

## Coronal sealing ability of different sealers on teeth obturation and the effectiveness of two different obturation techniques

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### Abstract

**Background and objectives:** The purpose of this study was to evaluate the effect of two sealers on coronal seal and the coronal sealing ability of two obturation techniques.

**Methods:** Forty extracted single-rooted human teeth were instrumented with the step-back technique and were irrigated with 5.25% sodium hypochlorite (NaOCl). The smear layer was removed by washing with 10 ml of 17% ethylene diamine tetra-acetic acid (EDTA) and 10 ml of 5.25% (NaOCl). All instrumented root canals were randomly divided into two experimental groups; Group A: 20 roots epoxy resin sealer (AH26) was used, Group B: 20 roots Zinc oxide euginol (ZOE) sealer was used. Each group of main groups were subdivided randomly into two obturation groups; 1. 10 roots obturated by thermo plasticized technique (obtura II), 2. 10 roots obturated by cold lateral compaction technique. The root surfaces were then coated with nail polish except for the coronal, then dye penetration study was conducted and samples were examined under the stereomicroscope. Data had been collected from three independent examiners and statistically analyzed using student t-test.

**Results:** There were significant differences between AH26 with ZOE in group obturated by obtura II and when obtura II technique compared with the cold lateral compaction technique in group of AH26 sealer.

**Conclusion:** Epoxy resin sealer (AH26) and obtura II gave the best results in coronal sealing when compared with Zinc oxide euginol sealer and cold lateral compaction technique.

**Keywords:** Coronal sealing, obturation, sealers.

### Introduction

An important consideration in endodontics is the ultimate seal of root canals both at coronal and apical ends to prevent microleakage that may cause root filling to fail.<sup>1,2</sup> Several in vitro experiments have demonstrated that some microorganisms can penetrate the coronal portion of root canal fillings and eventually reach the apical region in some cases.<sup>3,4</sup> Hence, preventing coronal leakage is essential to the success of root canal treatment<sup>5</sup>. Microleakage in root canals is complicated as many variables may contribute, such as anatomy and instrumented size of the root canal,

irrigating solutions, root filling techniques, physical and chemical properties of the sealer, and the infectious state of the canal.<sup>1</sup> The use of sealers during root canal obturation is essential for success and reduces the amount of microleakage obtained, regardless the technique of obturation used.<sup>6,7</sup> Studies showed that leakage may occur at the interfaces between the sealer and dentin, sealer and guttapercha and in spaces within the sealer, thus the quality of the filling depends largely on the sealing ability of the sealers.<sup>8</sup> Kopper et al.<sup>9</sup> showed that the resin-based root canal sealers presented lesser coronal

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leakage than zinc oxide – eugenole based sealers. Many different obturation techniques have been introduced ranging from solid core filling of gutta percha to its softening techniques with either solvents or heat in the attempt to secure the best possible obturation of the endodontic space and to increase the quality of sealing. Lateral cold condensation has been approved to be a very popular and clinically effective filling technique. It has the advantage of simple execution, conservative canal preparation and controlled filling.<sup>2,10,11</sup> While many thermoplasticized procedures and devices have been evaluated to improve the three-dimensional sealing of the root canal space and produce a more homogeneous canal seal<sup>11,12</sup>. Budd et al, 1991, reported that obtura II technique is superior to lateral condensation in adapting the filling material to the canal walls and effective in the obturation of accessory canals.<sup>13</sup>

The purpose of this study is to compare the coronal sealing ability of two endodontic sealers in concert with the quantity of microleakage associated with thermoplasticized injectable obturation technique with the lateral cold condensation.

## Methods

### 1. Sample selection and preparation

The spots were obtained from freshly extracted teeth. The external tissue debris, calculus, soft tissue and the clotted blood were removed with scaler and tooth brush under running tap water and collected in a special container containing distilled water. The collected teeth was subjected to de-coronation process. After that, each root with a single canal would be opted and checked by a stainless steel k-file (size # 15) (Densply, Maillefer, Switzerland) to verify the canal patency. The stainless steel k-file (size # 15) must reach the apical terminus and appear from the root apex slightly and tightly (just seen). Any root which not fulfilled this criterion had been discarded. After that the working length was calculated using stainless steel k-file

(size # 15) and the working length determined by kept it 1 mm short of the apex.

### 2. Instrumentation techniques

The instrumentation was started with hand k-file (#15) (Densply, Maillefer, Switzerland), which was introduced to the full working length and used in watch-winding action and was repeated for #20, #25, and #30 and the K-file #30 was considered the master apical file. Flaring of the canal to (#45) and recapitulation was executed with (# 30). The coronal third of each root was flared up to a 2-3 Gates Glidden bur (Antaeos, Germany) with a low-speed handpiece. After using each file, the canal was irrigated with 10 ml of 5.25% prepared NaOCl (Fas, Iraq) and in completion each canal was irrigated with 10 ml of 17% EDTA (META, Korea) and 10 ml of 5.25% NaOCl to remove the smear layer (organic and inorganic remnants). Finally, the root canals were dried with paper points.<sup>5</sup>

### 3. Sample grouping

The selected forty roots were divided by simple random method into 2 groups; Group A: in 20 roots AH26 sealer was used, Group B: in 20 roots ZOE sealer was used. Then each group was subdivided randomly into 2 subgroups; 1. 10 roots obturated by obtura II, 2. 10 roots obturated by cold lateral compaction technique.

### 4. Sealer mixing and application

In group A (20 canals), the powder and liquid of AH26 (Densply, Germany) were mixed on a cold dry clean glass slap in accordance with the manufacturing instructions (two to three volume units of powder with one volume unit of resin) to a homogeneous consistency. While in group B (20 canals), the powder and liquid of ZOE (Technical and General Ltd, UK) were mixed on slap according to the manufacturing instructions (three drops of the liquid dropped on the glass slap and the powder added until saturation of drops and till a middle concentration paste achieved). In both groups a finger spreader (size #30) (St. Dent, Austria) was used to apply sealer to the canals.

### 5. Obturation techniques

First sub group of each main groups obturated by injecting thermo-plasticized gutta-percha mass using the obtura II device via its needle which was inserted into the canals in three steps. As gutta-percha was injected, the tip felt raised, at this point, the hand was removed from the gun to stop gutta-percha ejection, the tip was removed from the canal and as soon as possible, cold finger pluggers (sizes # 30, # 35, and # 40) (JS Dental, China) were introduced inside the canals in such away they reached (to the coronal two thirds of the canal, to the coronal one third and to coronal 2-3 mm from the orifice respectively) for vertical compaction. While second

subgroup of each main group obturated with the cold lateral compaction technique (LCT). The master gutta-percha cone (size # 30) was inserted into the canal

by a tweezer. As soon as possible, finger spreader (size # 30) was introduced inside the canals in such away it reached 2mm short of the full working length with complete freedom and was used to adapt the master gutta-percha cone laterally to the proximal walls of the canals and to provide a space for the accessory gutta-percha cones. Standardized gutta-percha cones (size # 15) were used as accessory cones. The technique was considered completed when the spreader had no more space to penetrate the canal orifice. Finally, excess gutta-percha was removed using a heated Ash no. 49 aided with spirit lamp and was compacted later on vertically using heated endodontic finger plugger.

### 6. Dye penetration study

The root surfaces in all groups were covered with 2 layers of nail varnish, except for the coronal 2 mm. After the filling process all samples were stored in saline solution at 37° C (body temperature) for 72 hours. All specimens were centrifuged at 30g for 5 minutes in 2% methylene blue dye solution to allow the dye to enter into unfilled space of the canal. The specimens were washed out under running tap water for 5 minutes,

then each root was marked at the middle of mesial and distal sides with a longitudinal line by a permanent pen marker, then the roots sliced into two halves buccal and lingual using a diamond cutting disc (Komet, Germany) via slow-speed conventional hand-piece with water coolant.<sup>5</sup> Each half was affixed on microscopic slide by sticky wax (Vevy, Switzerland) to allow its examination under stereomicroscope

### 7. Stereomicroscope evaluation

The slides with samples were examined under the stereomicroscope (2x) by three pertinent endodontic experts (blinded to the

groups). They measured the linear dye penetration along the canal filling interface, from the coronal to the apical part of the root canal. For each sample three reading were taken so each group becomes thirty.

The criteria for the stereomicroscopic evaluation were as following:<sup>14</sup>

- Score 0: No dye penetration.
- Score 1: 0-0.9 mm dye penetration.
- Score 2: 1-1.9 mm dye penetration.
- Score 3: 2-2.9 mm dye penetration.
- Score 4:  $\geq 3$  mm dye penetration

**Results**

**Stereomicroscopic evaluation**

By using paired t- test, there were significant differences between AH26 with ZOE in group obturated by obtura II. Also there were significant differences when obtura II technique compared with the b

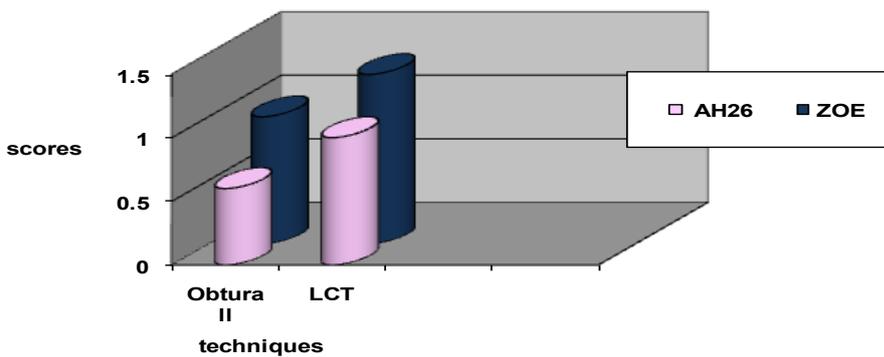
lateral compaction technique in group of AH26 scores at  $p < 0.05$ . While there was non-significant difference between the other group scores at  $p > 0.05$ , (table 1, 2 and fig.1). Generally groups of AH26 gave best results than groups of ZOE, especially when AH26 group obturated by obtura II.

**Table 1:** The descriptive statistic of stereomicroscope reading

Obturation technique	Sealers	No. of samples	Mean of scores	SD	Std. Error Mean
Obtura II	AH26	30	0.6	± 0.621	0.113
LCT	AH26	30	1.00	± 0.694	0.126
Obtura II	ZOE	30	1.00	± 0.830	0.151
LCT	ZOE	30	1.33	± 0.802	0.146

**Table 2:** t-test for difference between the groups (stereomicroscope)

technique	techniques differences	df	t-statistic	P-value	Sign.
Obtura II	<b>AH26</b> - ZOE	58	-2.112	0.039	S
LCT	<b>AH26</b> - ZOE	58	-1.720	0.091	NS
AH26	<b>Obtura II</b> - LCT	58	-2.350	0.022	S
ZOE	<b>Obtura II</b> - LCT	58	-1.581	0.119	NS



**Figure1:** Bar chart showing the techniques of stereomicroscope scores

## Discussion

Achieving an adequate coronal seal is one of the most important goals in endodontics, but there is wide variation in the sealing ability of different endodontic materials,<sup>5</sup> since root canal micro leakage is a complex subject because many variables may influence infiltration, such as root filling technique, physical and chemical properties of sealers and presence or absence of smear layer.<sup>15</sup> Many in vitro methods have been used to evaluate the sealing qualities of endodontic filling materials, but most studies have used methylene blue dye because it is inexpensive, easy to manipulate, has a high degree of staining, very small molecular weight even lower than that of bacterial toxins, the same leakage as butyric acid and shows a deeper penetration than other dyes therefore was used in this study.<sup>5,8,16</sup> Air entrapped within the root canal filling material or inside the root canal system may inhibit penetration of dye into the pores and gaps. Oliver and Abbott stated that after centrifugation at 3,000 rpm for 5 minutes, dye penetration was 91.7%; dye penetration by passive immersion was 20.7%. For this reason, active dye penetration tests have been employed whereby entrapped air is sucked out under a vacuum or the dye penetration test may be performed under high pressure has occasionally been recommended; centrifugation was used in the current study.<sup>5</sup> Removal of the smear layer can be considered an essential step in successful root canal treatment.<sup>17</sup> For this reason, the smear layer was removed in this study before evaluation of the penetration and adaptation of root canal filling materials. The quality of the filling depends largely on the sealing ability of the sealers. The failure of various sealers may be due to their chemical composition and physical properties (such as adhesiveness, dimensional stability, flow, solubility).<sup>8</sup> Generally, groups of AH26 sealer showed significantly less coronal leakage in comparison to groups of ZOE sealer especially

when canals obturated by obtura II although the result was non significant in group obturated by cold lateral compaction but gives better sealing. This result some what in agreement with some author's studies<sup>18-20</sup> as they showed that the epoxy resin sealer had better sealing ability than ZOE sealer and the most efficient adhesion between sealer and root canal walls achieved when epoxy resin sealer was used. Studies showed that these findings may possibly be attributed to the fact that resin based sealers has low contraction and solubility in comparison with ZOE-based in addition to it has resin components in their formulations, which improve their adherence to the intra canal dentin walls and is an important factor for leakage prevention.<sup>21,22</sup> About obturation techniques, groups of obtura II showed significantly less coronal leakage in comparison to groups of cold lateral compaction especially when AH26 used as a sealer. this result some what in agreement with some authors studies<sup>23,24</sup> as they showed that the cold lateral compaction show higher leakage than thermoplasticized technique. While this result disagreed with some studies,<sup>25</sup> it is concluded that the thermo plasticized technique present the higher level of infiltration than cold lateral compaction. The factors that may be considered in obtaining these conflicting results are: technique of instrumentation, type of sealer used, sealer thickness, type and concentration of chelating agents used, and the technique used to remove the smear layer. The concept of injectable thermo-plasticized gutta-percha arose following the demonstration that gutta-percha in a heated state, when mechanically forced under pressure, would three dimensionally fill the root canal system more effectively and quicker than lateral or vertical condensation.<sup>26</sup> Injected thermo-plasticized gutta-percha can adapt more effectively to irregularities in the canal.<sup>27</sup> On the other hand, cold lateral compaction produces many irregularities in the final mass of gutta-percha. It also does not reproduce

canal irregularities and there is an inadequate dispersion of the sealer leading to the formation of voids in and around the gutta-percha points. Therefore this drawback, may have contributed to the high leakage score seen in this group.<sup>24</sup>

### Conclusion

AH26 was produced better coronal seal specially when canals obturated by obtura II. Obtura II as obturation technique was produced better coronal seal than lateral compaction technique although there was non significant difference in groups of ZOE when used as a sealer.

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