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Apically extruded sealers - assessment of apical healing and sealer dissolution of extruded sealers and their effect on treatment outcome.

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Abstract

Aim: This retrospective study is aimed to assess the apical healing and resorption of sealer in cases where there has been inadvertent extrusion of Endo flas FS (ZOE based) and Seal apex (Calcium-hydroxide based), as well as how they affect treatment outcome.

Materials and methods: 30 patients (n=15 for Seal apex sealer and n=15 for Endo flas FS sealer) exhibiting sealer extrusion in immediate post obturation radiographs were included in this present study. Recall radiographs were taken after 6 months and 1 year and were compared with the previous immediate post obturation radiographs to evaluate apical healing and the extent of resorption of the sealer material.

Statistics: Pearson's Chi Square test was used for this study.

Results: At 6 month follow up, better healing was shown by Endo flas FS as compared to Seal apex with statistically non-significant difference. Apical healing for both Seal apex and Endo flas FS progressed with time. Sealer resorption was slightly higher in case of Endo flas FS than Seal apex with statistically non-significant difference.

Conclusion: In case of periapical extrusion, both Seal apex (Calcium hydroxide-based sealer) and Endo flas FS (ZOE based sealer) did not affect the treatment outcome.

Keywords: Endodontic treatment, Sealer extrusion, Obturation, Apical healing, Sealer resorption.

Introduction

It is crucial for the clinician to have a thorough understanding of root canal morphologies in order to provide optimal endodontic treatment[1]. The purpose of endodontic treatment is to completely clean the root canal system and eliminate the infection from the tooth[2]. Root canal filling material should remain confined to the apex of the root. At times, as a result of over instrumentation of the canals, there is a possibility of extrusion of sealers, irrigation solutions or even micro-

organisms beyond the root apex into the neighbouring periapical tissues[2].

Root canal obturation restricts the flow of fluids from peri-radicular tissues into the canals as well as micro-organisms and their by-products from the canals to the peri-radicular tissues[3]. In accordance with the guidelines approved by Comitato Intersocietario Coordinamento delle Associazioni Odontostomatologiche Italian in the year 2003, a small amount of endodontic material beyond the apex of the root could be considered admissible only if it does not cause insult to vitally important structures such as maxillary sinus and inferior alveolar nerve[4].

As long as the material is soluble in the tissue fluids, resorbable, biocompatible and the surrounding area is clear of infection, the peri-radicular tissues can tolerate small amounts of extrusion[5]. The apically extruded filling materials might hinder or impede the healing process of teeth exhibiting apical periodontitis[5].The sealer is responsible for sealing accessory canals, defects within the canals and inconsistencies between the filling materials and the canal walls[3]. Root canal sealer is used along with core root canal filling material e.g., Gutta percha.

Characteristics of an ideal sealer according to Grossman[6].

- Non - irritating to the surrounding tissues
- Insoluble
- Radiopaque
- Bacteriostatic properties
- Dimensionally stable
- If necessary, it should be easy to remove from the root canal
- Should not stain the tooth structure
- Good adhesion to the canal walls when set

Materials and method

The cases included in the study are treated by the author using a standardized treatment protocol over a period of one year. Informed consent was obtained from all patients. Inclusion criteria were single and multirooted teeth diagnosed clinically with chronic apical periodontitis with apical radiolucencies, confirmed radiographically. The patients included in the study did not have any systemic or immunological diseases which might affect the healing process.

The teeth included in the study are a part of (n=127) teeth from 98 patients treated by the author, over a period of 12 months. (n=50) teeth from 43 patients showed apical sealer extrusion in the immediate post-obturation radiographs. 30 patients (n=15 for Seal apex sealer and n=15 for Endo flas FS sealer) with one year recall radiographs were selected for the analysis of the study. The procedure followed: Local anaesthesia was administered (2% lignocaine and adrenaline 1:200,000; Lox, Neon Laboratories, Mumbai, India). The standardized root canal treatment protocol was performed using a strict aseptic technique with rubber dam isolation (Hygienic Dental Dam, Coltene Whale dent Inc., Germany). Coronal flaring was done with Gates Glidden burs (Dentsply Maillefer, Switzerland) and apical patency was checked with #10 K-file (Mani Inc., Japan).

The working length was established 1mm short of the root apex as indicated by the electronic apex locator (MM Control, Micro Mega, France) and confirmed by working length radiographs. Different rotary systems were used for Crown down preparation (Protaper Gold, Dentsply Maillefer, Switzerland; Hero shaper, Micro Mega, France; Gen Endo NiTi Rotary, Coltene Whale dent Pvt. Ltd. France).

Over instrumentation was avoided. Irrigation was frequently done using copious amounts of 2ml of 3% NaOCl (Prime dental, India) with a #30-gauge side vented needle (Canal clean, Ammdent). Final irrigation with 2ml of 17% EDTA solution (Provest Denpro, India) followed by final rinse with 5ml of distilled water. All teeth were treated in two visits with an interappointment calcium hydroxide medication for 7 days.

Obturation was done using Lateral compaction technique of gutta percha and sealer.

The sealers used were Endo flas FS (Sanlor, Colombia) and Seal apex (Sybron Endo, USA). All immediate post-obturation radiographs were taken using conventional method with films (E-Speed, Carestream Dental, NY, USA) with parallel cone technique.

The radiographic parameters were standardized (Geno ray EZX-60, portable X-RAY, Korea). Access restoration was done using Glass Ionomer Cement (3M ESPE, USA).

Follow up examination

For follow up examination, one periapical radiograph was taken for every patient using standardized conventional straight cone projection technique. Comparison between immediate post obturation radiographs and recall radiographs was done blindly by an examiner endodontist. Two main points of comparison were targeted, Apical healing and sealer resorption. If periodontal ligament space showed normal width and contour and surrounding radiolucency changes into normal appearing bone, these factors indicated that the periapical tissue was healthy[4].

Categories for Apical healing: No Healing, Incomplete Healing, Completely Healed.

(6 month and 1 year follow up radiographs were taken) Evaluation of sealer resorption was based on the presence/absence of apically extruded sealer material.

Categories for Sealer resorption: non-resorbed sealer, partially resorbed sealer, completely resorbed sealer.

Data analysis

Data was obtained and compiled on a MS Office Excel Sheet (version 2019, Microsoft Redmond Campus, Redmond, Washington, United States) and was subjected to statistical analysis with the help of the Statistical package of social sciences (SPSS V 26.0, IBM). Using Chi-square test, frequencies of categories of variables were compared with groups.

For all the statistical tests, $p<0.05$ was considered to be statistically significant, keeping α error at 5% and β error at 20%, thus giving a power to the study as 80%.

* = statistically significant difference ($p<0.05$)

** = statistically highly significant difference ($p<0.01$)

= non-significant difference ($p>0.05$)

Results

Resorption status between groups is depicted using Chi-square test in [Table 1].

Intergroup comparison of frequencies of apical healing for both the sealers at different time intervals using Chi-square test is depicted in [Table 2]. Intragroup comparison of frequencies of apical healing for both sealers at different time intervals using Chi-square test is depicted in [Table 3].

[Fig. 1] shows graphical representation of resorption status for both sealers. [Fig. 2] shows graphical representation of apical healing for both sealers at different time intervals. Radiographic representation of sealer dissolution seen in case of Endoflas FS [Image 1].

Radiographic representation of sealer dissolution seen in case of Seal apex [Image 2].

	Material	Total	Chi-square value	p value of Chi-square test

		Seal apex	Endo flas FS			
Resorption status (1 year)	CR	6	9	15	1.200	0.549#
	NR	3	2	5		
	PR	6	4	10		
	Total	15	15	30		

Table 1: Resorption status of extruded sealers (1 year follow up)

The frequencies between the groups showed a statistically non-significant difference (p>0.05).

		Material		Total	Chi-square value	p value of Chi-square test
		Seal apex	Endo flas FS			
Apical healing (6 months)	CH	5	8	13	1.450	0.484#
	IH	6	5	11		
	NH	4	2	6		
	Total	15	15	30		
Apical healing (1 year)	CH	8	9	17	0.259	0.879#
	IH	4	4	8		
	NH	3	2	5		
	Total	15	15	30		

Table2: Inter group comparison of frequencies of apical healing.

The frequencies between the groups showed a statistically non-significant difference (p>0.05).

		Time		Total	Chi-square value	p value of Chi-square test
		1 year	6 months			
Apical healing (Endo flas FS)	CH	9	8	17	0.170	0.919#
	IH	4	5	9		
	NH	2	2	4		
	Total	15	15	30		
Apical healing (Seal apex)	CH	8	5	13	1.235	0.539#
	IH	4	6	10		
	NH	3	4	7		
	Total	15	15	30		

Table 3: Intra group comparison of frequencies of apical healing

The frequencies between the groups showed a statistically non-significant difference (p>0.05).

Fig 1: Resorption status (1 year follow up – Seal apex and Endo flas FS)

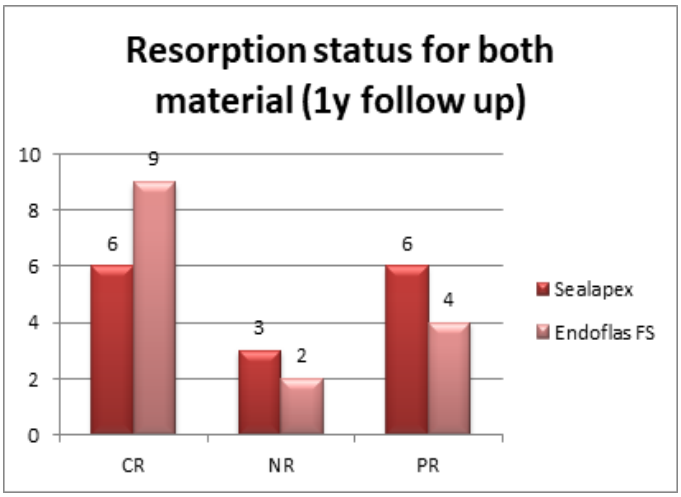

Fig 2: Apical healing (6 months and 1 year) vs material

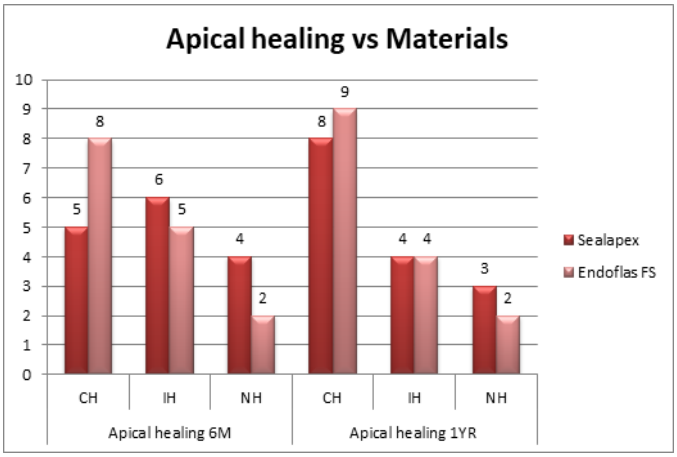

Fig 3: Representation of sealer resorption with Endo flas FS (1 year follow up)

(A) Post-obturation radiograph. Apically extruded sealer seen. (B)1 year follow up radiograph. Sealer resorption seen.

Fig 4: Representation of sealer resorption with Seal apex (1 year follow up)

(A)Post-obturation radiograph. Apically extruded sealer seen. (B)1 year follow up radiograph. Sealer resorption seen.

Discussion

This retrospective study assessed the effects of cases of inadvertent post – obturation apical extrusion of sealers on Apical healing and resorb ability of sealers. The European Society of Endodontology (ESE) recommends evaluating the results of endodontic treatment at least one year after completion to determine if the treatment was a success or not[5].

Additionally, ESE highlighted certain findings that determines the success of treatment e.g. No pain or swelling, absence of sinus tract, preservation of function, radiographically normal width and continuity of periodontal ligament space[5].

After being extruded via the apical foramen, sealers may dissolve in peri-radicular tissues, be phagocytosed or encapsulated by fibrous connective tissue[7]. The material's physio-chemical characteristics, particularly its solubility in water, will determine how it behaves[7]. When considering the material's stability in the interradicular space, this quality may be favourable; nevertheless, if the material is extruded into the peri-radicular tissues, it may not be an ideal property[7].

Seal apex comes under the widely used Calcium hydroxide-based sealers, while Endo flas FS represents the category of ZOE sealers. Overall, the results showed that there was not any definite difference between Seal apex and Endo flas FS sealers in terms of apical healing and resorb ability of the extruded sealers. Also apical healing was not negatively affected in presence of both Seal apex and Endo flas FS extruded sealers. Moreover, complete apical healing was more evident in case of Endo flas FS during 6m follow up than Seal apex (Fig.2). Whereas, incomplete healing was seen slightly more in case of Seal apex during 6m follow up than Endo flas FS (Fig.2). Apical healing for both Seal apex and Endo flas FS progressed with time. However, compared to Endo flas FS, Seal apex demonstrated a somewhat slower rate of apical healing. Resorbability was slightly higher in case on Endo flas FS than Seal apex (Fig.1).

Freshly mixed sealers possess toxicity which subsides as the sealer sets[4]. Several studies show that sealers eventually lose their irritating potential and then turn inert[5]. Majority of sealers cause momentary inflammatory reactions that go away with time[5]. Even when sealers are retained within the canal space, a variable degree of inflammation typically manifests where the sealers come into contact with the vital apical and peri-radicular tissues[7].

The infection was found to be more responsible for delayed apical healing or no healing cases rather than overfilling's cytotoxicity[5]. Over instrumentation can lead to excessive foramen expansion and distortion, makes it challenging to obtain the proper apical adaption of the filling material[7]. Additionally, teeth with apical periodontitis frequently exhibit apical root resorption, which can result in deformations that also impair the quality of the apical filling[7]. When tissue fluids and exudate escape into the canal and reach remaining bacteria to provide a growth substrate, the inadequacy of the apical seal becomes a concern[7]. Additionally, excessive instrumentation always causes debris from necrotic pulp and diseased dentin to be displaced into the peri-radicular tissues. Bacteria embedded in the debris that is inoculated therein may be physically shielded from the host defensive mechanisms, preventing healing[7].

The fact that sealer is not present does not imply that it has entirely dissolved into the peri-radicular tissue. Because radiographs are bi-dimensional, it is possible that the density or volume of the residual sealer was so small that it could not be identified radiographically, but could be proven histologically[4]. Also due to the study's retrospective nature, proper case randomization was not possible[7].

Conclusion

As long as the root canal system is thoroughly cleaned and obturated, the type of extruded sealer does not greatly alter the treatment outcome. Blatant extrusion of filling material should be prevented as they may give rise to postoperative problems[7].

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