillings display significantly lower rates (3–5).

However, there are circumstances in which it is not possible to control application of the material, and some apical extrusion occurs. In addition, the use of some thermoplasticized gutta-percha filling techniques is also associated with a higher incidence of filling material extrusion (6). When extruded, the fate of the filling material will depend on its solubility in the tissue fluids and susceptibility to phagocytosis, whereas its influence on treatment outcome arguably depends on the material's biocompatibility. It has been suggested that the lower healing rate associated with overfillings is a result of the cytotoxicity of the root filling material (7) or a foreign body reaction to some of its constituents (8, 9). However, evidence indicates that the apical extent of root canal fillings seems to have no direct correlation to treatment failure provided infection is absent (10–12). Overfilling may impair the prognosis of treatment of infected teeth with apical periodontitis, and this is possibly related to a deficient apical seal and/or previous overinstrumentation causing extrusion of infected debris (13). It has also been suggested that the extraradicular occurrence of a filling material may slow down the healing process of apical periodontitis (14).

Information on sealers' fate and influence on the outcome when apically extruded is scarce in the literature. A study evaluated the radiographic appearance of unintentionally extruded filling material and found that 2 zinc oxide and eugenol-based sealers were completely removed over time, and overfillings per se had no influence on treatment outcome (15). Studies have compared the effects of different sealers on the outcome (16–19), but none of them focused specifically on overfilling cases. Therefore, the present study was intended to evaluate cases of unintentional overfillings after using different sealers for the fate of the extruded material and its influence on endodontic treatment outcome.

## Materials and Methods

The teeth included in this retrospective study are a fraction of a number of teeth treated by a single operator in his private office using a standardized treatment protocol over a period of 30 years. In general, 1437 root canal-treated teeth (from 830 patients) were available for 1 or multiple follow-ups. Part of this sample ( $n = 816$ ) was the object

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of a previous follow-up study (5). Teeth exhibiting overfillings in the postobturation radiograph ( $n = 105$ ), with follow-up examinations ranging from 1 year to up to 30 years, were selected for analysis in the present study. Teeth with overextended gutta-percha points were not included. Seventy-five teeth presented with apical periodontitis lesions at the time of treatment as determined radiographically, whereas 30 teeth had normal apical tissues.

## Treatment Procedures

A diagnosis of “vital” or “necrotic” pulp was made on the basis of clinical signs and symptoms and periapical radiographs. All endodontic treatments were performed using a strict aseptic technique. After rubber dam isolation and field disinfection with 30% H<sub>2</sub>O<sub>2</sub> and 5% tincture of iodine, the working length was established at the apical constriction. This was accomplished by radiography alone and, since the late 1990s, with the help of an electronic apex locator checked with radiographs. Efforts were made to machine an apical “stop” at or near the apical constriction to adjust a gutta-percha master cone of appropriate size. After preflaring the coronal two thirds of the root canal with Gates-Glidden burs and hand instruments (Hedström files), the apical third was instrumented by using hand instruments (Hedström and K-type files). In all cases, care was taken to avoid the instrument passage beyond the working length (ie, patency files were not used). Irrigation was frequently made using copious amounts of 1% sodium hypochlorite with a minimum needle size. Teeth with the diagnosis of necrotic pulp were treated in 2 visits with an interappointment medication with calcium hydroxide, whereas teeth with a diagnosis of vital pulp were treated in a single visit.

The root canals were filled with laterally compacted gutta-percha and a sealer. Different sealers were randomly used and included the zinc oxide and eugenol-materials Pulp Canal Sealer (PCS; Sybron Dental, Orange, CA), PCS Extended Working Time (EWT) (Sybron Dental), Tubli-Seal (Sybron Dental), and Endomethasone (Septodont, Saint-Maur-des-Fossés, France); the resin-based sealer AH Plus (DeTrey GmbH, Konstanz, Germany); and the calcium hydroxide-based sealer Apexit (Ivoclar Vivadent, Schaan, Lichtenstein). After completion of the endodontic treatment, an appropriate restoration was placed (direct restoration in cases with moderate tooth structure loss or indirect restoration when cuspal coverage was indicated).

## Follow-up Examination and Data Analyses

At each follow-up occasion, at least 1 periapical radiograph in conventional straight projection was taken. Additional mesial- or distal-angled radiographs were taken in cases with more than 1 root canal in the same root. Radiographic examination was performed using the long cone technique (Explor-X 65 kV; Fiad, Trezzano, Italy, or Irix 70; Trophy, Marne-la-Vallée, France) with Kodak Ultraspeed film 31 × 41 (DF 58) or 22 × 35 (DF 54; Eastman Kodak Company, Rochester, NY). A film holder (Rinn Corp, Elgin, IL) was used in the large majority of cases, except when the patient did not cooperate. Radio-

graphs were processed manually in a darkroom following the recommendation of the manufacturer. In later periods, some digital systems were also used including RVG Gold (Trophy), Kodak RVG 6100 (Carestream Health, Atlanta, GA), and VistaScan Mini Plus (Dürr Dental AG, Bietigheim-Bissingen, Germany). Conventional radiographs were scanned (images were at least 10 × 15 cm at 300 DPI). All radiographs were incorporated in PowerPoint (Microsoft, Redmond, WA) files for further analyses.

Two examiners, who are experienced endodontists and were blinded to the sealer used, individually analyzed and compared the baseline and recall radiographs for the fate of the extruded sealer and treatment outcome. Radiographs were analyzed on the computer screen in a darkened room. For the determination of a sealer’s fate, the examiners recorded if the sealer was present or not in the recall radiographs in comparison with the radiographs taken at baseline. For the analysis of treatment outcome, Strindberg’s criteria (20) were used. Observers were calibrated against a set of 100 reference teeth. Healthy periradicular conditions were judged when both the contour and width of the periodontal ligament space were normal or the periodontal ligament contour was only slightly widened around excess filling. The appearance of the surrounding bone was normal. Diseased teeth presented any discernible apical radiolucency (20). For the follow-up periods of 1 and 2 years, another category was included (ie, “healing,” which was attributed to teeth that still showed lesions but with reduced sizes in comparison with the baseline radiograph). In multiradicular teeth, only the roots with overfillings were evaluated and recorded individually. When evaluations of fate and outcome provided by the 2 examiners disagreed (kappa values = 0.86 and 0.76, respectively, for fate and outcome analyses), a third experienced examiner was consulted.

## Data Analysis

For statistic analyses comparing the periradicular presence/absence (fate) of the different sealers and their influence on the outcome, data were grouped as 1-, 2- and >4-year recall and analyzed by means of the chi-square test with Yates’ correction and the Fisher exact test. The effect of the previous status of the periradicular tissues (healthy or diseased) on the outcome of teeth with overfillings was also compared by means of the Fisher exact test. The significance level was set at 5% ( $P < .05$ ).

## Results

Overall, 105 teeth having overfillings at baseline were included in the study. Of these, 63 were available for the 1-year follow-up, 73 for the 2-year follow-up (57 of which were also evaluated at 1 year), and all of them for the >4-year follow-up.

## Fate of the Extruded Sealer

At the 1-year follow-up, 3 cases from the Tubli-Seal group were examined, and in all of them the extruded material had completely disappeared. Complete removal was also observed for 6 of 14 (43%) and 5

**TABLE 1.** The Fate of Different Sealers after Unintentional Extrusion to the Periradicular Tissues over Different Follow-up Periods

Sealer	Baseline <i>n</i>	1-year follow-up		2-year follow-up		>4-year follow-up		Absent %
		Present	Absent	Present	Absent	Present	Absent	
AH Plus	20	13	1	16	1	17	3	15
Apexit	15	7	2	8	0	10	5	33
Endomethasone	15	7	2	4	5	2	13	87
PCS	28	8	6	8	8	5	23	82
PCS EWT	21	9	5	9	10	6	15	71
Tubli-Seal	6	0	3	0	4	0	6	100

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