Acta Scientific Dental Sciences
Volume 2 Issue 6 June 2018
Research Article

The Effectiveness of Two Coronal Sealing Materials on Coronal Micro leakage with Two Different Obturating Sealers (An *In Vitro* Study)

Shereen S Ghareeb*, Heba A Al-Asfouri and Angie G Ghoneim

Department of Endodontics, Faculty of Oral and Dental Medicine, Cairo University, Al Manial, Giza Governerate, Egypt

***Corresponding Author:** Shereen S Ghareeb, Department of Endodontics, Faculty of Oral and Dental Medicine, Cairo University, Al Manial, Giza Governerate, Egypt.

Received: April 03, 2018; **Published:** May 18, 2018

Abstract

Endofill and EZ-Fill obturating sealers were evaluated and compared for coronal micro leakage in the presence of additional coronal sealing by either Bond1 SF or KN_{100} as intra-orifice plugs. One hundred and two human single-canalled premolars were decoronated and instrumented, then divided into two groups: Group I (Endofill), Group II (Ez-fill) were used as obturating sealers.

Each group was subdivided into 3 sub-groups: Bond 1 SF in subgroup a, KN_{100} in subgroup b were placed as intra-orifice plugs, while subgroup C was left free of any coronal barriers, Samples were submerged in Methylene blue dye and leakage was measured after 1 day, 1 week and 1 month. Twelve samples representing all subgroups were examined by SEM. Ez-Fill cement demonstrated significantly better coronal sealing ability compared to Endofill ($p = 0.028$). The addition of Bond 1 SF or KN_{100} as intra orifice plugs had no effect on improving the coronal seal. Bond 1 SF however, showed less coronal leakage values than KN_{100} ($p = 0.096$) at the end of the study period.

Keywords: Coronal Sealing; Micro leakage; Sealers

Introduction

Clinicians strive to totally seal the root canal system in their attempt to ensure endodontic success. Sealers play a critical role in success of endodontic therapy by eliminating the space between the root canal wall and the core filling material, a variety of endodontic sealers are available commercially and while sealers based on zinc oxide/eugenol have been used traditionally, resin-based sealers showed less percentage of microleakage and greater depth of penetration into dentinal tubules compared to Zinc oxide/eugenol-based sealers [1,2]. EZ-Fill sealer used in this study is an epoxy/amine-based sealer that bonds chemically and physically to dentin and gutta percha showing excellent adhesion properties. Suchodolski and Piatowska [3] evaluated the sealing ability of AH plus, epiphany and EZZ-Fill sealers and results showed significant higher sealing ability for gutta percha/EZ-Fill and AH plus compared to Resilon/Epiphany system. On the other hand, several studies have shown that root fillings are susceptible to leakage when contaminated coronally by artificial saliva and microorganisms [4,5]. As no sealer or obturation technique consistently prevents leakage through the canal, it is very critical to maintain a coronal seal for preventing microleakage into the canal space [4-6]. The length of time that the obturation material can be exposed to the oral cavity before the integrity of the coronal seal is compromised has not been addressed [4]. In a study that evaluated the marginal leakage of different temporary restorative materials placed after endodontic treatment over 60 days time period, it was observed that coronal marginal leakage progresses over the course of time and it was concluded that irrespective of the period of time used, temporary sealing materials must not be kept in the root canals for a long period of time due to risk of contamination [7]. The frequently used time intervals in dental practice either between endodontic treatment appointments or while the permanent restoration is placed after the root canal system is obturated is 1, 2 and 4 weeks, however, coronal microleakage increased with time, the sealing ability of temporary coronal restorative materials deteriorated significantly after 4 weeks [8]. A variety of alternative methods including an additional material placed into the canal orifices after removal of a portion of gutta percha and sealer [4] have been suggested to prevent the entrance of oral fluids and microorganisms into the root canal system. More recently the use of glass ionomer cements, resin modified glass ionomers and flowable composites have been advocated to provide a better intra canal seal [9-11], KN_{100} used in this study is a nano-filled, resin-modified glass ionomer cement that include nano-fillers constituting 2/3 of the filler content with an additional advantage stated by the manufacturer which is simplified application procedures without the separate conditioning step. Castro., *et al.* [7] assessed the coronal microleakage of Clip F, Bioplic, Viremer, $KetacN_{100}$ as temporary restorative materials after endodontic treatment and found that Vitremer followed by $KetacN_{100}$ showed least coronal leakage. Bond 1 SF was also used in this study, it is a solvent free (SF) light cured, self-etch adhesive, by removing the solvent present in most other adhesives, this preserves high bond strength associated with total etch bonding agents and also protects against sensitivity, eliminates common technique sensitive issues such as under or over drying as claimed by the manufacturer. Although several studies have investigated the sealing qualities of restorative materials [12] their sealing ability as a coronal barrier after root canal treatment has not been compared with each other and the interaction between these barriers and the type of sealer used in obturation, also the effect of the presence and absence of these coronal barrier material on coronal microleakage and time length that might affect the coronal sealing ability of the used restorative materials in endodontically treated teeth. Therefore, the aim of this study was to evaluate the effect of EZ-Fill and Endofill as different obturating sealers on coronal microleakage and the effectiveness of KN_{100} and Bond 1 SF as intra coronal sealing materials on coronal microleakage and the effect of Endofill and EZ-Fill on coronal microleakage as obturating sealers in the absence of coronal barriers over a certain period of time.

Materials and Methods

One hundred and two, single canalled premolars were utilized, teeth were stored in distilled water till used in the study.

All teeth were decoronated just apical to the cement-enamel junction with low speed disc under water-spray coolant.

A#15 k-file was introduced into the canal to measure the working length. The root canals were prepared with Protaper rotarty system (Dentsply Maillefer, Ballaigues, Switzerland) in a crown down technique and preparation was finished till file F4. The irrigant was 2 ml of 2.5% Naocl between each file size delivered with a 27-gauge needle.

The teeth were then randomly divided into two groups of 51 each to be filled with gutta-percha using lateral condensation technique and one of the two sealer:

- **Group I:** Endofill sealer (Dentsply, industria e comerico Itda, ptropolis, RJ, Brazil)
- **Group II:** EZ-Fill sealer: ESSENTIAL DENTAL SYSTEM, Hachensack, NJ, U.S.A), EZ-Fill was applied by a bidirectional spiral supplied within the sealer kit.

Following obturation, 2 mm of the coronal gutta-percha was removed from all the roots of both main groups were further divided into 3 sub-groups (of 17 each) according to the intra-orifice plug material placed in the created 2 mm space, as following:

- Subgroup a: Bond1 SF (pentron clinical, U.S.A)
- Subgroup b: KN_{100} Glassionomer (3M ESPE, Stpaul, U.S.A)
- Subgroup C: roots were left without intra-orifice plugs.

After filling, roots were stored in a container at 37°C and 100% humidity for 48 hours to allow complete setting of the sealer and coronal barrier materials.

The apical leakage was then evaluated with dye extraction technique as described by Camps and Pashely [13].

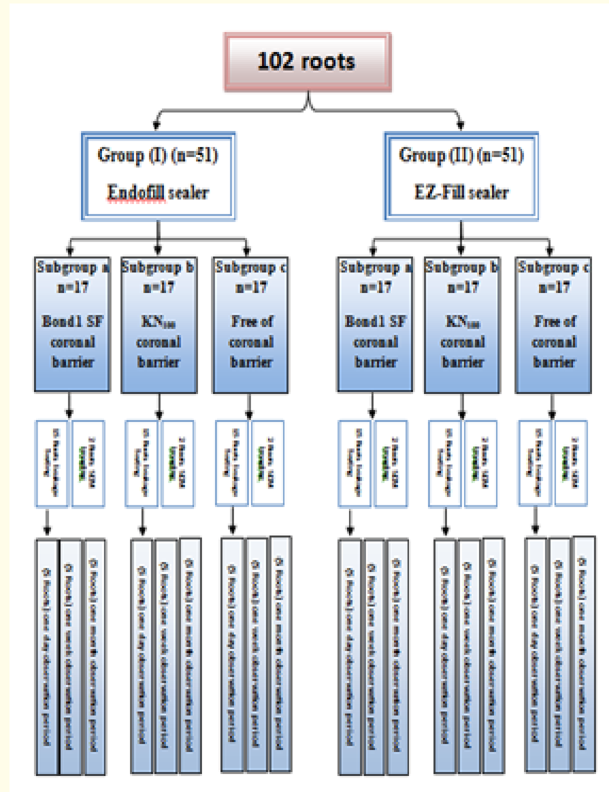

Figure 1: Diagram showing the grouping of samples.

Roots of each main group were covered with 2 layers of nail varnish except for the coronal 2 mm and their apical foramina were sealed with molten sticky wax. Five roots from each subgroup were submerged in separate eppendorfs that were filled with 2% Methylene blue dye solution (Faculty of pharmacy, Ain shams university, Egypt) and were kept for either 1day, 1 week or 1 month under normal atmospheric pressure. After storage period, roots were rinsed under tap water for 30 minutes and varnish was removed with a polishing disk. Samples were placed in different eppendorfs containing 1000 micro liters concentrated 69% wt nitric acid (Teba for chemical industries, Cairo, Egypt) for 72 hours then, eppendorfs were centrifuged at 14.000 rpm for 5 minutes to separate gutta-percha debris from the extracted dye.

A 100 microlitres of the supernatant from each eppendorf was transferred to a 96-well plate and the optical density of the solution was determined by an automatic micro-plate Spectrophotometer (Stat Fax 2100, Awareness technologies, Inc, Florida, U.S.A) at 545 nm using concentrated nitric acid as the blank.

Scanning electron microscope (SEM)

Twelve samples representing all subgroups with the same criteria, prepared and filled the same way as samples used in dye extraction microleakage test were left for the purpose of evaluating dentin/coronal barrier and sealers interfaces were subjected to SEM imaging. Each sample was split into 2 longitudinal halves by cutting 2 opposing longitudinal grooves using an air cooled fine double sided diamond disk on the buccal and lingual root surfaces through an imaginary line bisecting the mesiodistal dimension of the root , a sharp edge of a bi-beveled straight chisel was placed in the groove with a single impact force to split the roots , then samples were dehydrated in ascending concentrations of alcohol subjected to critical point of drying and mounted on aluminum studs, sputtered vacuum coated with gold layer in a special gold sputtering device S150A sputter coater.

Specimens were examined for homogenicity and adaptation of sealers and coronal barriers to dentinal walls. The photo micrographs were carried out using SEM model Philips xLl30 attached with EDX unit with accelerating voltage 30 k.v., magnification 10X up to 400,000 X, resolution w (3.5 nm) at magnification X500 and X1000

Statistical analysis

Student-T-test has been used to study the difference between tested obturating materials on mean coronal microleakage within each tested group.

One way-ANOVA was used to study the difference between coronal barriers, Time, sealers and interaction between variables on mean coronal micro leakage within each group.

Tukey's post-hoc test was used for pair-wise comparison between the means when ANOVA test is significant.

The significant value was set at p ≤ 0.05.

Results

Regarding sealers: Endofill sealer showed significantly higher coronal microleakage than EZ-Fill sealer with a mean coronal leakage (0.56 ± 0.25) for Endofill sealer and (0.49 ± 0.26) for EZ-fill sealer at p = 0.028.

	Sealer				*p*-value
	Group I (Endofill sealer)		Group II (EZ-Fill sealer)		
	Mean	SD	Mean	SD	
Micro-Leakage	0.56	0.25	0.49	0.26	0.028*

Table 1: Mean and standard deviation (SD) for the coronal micro-leakage for different sealers regardless of other variables.

Comparing the coronal barriers regardless other variables KN100 showed highest mean coronal microleakage (0.55 ± 0.31), followed by free-coronal barrier group (0.55 ± 0.23) and the least mean value with Bond1SF (0.49 ± 0.22) at P = (0.096). Values were statistically insignificant in between them all.

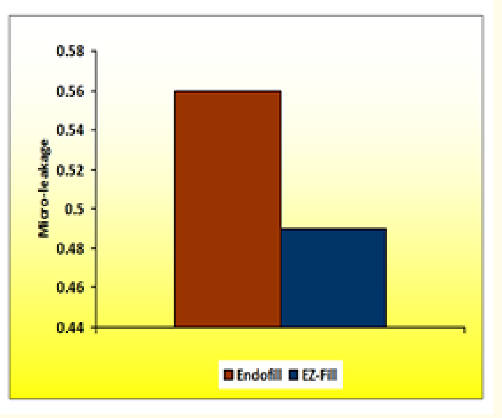

Figure 2: Histogram showing the mean coronal micro-leakage for different sealers regardless of other variables.

	Coronal Barrier						*p*-value
	Sub-group a (Bond1 SF coro nal barrier)		Sub-group b (KN_{100} coronal barrier)		Sub-group c (Free of coronal barrier)		
	Mean	SD	Mean	SD	Mean	SD	
Micro-Leakage	0.49	0.22	0.55	0.31	0.55	0.23	0.096 NS

Table 2: Mean and standard deviation (SD) for the coronal micro-leakage for different coronal barriers regardless of other variables.

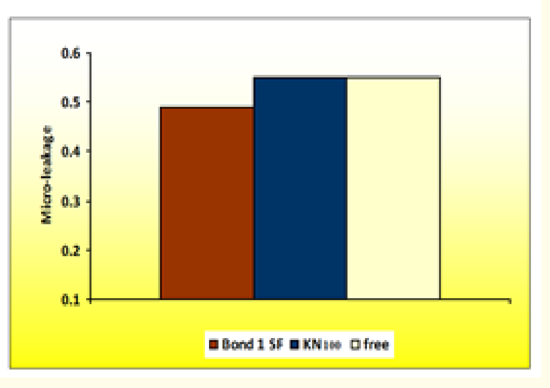

Figure 3: Histogram showing the mean coronal micro-leakage for different coronal barriers regardless of other variables.

Time was a significant variable when it comes to coronal microleakage.

One day storage in methylene blue dye showed the lowest significant mean coronal microleakage (0.34 ± 0.19) followed by one week (0.45 ± 0.20) and the highest mean value was after one-month storage period (0.75 ± 0.18) at p ≤ 0.01.

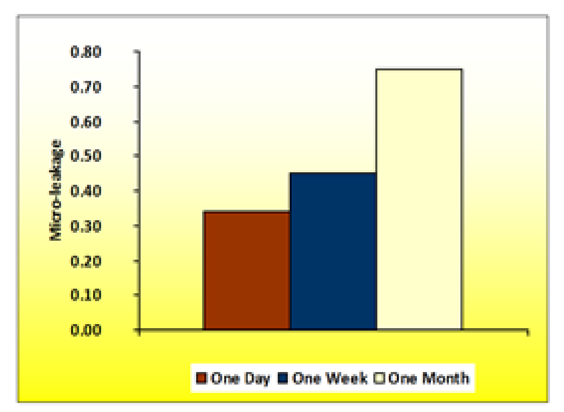

Figure 4: Histogram showing the mean coronal micro-leakage for different times regardless of other variables.

	Storage Time						p-value
	One Day		One week		One month		
	Mean	SD	Mean	SD	Mean	SD	
Micro-Leakage	0.34[a]	0.19	0.45[b]	0.20	0.75[c]	0.18	≤ 0.001*

Table 3: Mean and standard deviation (SD) for the coronal micro-leakage for different time regardless of other variables.

SEM results

EZ-Fill sealer showed better adaptation to dentin walls with no observed gaps at sealer/dentin interface. Figure 5a, compared to wide gaps that were present at Endofill /dentin interface (Figure 5b).

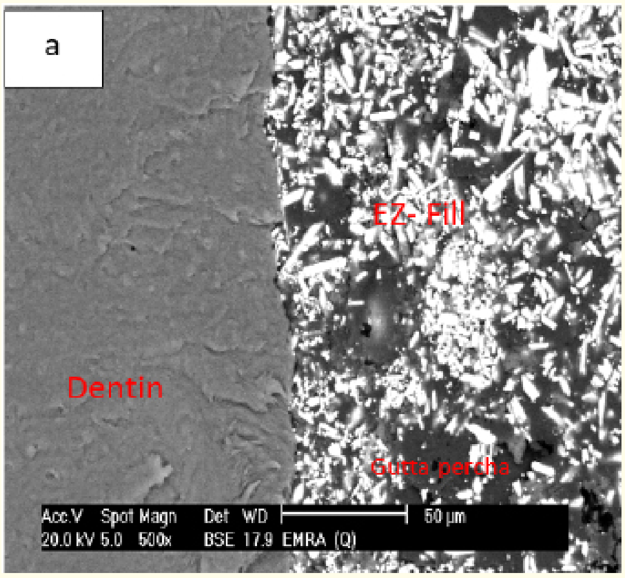

Figure 5a

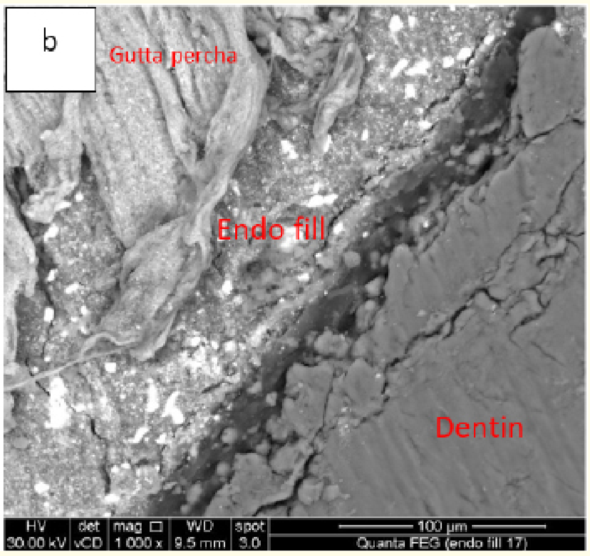

Figure 5b

On the other hand, Bond 1SF intracoronal barrier material showed more heterogenous structure and better adaptation in terms of proximity to surrounding dentinal walls (Figure 6a), compared to granular structure and poor adaptation with wide gaps seen in KN_{100} barrier/dentin interface (Figure 6b).

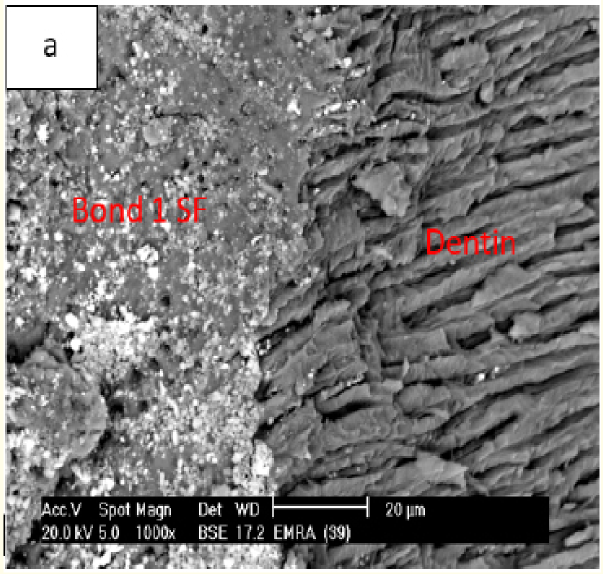

Figure 6a

Discussion

The results of coronal microleakage showed that there is no statistical significant difference between coronal microleakage of Bond 1 SF, KN_{100} barriers and barrier.

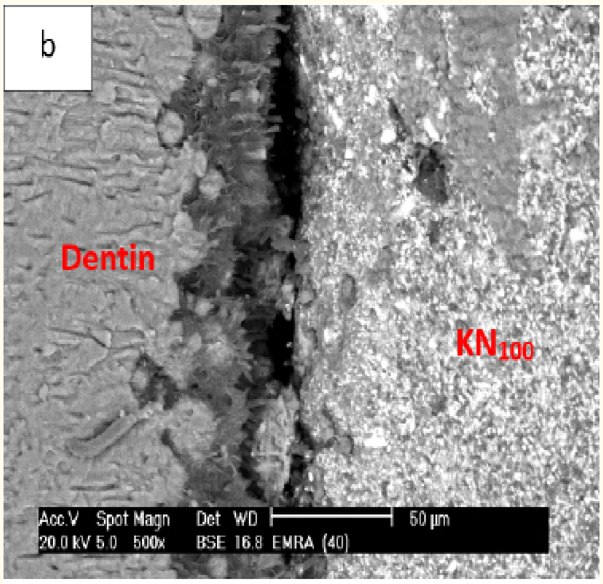

Figure 6b

Free samples, this comes in accordance with Castro., *et al.* [7] who found none of the tested materials in his study (vitremer, KN_{100}, and clip F) was able to prevent coronal microleakage. However, Bond 1 SF showed least coronal microleakage while KN_{100} had the highest coronal microleakage even when compared to barrier-free samples.

A possible interpretation for the high coronal leakage of KN_{100} could be the volumetric shrinkage of the glass-ionomer based materials upon setting thus, providing a potential avenue for microleakage specially with light cured types which was confirmed by the SEM findings, that showed poor adaptation of KN_{100} (RMGI) in the form of interfacial gaps along with cracks and voids within the bulk of the material. On the contrary, Rahimi., *et al.* [15] stated that nano-sized fillers allow the filled resin to accommodate to the diameter of the dentinal tubules with better penetration.

On the other hand, the highest coronal seal of Bond 1 SF may be contributed to its composition that is solvent free.

According to Tay., *et al*. [16] excessive primer/ adhesive solvent at the interfacial layer of self-etching systems provides channels for nano-leakage so, elimination of this solvent might improve the adaptation of the adhesive to the dentinal wall.

Leonard., *et al.* [14] showed that the use of dentin bonding agents and resins seal more effective than glass ionomer who stated that this might be due to the hydrophilic methacrylate particles incorporated in the bonding agent allowing for greater penetration in dentinal tubules.

Again, the SEM findings were coincident with such results as Bond SF barrier showed good adaptation to dentinal walls through close proximity to the walls and appeared more homogenous with no cracks compared to KN_{100}.This comes in agreement with the work of Sen., *et al.* [17].

As for the sealers, results showed statistically significant difference in coronal microleakage between EZ-fill and Endofill sealers having EZ-Fills showing the least coronal microleakage.

This comes in accordance with findings of Miltec., *et al.* [18] where an epoxy-resin based material showed good sealing ability even when used as the sole filling in root canal greater leakage for sealer based on Zno/E compared to epoxy-resin based sealers was also found by Ouguntebi and Shen [19].

This inferior coronal sealing ability of Endofill sealer might be attributed to high solubility and hydrophobic propensity of Zno/E based sealers [20], in addition to the relatively higher viscosity that resulted in numerous pores and vacuoles of large diameter This was also observed in SEM images, EZ-fill exhibits less structural defects and appeared strongly adapted to the dentinal wall, opposite to Endofill sealer that was heterogenous with wide gaps interfacially between the sealer and the dentinal wall.

The time factor in this study was significant

It was revealed that the longer the materials were left in dye the more the coronal leakage values were scored throughout the period of the study irrelative to other factors [4,5,21], Likewise Schwartz and Robbins [22] found the time between obturation and placement of the permanent restoration to be critical to prevent recontamination of the remaining apical gutta percha.

Conclusion

Within the limitation of the experimental design and test parameters it could be concluded that:

- Neither Bond 1 SF nor KN_{100} were capable of completely sealing the root canals against coronal micro leakage when placed as intra-orifice plugs.
- The use of EZ- Fill as an obturating sealer with gutta percha in endodontically treated reduces coronal microleakage
- The longer the endodontically treated tooth left without coronal restoration the more it is exposed to coronal microleakage, which necessitates the placement of final coronal restoration as soon as possible.

Bibliography

1. Xu Q., *et al*. "A new quantitative method using glucose for analysis of endodontic leakage". *Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontology* 99.1 (2005): 107-111.
2. Dadpe A and Kamra AI. "A scanning electron microscopic evaluation of the penetration of root canal dentinal tubules by four different endodontic sealers: A zinc oxide eugenol-based sealer, two resin-based sealers and polydimethyl siloxane-based sealer". *Medical Journals of India* 24 (2012): 50-58.

3. Suchodolski Ł and Piatowska D. "Assessment of the sealing ability of some root canal sealers applied using lateral condensation and single point techniques". *Annales Academiae Medicae Stetinensis* 56.1 (2010): 81-86.

4. Swanson K and Madison S. "An evaluation of coronal microleakage in endodontically treated teeth. Part I. Time Periods". *Journal of Endodontics* 13.2 (1987): 56-59.

5. Torabinejad M., *et al*. "*In vitro* bacterial penetration of coronally unsealed endodontically treated teeth". *Journal of Endodontics* 16.12 (1990): 566-569.

6. Ray HA and Trope M. "Periapical status of endodontically treated teeth in relation to the technical quality of the root canal filling and the coronal restoration". *International Endodontic Journal* 28.1 (1995): 12-18.

7. Castro PHDF., *et al*. "Evaluation of marginal leakage of different temporary restorative materials in endodontics". *Contemporary Clinical Dentistry* 4.4 (2013): 472-475.

8. Madarati A., *et al*. "Time dependence of coronal seal of temporary materials used in endodontics". *Australian Endodontic Journal* 34.3 (2008): 89-93.

9. Beckham BM., *et al*. "An evaluation of three materials as barriers to coronal microleakage in endodontically treated teeth". *Journal of Endodontics* 19.8 (1993): 388-391.

10. Galvan RR., *et al*. "Coronal microleakage of five materials used to create an intracoronal seal in endodontically treated teeth". *Journal of Endodontics* 28.2 (2002): 56-61.

11. Zaia AA., *et al*. "An *in vitro* evaluation of four materials as barriers to coronal microleakage in root-filled teeth". *International Endodontic Journal* 35.9 (2002): 729-734.

12. Belli S., *et al*. "Adhesive sealing of the pulp chamber". *Journal of Endodontics* 27.8 (2001): 521-526.

13. Camps J and Pashly D. "Reliability of dye penetration studies". *Journal of Endodontics* 29.9 (2003): 592-594.

14. Leonard JE., *et al*. "Apical and coronal seal of root obturated with a dentin bonding agent and resin". *International Endodontic Journal* 29.2 (1996): 76-83.

15. Rahimi M., *et al*. "Bonding of resin-based sealers to root dentin". *Journal of Endodontics* 35.1 (2009): 121-124.

16. Tay FR., *et al*. "A single-step adhesives are permeable membranes". *Journal of Dentistry* 30.7-8 (2002): 371-382.

17. Sen BH., *et al*. "The effect of tubular penetration of root canal sealers on dye microleakage". *International Endodontic Journal* 29.1 (1996): 23-28.

18. Miletić I., *et al*. "Leakage of five root canal sealers". *International Endodontic Journal* 32.5 (1999): 415-418.

19. Oguntebi BR and Shen C. "Effect of different sealers on thermo-plasticized gutta-percha root canal obturations". *Journal of Endodontics* 18.8 (1992): 363-366.

20. Zmener O., *et al*. "Significance of Moist Root Canal Dentin with the use of methacrylate-based Endodontic sealer". *Journal of Endodontics* 34.1 (2008): 76-79.

21. Khayat A., *et al*. "Human saliva penetration of coronally unsealed obturated root canals". *Journal of Endodontics* 19.9 (1993): 458-461.

22. Schwartz RS and Robbins JW. "Post placement and restoration of endodontically treated teeth: a literature review". *Journal of Endodontics* 30.5 (2004): 289-301.

Volume 2 Issue 6 June 2018